CARDIOLOGY MCQs

Q-1

A 62-year-old man is admitted to hospital following a myocardial infarction. Four days after admission he develops a further episode of central crushing chest pain. Which is the best cardiac marker to investigate his chest pain?

A. LDH
B. Troponin I
C. Troponin T
D. CK-MB
E. AST

ANSWER:
CK-MB

EXPLANATION:
By day four the CK-MB levels should have returned to normal from the initial myocardial infarction. If the CK-MB levels are elevated it would indicate a further coronary event

CARDIAC ENZYMES AND PROTEIN MARKERS
Interpretation of the various cardiac enzymes has now largely been superceded by the introduction of troponin T and I. Questions still however commonly appear in exams.

Key points for the exam

- myoglobin is the first to rise
- CK-MB is useful to look for reinfarction as it returns to normal after 2-3 days (troponin T remains elevated for up to 10 days)

	Begins to rise	Peak value	Returns to normal
Myoglobin	1-2 hours	6-8 hours	1-2 days
CK-MB	2-6 hours	16-20 hours	2-3 days
CK	4-8 hours	16-24 hours	3-4 days
Trop T	4-6 hours	12-24 hours	7-10 days
AST	12-24 hours	36-48 hours	3-4 days
LDH	24-48 hours	72 hours	8-10 days

Q-2

A patient is admitted with central chest pain and a diagnosis of non-ST elevation myocardial infarction is made. Aspirin and fondaparinux are given. What is the mechanism of action of fondaparinux?

A. Reversible direct thrombin inhibitor
B. Glycoprotein IIb/IIIa receptor antagonist
C. Inhibits antithrombin III
D. Inhibits ADP binding to its platelet receptor
E. Activates antithrombin III

ANSWER:
Activates antithrombin III

EXPLANATION:
Fondaparinux works in a similar way to low-molecular weight heparin.

ACUTE CORONARY SYNDROME: MANAGEMENT OF NSTEMI
NICE produced guidelines in 2013 on the Secondary prevention in primary and secondary care for patients following a myocardial infarction management of unstable angina and non-ST elevation myocardial infarction (NSTEMI). These superceded the 2010 guidelines which advocated a risk-based approach to management which determined whether drugs such as clopidogrel were given.

All patients should receive

- aspirin 300mg
- nitrates or morphine to relieve chest pain if required

Whilst it is common that non-hypoxic patients receive oxygen therapy there is little evidence to support this approach. The 2008 British Thoracic Society oxygen therapy guidelines advise not giving oxygen unless the patient is hypoxic.

Antithrombin treatment. Fondaparinux should be offered to patients who are not at a high risk of bleeding and who are not having angiography within the next 24 hours. If angiography is likely within 24 hours or a patients creatinine is > 265 µmol/l unfractionated heparin should be given.

Clopidogrel 300mg should be given to all patients and continued for 12 months.

Intravenous glycoprotein IIb/IIIa receptor antagonists (eptifibatide or tirofiban) should be given to patients who have an intermediate or higher risk of adverse cardiovascular events (predicted 6-month mortality above 3.0%), and who are scheduled to undergo angiography within 96 hours of hospital admission.

Coronary angiography should be considered within 96 hours of first admission to hospital to patients who have a predicted 6-month mortality above 3.0%. It should also be performed as soon as possible in patients who are clinically unstable.

The table below summaries the mechanism of action of drugs commonly used in the management of acute coronary syndrome:

Medication	Mechanism of action
Aspirin	Antiplatelet - inhibits the production of thromboxane A2
Clopidogrel	Antiplatelet - inhibits ADP binding to its platelet receptor

Medication	Mechanism of action
Enoxaparin	Activates antithrombin III, which in turn potentiates the inhibition of coagulation factors Xa
Fondaparinux	Activates antithrombin III, which in turn potentiates the inhibition of coagulation factors Xa
Bivalirudin	Reversible direct thrombin inhibitor
Abciximab, eptifibatide, tirofiban	Glycoprotein IIb/IIIa receptor antagonists

Q-3

An 83-year-old male presents with ischaemic sounding chest pain that has persisted for the past one hour. A 12-lead ECG is performed and shows deep T wave inversion in leads V1 and V2.

Which is the most likely implicated coronary artery?

A. Left circumflex artery
B. Left main stem artery
C. Proximal left anterior descending artery
D. Right coronary artery
E. Distal left anterior descending artery

ANSWER:
Proximal left anterior descending artery

EXPLANATION:
Wellens' syndrome is an ECG manifestation of critical proximal left anterior descending (LAD) coronary artery stenosis in patients with unstable angina. It is characterized by symmetrical, often deep (>2 mm), T wave inversions in the anterior precordial leads.

ECG: CORONARY TERRITORIES
The table below shows the correlation between ECG changes and coronary territories:

	ECG changes	Coronary artery
Anteroseptal	V1-V4	Left anterior descending
Inferior	II, III, aVF	Right coronary
Anterolateral	V4-6, I, aVL	Left anterior descending or left circumflex
Lateral	I, aVL +/- V5-6	Left circumflex
Posterior	Tall R waves V1-2	Usually left circumflex, also right coronary

Diagram showing the correlation between ECG changes and coronary territories in acute coronary syndrome

Q-4

Your review a 41-year-old woman. Four months ago she developed a deep vein thrombosis and was warfarinised with a target INR of 2.5. She has presented with a swollen, tender left calf and a Doppler scan confirms a further deep vein thrombosis. Her INR has been above 2.0 for the past three months. You organise some investigations to exclude an underlying prothrombotic condition. What should happen regarding her anticoagulation?

A. Switch to treatment dose low-molecular weight heparin
B. Continue on warfarin, continue with INR target of 2.5
C. Add aspirin 75 mg od
D. Continue on warfarin, increase INR target to 3.0
E. Continue on warfarin, increase INR target to 3.5

ANSWER:
Continue on warfarin, increase INR target to 3.5

EXPLANATION:
WARFARIN
Warfarin is an oral anticoagulant which inhibits the reduction of vitamin K to its active hydroquinone form, which in turn acts as a cofactor in the carboxylation of clotting factor II, VII, IX and X (mnemonic = 1972) and protein C.

Indications
- venous thromboembolism: target INR = 2.5, if recurrent 3.5
- atrial fibrillation, target INR = 2.5
- mechanical heart valves, target INR depends on the valve type and location. Mitral valves generally require a higher INR than aortic valves.

Patients on warfarin are monitored using the INR (international normalised ration), the ratio of the prothrombin time for the patient over the normal prothrombin time. Warfarin has a long half-life and achieving a stable INR may take several days. There a variety of loading regimes and computer software is now often used to alter the dose.

Factors that may potentiate warfarin
- liver disease
- P450 enzyme inhibitors, e.g.: amiodarone, ciprofloxacin
- cranberry juice
- drugs which displace warfarin from plasma albumin, e.g. NSAIDs
- inhibit platelet function: NSAIDs

Side-effects
- haemorrhage
- teratogenic, although can be used in breastfeeding mothers
- skin necrosis: when warfarin is first started biosynthesis of protein C is reduced. This results in a temporary procoagulant state after initially starting warfarin,

normally avoided by concurrent heparin administration. Thrombosis may occur in venules leading to skin necrosis
- purple toes

Q-5

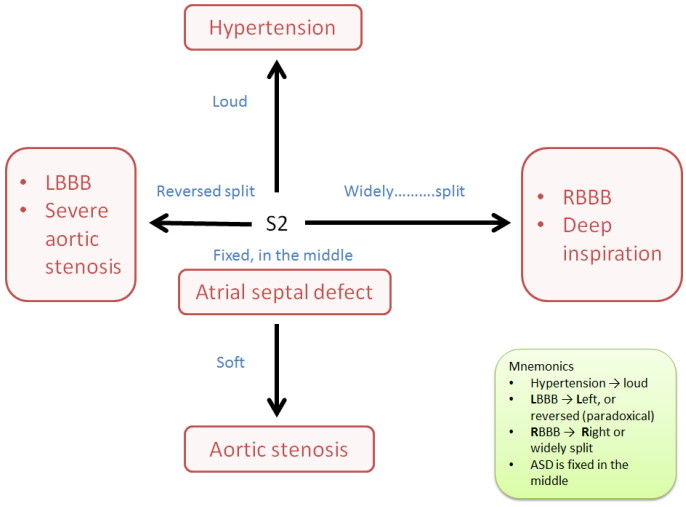
A 71-year-old man with a history of ischaemic heart disease is brought to the Emergency Department following a 'collapse'. He now feels back to normal. The ECG shows sinus rhythm, 94/min with left bundle branch block. Given the ECG findings, which one of the following is most likely to be found on auscultation of the heart?

A. Fixed split S2
B. Loud S1
C. Third heart sound (S3)
D. Widely split S2
E. Reversed split S2

ANSWER:
Reversed split S2

EXPLANATION:
Second heart sound (S2)
- ***loud: hypertension***
- ***soft: AS***
- ***fixed split: ASD***
- ***reversed split: LBBB***

HEART SOUNDS: S2
S2 is caused by the closure of the aortic valve (A2) closely followed by that of the pulmonary valve (P2)



Causes of a loud S2
- hypertension: systemic (loud A2) or pulmonary (loud P2)
- hyperdynamic states
- atrial septal defect without pulmonary hypertension

Causes of a soft S2
- aortic stenosis

Causes of fixed split S2
- atrial septal defect

Causes of a widely split S2
- deep inspiration
- RBBB
- pulmonary stenosis
- severe mitral regurgitation

Causes of a reversed (paradoxical) split S2 (P2 occurs before A2)
- LBBB
- severe aortic stenosis
- right ventricular pacing
- WPW type B (causes early P2)
- patent ductus arteriosus

Q-6

The use of beta-blockers in treating hypertension has declined sharply in the past five years. Which one of the following best describes the reasons why this has occurred?

- **Less likely to prevent stroke + potential impairment of glucose tolerance**
- **Less likely to prevent myocardial infarctions + potential impairment of glucose tolerance**
- **High rate of interactions with other commonly prescribed medications (e.g. Calcium channel blockers)**
- **Increased incidence of reported adverse effects**
- **Increased incidence of chronic obstructive pulmonary disease**

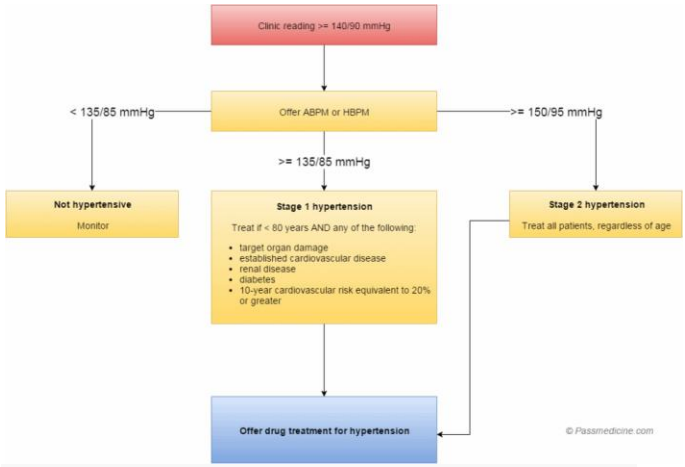
ANSWER:
Less likely to prevent stroke + potential impairment of glucose tolerance

EXPLANATION:
This was demonstrated in the Anglo-Scandinavian Cardiac Outcomes Trial-Blood Pressure Lowering Arm (ASCOT-BPLA).

HYPERTENSION: MANAGEMENT
NICE published updated guidelines for the management of hypertension in 2011. Some of the key changes include:
- classifying hypertension into stages
- recommending the use of ambulatory blood pressure monitoring (ABPM) and home blood pressure monitoring (HBPM)
- calcium channel blockers are now considered superior to thiazides
- bendroflumethiazide is no longer the thiazide of choice

Blood pressure classification
This becomes relevant later in some of the management decisions that NICE advocate.

Stage	Criteria
Stage 1 hypertension	Clinic BP >= 140/90 mmHg and subsequent ABPM daytime average or HBPM average BP >= 135/85 mmHg
Stage 2 hypertension	Clinic BP >= 160/100 mmHg and subsequent ABPM daytime average or HBPM average BP >= 150/95 mmHg
Severe hypertension	Clinic systolic BP >= 180 mmHg, or clinic diastolic BP >= 110 mmHg



Flow chart showing simplified schematic for diagnosis hypertension following NICE guidelines

Managing hypertension

Lifestyle advice should not be forgotten and is frequently tested in exams:

- a low salt diet is recommended, aiming for less than 6g/day, ideally 3g/day. The average adult in the UK consumes around 8-12g/day of salt. A recent BMJ paper* showed that lowering salt intake can have a significant effect on blood pressure. For example, reducing salt intake by 6g/day can lower systolic blood pressure by 10mmHg
- caffeine intake should be reduced
- the other general bits of advice remain: stop smoking, drink less alcohol, eat a balanced diet rich in fruit and vegetables, exercise more, lose weight

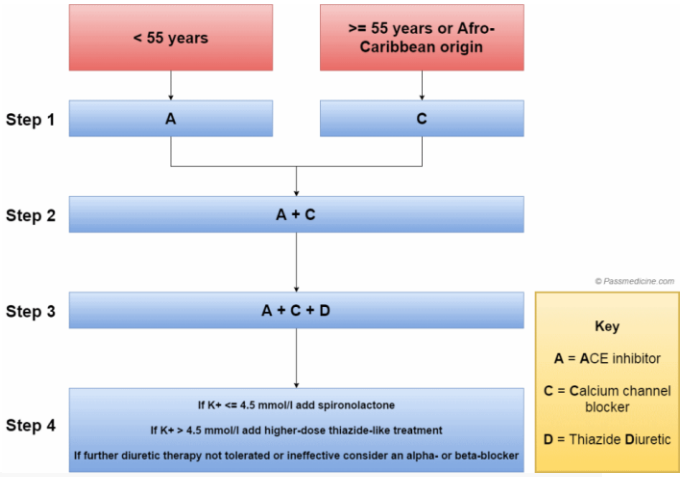
ABPM/HBPM >= 135/85 mmHg (i.e. stage 1 hypertension)

- treat if < 80 years of age AND any of the following apply; target organ damage, established cardiovascular disease, renal disease, diabetes or a 10-year cardiovascular risk equivalent to 20% or greater

ABPM/HBPM >= 150/95 mmHg (i.e. stage 2 hypertension)

- offer drug treatment regardless of age

For patients < 40 years consider specialist referral to exclude secondary causes.



Flow chart showing the management of hypertension as per current NICE guidelines

Step 1 treatment

- patients < 55-years-old: ACE inhibitor (A)
- patients >= 55-years-old or of Afro-Caribbean origin: calcium channel blocker

Step 2 treatment

- ACE inhibitor + calcium channel blocker (A + C)

Step 3 treatment

- add a thiazide diuretic (D, i.e. A + C + D)
- NICE now advocate using either chlorthalidone (12.5-25.0 mg once daily) or indapamide (1.5 mg modified-release once daily or 2.5 mg once daily) in preference to a conventional thiazide diuretic such as bendroflumethiazide

NICE define a clinic BP >= 140/90 mmHg after step 3 treatment with optimal or best tolerated doses as resistant hypertension. They suggest step 4 treatment or seeking expert advice

Step 4 treatment

- consider further diuretic treatment
- if potassium < 4.5 mmol/l add spironolactone 25mg od
- if potassium > 4.5 mmol/l add higher-dose thiazide-like diuretic treatment
- if further diuretic therapy is not tolerated, or is contraindicated or ineffective, consider an alpha- or beta-blocker

Patients who fail to respond to step 4 measures should be referred to a specialist. NICE recommend:

If blood pressure remains uncontrolled with the optimal or maximum tolerated doses of four drugs, seek expert advice if it has not yet been obtained.

Blood pressure targets

	Clinic BP	ABPM / HBPM
Age < 80 years	140/90 mmHg	135/85 mmHg
Age > 80 years	150/90 mmHg	145/85 mmHg

New drugs

Direct renin inhibitors

- e.g. Aliskiren (branded as Rasilez)
- by inhibiting renin blocks the conversion of angiotensinogen to angiotensin I
- no trials have looked at mortality data yet. Trials have only investigated fall in blood pressure. Initial trials suggest aliskiren reduces blood pressure to a similar extent as angiotensin converting enzyme (ACE) inhibitors or angiotensin-II receptor antagonists
- adverse effects were uncommon in trials although diarrhoea was occasionally seen
- only current role would seem to be in patients who are intolerant of more established antihypertensive drugs

Q-7

What does troponin T bind to?

A. Tropomyosin
B. Actin in thin myofilaments
C. Protein kinase C inhibitors
D. Calcium ions
E. T-tubule membrane wall

ANSWER:
Tropomyosin

EXPLANATION:
Tropomyosin is a protein which regulates actin. It associates with actin in muscle fibres and regulates muscle contraction by regulating the binding of myosin.

Please see Q-1 for Cardiac Enzymes and Protein Markers

Q-8

A 70-year-old man presented to the emergency department following a fall and head injury. This is his third fall in the past 12 months. He has a background of persistent atrial fibrillation, type 2 diabetes mellitus and Parkinson's disease. He is taking apixaban 5mg BD, bisoprolol 5mg OD, co-beneldopa 100mg QDS, and metformin 1g BD.

CT head reveals no acute findings.

What is the most appropriate management regarding his anticoagulation?

A. Stop apixaban for now, optimise his Parkinson's medication, and consider restarting in 6 months
B. Switch to aspirin
C. Stop anticoagulation
D. Stop apixaban for now, optimise his Parkinson's medication, and consider starting warfarin in 6 months
E. Continue apixaban

ANSWER:
Continue apixaban

EXPLANATION:
Risk of falls alone is not sufficient reasoning to withhold anticoagulation
Do not withhold anticoagulation solely because of the risk of falls (NICE CG180). There is no other reason to consider withdrawing anticoagulation here. One study used experimental modelling to conclude that a patient with a 5% annual stroke risk (CHADS 2-3) would need to fall approximately 295 times per year for the benefits of anticoagulation to be out-weighed by the risk of fall-related intracranial haemorrhage. All of the other answers involve stopping or pausing oral anticoagulation and are therefore incorrect.

ATRIAL FIBRILLATION: ANTICOAGULATION

NICE updated their guidelines on the management of atrial fibrillation (AF) in 2014. They suggest using the **CHA2DS2-VASc** score to determine the most appropriate anticoagulation strategy. This scoring system superceded the CHADS2 score.

	Risk factor	Points
C	Congestive heart failure	1
H	Hypertension (or treated hypertension)	1
A_2	Age >= 75 years	2
	Age 65-74 years	1
D	Diabetes	1
S_2	Prior Stroke or TIA	2
V	Vascular disease (including ischaemic heart disease and peripheral arterial disease)	1
S	Sex (female)	1

The table below shows a suggested anticoagulation strategy based on the score:

Score	Anticoagulation
0	No treatment
1	Males: Consider anticoagulation Females: No treatment (this is because their score of 1 is only reached due to their gender)
2 or more	Offer anticoagulation

NICE recommend that we offer patients a choice of anticoagulation, including warfarin and the novel oral anticoagulants (NOACs). There are complicated rules surrounding which NOAC is licensed for which risk factor - these can be found in the NICE guidelines. Aspirin is no longer recommended for reducing stroke risk in patients with AF

Doctors have always thought carefully about the risk/benefit profile of starting someone on warfarin. A history of falls, old age, alcohol excess and a history of previous bleeding are common things that make us consider whether warfarinisation is in the best interests of the patient. NICE now recommend we formalise this risk assessment using the HASBLED scoring system.

	Risk factor	Points
H	Hypertension, uncontrolled, systolic BP > 160 mmHg	1
A	Abnormal renal function (dialysis or creatinine > 200) Or Abnormal liver function (cirrhosis, bilirubin > 2 times normal, ALT/AST/ALP > 3 times normal	1 for any renal abnormalities 1 for any liver abnormalities
S	Stroke, history of	1
B	Bleeding, history of bleeding or tendency to bleed	1
L	Labile INRs (unstable/high INRs, time in therapeutic range < 60%)	1
E	Elderly (> 65 years)	1
D	Drugs Predisposing to Bleeding (Antiplatelet agents, NSAIDs) Or Alcohol Use (>8 drinks/week)	1 for drugs 1 for alcohol

There are no formal rules on how we act on the HAS-BLED score although a score of >= 3 indicates a 'high risk' of bleeding, defined as intracranial haemorrhage, hospitalisation, haemoglobin decrease >2 g/L, and/or transfusion.

Q-9

A 44-year-old man is seen in the cardiology clinic. For the past 6 months he has been experiencing episodes of palpitations associated with pre-syncopal symptoms. An ECG taken in clinic shows T wave inversion in leads V1-3 associated with a notch at the end of the QRS complex. He is known to have a family history of sudden cardiac death. What is the most likely diagnosis?

A. Arrhythmogenic right ventricular cardiomyopathy
B. Catecholaminergic polymorphic ventricular tachycardia
C. Hypertrophic obstructive cardiomyopathy
D. Long QT syndrome
E. Brugada syndrome

ANSWER:
Arrhythmogenic right ventricular cardiomyopathy

EXPLANATION:
The notch at the end of the QRS complex is referred to as an epsilon wave.

ARRHYTHMOGENIC RIGHT VENTRICULAR CARDIOMYOPATHY
Arrhythmogenic right ventricular cardiomyopathy (ARVC, also known as arrhythmogenic right ventricular dysplasia or ARVD) is a form of inherited cardiovascular disease which may present with syncope or sudden cardiac death. It is generally regarded as the second most common cause of sudden cardiac death in the young after hypertrophic cardiomyopathy.

Pathophysiology
- inherited in an autosomal dominant pattern with variable expression
- the right ventricular myocardium is replaced by fatty and fibrofatty tissue
- around 50% of patients have a mutation of one of the several genes which encode components of desmosome

Presentation
- palpitations
- syncope
- sudden cardiac death

Investigation
- ECG abnormalities in V1-3, typically T wave inversion. An epsilon wave is found in about 50% of those with ARV - this is best described as a terminal notch in the QRS complex
- echo changes are often subtle in the early stages but may show an enlarged, hypokinetic right ventricle with a thin free wall
- magnetic resonance imaging is useful to show fibrofatty tissue

Management
- drugs: sotalol is the most widely used antiarrhythmic
- catheter ablation to prevent ventricular tachycardia
- implantable cardioverter-defibrillator

Naxos disease
- an autosomal recessive variant of ARVC
- a triad of ARVC, palmoplantar keratosis, and woolly hair

Q-10

A 41-year-old man is admitted with left-sided pleuritic chest pain. He has a dry cough and reports that the pain is relieved by sitting forward. For the past three days he has been experiencing flu-like symptoms. Given the likely diagnosis, what is the most likely finding on ECG?

A. Large S wave in lead I, a large Q wave in lead III and an inverted T wave in lead III
B. Atrial fibrillation
C. Widespread ST elevation
D. ST segment depression in the anterior leads
E. Hyperacute T waves

ANSWER:
Widespread ST elevation

EXPLANATION:
ACUTE PERICARDITIS
Pericarditis is one of the differentials of any patient presenting with chest pain.

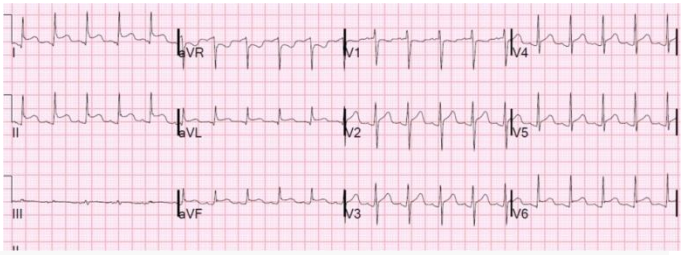
Features
- chest pain: may be pleuritic. Is often relieved by sitting forwards
- other symptoms include non-productive cough, dyspnoea and flu-like symptoms
- pericardial rub
- tachypnoea
- tachycardia

Causes

- viral infections (Coxsackie)
- tuberculosis
- uraemia (causes 'fibrinous' pericarditis)
- trauma
- post-myocardial infarction, Dressler's syndrome
- connective tissue disease
- hypothyroidism
- malignancy

ECG changes

- widespread 'saddle-shaped' ST elevation
- PR depression: most specific ECG marker for pericarditis



ECG showing pericarditis. Note the widespread nature of the ST elevation and the PR depression

Q-11

A 65-year-old patient with chronic kidney disease is found to have a deficiency of antithrombin III after he presented to emergency department with left leg pain and swelling.

A doppler-ultrasound scan of the leg confirms deep venous thrombosis (DVT). The patient is started on dabigatran.

What is the mechanism of action of dabigatran?

A. Activates anti-thrombin III
B. P2Y12 inhibitor
C. Glycoprotein IIb/IIIa inhibitor
D. Direct thrombin inhibitor
E. Direct factor X activator

ANSWER:
Direct thrombin inhibitor

EXPLANATION:
Dabigatran is a direct thrombin inhibitor
Below is a table of the drugs and their mechanisms of actions (MOA):

Drug name	*MOA*
Heparin	*activates anti-thrombin III*
Clopidogrel	*P2Y12 inhibitor*
Abciximab	*glycoprotein IIb/IIIa inhibitor*
Dabigatran	*direct thrombin inhibitor*
Rivaroxaban	*direct factor X inhibitor*

DABIGATRAN

Dabigatran is an oral anticoagulant that works by being a direct thrombin inhibitor. It is one of the drugs developed over the past 10-15 years as an alternative to warfarin, with the advantage that it does not require regular monitoring.

What is dabigatran used for?

Dabigatran is currently used for two main indications.

Firstly it is an option in the prophylaxis of venous thromboembolism following hip or knee replacement surgery.

Secondly, it is also licensed in the UK for prevention of stroke in patients with non-valvular atrial fibrillation who have one or more of the following risk factors present:

- previous stroke, transient ischaemic attack or systemic embolism
- left ventricular ejection fraction below 40%
- symptomatic heart failure of New York Heart Association (NYHA) class 2 or above
- age 75 years or older
- age 65 years or older with one of the following: diabetes mellitus, coronary artery disease or hypertension

What are the known side-effects of dabigatran?

Unsurprisingly haemorrhage is the major adverse effect.

Doses should be reduced in chronic kidney disease and dabigatran should not be prescribed if the creatinine clearance is < 30 ml/min.

Drug Safety Update 2013

The RE-ALIGN study showed significantly higher bleeding and thrombotic events in patients with recent mechanical heart valve replacement using dabigatran compared with warfarin.

Previously there had been no guidance to support the use of dabigatran in patients with prosthetic heart valves but the advice has now changed to dabigatran being contraindicated in such patients.

Q-12

A 31 year-old smoker is seen in the Emergency Department with a 3-day history of worsening, left-sided pleuritic chest pain, associated with worsening shortness of breath. He has no past medical history. His observations are: blood pressure 78/46 mmHg, saturations 81% on 8L/min oxygen via face mask, heart rate 147 bpm and temperature 37.3 degrees Celsius. He appears clammy, pale and unwell.

On examination, lung auscultation is normal. An ECG shows sinus tachycardia with right heart strain. He has not responded to adequate fluid resuscitation. After applying high-flow oxygen, what is the best course of action?

A. **Urgent computed tomography pulmonary angiogram (CTPA)**
B. **Intravenous fluid resuscitation and broad-spectrum antibiotics**
C. **Intravenous alteplase**
D. **Urgent transthoracic echocardiography**
E. **Admission for treatment-dose low molecular weight heparin (LWMH)**

ANSWER:
Intravenous alteplase

EXPLANATION:
This man has a history consistent with pulmonary embolism (PE), with significant haemodynamic instability as evidenced by his hypotension and tachycardia. Although both a transthoracic echocardiogram and CTPA would be useful investigations, treatment should not be delayed in these circumstances. The British Thoracic Society guidelines for treatment of PE state that thrombolysis 'may be instituted on clinical grounds alone if cardiac arrest is imminent' as in this case.

PULMONARY EMBOLISM: MANAGEMENT
The NICE guidelines of 2012 provided some clarity on how long patients should be anticoagulated for after a pulmonary embolism (PE). Selected points are listed below.

Low molecular weight heparin (LMWH) or fondaparinux should be given initially after a PE is diagnosed. An exception to this is for patients with a massive PE where thrombolysis is being considered. In such a situation unfractionated heparin should be used.

- a vitamin K antagonist (i.e. warfarin) should be given within 24 hours of the diagnosis
- the LMWH or fondaparinux should be continued for at least 5 days or until the international normalised ratio (INR) is 2.0 or above for at least 24 hours, whichever is longer, i.e. LMWH or fondaparinux is given at the same time as warfarin until the INR is in the therapeutic range
- warfarin should be continued for at least 3 months. At 3 months, NICE advise that clinicians should 'assess the risks and benefits of extending treatment'
- NICE advise extending warfarin beyond 3 months for patients with unprovoked PE. This essentially means that if there was no obvious cause or provoking factor (surgery, trauma, significant immobility) it may imply the patient has a tendency to thrombosis and should be given treatment longer than the norm of 3 months
- for patients with active cancer NICE recommend using LMWH for 6 months

Thrombolysis

- thrombolysis is now recommended as the first-line treatment for massive PE where there is circulatory failure (e.g. hypotension). Other invasive approaches should be considered where appropriate facilities exist

Q-13

Mr Brown is a 62-year-old man with colon cancer. He is undergoing adjuvant chemotherapy, however in the past six months has suffered four deep vein thrombotic (DVT) events, despite being optimally anti-coagulated with the maximum dose of dabigatran. On one occasion he suffered a DVT during treatment with dalteparin (a low molecular weight heparin) . He has been admitted with symptoms of another DVT.

How should his DVT be treated?

A. **Add apixaban to his prescription**
B. **Initiate end of life drugs and prepare the family**
C. **Increase the dose of dabigatran off-licence**
D. **Prescribe Thrombo-Embolic Deterrent (TED) stockings**
E. **Insert an inferior vena caval filter**

ANSWER:
Insert an inferior vena caval filter

EXPLANATION:
Patients with recurrent venous thromboembolic disease may be considered for an inferior vena cava filter
This patient has cancer and suffered multiple DVTs in a short space of time, despite being fully anti-coagulated. NICE have produced guidelines on such patients:

'Consider inferior vena caval filters for patients with recurrent proximal DVT or PE despite adequate anticoagulation treatment only after considering alternative treatments such as:
increasing target INR to 3–4 for long term high-intensity oral anticoagulant therapy or
switching treatment to LMWH.'

[NICE (2015) Venous thromboembolic diseases: diagnosis, management and thrombophilia testing. CG144]

Add apixaban to his prescription - This is not the most appropriate answer. This patient has already been trailed on a LMWH. An inferior vena caval filter is the most appropriate next step.

Initiate end of life drugs and prepare the family - This is not the most appropriate answer. This clinical description does not give any indication to initiate an end of life pathway. This would be something to discuss with their oncologist.

Increase the dose of dabigatran off-licence - This is not the most appropriate answer. The patient is already on maximum dose and increasing it further, beyond recommended levels, could cause harm.

Prescribe Thrombo-Embolic Deterrent (TED) stockings - This is not the most appropriate answer. A medical or surgical patient will likely be prescribed these on admission as

prophylaxis. However, they are of limited use in treating a DVT.

Insert an inferior vena caval filter - This is the correct answer. As per NICE guidelines above, this patient should be considered for an IVC filter.

Please see Q-12 for Pulmonary Embolism: Management

Q-14

A 35-year-old female has paroxysmal atrial fibrillation and was successfully treated with DC cardioversion 1 week ago. She is now resultantly on warfarin. A subsequent post-cardioversion echocardiogram shows no structural abnormalities.

How long should the warfarin be continued?

A. 3 months
B. Stop immediately
C. 4 weeks
D. Indefinitely
E. 6 months

ANSWER:
4 weeks

EXPLANATION:
It is recommended warfarin be continued for at least 4 weeks after successful cardioversion. If there is structural abnormalities or the atrial fibrillation is likely to re-occur then long term anti-coagulation is recommended.

ATRIAL FIBRILLATION: CARDIOVERSION
There are two scenarios where cardioversion may be used in atrial fibrillation:

- electrical cardioversion as an emergency if the patient is haemodynamically unstable
- electrical or pharmacological cardioversion as an elective procedure where a rhythm control strategy is preferred.

The notes below refer to cardioversion being used in the elective scenario for rhythm control. The wording of the 2014 NICE guidelines is as follows:

offer rate or rhythm control if the onset of the arrhythmia is less than 48 hours, and start rate control if it is more than 48 hours or is uncertain

Onset < 48 hours
If the atrial fibrillation (AF) is definitely of less than 48 hours onset patients should be heparinised. Patients who have risk factors for ischaemic stroke should be put on lifelong oral anticoagulation. Otherwise, patients may be cardioverted using either:

- electrical - 'DC cardioversion'
- pharmacology - amiodarone if structural heart disease, flecainide or amiodarone in those without structural heart disease

Following electrical cardioversion if AF is confirmed as being less than 48 hours duration then further anticoagulation is unnecessary

Onset > 48 hours
If the patient has been in AF for more than 48 hours then anticoagulation should be given for at least 3 weeks prior to cardioversion. An alternative strategy is to perform a transoesophageal echo (TOE) to exclude a left atrial appendage (LAA) thrombus. If excluded patients may be heparinised and cardioverted immediately.

NICE recommend electrical cardioversion in this scenario, rather than pharmacological.

If there is a high risk of cardioversion failure (e.g. Previous failure or AF recurrence) then it is recommend to have at least 4 weeks amiodarone or sotalol prior to electrical cardioversion

Following electrical cardioversion patients should be anticoagulated for at least 4 weeks. After this time decisions about anticoagulation should be taken on an individual basis depending on the risk of recurrence

Q-15

A 68-year-old man with a past history of aortic stenosis is reviewed in clinic. Which one of the following features would most guide the timing of surgery?

A. Symptomatology of patient
B. Aortic valve gradient of 36 mmHg
C. Pulse pressure
D. Loudness of murmur
E. Left ventricular ejection fraction

ANSWER:
Symptomatology of patient

EXPLANATION:
Aortic stenosis management: AVR if symptomatic, otherwise cut-off is gradient of 40 mmHg

AORTIC STENOSIS
Clinical features of symptomatic disease

- chest pain
- dyspnoea
- syncope

Features of severe aortic stenosis

- narrow pulse pressure
- slow rising pulse
- delayed ESM
- soft/absent S2
- S4
- thrill
- duration of murmur
- left ventricular hypertrophy or failure

Causes of aortic stenosis

- degenerative calcification (most common cause in older patients > 65 years)
- bicuspid aortic valve (most common cause in younger patients < 65 years)
- William's syndrome (supravalvular aortic stenosis)
- post-rheumatic disease
- subvalvular: HOCM

Management

- if asymptomatic then observe the patient is general rule
- if symptomatic then valve replacement
- if asymptomatic but valvular gradient > 40 mmHg and with features such as left ventricular systolic dysfunction then consider surgery
- balloon valvuloplasty is limited to patients with critical aortic stenosis who are not fit for valve replacement

Q-16

A 15-year-old collapses and dies whilst playing football and school. He had no past medical history of note. Post-mortem examination reveals asymmetric concentric enlargement of the myocardial septum. Given the likely diagnosis, what is the chance his sister will also have the same underlying disorder?

A. 0%
B. 25%
C. 50%
D. 100%
E. 66%

ANSWER:
50%

EXPLANATION:
The underlying diagnosis is hypertrophic obstructive cardiomyopathy which is an autosomal dominant disorder. His sister therefore has a 50% chance of being affected.

HOCM: FEATURES
Hypertrophic obstructive cardiomyopathy (HOCM) is an autosomal dominant disorder of muscle tissue caused by defects in the genes encoding contractile proteins. The most common defects involve a mutation in the gene encoding β-myosin heavy chain protein or myosin binding protein C. The estimated prevalence is 1 in 500.

Features

- often asymptomatic
- dyspnoea, angina, syncope
- sudden death (most commonly due to ventricular arrhythmias), arrhythmias, heart failure
- jerky pulse, large 'a' waves, double apex beat
- ejection systolic murmur: increases with Valsalva manoeuvre and decreases on squatting

Associations

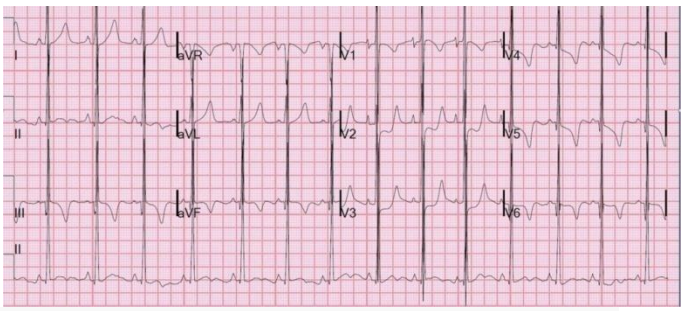
- Friedreich's ataxia
- Wolff-Parkinson White

Echo - mnemonic - MR SAM ASH

- mitral regurgitation (MR)
- systolic anterior motion (SAM) of the anterior mitral valve leaflet
- asymmetric hypertrophy (ASH)

ECG

- left ventricular hypertrophy
- progressive T wave inversion
- deep Q waves
- atrial fibrillation may occasionally be seen



ECG showing typical changes of HOCM including LVH and T wave inversion

Q-17

Which one of the following is least associated with aortic regurgitation?

A. Rheumatic fever
B. William's syndrome
C. Syphilis
D. Bicuspid aortic valve
E. Post-rheumatic disease

ANSWER:
William's syndrome

EXPLANATION:
William's syndrome is associated with supravalvular aortic stenosis.

AORTIC REGURGITATION
Features

- early diastolic murmur
- collapsing pulse
- wide pulse pressure
- mid-diastolic Austin-Flint murmur in severe AR - due to partial closure of the anterior mitral valve cusps caused by the regurgitation streams

Causes (due to valve disease)
rheumatic fever
infective endocarditis
connective tissue diseases e.g. RA/SLE
bicuspid aortic valve

Causes (due to aortic root disease)

- aortic dissection
- spondylarthropathies (e.g. ankylosing spondylitis)
- hypertension
- syphilis
- Marfan's, Ehler-Danlos syndrome

Q-18

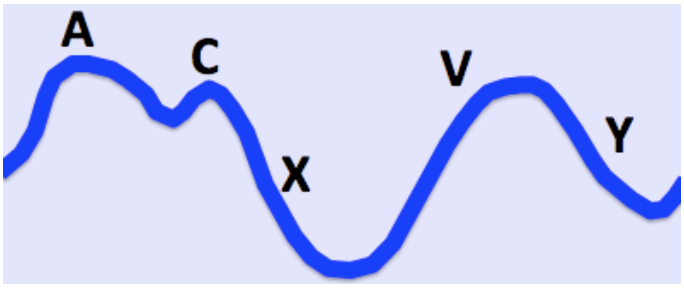
Which part of the jugular venous waveform is associated with the opening of the tricuspid valve?

A. x descent
B. v wave
C. a wave
D. c wave
E. y descent

ANSWER:
y descent

EXPLANATION:
JVP: y descent = opening of tricuspid valve

JUGULAR VENOUS PULSE
As well as providing information on right atrial pressure, the jugular vein waveform may provide clues to underlying valvular disease. A non-pulsatile JVP is seen in superior vena caval obstruction. Kussmaul's sign describes a paradoxical rise in JVP during inspiration seen in constrictive pericarditis.



'a' wave = atrial contraction

- large if atrial pressure e.g. tricuspid stenosis, pulmonary stenosis, pulmonary hypertension
- absent if in atrial fibrillation

Cannon 'a' waves

- caused by atrial contractions against a closed tricuspid valve
- are seen in complete heart block, ventricular tachycardia/ectopics, nodal rhythm, single chamber ventricular pacing

'c' wave

- closure of tricuspid valve
- not normally visible

'v' wave

- due to passive filling of blood into the atrium against a closed tricuspid valve
- giant v waves in tricuspid regurgitation

'x' descent = fall in atrial pressure during ventricular systole

'y' descent = opening of tricuspid valve

Q-19

You receive the blood results of a 76-year-old man who takes warfarin following a pulmonary embolism two months ago. He recently completed a course of antibiotics.

INR 8.4

On reviewing the patient he is well with no bleeding or bruising. What is the most appropriate action?

A. Stop warfarin + restart when INR < 5.0 + give low-molecular weight heparin until warfarin restarted
B. Oral vitamin K 5mg + stop warfarin + repeat INR after 24 hours
C. Stop warfarin + restart when INR < 3.0
D. Stop warfarin + restart when INR < 5.0
E. Fresh frozen plasma + restart warfarin when INR < 5.0

ANSWER:
Oral vitamin K 5mg + stop warfarin + repeat INR after 24 hours

EXPLANATION:
The BNF recommends a dose of between 1 to 5mg of vitamin K in this situation.

WARFARIN: MANAGEMENT OF HIGH INR
The following is based on the BNF guidelines, which in turn take into account the British Committee for Standards in Haematology (BCSH) guidelines. A 2005 update of the BCSH guidelines emphasised the preference of prothrombin complex concentrate over FFP in major bleeding.

Situation	Management
Major bleeding	Stop warfarin Give intravenous vitamin K 5mg Prothrombin complex concentrate - if not available then FFP*
INR > 8.0 Minor bleeding	Stop warfarin Give intravenous vitamin K 1-3mg Repeat dose of vitamin K if INR still too high after 24 hours Restart warfarin when INR < 5.0
INR > 8.0 No bleeding	Stop warfarin Give vitamin K 1-5mg by mouth, using the intravenous preparation orally Repeat dose of vitamin K if INR still too high after 24 hours Restart when INR < 5.0
INR 5.0-8.0 Minor bleeding	Stop warfarin Give intravenous vitamin K 1-3mg Restart when INR < 5.0
INR 5.0-8.0 No bleeding	Withhold 1 or 2 doses of warfarin Reduce subsequent maintenance dose

*as FFP can take time to defrost prothrombin complex concentrate should be considered in cases of intracranial haemorrhage

Q-20

A 52-year-old man is seen in the hypertension clinic. He was diagnosed around three months ago and started on ramipril. This has been titrated up to 10mg od but his blood pressure remains around 156/92 mmHg. What is the most appopriate next step in management?

A. Add bendroflumethiazide
B. Add bisoprolol
C. Switch ramipril to perindopril
D. Add amlodipine
E. Add losartan

ANSWER:
Add amlodipine

EXPLANATION:
Calcium channel blockers are now preferred to thiazides in the treatment of hypertension
The 2011 NICE guidelines reflected the changing evidence base supporting the use of calcium channel blockers in preference to thiazide-type diuretics in the management of hypertension.

Please see Q-6 for Hypertension: Management

Q-21

A 45-year-old man is diagnosed with endocarditis of the aortic valve. He is treated with intravenous benzylpenicillin and gentamicin. What is the most important ECG change to monitor for?

A. Left ventricular hypertrophy (by voltage criteria)
B. Reflex tachycardia
C. ST segment depression
D. Prolonged QT interval
E. Prolonged PR interval

ANSWER:
Prolonged PR interval

EXPLANATION:
A prolonged PR interval could indicate the development of an aortic abscess, an indication for surgery

ECG: PR INTERVAL
Causes of a prolonged PR interval
- idiopathic
- ischaemic heart disease
- digoxin toxicity
- hypokalaemia*
- rheumatic fever
- aortic root pathology e.g. abscess secondary to endocarditis
- Lyme disease
- sarcoidosis
- myotonic dystrophy

A prolonged PR interval may also be seen in athletes

A short PR interval is seen in Wolff-Parkinson-White syndrome

*hyperkalaemia can rarely cause a prolonged PR interval, but this is a much less common association than hypokalaemia

Q-22

A 62-year-old man is examined in the cardiology clinic. During cardiac auscultation it is noted that the pulmonary component of the second heart sound occurs before the aortic. Which one of the following is associated with this finding?

A. Pulmonary stenosis
B. Left bundle branch block
C. Right bundle branch block
D. Atrial septal defect
E. Deep inspiration

ANSWER:
Left bundle branch block

EXPLANATION:
Second heart sound (S2)
- ***loud: hypertension***
- ***soft: AS***
- ***fixed split: ASD***
- ***reversed split: LBBB***

Left bundle branch block causes a reversed split second heart sound. Atrial septal defects cause fixed splitting of S2

Please see Q-5 for Heart Sounds: S2

Q-23

Which one of the following features would indicate cardiac tamponade rather than constrictive pericarditis?

A. Raised JVP
B. Muffled heart sounds
C. No Y descent on JVP
D. Hypotension
E. Tachycardia

ANSWER:
No Y descent on JVP

EXPLANATION:
In cardiac tamponade there is characteristically no Y descent on the JVP. The other four features are seen in both cardiac tamponade and constrictive pericarditis

CARDIAC TAMPONADE

Features

- dyspnoea
- raised JVP, with an absent Y descent - this is due to the limited right ventricular filling
- tachycardia
- hypotension
- muffled heart sounds
- pulsus paradoxus
- Kussmaul's sign (much debate about this)
- ECG: electrical alternans

The key differences between constrictive pericarditis and cardiac tamponade are summarised in the table below:

	Cardiac tamponade	Constrictive pericarditis
JVP	Absent Y descent	X + Y present
Pulsus paradoxus	Present	Absent
Kussmaul's sign	Rare	Present
Characteristic features		Pericardial calcification on CXR

A commonly used mnemonic to remember the absent Y descent in cardiac tamponade is TAMponade = TAMpaX

Q-24

A patient with known heart failure has slight limitation of physical activity. She is comfortable at rest but ordinary activities such as walking to the local shops results in fatigue, palpitations or dyspnoea. What New York Heart Association class best describes the severity of their disease?

A. NYHA Class 0
B. NYHA Class I
C. NYHA Class II
D. NYHA Class III
E. NYHA Class IV

ANSWER:
NYHA Clas II

EXPLANATION:
HEART FAILURE: NYHA CLASSIFICATION
The New York Heart Association (NYHA) classification is widely used to classify the severity of heart failure:

NYHA Class I

- no symptoms
- no limitation: ordinary physical exercise does not cause undue fatigue, dyspnoea or palpitations

NYHA Class II

- mild symptoms
- slight limitation of physical activity: comfortable at rest but ordinary activity results in fatigue, palpitations or dyspnoea

NYHA Class III

- moderate symptoms
- marked limitation of physical activity: comfortable at rest but less than ordinary activity results in symptoms

NYHA Class IV

- severe symptoms
- unable to carry out any physical activity without discomfort: symptoms of heart failure are present even at rest with increased discomfort with any physical activity

Q-25

A 36-year-old man has presented to the emergency department with palpitations. His heart rate was 138 beats per minute and an ECG showed a likely supraventricular tachycardia. The registrar asks you to draw up 6mg of adenosine.

Which of the following drugs may reduce the action of adenosine?

A. Dipyridamole
B. Bupivacaine
C. Aminophylline
D. Amiodarone
E. Montelukast

ANSWER:
Aminophylline

EXPLANATION:
Aminophylline reduces the effect of adenosine
The answer is aminophylline. dipyridamole classically enhances the action. This is commonly remembered with the mnemonic DEAR. Bupivicaine (and other -caines) all also enhance the action of adenosine.

Amiodarone and montelukast are distractors, that have no notable effect.

ADENOSINE
The effects of adenosine are enhanced by dipyridamole (anti-platelet agent) and blocked by theophyllines. It should be avoided in asthmatics due to possible bronchospasm.

Mechanism of action

- causes transient heart block in the AV node
- agonist of the A1 receptor which inhibits adenylyl cyclase thus reducing cAMP and causing hyperpolarization by increasing outward potassium flux
- adenosine has a very short half-life of about 8-10 seconds

Adverse effects

- chest pain
- bronchospasm
- can enhance conduction down accessory pathways, resulting in increased ventricular rate (e.g. WPW syndrome)

Q-26

Which one of the following is least likely to cause dilated cardiomyopathy?

A. Wilson's disease
B. Haemochromatosis
C. Coxsackie B
D. Hypertension
E. Alcohol

ANSWER:
Wilson's disease

EXPLANATION:
Haemochromatosis is more commonly associated with restrictive cardiomyopathy but a dilated pattern may also be seen. There is a known association between Wilson's disease and cardiomyopathy but this is extremely rare and not often clinically significant

DILATED CARDIOMYOPATHY

Dilated cardiomyopathy (DCM) basics
- dilated heart leading to systolic (+/- diastolic) dysfunction
- all 4 chambers affected but LV more so than RV
- features include arrhythmias, emboli, mitral regurgitation
- absence of congenital, valvular or ischaemic heart disease

Causes often considered separate entities
- alcohol: may improve with thiamine
- postpartum
- hypertension

Other causes
- inherited (see below)
- infections e.g. Coxsackie B, HIV, diphtheria, parasitic
- endocrine e.g. Hyperthyroidism
- infiltrative* e.g. Haemochromatosis, sarcoidosis
- neuromuscular e.g. Duchenne muscular dystrophy
- nutritional e.g. Kwashiorkor, pellagra, thiamine/selenium deficiency
- drugs e.g. Doxorubicin

Inherited dilated cardiomyopathy
- around a third of patients with DCM are thought to have a genetic predisposition
- a large number of heterogeneous defects have been identified
- the majority of defects are inherited in an autosomal dominant fashion although other patterns of inheritance are seen

*these causes may also lead to restrictive cardiomyopathy

Q-27

An obese 45-year-old male, with known hyperlipidaemia and peripheral vascular disease, presents with a right parietal ischaemic stroke. He reports trouble sleeping and laying flat at night that began after a flu-like illness 3 months ago, and reports some exertional dyspnoea. Which of the following investigations are most likely to find the cause of the stroke?

A. Echocardiogram
B. CT brain with angiography
C. Magnetic resonance imaging / Magnetic resonance angiography(MRI/MRA)
D. Carotid doppler of carotid vessels
E. CT Chest with contrast

ANSWER:
Echocardiogram

EXPLANATION:
The underlying diagnosis is a viral myocarditis precipitating a dilated cardiomyopathy and causing a cardioembolic stroke. Previously, the enteroviruses (including coxsackievirus) were the most common identified viruses. Currently, parvovirus B-19 and human herpes virus 6 are considered the most common causes of viral myocarditis. The echo may show reduced left ventricular ejection fraction, myocardial dyssynchrony (myocardial segments contract at different points in time), thinning of the left ventricular wall and a dilated left ventricle. Trouble sleeping and laying flat at night and the exertional dyspnoea after a flu-like illness are key features suggestive of a viral myocarditis.

CT brain and MRI/MRA will show the effect of the stroke, and not the cause. Carotid doppler ultrasonography of the carotids will not show the cause, as the cause is cardioembolic stroke.

Please see Q-26 for Dilated Cardiomyopathy

Q-28

A 54-year-old male with no past medical history is found to be in atrial fibrillation during a consultation regarding a sprained ankle. He reports no history of palpitations or dyspnoea. After discussing treatment options he elects not to be cardioverted. Examination of the cardiovascular system is otherwise unremarkable with a blood pressure of 118/76 mmHg. According to the latest NICE guidelines, if the patient remains in chronic atrial fibrillation what is the most suitable treatment to offer?

A. No treatment
B. Warfarin
C. Dabigatran
D. Aspirin + dipyridamole
E. Aspirin

ANSWER:
No treatment

EXPLANATION:
Young man with AF, no TIA or risk factors, no treatment is now preferred to aspirin
The CHA2DS2-VASc score for this man is 0. NICE therefore recommend that he does not require anticoagulation.

Please see Q-8 for Atrial Fibrillation: Anticoagulation

Q-29

A 75-year-old woman is brought to the Emergency Department by her family. She has been getting more short-of-breath over the last 6 weeks and says her energy levels are low. An ECG on arrival shows atrial fibrillation at a rate of 114 / min. Blood pressure is 128/80 mmHg and a chest x-ray is unremarkable. What is the appropriate drug to control the heart rate?

A. Felodipine
B. Amiodarone
C. Digoxin
D. Flecainide
E. Bisoprolol

ANSWER:
Bisoprolol

EXPLANATION:
Atrial fibrillation: rate control - beta blockers preferable to digoxin
This question reiterates an important point which frequently comes up in exams - digoxin is no longer first-line for rate control in atrial fibrillation. Her shortness-of-breath is likely to be rate related and does not necessarily mean that she is in heart failure. This is supported by a normal chest x-ray.

Please see the NICE guidelines for further information.

ATRIAL FIBRILLATION: RATE CONTROL AND MAINTENANCE OF SINUS RHYTHM
The Royal College of Physicians and NICE published guidelines on the management of atrial fibrillation (AF) in 2006. The following is also based on the joint American Heart Association (AHA), American College of Cardiology (ACC) and European Society of Cardiology (ESC) 2012 guidelines

Agents used to control rate in patients with atrial fibrillation
- beta-blockers
- calcium channel blockers
- digoxin (not considered first-line anymore as they are less effective at controlling the heart rate during exercise. However, they are the preferred choice if the patient has coexistent heart failure)

Agents used to maintain sinus rhythm in patients with a history of atrial fibrillation
- sotalol
- amiodarone
- flecainide
- others (less commonly used in UK): disopyramide, dofetilide, procainamide, propafenone, quinidine

The table below indicates some of the factors which may be considered when considering either a rate control or rhythm control strategy

Factors favouring rate control	Factors favouring rhythm control
Older than 65 years History of ischaemic heart disease	Younger than 65 years Symptomatic First presentation Lone AF or AF secondary to a corrected precipitant (e.g. Alcohol) Congestive heart failure

Q-30

A 44-year-old gentleman presents to the emergency department with chest pain. As the acting cardiology registrar, you are asked to see him immediately as he ECG shows ST segment elevation in multiple leads. When you arrive, he is sitting in bed leaning forward to rest his arms on his knees.

His past medical history includes hypertension, type 1 diabetes mellitus (diagnosed aged 11) and his father died from a myocardial infarction age 60. In addition to this, he tells you he has been well recently apart from a slight 'sore throat' 2 weeks ago that cleared up with no problems. He first noticed the chest pain 4 hours ago while still in bed this morning and he describes it as left sided chest pain with no radiation. He has taken 1g paracetamol with minimal improvement.

Given the likely diagnosis, which of the following is the most specific ECG finding in this condition?

A. Reciprocal ST depression
B. Shortened PR interval
C. 'Tombstoning' ST elevation in all precordial leads
D. Peaked T waves
E. PR depression

ANSWER:
PR depression

EXPLANATION:
The most likely diagnosis in the case is acute pericarditis. Though he does have some risk factors for ischaemic heart disease, there are points in the history which lead you towards a diagnosis of pericarditis: the history of viral illness, widespread ST elevation and posture of the patient (sitting forward suggesting this is comfortable/gives some pain relief) are typical.

All of the above ECG features may be seen in pericarditis. However, the only specific finding is PR depression and therefore this is the most appropriate answer. In addition to this, ST elevation in pericarditis would classically be described as 'saddle-shaped.'

Please see Q-10 for Acute Pericarditis

Q-31

A 45-year-old female develops pleuritic chest pain following a hysterectomy 10 days ago. Low-molecular weight heparin is given initially and CTPA confirms a pulmonary embolism. There is no previous history of venous thromboembolism. How long should the patient be warfarinised for?

A. Not suitable for anticoagulation
B. At least 4 weeks
C. At least 3 months
D. At least 6 months
E. 12 months

ANSWER:
At least 3 months

EXPLANATION:
As this patient has a temporary risk factor for a thromboembolic event the recommended period of anticoagulation is 3 months.

Please see Q-12 for Pulmonary Embolism: Management

Q-32

What is the role of troponin in cardiac muscle?

A. Component of the thick filaments
B. Acts as a lining of the T tubules
C. Anchors thick filament to Z-discs
D. Component of the thin filaments
E. Anchors thick and thin filaments together

ANSWER:
Component of the thin filaments

EXPLANATION:
The other components of thin filaments are actin and tropomyosin. Thick filaments are primarily composed of myosin.

Please see Q-1 for Cardiac Enzymes and Protein Markers

Q-33

A 31-year-old woman of Malaysian origin presents with headache, malaise and joint pains. For the past few months she has also experienced pain in the calves after walking any significant distance. On examination her pulse is 78/min and blood pressure in the left arm is noted to be 154/98 mmHg. Due to this raised reading it is measured in the right arm and found to be 132/80 mmHg. An early diastolic murmur is noted in aortic area and a bruit is present in the carotids. Examination of the respiratory system is unremarkable. What is the most likely diagnosis?

A. Coarctation of the aorta
B. Supravalvular aortic stenosis
C. Takayasu's arteritis
D. Buerger's disease
E. Polyarteritis nodosa

ANSWER:
Takayasu's arteritis

EXPLANATION:
The early diastolic murmur is caused by aortic regurgitation, which is seen in around 20% of patients with Takayasu's arteritis.

TAKAYASU'S ARTERITIS
Takayasu's arteritis is a large vessel vasculitis. It typically causes occlusion of the aorta and questions commonly refer to an absent limb pulse. It is more common in females and Asian people

Features
- systemic features of a vasculitis e.g. malaise, headache
- unequal blood pressure in the upper limbs
- carotid bruit
- intermittent claudication
- aortic regurgitation (around 20%)

Angiography showing multiple stenoses in the branches of the aorta secondary to Takayasu's arteritis

Associations
- renal artery stenosis

Management
- steroids

Q-34

A 45-year-old female is due to undergo a dental extraction for relief of neuralgic pain. Additionally, she is having a hysterectomy in 4 weeks for a fibroid uterus with menorrhagia. She mentions to you that she has previously been diagnosed with a heart murmur and wants to know if this will affect her operation.

In regard to her valvular heart disease and associated risk, what is the most appropriate thing to advise her?

A. She should have antibiotic prophylaxis at the time of hysterectomy only
B. She should have antibiotic prophylaxis for both procedures
C. She is not at risk of infective endocarditis so should not worry
D. She is at theoretical risk of infective endocarditis but antibiotic prophylaxis is no longer advised routinely for either procedure
E. She should be offered chlorhexidine mouthwash as prophylaxis when undergoing the dental extraction

ANSWER:
She is at theoretical risk of infective endocarditis but antibiotic prophylaxis is no longer advised routinely for either procedure

EXPLANATION:
Antibiotic prohylaxis to prevent infective endocarditis is not routinely recommended in the UK for dental and other procedures
The answer to this question is based on NICE Guidance (CG64 - March 2008).

According to this guidance, as neither procedure requires prophylaxis (either antibiotics or mouthwash) the only appropriate answer here is 4: that the patient is at theoretical risk of infective endocarditis but that antibiotic prophylaxis is no longer routinely recommended.

INFECTIVE ENDOCARDITIS: PROPHYLAXIS
The 2008 guidelines from NICE have radically changed the list of procedures for which antibiotic prophylaxis is recommended

NICE recommends the following procedures do not require prophylaxis:
- dental procedures
- upper and lower gastrointestinal tract procedures
- genitourinary tract; this includes urological, gynaecological and obstetric procedures and childbirth
- upper and lower respiratory tract; this includes ear, nose and throat procedures and bronchoscopy

The guidelines do however suggest:
- any episodes of infection in people at risk of infective endocarditis should be investigated and treated promptly to reduce the risk of endocarditis developing
- if a person at risk of infective endocarditis is receiving antimicrobial therapy because they are undergoing a gastrointestinal or genitourinary procedure at a site where there is a suspected infection they should be given an antibiotic that covers organisms that cause infective endocarditis

It is important to note that these recommendations are not in keeping with the American Heart Association/European Society of Cardiology guidelines which still advocate antibiotic prophylaxis for high-risk patients who are undergoing dental procedures.

Q-35

A 62-year-old female with no past medical history is admitted to hospital with a left-sided hemiparesis. Examination reveals that she is in atrial fibrillation. CT scan of her brain shows a cerebral infarction. What is the most appropriate anticoagulation strategy for this patient?

A. Life-long warfarin, started immediately
B. Aspirin started immediately switching to life-long warfarin after 2 weeks
C. Life-long aspirin, started immediately
D. Life-long aspirin started after 2 weeks
E. 6 months of warfarin, started immediately

ANSWER:
Aspirin started immediately switching to life-long warfarin after 2 weeks

EXPLANATION:
ATRIAL FIBRILLATION: POST-STROKE
NICE issued guidelines on atrial fibrillation (AF) in 2006. They included advice on the management of patients with AF who develop a stroke or transient-ischaemic attack (TIA).

Recommendations include:
- following a stroke or TIA warfarin should be given as the anticoagulant of choice. Aspirin/dipyridamole should only be given if needed for the treatment of other comorbidities
- in acute stroke patients, in the absence of haemorrhage, anticoagulation therapy should be commenced after 2 weeks. If imaging shows a very large cerebral infarction then the initiation of anticoagulation should be delayed

Q-36

Which of the following signs is not associated with the development of Eisenmenger's syndrome in a patient with a ventricular septal defect?

A. Worsening of systolic murmur
B. Raised JVP
C. Loud second heart sound
D. Cyanosis
E. Large 'a' waves in jugular venous waveform

ANSWER:
Worsening of systolic murmur

EXPLANATION:
Eisenmenger's syndrome is characterised by the reversal of the left-right shunt due to pulmonary hypertension. The original murmur may disappear once Eisenmenger's syndrome develops

EISENMENGER'S SYNDROME
Eisenmenger's syndrome describes the reversal of a left-to-right shunt in a congenital heart defect due to pulmonary hypertension. This occurs when an uncorrected left-to-right leads to remodeling of the pulmonary microvasculature, eventually causing obstruction to pulmonary blood and pulmonary hypertension.

Associated with
- ventricular septal defect
- atrial septal defect
- patent ductus arteriosus

Features
- original murmur may disappear
- cyanosis
- clubbing
- right ventricular failure
- haemoptysis, embolism

Management
- heart-lung transplantation is required

Q-37
A 67-year-old female is prescribed simvastatin for hyperlipidaemia. Which one of the following is most likely to interact with her medication?

A. Orange juice
B. Apple juice
C. Grapefruit juice
D. Cranberry juice
E. Carrot juice

ANSWER:
Grapefruit juice

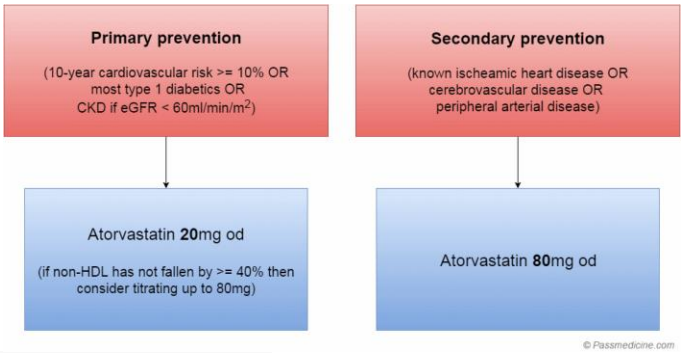
EXPLANATION:
Grapefruit juice is a potent inhibitor of the cytochrome P450 enzyme CYP3A4

STATINS
Statins inhibit the action of HMG-CoA reductase, the rate-limiting enzyme in hepatic cholesterol synthesis

Adverse effects
- myopathy: includes myalgia, myositis, rhabdomyolysis and asymptomatic raised creatine kinase. Risks factors for myopathy include advanced age, female sex, low body mass index and presence of multisystem disease such as diabetes mellitus. Myopathy is more common in lipophilic statins (simvastatin, atorvastatin) than relatively hydrophilic statins (rosuvastatin, pravastatin, fluvastatin)
- liver impairment: the 2014 NICE guidelines recommend checking LFTs at baseline, 3 months and 12 months. Treatment should be discontinued if serum transaminase concentrations rise to and persist at 3 times the upper limit of the reference range
- there is some evidence that statins may increase the risk of intracerebral haemorrhage in patients who've previously had a stroke. This effect is not seen in primary prevention. For this reason the Royal College of Physicians recommend avoiding statins in patients with a history of intracerebral haemorrhage

Who should receive a statin?
- all people with established cardiovascular disease (stroke, TIA, ischaemic heart disease, peripheral arterial disease)
- following the 2014 update, NICE recommend anyone with a 10-year cardiovascular risk >= 10%
- patients with type 2 diabetes mellitus should now be assessed using QRISK2 like other patients are, to determine whether they should be started on statins
- patients with type 1 diabetes mellitus who were diagnosed more than 10 years ago OR are aged over 40 OR have established nephropathy

Statins should be taken at night as this is when the majority of cholesterol synthesis takes place. This is especially true for simvastatin which has a shorter half-life than other statins



Graphic showing choice of statin.

Q-38

A 59-year-old patient was found to have a moderate hypercalcaemia in a routine blood sample order by his general practitioner. He is only taking a non-prescribed prophylactic dose of vitamin D for the last six months, which he had bought over the counter. On examination he is bright and alert, well perfused with moist mucous membranes. There is no neurological symptoms and electrocardiogram shows a normal sinus rhythm. Hypercalcaemia is a relatively frequent clinical problem and although clinical signs and symptoms of all hypercalcaemia tend to be similar, there are several clinical features that may help to distinguish them according to aetiology. Which of the following medical conditions is less likely to produce hypercalcemia?

A. Multiple myeloma
B. Primary hyperparathyroidism
C. Sarcoidosis
D. Hodgkin's lymphoma
E. Familial hypomagnesemia with hypercalciuria and nephrocalcinosis

ANSWER:
Familial hypomagnesemia with hypercalciuria and nephrocalcinosis

EXPLANATION:
Loop diuretics can cause hyponatraemia, metabolic alkalosis, hypokalaemia and hypercalciuria
Hypercalcaemia is a common finding in patients with any type of cancer, including haematological neoplasms such as Hodgkin's lymphoma and multiple myeloma. Myeloma can cause hypercalcaemia by breaking down bone matter which leads to the release of calcium into the blood.

Primary hyperthyroidism can increase calcium levels by the action of parathyroid hormone (PTH).

Sarcoidosis can be responsible for raised serum calcium levels by uncontrolled synthesis of 1,25-dihydroxyvitamin D3 by macrophages. 1,25-dihydroxyvitamin D3 is the activate form of vitamin D which leads to an increased absorption of calcium in the intestine.

Familial hypomagnesemia with hypercalciuria and nephrocalcinosis autosomal-recessive renal tubular disorder characterized by excessive urinary losses of magnesium and calcium, bilateral nephrocalcinosis and progressive renal failure. There is a huge flow of calcium to the kidney, where most of it is excreted and not reabsorbed so is less likely to cause hypercalcaemia but most likely to cause hypocalcaemia instead.

LOOP DIURETICS
Furosemide and bumetanide are loop diuretics that act by inhibiting the Na-K-Cl cotransporter (NKCC) in the thick ascending limb of the loop of Henle, reducing the absorption of NaCl. There are two variants of NKCC; loop diuretics act on NKCC2, which is more prevalent in the kidneys.

Indications
- heart failure: both acute (usually intravenously) and chronic (usually orally)
- resistant hypertension, particularly in patients with renal impairment

Adverse effects
- hypotension
- hyponatraemia
- hypokalaemia, hypomagnesaemia
- hypochloraemic alkalosis
- ototoxicity
- hypocalcaemia
- renal impairment (from dehydration + direct toxic effect)
- hyperglycaemia (less common than with thiazides)
- gout

Q-39

You are asked to urgently review a 61-year-old female on the cardiology ward due to difficulty in breathing. On examination she has a raised JVP with bilateral fine crackles to the mid zones. Blood pressure is 94/60 mmHg and the pulse is 140-150 and irregular. ECG confirms atrial fibrillation. What is the most appropriate management?

A. IV amiodarone
B. IV digoxin
C. Urgent synchronised DC cardioversion
D. Oral digoxin
E. IV flecainide

ANSWER:
Urgent synchronised DC cardioversion

EXPLANATION:
Heart failure is one of the adverse signs indicating the need for urgent synchronised DC cardioversion

PERI-ARREST RHYTHMS: TACHYCARDIA
The 2015 Resuscitation Council (UK) guidelines have simplified the advice given for the management of peri-arrest tachycardias. Separate algorithms for the management of broad-complex tachycardia, narrow complex tachycardia and atrial fibrillation have been replaced by one unified treatment algorithm

Following basic ABC assessment, patients are classified as being stable or unstable according to the presence of any adverse signs:
- shock: hypotension (systolic blood pressure < 90 mmHg), pallor, sweating,
- cold, clammy extremities, confusion or impaired consciousness
- syncope
- myocardial ischaemia
- heart failure

If any of the above adverse signs are present then synchronised DC shocks should be given

Treatment following this is given according to whether the QRS complex is narrow or broad and whether the rhythm is regular or irregular. The full treatment algorithm can be found at the Resuscitation Council website, below is a very limited summary:

Broad-complex tachycardia
Regular
- assume ventricular tachycardia (unless previously confirmed SVT with bundle branch block)
- loading dose of amiodarone followed by 24 hour infusion

Irregular
1. AF with bundle branch block - treat as for narrow complex tachycardia
2. Polymorphic VT (e.g. Torsade de pointes) - IV magnesium

Narrow-complex tachycardia
Regular
- vagal manoeuvres followed by IV adenosine
- if above unsuccessful consider diagnosis of atrial flutter and control rate (e.g. Beta-blockers)

Irregular
- probable atrial fibrillation
- if onset < 48 hr consider electrical or chemical cardioversion
- rate control (e.g. Beta-blocker or digoxin) and anticoagulation

Q-40

A 71-year-old woman is admitted with acute dyspnoea to the Emergency Department. Oxygen saturations are 94% on 28% supplementary oxygen and her respiratory rate is 30/min. A rapid B-type natriuretic peptide (BNP) assay is reported as follows:

BNP 62 pg/ml

What is the best interpretation of this result?

A. No conclusion can be drawn from this result
B. Pulmonary embolism is the most likely cause of her symptoms
C. If a further BNP level is above 50 pg/ml after one hour then this is diagnostic of heart failure
D. Heart failure is unlikely to be the cause of her dyspnoea
E. Heart failure is highly likely to be the cause of her dyspnoea

ANSWER:
Heart failure is unlikely to be the cause of her dyspnoea

EXPLANATION:
B-TYPE NATRIURETIC PEPTIDE
B-type natriuretic peptide (BNP) is a hormone produced mainly by the left ventricular myocardium in response to strain.

Whilst heart failure is the most obvious cause of raised BNP levels any cause of left ventricular dysfunction such as myocardial ischaemia or valvular disease may raise levels. Raised levels may also be seen due to reduced excretion in patients with chronic kidney disease. Factors which reduce BNP levels include treatment with ACE inhibitors, angiotensin-2 receptor blockers and diuretics.

Effects of BNP
- vasodilator
- diuretic and natriuretic
- suppresses both sympathetic tone and the renin-angiotensin-aldosterone system

Clinical uses of BNP
Diagnosing patients with acute dyspnoea
- a low concentration of BNP(< 100pg/ml) makes a diagnosis of heart failure unlikely, but raised levels should prompt further investigation to confirm the diagnosis
- NICE currently recommends BNP as a helpful test to rule out a diagnosis of heart failure

Prognosis in patients with chronic heart failure
- initial evidence suggests BNP is an extremely useful marker of prognosis

Guiding treatment in patients with chronic heart failure
- effective treatment lowers BNP levels

Screening for cardiac dysfunction
- not currently recommended for population screening

Q-41

A 70-year-old man with a background of ischaemic heart disease and peripheral arterial disease presents to the Emergency Department. He has been feeling generally unwell for the past two days with fever and myalgia but this morning developed a purple, cold left middle toe. On examination there are signs of early ischaemia to the toe and a faint livedo reticularis rash is seen on the foot. A diagnosis of cholesterol embolisation is suspected. Which of the following features would be most supportive of this diagnosis?

A. Lymphocytosis
B. Thrombocytosis
C. Neutrophilia
D. Thrombocytopaenia
E. Eosinophilia

ANSWER:
Eosinophilia

EXPLANATION:

Eosinophilia is seen in around 70% of cases of cholesterol embolisation.

CHOLESTEROL EMBOLISATION

Overview

- cholesterol emboli may break off causing renal disease
- seen more commonly in arteriopaths, abdominal aortic aneurysms

Features

- eosinophilia
- purpura
- renal failure
- livedo reticularis

Q-42

You get bleeped in the middle of your night shift to talk to a worried father who's daughter has been admitted with cyanosis. He tells you that they were aware she has had a murmur since birth, but it has only been the last few days in which she has had symptoms. You believe that this is a case of Eisenmenger's syndrome.

What is the medical definition of Eisenmenger's syndrome?

A. The reversal of a right-to-left shunt
B. An audible ventricular septal defect
C. Presence of a ventricular septal defect alongside an atrial septal defect
D. The reversal of a left-to-right shunt
E. All four of the following: overriding aorta, pulmonary stenosis, right ventricular hypertrophy, ventricular septal defect

ANSWER:

The reversal of a left-to-right shunt

EXPLANATION:

Eisenmenger's syndrome - the reversal of a left-to-right shunt

Eisenmenger's syndrome is the reversal of left-to-right shunt associated with ventricular septal defects, atrial septal defect and a patent ductus arteriosus.

Please see Q-36 for Eisenmenger's Syndrome

Q-43

You have been asked to supervise an exercise tolerance test (ETT) for a 70-year-old patient with suspected ischaemic heart disease who has been experiencing exertional chest pain. He has had no recent episodes of severe chest pain and feels well today. Before starting the test his pulse is 84/min and blood pressure is 130/80 mmHg. Once the ETT has begun, which one of the following is the strongest indication for stopping the test?

A. Blood pressure of 105/70 mmHg
B. Heart rate of 130/min
C. Systolic blood pressure of 215 mmHg
D. ST depression of 2mm
E. ST elevation of 1mm

ANSWER:

Blood pressure of 105/70 mmHg

EXPLANATION:

EXERCISE TOLERANCE TESTS

Exercise tolerance tests (ETT, also exercise ECG) are used for a variety of indications:

- assessing patients with suspected angina - however the 2010 NICE Chest pain of recent onset guidelines do not support the use of ETTs for all patients
- risk stratifying patients following a myocardial infarction
- assessing exercise tolerance
- risk stratifying patients with hypertrophic cardiomyopathy

ETT has a sensitivity of around 80% and a specificity of 70% for ischaemic heart disease.

Heart rate:

- maximum predicted heart rate = 220 - patient's age
- the target heart rate is at least 85% of maximum predicted to allow reasonable interpretation of
- a test as low-risk or negative

Contraindications

- myocardial infarction less than 7 days ago
- unstable angina
- uncontrolled hypertension (systolic BP > 180 mmHg) or hypotension (systolic BP < 90 mmHg)
- aortic stenosis
- left bundle branch block: this would make the ECG very difficult to interpret

Stop if:

- exhaustion / patient request
- 'severe', 'limiting' chest pain
- > 3mm ST depression
- > 2mm ST elevation.Stop if rapid ST elevation and pain
- systolic blood pressure > 230 mmHg
- systolic blood pressure falling > 20 mmHg
- attainment of maximum predicted heart rate
- heart rate falling > 20% of starting rate
- arrhythmia develops

Q-44

A 35-year-old woman who presents with progressive dyspnoea is diagnosed as having primary pulmonary hypertension. She is started on an endothelin receptor antagonist. What is the aim of this treatment?

A. **Increase blood flow to the lungs**
B. **Reduce the risk of secondary pulmonary fibrosis**
C. **Reduce pulmonary vascular resistance leading to reduced right ventricle (RV) systolic pressure**
D. **Decrease the pulmonary venous pressure**
E. **Increase the oxygen saturation of venous blood flowing to the left atrium**

ANSWER:
Reduce pulmonary vascular resistance leading to reduced right ventricle (RV) systolic pressure

EXPLANATION:
Endothelin receptor antagonists decrease pulmonary vascular resistance in patients with primary pulmonary hypertension
The aim of endothelin receptor antagonist therapy is to reduce pulmonary vascular resistance and hence reduce the strain on the right ventricle. Right ventricular failure is the most common cause of death in patients with primary pulmonary hypertension.

PULMONARY ARTERIAL HYPERTENSION
Pulmonary arterial hypertension (PAH) may be defined as a resting mean pulmonary artery pressure of >= 25 mmHg. Endothelin thought to play a key role in pathogenesis of PAH. It is more common in females and typically presents between the ages of 30-50 years. Pulmonary hypertension may of course develop secondary to chronic lung diseases such as COPD - PAH is diagnosed in the absence of this although certain factors increase the risk, including HIV, cocaine and anorexigens (e.g. fenfluramine). Around 10% of cases are inherited in an autosomal dominant fashion.

Features
- progressive exertional dyspnoea is the classical presentation
- other possible features include exertional syncope, exertional chest pain and peripheral oedema
- cyanosis
- right ventricular heave, loud P2, raised JVP with prominent 'a' waves, tricuspid regurgitation

Management should first involve treating any underlying conditions, for example with anticoagulants or oxygen. Following this, it has now been shown that acute vasodilator testing is central to deciding on the appropriate management strategy. Acute vasodilator testing aims to decide which patients show a significant fall in pulmonary arterial pressure following the administration of vasodilators such as intravenous epoprostenol or inhaled nitric oxide

If there is a positive response to acute vasodilator testing (a minority of patients)
- oral calcium channel blockers

If there is a negative response to acute vasodilator testing (the vast majority of patients)
- prostacyclin analogues: treprostinil, iloprost
- endothelin receptor antagonists: bosentan
- phosphodiesterase inhibitors: sildenafil

Patients with progressive symptoms should be considered for a heart-lung transplant.

Q-45
What is the main mechanism of action of simvastatin?

A. **Bile acid sequestrant**
B. **Decreases hepatic HDL synthesis**
C. **Inhibits lipoprotein lipase**
D. **Decreases intrinsic cholesterol synthesis**
E. **Agonists of PPAR-alpha**

ANSWER:
Decreases intrinsic cholesterol synthesis

EXPLANATION:
Statins inhibit HMG-CoA reductase, the rate-limiting enzyme in hepatic cholesterol synthesis

Please see Q-37 for Statins

Q-46
You are a CT1 in Acute Medicine covering the hospital at night. You are called to the surgical ward to see a 35-year-old patient who is reporting palpitations. She is known to have Wolff-Parkinson-White syndrome. Her ECG shows fast atrial fibrillation. On examination, there is no evidence of haemodynamic instability. What is the most appropriate pharmacological management option for this patient?

A. **Adenosine**
B. **Verapamil**
C. **Metoprolol**
D. **Digoxin**
E. **Flecainide**

ANSWER:
Flecainide

EXPLANATION:
In patients with accessory pathways, such as those with Wolff-Parkinson-White syndrome, AV nodal blocking drugs should be avoided in atrial fibrillation. This is because blocking the AV node may enhance the rate of conduction through the accessory pathway, causing atrial fibrillation to degenerate into ventricular fibrillation (VF).

Verapamil exerts the most reliable and long-lasting effect on AV node refractoriness and therefore is the most contra-indicated in this scenario. Adenosine has a similar effect and has also been associated with precipitating VF in pre-excited atrial fibrillation.

Beta-blockers and digoxin also inhibit AV node conduction.

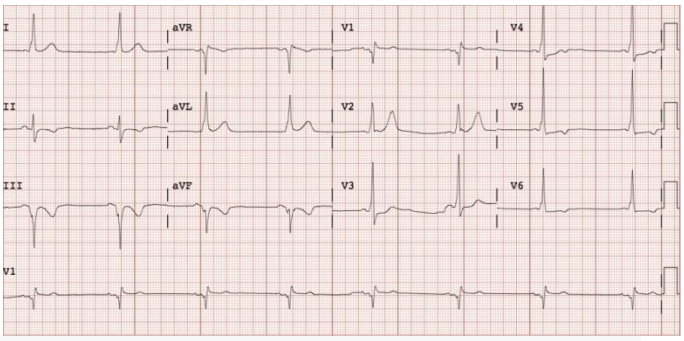
Flecainide is a sodium channel blocker (Class Ic anti-arrhythmic) which will reduce the excitability of the atrial and ventricular myocardium without AV nodal blockade.

WOLFF-PARKINSON WHITE

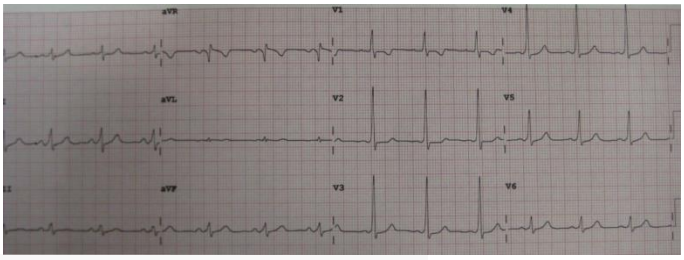
Wolff-Parkinson White (WPW) syndrome is caused by a congenital accessory conducting pathway between the atria and ventricles leading to a atrioventricular re-entry tachycardia (AVRT). As the accessory pathway does not slow conduction AF can degenerate rapidly to VF

Possible ECG features include:

- short PR interval
- wide QRS complexes with a slurred upstroke - 'delta wave'
- left axis deviation if right-sided accessory pathway*
- right axis deviation if left-sided accessory pathway*



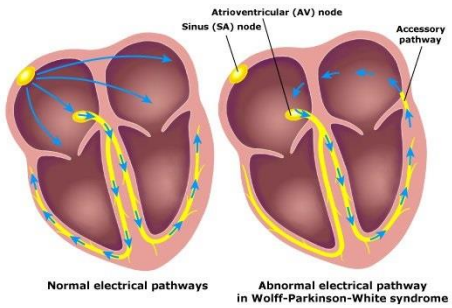
ECG showing short PR interval associated with a slurred upstroke (delta wave). Note the non-specific ST-T changes which are common in WPW and may be mistaken for ischaemia. The left axis deviation means that this is type B WPW, implying a right-sided pathway



Further example showing a characteristic delta wave

Differentiating between type A and type B**

- type A (left-sided pathway): dominant R wave in V1
- type B (right-sided pathway): no dominant R wave in V1



Associations of WPW

- HOCM
- mitral valve prolapse
- Ebstein's anomaly
- thyrotoxicosis
- secundum ASD

Management

- definitive treatment: radiofrequency ablation of the accessory pathway
- medical therapy: sotalol***, amiodarone, flecainide

*in the majority of cases, or in a question without qualification, Wolff-Parkinson-White syndrome is associated with left axis deviation

**there is a rare type C WPW, WPW in which the delta waves are upright in leads V1-V4 but negative in leads V5-V6

***sotalol should be avoided if there is coexistent atrial fibrillation as prolonging the refractory period at the AV node may increase the rate of transmission through the accessory pathway, increasing the ventricular rate and potentially deteriorating into ventricular fibrillation

Q-47

A 53-year-old man is reviewed in the cardiology clinic with a history of chest pain and syncope. On examination he has an ejection systolic murmur radiating to the carotid area. What is the most likely cause of his symptoms?

A. Bicuspid aortic valve
B. Aortic root abscess
C. Post rheumatic fever
D. Posterior myocardial infarction
E. Calcification of the aortic valve

ANSWER:

Bicuspid aortic valve

EXPLANATION:

Aortic stenosis - most common cause:

- ***younger patients < 65 years: bicuspid aortic valve***
- ***older patients > 65 years: calcification***

Please see Q-15 for Aortic Stenosis

Q-48

A 76-year-old gentleman is admitted through the Emergency Department with worsening shortness of breath and ankle swelling on a background of left ventricular failure secondary to ischaemic heart disease. He has bibasal crepitations on auscultation and a raised JVP of 4 cm with peripheral pitting oedema to his knees. He is commenced on IV furosemide.

What is the mechanism of action of furosemide?

A. **Inhibition of the Na+Cl- transporter in the distal convoluted tubule**
B. **Aldosterone antagonist**
C. **Inhibition of the Na+/K+/2Cl- co-transporter in the thick ascending limb of the loop of Henle**
D. **Inhibition of the Na+/K+/2Cl- co-transporter in the proximal tubule**
E. **Inhibition of sodium channels in the collecting tubules**

ANSWER:
Inhibition of the Na+/K+/2Cl- co-transporter in the thick ascending limb of the loop of Henle

EXPLANATION:
Loop diuretics (furosemide, bumetanide) act by inhibiting the Na+/K+/2Cl- cotransporter in the thick ascending limb of the loop of Henle. This causes loss of water along with sodium chloride, potassium, calcium, and hydrogen ions.

Explanation for other options:
1. Describes mechanism of thiazide diuretics
2. Spironolactone and eplerenone are examples of aldosterone antagonists
4. This answer is incorrect
5. Describes mechanism of amiloride and triamterene

Please see Q-38 for Loop Diuretics

Q-49

A 67-year-old man with a history of hypertension presents to the emergency department with a 24hr history of dyspnoea and palpitations. He also complains of mild chest discomfort. On examination, you note an irregularly irregular pulse of 115 beats per minute, blood pressure 95 / 70 mmHg and a respiratory rate of 20 breaths/min. He denies any regular medication and insists he has never experienced anything like this before. An ECG shows absent P waves with QRS complexes irregularly irregular intervals.

What is the most appropriate management?

A. **Clopidogrel**
B. **Direct current cardioversion**
C. **Bisoprolol**
D. **IV adenosine**
E. **Digoxin**

ANSWER:
Direct current cardioversion

EXPLANATION:
New onset AF is considered for electrical cardioversion if it presents within 48 hours of presentation
This is an individual presenting a clinical picture of new-onset atrial fibrillation. A blood pressure of 95/70 mmHg in a patient with a history of high blood pressure, who is currently not taking any blood pressure medication is quite concerning. It suggests that he is hemodynamically unstable. The most appropriate treatment for new-onset atrial fibrillation (AF) within 48hrs is DC cardioversion if unstable or either DC cardioversion or pharmacological cardioversion. Beta-blockers can be used for rate control. Clopidogrel is not a treatment of AF. Bisoprolol would be a suitable alternative if the patient was more stable. Digoxin is ideal for patients with AF and heart failure. IV adenosine is a treatment for narrow complex supraventricular tachyarrhythmias

Please see Q-14 for Atrial Fibrillation: Cardioversion

Q-50

A 79-year-old woman is reviewed. She has taken bendroflumethiazide 2.5mg od for the past 10 years for hypertension. Her current blood pressure is 150/94 mmHg. Clinical examination is otherwise unremarkable. An echocardiogram from two months ago is reported as follows:

Ejection fraction 48%, moderate left ventricular hypertrophy. Minimal MR noted

What is the most appropriate next step in management?

A. **Increase bendroflumethiazide to 5mg od**
B. **Stop bendroflumethiazide + start frusemide 40mg od**
C. **Add ramipril 1.25mg od**
D. **Stop bendroflumethiazide + start ramipril 1.25mg od**
E. **Add amlodipine 5mg od**

ANSWER:
Add ramipril 1.25mg od

EXPLANATION:
The echocardiogram shows a degree of left ventricular impairment. It is important an ACE inhibitor is started in such patients. This will help to both control her blood pressure and also slow the deterioration in her cardiac function.

Even though bendroflumethiazide is no longer the recommend thiazide of choice, and thiazides now come 'third' in the A + C + D guidelines, NICE do not recommend stopping treatment in patients who are already taking the drug.

A beta-blocker should also be added in the near future given the left ventricular impairment.

Please see Q-6 for Hypertension: Management

Q-51

A 34-year-old woman is referred to cardiology as her primary care doctor has identified a systolic murmur. As part of the investigations she undergoes cardiac catherisation. The following results are obtained from the right side of the heart:

Oxygen saturation
Right atrium 71%
Right ventricle 82%
Pulmonary artery 81%

The left side of the heart is also assessed:

Oxygen saturation
Left atrium 99%
Left ventricle 98%
Aorta 97%

What is the most likely diagnosis?

A. Ventricular septal defect
B. Patent ductus arteriosus
C. Atrial septal defect with Eisenmenger's syndrome
D. Atrial septal defect
E. Ventricular septal defect with Eisenmenger's syndrome

ANSWER:
Ventricular septal defect

EXPLANATION:
CARDIAC CATHERISATION AND OXYGEN SATURATION LEVELS
Questions regarding cardiac catherisation and oxygen saturation levels can seem daunting at first but a few simple rules combined with logical deduction can usual produce the answer.

Let's start with the basics:

- deoxygenated blood returns to the right side of the heart via the superior vena cava (SVC) and inferior vena cava (IVC). It has an oxygen saturation level of around 70%. The right atrium (RA), right ventricle (RV) and pulmonary artery (PA) normally have oxygen saturation levels of around 70%
- the lungs oxygenate the blood to a level of around 98-100%. The left atrium (LA), left ventricle (LV) and aorta should all therefore have oxygen saturation levels of 98-100%

The table below shows the oxygen saturations that would be expected in different scenarios:

Diagnosis & notes	RA	RV	PA	LA	LV	Aorta
Normal	70%	70%	70%	100%	100%	100%
Atrial septal defect (ASD) The oxygenated blood in the LA mixes with the deoxygenated blood in the RA, resulting in intermediate levels of oxygenation from the RA onwards	85%	85%	85%	100%	100%	100%
Ventricular septal defect (VSD) The oxygenated blood in the LV mixes with the deoxygenated blood in the RV, resulting in intermediate levels of oxygenation from the RV onwards. The RA blood remains deoxygenated	70%	85%	85%	100%	100%	100%
Patent ductus arteriosus (PDA) Remember, a PDA connects the higher pressure aorta with the lower pressure PA. This results in only the PA having intermediate oxygenation levels	70%	70%	85%	100%	100%	100%
VSD with Eisenmenger's	70%	70%	70%	100%	85%	85%
PDA with Eisenmenger's	70%	70%	70%	100%	100%	85%
ASD with Eisenmenger's	70%	70%	70%	85%	85%	85%

Q-52

A 65-year-old female with a known history of heart failure presents for an annual check-up. She is found to have a blood pressure of 170/100 mmHg. Her current medications are furosemide and aspirin. What is the most appropriate medication to add?

A. Bendroflumethiazide
B. Spironolactone
C. Bisoprolol
D. Verapamil
E. Enalapril

ANSWER:
Enalapril

EXPLANATION:
Both enalapril and bisoprolol have been shown to improve prognosis in patients with heart failure. Enalapril however would also be better at treating the hypertension. NICE guidelines recommend the introduction of an ACE inhibitor prior to a beta-blocker in patients with chronic heart failure

HEART FAILURE: DRUG MANAGEMENT
A number of drugs have been shown to improve mortality in patients with chronic heart failure:

- ACE inhibitors (SAVE, SOLVD, CONSENSUS)
- spironolactone (RALES)
- beta-blockers (CIBIS)
- hydralazine with nitrates (VHEFT-1)

No long-term reduction in mortality has been demonstrated for loop diuretics such as furosemide.

NICE issued updated guidelines on management in 2010, key points include:

- first-line treatment for all patients is both an ACE-inhibitor and a beta-blocker
- second-line treatment is now either an aldosterone antagonist, angiotensin II receptor blocker or a hydralazine in combination with a nitrate
- if symptoms persist cardiac resynchronisation therapy or digoxin* should be considered. An alternative supported by NICE in 2012 is ivabradine. The criteria for ivabradine

include that the patient is already on suitable therapy (ACE-inhibitor, beta-blocker + aldosterone antagonist), has a heart rate > 75/min and a left ventricular fraction < 35%
- diuretics should be given for fluid overload
- offer annual influenza vaccine
- offer one-off** pneumococcal vaccine

Beta-blockers licensed to treat heart failure in the UK include bisoprolol, carvedilol, and nebivolol.

*digoxin has also not been proven to reduce mortality in patients with heart failure. It may however improve symptoms due to its inotropic properties. Digoxin is strongly indicated if there is coexistent atrial fibrillation

**adults usually require just one dose but those with asplenia, splenic dysfunction or chronic kidney disease need a booster every 5 years

Q-53

A 66-year-old man presents with shortness-of-breath on exertion. On examination his blood pressure is 128/76 mmHg, pulse 78 / min and regular. Auscultation of his chest reveals an early diastolic murmur. Which one of the following conditions is most associated with this kind of murmur?

A. Atrial septal defect
B. Mitral stenosis
C. Hypertrophic obstructive cardiomyopathy
D. Aortic regurgitation
E. Mitral regurgitation

ANSWER:
Aortic regurgitation

EXPLANATION:
MURMURS
Ejection systolic
- aortic stenosis
- pulmonary stenosis, HOCM
- ASD, Fallot's

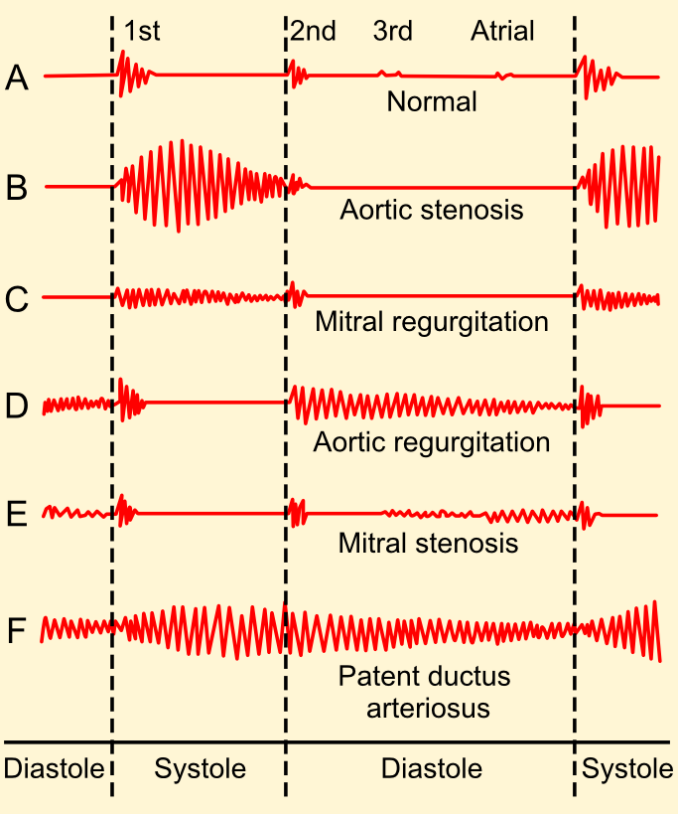
Holosystolic (pansystolic)
- mitral/tricuspid regurgitation (high-pitched and 'blowing' in character)
- VSD ('harsh' in character)

Late systolic
- mitral valve prolapse
- coarctation of aorta

Early diastolic
- aortic regurgitation (high-pitched and 'blowing' in character)
- Graham-Steel murmur (pulmonary regurgitation, again high-pitched and 'blowing' in character)

Mid-late diastolic
mitral stenosis ('rumbling' in character)
Austin-Flint murmur (severe aortic regurgitation, again is 'rumbling' in character)

Continuous machine-like mumur
patent ductus arteriosus



Q-54

A patient develops a broad complex tachycardia two days following a myocardial infarction. Intravenous amiodarone is given.

Which one of the following best describes the primary mechanism of action of amiodarone?

A. Blocks voltage-gated potassium channels
B. Shortens QT interval
C. Blocks voltage-gated sodium channels
D. Opens sodium channels
E. Blocks voltage-gated calcium channels

ANSWER:
Blocks voltage-gated potassium channels

EXPLANATION:
Amiodarone - MOA: blocks potassium channels

AMIODARONE
Amiodarone is a class III antiarrhythmic agent used in the treatment of atrial, nodal and ventricular tachycardias. The

main mechanism of action is by blocking potassium channels which inhibits repolarisation and hence prolongs the action potential. Amiodarone also has other actions such as blocking sodium channels (a class I effect)

The use of amiodarone is limited by a number of factors

- long half-life (20-100 days)
- should ideally be given into central veins (causes thrombophlebitis)
- has proarrhythmic effects due to lengthening of the QT interval
- interacts with drugs commonly used concurrently (p450 inhibitor) e.g. Decreases metabolism of warfarin
- numerous long-term adverse effects (see below)

Monitoring of patients taking amiodarone
TFT, LFT, U&E, CXR prior to treatment
TFT, LFT every 6 months

Adverse effects of amiodarone use

- thyroid dysfunction: both hypothyroidism and hyper-thyroidism
- corneal deposits
- pulmonary fibrosis/pneumonitis
- liver fibrosis/hepatitis
- peripheral neuropathy, myopathy
- photosensitivity
- 'slate-grey' appearance
- thrombophlebitis and injection site reactions
- bradycardia
- lengths QT interval

Q-55

You are considering prescribing an antibiotic to a 28-year-old man who tells you he has Long QT syndrome. Which antibiotic is it most important to avoid?

A. Doxycycline
B. Trimethoprim
C. Erythromycin
D. Rifampicin
E. Co-amoxiclav

ANSWER:
Erythromycin

EXPLANATION:
LONG QT SYNDROME
Long QT syndrome (LQTS) is an inherited condition associated with delayed repolarization of the ventricles. It is important to recognise as it may lead to ventricular tachycardia and can therefore cause collapse/sudden death. The most common variants of LQTS (LQT1 & LQT2) are caused by defects in the alpha subunit of the slow delayed rectifier potassium channel. A normal corrected QT interval is less than 430 ms in males and 450 ms in females.

Causes of a prolonged QT interval:

Congenital	Drugs*	Other
• Jervell-Lange-Nielsen syndrome (includes deafness and is due to an abnormal potassium channel) • Romano-Ward syndrome (no deafness)	• amiodarone, sotalol, class 1a antiarrhythmic drugs • tricyclic antidepressants, selective serotonin reuptake inhibitors (especially citalopram) • methadone • chloroquine • terfenadine** • erythromycin • haloperidol	• electrolyte: hypocalcaemia, hypokalaemia, hypomagnesaemia • acute myocardial infarction • myocarditis • hypothermia • subarachnoid haemorrhage

Features

- may be picked up on routine ECG or following family screening
- Long QT1 - usually associated with exertional syncope, often swimming
- Long QT2 - often associated with syncope occurring following emotional stress, exercise or auditory stimuli
- Long QT3 - events often occur at night or at rest
- sudden cardiac death

Management

- avoid drugs which prolong the QT interval and other precipitants if appropriate (e.g. Strenuous exercise)
- beta-blockers***
- implantable cardioverter defibrillators in high risk cases

*the usual mechanism by which drugs prolong the QT interval is blockage of potassium channels. See the link for more details

**a non-sedating antihistamine and classic cause of prolonged QT in a patient, especially if also taking P450 enzyme inhibitor, e.g. Patient with a cold takes terfenadine and erythromycin at the same time

***note sotalol may exacerbate long QT syndrome

Q-56

You are seeing John, a 50-year-old man who is complaining of central constricting chest pain. Walking up the stairs triggers the pain. The pain goes away with resting. He experiences some shortness of breath but denies any syncope or palpitations. He suffers from hypertension and diabetes. He takes verapamil for migraine prophylaxis. His other medications include GTN spray, aspirin, atorvastatin, Ramipril and metformin. On examination, his rhythm seems to be irregular. There is no murmur on auscultation of the heart. There is no tenderness on chest wall palpation.

He is asking for a medication that would be helpful to prevent the chest pain from occurring. What is the most appropriate treatment?

A. Bisoprolol
B. Digoxin
C. Metoprolol
D. Nicorandil
E. Ibuprofen

ANSWER:
Nicorandil

EXPLANATION:
Beta-blockers e.g. bisoprolol should not be used with verapamil due to the risk of bradycardia, heart block, congestive heart failure
This is a typical angina history. Beta-blocker is a first line Angina prophylaxis. However, this man is taking verapamil for his migraine. Verapamil should not be used with beta blocker due to the risk of bradycardia, heart block or even congestive cardiac failure. Therefore, bisoprolol and metoprolol are incorrect answers. Ibuprofen and digoxin do not reduce the frequency of angina. Therefore, the next line for prophylaxis of angina is Nicorandil.

BETA-BLOCKERS
Beta-blockers are an important class of drug used mainly in the management of cardiovascular disorders.

Indications
- angina
- post-myocardial infarction
- heart failure: beta-blockers were previously avoided in heart failure but there is now strong evidence that certain beta-blockers improve both symptoms and mortality
- arrhythmias: beta-blockers have now replaced digoxin as the rate-control drug of choice in atrial fibrillation
- hypertension: the role of beta-blockers has diminished in recent years due to a lack of evidence in terms of reducing stroke and myocardial infarction.
- thyrotoxicosis
- migraine prophylaxis
- anxiety

Examples
- atenolol
- propranolol: one of the first beta-blockers to be developed. Lipid soluble therefore crosses the blood-brain barrier

Side-effects
- bronchospasm
- cold peripheries
- fatigue
- sleep disturbances, including nightmares

Contraindications
- uncontrolled heart failure
- asthma
- sick sinus syndrome
- concurrent verapamil use: may precipitate severe bradycardia

Q-57

A 35-year-old female presents with a deep vein thrombosis in the third trimester of pregnancy. Whilst in the Emergency Department she develops a left hemiparesis. What underlying cardiac abnormality is most likely to be responsible?

A. Primum ASD
B. Secundum ASD
C. Patent foramen ovale
D. VSD
E. Patent ductus arteriosus

ANSWER:
Patent foramen ovale

EXPLANATION:
Whilst atrial septal defects may allow emboli to pass from the right side of the heart to the left side, the most common cause is a patent foramen ovale

PATENT FORAMEN OVALE
Patent foramen ovale (PFO) is present in around 20% of the population. It may allow embolus (e.g. from DVT) to pass from right side of the heart to the left side leading to a stroke - 'a paradoxical embolus'

There also appears to be an association between migraine and PFO. Some studies have reported improvement in migraine symptoms following closure of the PFO.

The management of patients with PFO who've had a stroke remains controversial. Options include antiplatelet therapy, anticoagulant therapy or PFO closure.

Q-58

A 72-year-old man who has a history of ischaemic heart disease and left ventricular dysfunction is admitted with dyspnoea. He has not taken his diuretics for three days as he ran out. On examination you note bilateral crackles to the midzones and a respiratory rate of 30/min. Which other clinical finding is most specific with this presentation?

A. Bisferiens pulse
B. Wide pulse pressure
C. Warm peripheries
D. Pulsus alternans
E. Fourth heart sound (S4)

ANSWER:
Pulsus alternans

EXPLANATION:
Pulsus alternans - seen in left ventricular failure

PULSES
Pulsus paradoxus
- greater than the normal (10 mmHg) fall in systolic blood pressure during inspiration → faint or absent pulse in inspiration
- severe asthma, cardiac tamponade

Slow-rising/plateau
- aortic stenosis

Collapsing
- aortic regurgitation
- patent ductus arteriosus
- hyperkinetic (anaemia, thyrotoxic, fever, exercise/pregnancy)

Pulsus alternans
- regular alternation of the force of the arterial pulse
- severe LVF

Bisferiens pulse
- 'double pulse' - two systolic peaks
- mixed aortic valve disease

'Jerky' pulse
- hypertrophic obstructive cardiomyopathy*

*HOCM may occasionally be associated with a bisferiens pulse

Q-59

A 60-year-old man who is investigated for exertional chest pain is diagnosed as having angina pectoris. Which one of the following drugs is most likely to improve his long-term prognosis?

A. Atenolol
B. Aspirin
C. Isosorbide mononitrate
D. Ramipril
E. Nicorandil

ANSWER:
Aspirin

EXPLANATION:
Strong evidence exists supporting the use of aspirin in stable angina. The benefit of ACE inhibitors and beta-blockers are significant in patients who've had a myocardial infarction but modest in those with stable angina. Please see the CKS link for a review of the most recent trials.

ANGINA PECTORIS: DRUG MANAGEMENT
The management of stable angina comprises lifestyle changes, medication, percutaneous coronary intervention and surgery. NICE produced guidelines in 2011 covering the management of stable angina

Medication
- all patients should receive aspirin and a statin in the absence of any contraindication
- sublingual glyceryl trinitrate to abort angina attacks
- NICE recommend using either a beta-blocker or a calicum channel blocker first-line based on 'comorbidities, contraindications and the person's preference'
- if a calcium channel blocker is used as monotherapy a rate-limiting one such as verapamil or diltiazem should be used. If used in combination with a beta-blocker then use a long-acting dihydropyridine calcium-channel blocker (e.g. modified-release nifedipine). Remember that beta-blockers should not be prescribed concurrently with verapamil (risk of complete heart block)
- if there is a poor response to initial treatment then medication should be increased to the maximum tolerated dose (e.g. for atenolol 100mg od)
- if a patient is still symptomatic after monotherapy with a beta-blocker add a calcium channel blocker and vice versa
- if a patient is on monotherapy and cannot tolerate the addition of a calcium channel blocker or a beta-blocker then consider one of the following drugs: a long-acting nitrate, ivabradine, nicorandil or ranolazine
- if a patient is taking both a beta-blocker and a calcium-channel blocker then only add a third drug whilst a patient is awaiting assessment for PCI or CABG

Nitrate tolerance
- many patients who take nitrates develop tolerance and experience reduced efficacy
- the BNF advises that patients who develop tolerance should take the second dose of isosorbide mononitrate after 8 hours, rather than after 12 hours. This allows blood-nitrate levels to fall for 4 hours and maintains effectiveness
- this effect is not seen in patients who take modified release isosorbide mononitrate

Ivabradine
- a new class of anti-anginal drug which works by reducing the heart rate
- acts on the If ('funny') ion current which is highly expressed in the sinoatrial node, reducing cardiac pacemaker activity
- adverse effects: visual effects, particular luminous phenomena, are common. Headache. Bradycardia, due to the mechanism of action, may also be seen
- there is no evidence currently of superiority over existing treatments of stable angina

Q-60

You are an SHO working at district general hospital in Cornwall. A 56-year-old man presents to the emergency department with crushing central chest pain that started 30 minutes ago. His ECG demonstrates ST elevation in the anterior leads and he is treated for an ST-elevation myocardial infarction (STEMI). So far he has been given aspirin, clopidogrel, low-molecular weight heparin (LMWH) and his chest pain has significantly improved with sublingual GTN and IV morphine + metoclopramide. There is no cath-lab on site and and the nearest percutaneous coronary intervention (PCI) centre in Truro is approximately 2 ½ hours away. Which of the following is the most appropriate course of action?

A. Transfer to PCI centre
B. Give bivalirudin
C. Start infusion of unfractionated heparin and transfer to PCI centre
D. Give alteplase
E. Give ticagrelor

ANSWER:
Give alteplase

EXPLANATION:
In management of STEMI if primary PCI cannot be delivered within 120 minutes then thrombolysis should be given
In the management of STEMI fibrinolysis with a drug such as alteplase should be offered if primary PCI cannot be delivered within 120 minutes of the time when fibrinolysis could have been given.

This problem is most often encountered when a patient initially presents to a district general hospital that lacks a PCI centre. Ambulances are generally directed to PCI centres in cases of chest pain and this has reduced the frequency with which this occurs.

If a repeat ECG at 90 minutes does not show resolution of ST elevation the patient will require transfer to a PCI centre regardless.

1- This is inappropriate. The transfer time is over 120 minutes from when fibrinolysis could be given. This would therefore be an unacceptable delay.

2- This is a direct thrombin inhibitor. It has a role in STEMI management but would not address the main issue which is the need for PCI/fibrinolysis.

3- Though sometimes used in STEMI again, fibrinolysis or PCI are needed. Additionally, the patient has already had LMWH so this would not make a difference

4- Correct! As the time to PCI is more than 120 minutes from the time at which fibrinolysis (with alteplase in this example) could be given, fibrinolysis should be offered.

5. This is an antagonist of the P2Y12 adenosine diphosphate receptor like clopidogrel, which has already been given. Adding ticagrelor would therefore confer no benefit in this scenario

Please see Q-2 for Acute Coronary Syndrome: management of NSTEMI

Q-61

A 52-year-old man with a history of hypertension is found to have a 10-year cardiovascular disease risk of 28%. A decision is made to start atorvastatin 20mg on. Liver function tests are performed prior to initialising treatment:

Bilirubin	**10 µmol/l (3 - 17 µmol/l)**
ALP	**96 u/l (30 - 150 u/l)**
ALT	**30 u/l (10 - 45 u/l)**
Gamma-GT	**28 u/l (10 - 40 u/l)**

Three months later the LFTs are repeated:

Bilirubin	**12 µmol/l (3 - 17 µmol/l)**
ALP	**107 u/l (30 - 150 u/l)**
ALT	**104 u/l (10 - 45 u/l)**
Gamma-GT	**76 u/l (10 - 40 u/l)**

What is the most appropriate course of action?

A. Continue treatment and repeat LFTs in 1 month
B. Check creatine kinase
C. Reduce dose to atorvastatin 10mg on and repeat LFTs in 1 month
D. Stop treatment and consider alternative lipid lowering drug
E. Stop treatment and refer to gastroenterology

ANSWER:
Continue treatment and repeat LFTs in 1 month

EXPLANATION:
Treatment with statins should be discontinued if serum transaminase concentrations rise to and persist at 3 times the upper limit of the reference range.

Please see Q-37 for Statins

Q-62

A patient with severe aortic stenosis is noted to have a fourth heart sound. Which part of the ECG does this best correlate with?

A. U wave
B. QRS complex

C. P wave
D. ST segment
E. T wave

ANSWER:
P wave

EXPLANATION:
HEART SOUNDS
The first heart sound (S1) is caused by closure of the mitral and tricuspid valves whilst the second heart sound (S2) is due to aortic and pulmonary valve closure

S1
- closure of mitral and tricuspid valves
- soft if long PR or mitral regurgitation
- loud in mitral stenosis

S2
- closure of aortic and pulmonary valves
- soft in aortic stenosis
- splitting during inspiration is normal

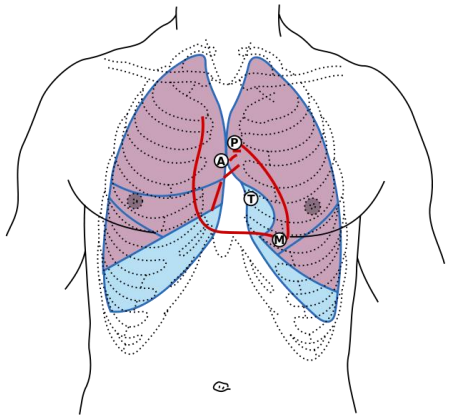
S3 (third heart sound)
- caused by diastolic filling of the ventricle
- considered normal if < 30 years old (may persist in women up to 50 years old)
- heard in left ventricular failure (e.g. dilated cardiomyopathy), constrictive pericarditis (called a pericardial knock) and mitral regurgitation

S4 (fourth heart sound)
- may be heard in aortic stenosis, HOCM, hypertension
- caused by atrial contraction against a stiff ventricle
- in HOCM a double apical impulse may be felt as a result of a palpable S4

Sites of auscultation

Valve	Site
Pulmonary valve	Left second intercostal space, at the upper sternal border
Aortic valve	Right second intercostal space, at the upper sternal border
Mitral valve	Left fifth intercostal space, just medial to mid clavicular line
Tricuspid valve	Left fourth intercostal space, at the lower left sternal border

The diagram below demonstrates where the various cardiac valves are best heard.



Q-63

A 66-year-old male with a 75 pack year history of smoking is admitted with a 2 hour history of central crushing chest pain radiating to his jaw. ECG revealed ST depression in II, III, aVF. 6 hour troponin I was 450ng/L. Grace score revealed 6 month mortality risk of 9%. The patient was started on Tirofiban whilst waiting for angiography.

What is the mechanism of action of Tirofiban?

A. ADP receptor antagonist
B. Factor Xa inhibitor
C. GpIIb/IIIa inhibitor
D. Cox inhibitor
E. Direct thrombin inhibitor

ANSWER:
GpIIb/IIIa inhibitor

EXPLANATION:
This 66-year-old male has presented with a non ST elevated myocardial infarction. Detailed management of NSTEMI's vary from trust to trust, but often involve performing a 6 month mortality score (GRACE) to guide treatment. If your score is greater than intermediate risk (>3%) a glycoprotein inhibitor is started prior to angiography within 96 hours.

Grace score:

Lowest (<1.5%)	*Low (1.5-3.0%)*	*Intermediate (3-6%)*	*High (6-9%)*	*Highest(>9%)*
Aspirin 12 months	*Aspirin + Clopidogrel for 12 months & outpatient perfusion/stress imaging*	*Glycoprotein inhibitor & angiography within 96 hours*	*Glycoprotein inhibitor & angiography within 96 hours*	*Glycoprotein inhibitor & angiography within 96 hours*

GpIIb/IIIa (glycoprotein) inhibitors include: Eptifibatide, Tirofiban and Abciximab (monoclonal antibody hence MAB).

Please see Q-2 for Acute Coronary Syndrome: management of NSTEMI

Q-64

A 17-year-old female presents with recurrent attacks of collapse. These episodes typically occur without warning and have occurred whilst she was running for a bus. There is no significant past medical history and the only family history of note is that her father died suddenly when he was 38-years-old. What is the likely cause?

A. Vaso-vagal attacks
B. Anxiety
C. Epilepsy
D. Cardiogenic syncope
E. Malingering

ANSWER:
Cardiogenic syncope

EXPLANATION:
Sudden death, unusual collapse in young person - ? HOCM
This is a rather vague question. However, a family history of sudden death should make you think of conditions such as hypertrophic obstructive cardiomyopathy

Please see Q-16 for HOCM: Features

Q-65

A 30-year-old woman is admitted to the Emergency Department following the acute onset of palpitations. Blood pressure is 124/84 mmHg and her pulse is 150/min. An ECG shows a narrow complex tachycardia. Intravenous access is gained and 6mg of adenosine is given with no effect. What is the most appropriate next step?

A. Intravenous adenosine 12 mg
B. Intravenous adenosine 6mg
C. Intravenous verapamil 2.5-5 mg
D. Radio-frequency ablation
E. Electrical cardioversion

ANSWER:
Intravenous adenosine 12 mg

EXPLANATION:
A further dose of adenosine should be given if there is no response to the initial injection. Please see the Resuscitation Council (UK) link for further details.

SUPRAVENTRICULAR TACHYCARDIA
Whilst strictly speaking the term supraventricular tachycardia (SVT) refers to any tachycardia that is not ventricular in origin the term is generally used in the context of paroxysmal SVT. Episodes are characterised by the sudden onset of a narrow complex tachycardia, typically an atrioventricular nodal re-entry tachycardia (AVNRT). Other causes include atrioventricular re-entry tachycardias (AVRT) and junctional tachycardias.

Acute management
- vagal manoeuvres: e.g. Valsalva manoeuvre
- intravenous adenosine 6mg → 12mg → 12mg: contraindicated in asthmatics - verapamil is a preferable option
- electrical cardioversion

Prevention of episodes
- beta-blockers
- radio-frequency ablation

Q-66

You review a 24-year-old woman who has recently been diagnosed as having long QT syndrome type I (LQTS1). You are discussing the need to avoid certain drugs and other aggravating factors. Which one of the following should be avoided if possible?

A. Methotrexate
B. Sertraline
C. Grapefruit juice
D. Carbamazepine
E. Doxycycline

ANSWER:
Sertraline

EXPLANATION:
Please see Q-55 for Long QT Syndrome

Q-67

A patient is given aspirin 300 mg after developing an acute coronary syndrome. What is the mechanism of action of aspirin to achieve an antiplatelet effect?

A. Inhibits the production of thromboxane A2
B. Inhibits ADP binding to its platelet receptor
C. Inhibits the production of prostaglandin H2
D. Glycoprotein IIb/IIIa receptor antagonist
E. Inhibits the production of prostacyclin (PGI2)

ANSWER:
Inhibits the production of thromboxane A2

EXPLANATION:

Please see Q-2 for Acute Coronary Syndrome: management of NSTEMI

Q-68

A 73 year-old male has progressive exertional dyspnoea due to progressive systolic heart failure with a left ventricular ejection fraction of 30%. What investigation is most useful in predicting symptomatic response to cardiac resynchronisation therapy?

A. **Cardiac MRI**
B. **Transoesophageal Echo**
C. **Coronary angiogram**
D. **ECG**
E. **Nuclear perfusion scan**

ANSWER:
ECG

EXPLANATION:
The key diagnostic tests used to identify patients likely to benefit from cardiac resynchronization therapy is the transthoracic echocardiogram and ECG. Those with left ventricular ejection fractions of <35% and a LBBB (QRS duration greater than 120 ms) on ECG are excellent candidates for CRT (biventricular pacing). The echo will show asynchronous contraction of the LV and RV and subsequently reduced ejection fraction. A transoesophageal echo is not required.
Biventricular pacing improves quality of life and exercise tolerance amongst other endpoints, and does so by ensuring that the ventricles contract at the same time (resynchronization) due to asynchronous stimulation (LBBB causing asynchronous activation) via the conduction system.

HEART FAILURE: NON-DRUG MANAGEMENT
Cardiac resynchronisation therapy
- for patients with heart failure and wide QRS
- biventricular pacing
- improved symptoms and reduced hospitalisation in NYHA class III patients

Exercise training
- improves symptoms but not hospitalisation/mortality

Q-69

A 51-year-old man is started on lisinopril after being found to have an average blood pressure of 154/93 on ambulatory blood pressure monitoring. Around two weeks after starting treatment he represents with a persistent dry cough. Accumulation of which one of the following proteins is responsible for this?

A. **Adenosine**
B. **Histamine**
C. **Bradykinin**
D. **Acetylcholine**
E. **Neurokinin A**

ANSWER:
Bradykinin

EXPLANATION:
ACE INHIBITORS
Angiotensin-converting enzyme (ACE) inhibitors are now the established first-line treatment in younger patients with hypertension and are also extensively used to treat heart failure. They are known to be less effective in treating hypertensive Afro-Caribbean patients. ACE inhibitors are also used to treat diabetic nephropathy and have a role in secondary prevention of ischaemic heart disease.

Mechanism of action:
- inhibit the conversion angiotensin I to angiotensin II

Side-effects:
- cough: occurs in around 15% of patients and may occur up to a year after starting treatment. Thought to be due to increased bradykinin levels
- angioedema: may occur up to a year after starting treatment
- hyperkalaemia
- first-dose hypotension: more common in patients taking diuretics

Cautions and contraindications
- pregnancy and breastfeeding - avoid
- renovascular disease - significant renal impairment may occur in patients who have undiagnosed bilateral renal artery stenosis
- aortic stenosis - may result in hypotension
- patients receiving high-dose diuretic therapy (more than 80 mg of furosemide a day) - significantly increases the risk of hypotension
- hereditary of idiopathic angioedema

Monitoring
- urea and electrolytes should be checked before treatment is initiated and after increasing the dose
- a rise in the creatinine and potassium may be expected after starting ACE inhibitors. Acceptable changes are an increase in serum creatinine, up to 30%* from baseline and an increase in potassium up to 5.5 mmol/l*.

Q-70

A 62-year-old man comes for review. In the past month he has had two episodes of 'passing out'. The first occurred whilst going upstairs. The second occurred last week whilst he was getting out of a swimming pool. There were no warning signs prior to these episodes. He was told by people who witnessed the episode last week that he was only 'out' for around 15 seconds. He reports feeling 'groggy' for only a few seconds after the episode. On examination pulse is 90 / minute, blood pressure 110/86 mmHg, his lungs are clear and there is a systolic murmur which radiates to the carotid area. Which one of the following investigations should be arranged first?

A. **24 hour ECG monitor**
B. **Echocardiogram**
C. **Exercise tolerance test**
D. **CT head**
E. **Carotid doppler**

ANSWER:
Echocardiogram

EXPLANATION:

The systolic murmur may be a pointer to aortic stenosis (AS). Syncope is a late sign and typically occurs on exertion in patients with AS. It is therefore important to exclude this condition as a priority.

An exercise tolerance test would be contraindicated in a patient with suspected aortic stenosis.

Please see Q-15 for Aortic Stenosis

Q-71

A 30-year-old woman presents to the Emergency Department with a one-day history of central chest pain. The pain is described as severe, non-radiating and eases on expiration. Clinical examination of her cardiorespiratory system is unremarkable other than a heart rate of 96 / min. An ECG shows widespread ST elevation in the anterior, inferior and lateral leads. Bloods show the following:

Full blood count Normal
Urea and electrolystes Normal
Troponin I 0.8 ng/mL (< 0.2 ng/mL)

What is the most likely diagnosis?

A. Pulmonary embolism
B. Acute coronary syndrome
C. Hypertrophic obstructive cardiomyopathy
D. Acute pericarditis
E. Arrhythmogenic right ventricular cardiomyopathy

ANSWER:
Acute pericarditis

EXPLANATION:

A modest rise in troponin is seen in around one-third of patients with acute pericarditis.

Please see Q-10 for Acute Pericarditis

Q-72

Which one of the following electrolyte disturbances is most associated with the development of a prolonged QT interval on ECG?

A. Hyponatraemia
B. Hypocalcaemia
C. Hyperkalaemia
D. Hypercalcaemia
E. Hypophosphataemia

ANSWER:
Hypocalcaemia

EXPLANATION:

Please see Q-55 for Long QT Syndrome

Q-73

A 63-year-old gentleman presents feeling generally unwell. He has had a cough for one week. He has been feeling unwell for the last three days, not eating very much, feeling nauseated and having episodes of shivering. He has a background of osteoarthritis, ischaemic heart disease, hypertension and high cholesterol. His observations show a temperature of 38.3 degrees Celsius, heart rate 136 beats per minute, blood pressure of 139/78 mmHg and respiratory rate of 16 breaths per minute. On examination, his hands feel hot and clammy, and there are crepitations heard on auscultation of the right side of his chest. His abdomen feels soft and non-tender. His pulse is irregular and fast. An ECG demonstrates irregular narrow complex tachycardia. What is the most appropriate acute management to help treat his tachycardia?

A. Anticoagulation
B. Bisoprolol
C. Digoxin
D. Amiodarone
E. Antibiotics

ANSWER:
Antibiotics

EXPLANATION:

The correct answer is antibiotics. This is a patient with AF likely secondary to a community acquired pneumonia, as is suggested by cough, crepitations and fever. In infection driven acute AF it is more appropriate to treat the underlying cause rather than to directly control the heart rate. Bisoprolol and digoxin would be more appropriate in rate-control of chronic AF, whilst amiodarone would could be used for chemical cardiovert chronic AF. Anticoagulation should be considered, but is not the most acute issue.

Please see Q-29 for Atrial Fibrillation: Rate Control and Maintenance of Sinus Rhythm

Q-74

A 66-year-old lady presented to the emergency department with a 5-minute history of right upper limb weakness which spontaneously resolved. She had a past medical history of hypertension, for which she is taking amlodipine 10mg once daily. She is not diabetic. She currently smokes 10 cigarettes a day. Her examination was remarkable for an irregularly irregular heartbeat. Electrocardiogram confirms a diagnosis of atrial fibrillation. CT head showed no evidence of intracranial haemorrhage. She is otherwise well with a normal renal function. What is the most appropriate next step?

A. Refer to anti coagulation clinic
B. Start 300mg aspirin and discharge home
C. Non-urgent referral to the TIA clinic
D. Commence the patient on anticoagulation
E. Refer the patient to psychiatry

ANSWER:
Commence the patient on anticoagulation

EXPLANATION:
This lady has had a transient ischaemic attack (TIA) on a background of atrial fibrillation. In view of her ABCD2 score, she will require referral to the TIA clinic. The presence of AF is independently considered to place the patient in the high-risk category, and will, therefore necessitate urgent referral to the TIA clinic.

Her CHADS-VASC score will necessitate anti-coagulation. Given the lack of efficacy of aspirin in AF, it is important that this lady is commenced on anticoagulation as a priority to reduce the risk of further stroke in the interim. The CT head has ruled out intra-cranial haemorrhage, and therefore this TIA is likely a cardio-embolic phenomenon for which anticoagulation is more efficacious than aspirin. Clearly, a psychiatric referral is inappropriate.

ATRIAL FIBRILLATION: A VERY BASIC INTRODUCTION
Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia. It is very common, being present in around 5% of patients over aged 70-75 years and 10% of patients aged 80-85 years. Whilst uncontrolled atrial fibrillation can result in symptomatic palpitations and inefficient cardiac function probably the most important aspect of managing patients with AF is reducing the increased risk of stroke which is present in these patients.

Types of atrial fibrillation
AF may by classified as either first detected episode, paroxysmal, persistent or permanent.

- first detected episode (irrespective of whether it is symptomatic or self-terminating)
- recurrent episodes, when a patient has 2 or more episodes of AF. If episodes of AF terminate spontaneously then the term paroxysmal AF is used. Such episodes last less than 7 days (typically < 24 hours). If the arrhythmia is not self-terminating then the term persistent AF is used. Such episodes usually last greater than 7 days
- in permanent AF there is continuous atrial fibrillation which cannot be cardioverted or if attempts to do so are deemed inappropriate. Treatment goals are therefore rate control and anticoagulation if appropriate

Symptoms and signs
Symptoms

- palpitations
- dyspnoea
- chest pain

Signs

- an irregularly irregular pulse

Investigations
An ECG is essential to make the diagnosis as other conditions can give an irregular pulse, such as ventricular ectopics or sinus arrhythmia.

Management
There are two key parts of managing patients with AF:
1. Rate/rhythm control
2. Reducing stroke risk

Rate vs. rhythm control
There are two main strategies employed in dealing with the arrhythmia element of atrial fibrillation:

- **rate control:** accept that the pulse will be irregular, but slow the rate down to avoid negative effects on cardiac function
- **rhythm control:** try to get the patient back into, and maintain, normal sinus rhythm. This is termed cardioversion. Drugs (pharmacological cardioversion) and synchronised DC electrical shocks (electrical cardioversion) may be used for this purpose

For many years the predominant approach was to try and maintain a patient in sinus rhythm. This approach changed in the early 2000's and now the majority of patients are managed with a rate control strategy. NICE advocate using a rate control strategy except in a number of specific situations such as coexistent heart failure, first onset AF or where there is an obvious reversible cause.

Rate control
A **beta-blocker** or a **rate-limiting calcium channel blocker** (e.g. diltiazem) is used first-line to control the rate in AF.

If one drug does not control the rate adequately NICE recommend combination therapy with any 2 of the following:

- a betablocker
- diltiazem
- digoxin

Rhythm control
As mentioned above there are a subgroup of patients for whom a rhythm control strategy should be tried first. Other patients may have had a rate control strategy initially but switch to rhythm control if symptoms/heart rate fails to settle.

When considering cardioversion it is very important to remember that the moment a patient switches from AF to sinus rhythm presents the highest risk for embolism leading to stroke. Imagine the thrombus formed in the fibrillating atrium suddenly being pushed out when sinus rhythm is restored. For this reason patients must either have had a short duration of symptoms (less than 48 hours) or be anticoagulated for a period of time prior to attempting cardioversion.

Reducing stroke risk
Some patients with AF are at a very low risk of stroke whilst others are at a very significant risk. Clinicians use risk stratifying tools such as the CHA2DS2-VASc score to determine the most appropriate anticoagulation strategy.

	Risk factor	Points
C	Congestive heart failure	1
H	Hypertension (or treated hypertension)	1
A_2	Age >= 75 years	2
	Age 65-74 years	1
D	Diabetes	1
S_2	Prior Stroke or TIA	2
V	Vascular disease (including ischaemic heart disease and peripheral arterial disease)	1
S	Sex (female)	1

The table below shows a suggested anticoagulation strategy based on the score:

Score	Anticoagulation
0	No treatment
1	Males: Consider anticoagulation Females: No treatment (this is because their score of 1 is only reached due to their gender)
2 or more	Offer anticoagulation

NICE recommend that we offer patients a choice of anticoagulation, including warfarin and the novel oral anticoagulants (NOACs).

Q-75

You are on the cardiac arrest team and are called to the emergency department for a 25-year-old male who has arrived in cardiac arrest. He collapsed while playing football. His brother is present: he reports that their father died suddenly in his 30s and they were later told he had hypertrophic obstructive cardiomyopathy (HOCM). Screening had been discussed with both his children but this had not happened yet.

Assuming the diagnosis is the same, which of the following is likely to confer the poorest prognosis?

A. Genetic mutation in troponin T
B. Left ventricular wall thickness 25mm
C. Preceding symptoms of chest pain
D. Atrial fibrillation on 24 hour holter monitoring
E. Increased blood pressure during exercise

ANSWER:
Genetic mutation in troponin T

EXPLANATION:
Of those listed above, only one is an appropriate answer. Specific genetic mutations (such as in myosin binding protein C and troponin T) have been recognised as poor prognostic features in HOCM. B is incorrect as it is a ventricular wall thickness > 30mm that has been associated with a poor outcome. C is incorrect as it is preceding symptoms of syncope, not chest pain that is associated. Non sustained ventricular tachycardia, not atrial fibrillation, on holter monitoring is associated with a poor outcome, therefore D is incorrect. Finally, it would be a low blood pressure during exercise that would be associated with a poor prognosis therefore E is also an inappropriate answer.

The question in this case concerns poor prognostic features of hypertrophic obstructive cardiomyopathy. Of those listed above, the only appropriate answer of a poor prognostic feature is mutations in troponin T. The others are incorrect for the poor prognostic criteria

HOCM: PROGNOSTIC FACTORS
Hypertrophic obstructive cardiomyopathy (HOCM) is an autosomal dominant disorder of muscle tissue caused by defects in the genes encoding contractile proteins. Mutations to various proteins including beta-myosin, alpha-tropomyosin and troponin T have been identified. Septal hypertrophy causes left ventricular outflow obstruction. It is an important cause of sudden death in apparently healthy individuals.

Poor prognostic factors
- syncope
- family history of sudden death
- young age at presentation
- non-sustained ventricular tachycardia on 24 or 48-hour Holter monitoring
- abnormal blood pressure changes on exercise

An increased septal wall thickness is also associated with a poor prognosis.

Q-76

A 65-year-old female is admitted with a suspected infective exacerbation of chronic obstructive pulmonary disease. On examination she is dyspnoeic with a blood pressure of 112/68 mmHg. Electrocardiogram shows an irregular, narrow-complex tachycardia with a rate of 130 bpm. At least three different P wave morphologies are seen. A diagnosis of multifocal tachycardia is suspected. What is the most appropriate management?

A. Adenosine
B. Digoxin
C. Verapamil
D. Atenolol
E. DC cardioversion

ANSWER:
Verapamil

EXPLANATION:
MULTIFOCAL ATRIAL TACHYCARDIA
Multifocal atrial tachycardia (MAT) may be defined as a irregular cardiac rhythm caused by at least three different sites in the atria, which may be demonstrated by morphologically distinctive P waves. It is more common in elderly patients with chronic lung disease, for example COPD

Management
- correction of hypoxia and electrolyte disturbances
- rate-limiting calcium channel blockers are often used first-line
- cardioversion and digoxin are not useful in the management of MAT

Q-77

A 25-year-old female is found to have a left hemiparesis following a deep vein thrombosis. An ECG shows RBBB with right axis deviation. What is the most likely underlying diagnosis?

A. Ventricular septal defect
B. Patent ductus arteriosus
C. Ostium primum atrial septal defect
D. Ostium secundum atrial septal defect
E. Tetralogy of Fallot

ANSWER:
Ostium secundum atrial septal defect

EXPLANATION:
The ostium secundum in this patient has allowed passage of an embolus from the right-sided circulation to the left causing a stroke

ATRIAL SEPTAL DEFECTS
Atrial septal defects (ASDs) are the most likely congenital heart defect to be found in adulthood. They carry a significant mortality, with 50% of patients being dead at 50 years. Two types of ASDs are recognised, ostium secundum and ostium primum. Ostium secundum are the most common

Features
- ejection systolic murmur, fixed splitting of S2
- embolism may pass from venous system to left side of heart causing a stroke

Ostium secundum (70% of ASDs)
- associated with Holt-Oram syndrome (tri-phalangeal thumbs)
- ECG: RBBB with RAD

Ostium primum
- present earlier than ostium secundum defects
- associated with abnormal AV valves
- ECG: RBBB with LAD, prolonged PR interval

Q-78

A 56-year-old man is admitted to the Emergency Department with headaches, chest pain and confusion. His initial observations show a blood pressure of 250/140 mmHg, pulse 90/min and temperature of 36.4º. On examination the blood pressure is confirmed and is equal in both arms. Blurring of the optic discs is noted on examination. He has no significant medical history and takes no regular medications. What is the most suitable initial management?

A. Oral ramipril
B. Intravenous phentolamine
C. Venesection
D. Intravenous nitroprusside
E. Intravenous hydralazine

ANSWER:
Intravenous nitroprusside

EXPLANATION:
This patient has malignant hypertension. The presence of papilloedema is an indication for the use of intravenous agents rather than slower acting oral preparations.

MALIGNANT HYPERTENSION

Basics
- severe hypertension (e.g. >200/130 mmHg)
- occurs in both essential and secondary types
- fibrinoid necrosis of blood vessels, leading to retinal haemorrhages, exudates, and proteinuria, haematuria due to renal damage (benign nephrosclerosis).
- can lead to cerebral oedema → encephalopathy

Features
- classically: severe headaches, nausea/vomiting, visual disturbance
- however chest pain and dyspnoea common presenting symptoms
- papilloedema
- severe: encephalopathy (e.g. seizures)

Management
- reduce diastolic no lower than 100mmHg within 12-24 hrs
- bed rest
- most patients: oral therapy e.g. atenolol
- if severe/encephalopathic: IV sodium nitroprusside/labetolol

Q-79

A 50-year-old man presents to the emergency department with heart palpitations. He is not experiencing chest pain. He has a long history of alcohol abuse. On examination there is no signs of shock, heart failure or syncope. He appears malnourished. An ECG shows an irregular tachycardia of 165 beats per minute with a QRS duration of 155ms. Laboratory results reveal a potassium of 2.1 mmol/l.

What should be the next step in management?

A. Administration of 1mg of intravenous adrenaline and 300mg of intravenous amiodarone
B. Defibrillation
C. Defibrillation and 1mg of intravenous adrenaline
D. Defibrillation and 300mg of intravenous amiodarone
E. Administration of 2g of magnesium

ANSWER:
Administration of 2g of magnesium

EXPLANATION:
The irregular tachycardia with a broad QRS complex is suggestive of either polymorphic ventricular tachycardia (VT), pre-excited atrial fibrillation, or atrial fibrillation with bundle branch block. The long history of alcohol abuse and the severe hypokalaemia make polymorphic ventricular tachycardia (Torsade de Pointes) the most likely diagnosis in this case. As per the Resuscitation Council tachycardia guidelines, as the patient has no adverse features, they should receive 2g of magnesium.

VENTRICULAR TACHYCARDIA: MANAGEMENT
Whilst a broad complex tachycardia may result from a supraventricular rhythm with aberrant conduction, the European Resuscitation Council advise that in a peri-arrest situation it is assumed to be ventricular in origin

If the patient has adverse signs (systolic BP < 90 mmHg, chest pain, heart failure, syncope) then immediate cardioversion is indicated. In the absence of such signs antiarrhythmics may be used. If these fail, then electrical cardioversion may be needed with synchronised DC shocks

Drug therapy
- amiodarone: ideally administered through a central line
- lidocaine: use with caution in severe left ventricular impairment
- procainamide

Verapamil should NOT be used in VT

If drug therapy fails
- electrophysiological study (EPS)
- implant able cardioverter-defibrillator (ICD) - this is particularly indicated in patients with significantly impaired LV function

Q-80

Which of the following is least associated with mitral valve prolapse?

A. Osteogenesis imperfecta
B. Pseudoxanthoma elasticum
C. Turner's syndrome
D. Marfan's syndrome
E. Acromegaly

ANSWER:
Acromegaly

EXPLANATION:
Whilst some patients with acromegaly have mitral valve prolapse (MVP) it is not a common association. It should be remembered that the prevalence of MVP in a standard population is around 5-10%

MITRAL VALVE PROLAPSE
Mitral valve prolapse is common, occurring in around 5-10 % of the population. It is usually idiopathic but may be associated with a wide variety of cardiovascular disease and other conditions

Associations
- congenital heart disease: PDA, ASD
- cardiomyopathy
- Turner's syndrome
- Marfan's syndrome, Fragile X
- osteogenesis imperfecta
- pseudoxanthoma elasticum
- Wolff-Parkinson White syndrome
- long-QT syndrome
- Ehlers-Danlos Syndrome
- polycystic kidney disease

Features
- patients may complain of atypical chest pain or palpitations
- mid-systolic click (occurs later if patient squatting)
- late systolic murmur (longer if patient standing)
- complications: mitral regurgitation, arrhythmias (including long QT), emboli, sudden death

Q-81

You are reviewing a 56-year-old man who has recently been successfully cardioverted following an episode of ventricular tachycardia. He had recently been treated with a course of erythromycin. You are interested to see if he has an underlying prolonged QT interval. What is the most appropriate way to measure the QT interval on the ECG?

A. Time between the end of the Q wave and the start of the T wave
B. Time between the start of the Q wave and the end of the T wave
C. Time between the end of the QRS waveform and the start of the T wave
D. Time between the end of the Q wave and the end of the T wave
E. Time between the start of the Q wave and the start of the T wave

ANSWER:
Time between the start of the Q wave and the end of the T wave

EXPLANATION:
QT interval: Time between the start of the Q wave and the end of the T wave

Please see Q-55 for Long QT Syndrome

Q-82

A 57-year-old patient with acute pulmonary oedema is admitted to the ITU department. She has no past medical history of note. A Swan-Ganz catheter is inserted to enable measurement of the pulmonary capillary wedge pressure. Which chamber of the heart does this pressure generally equate to?

A. The difference between the left atrium and right ventricle
B. Left ventricle
C. Left atrium
D. Right ventricle
E. Right atrium

ANSWER:
Left atrium

EXPLANATION:
PULMONARY CAPILLARY WEDGE PRESSURE
Pulmonary capillary wedge pressure (PCWP) is measured using a balloon tipped Swan-Ganz catheter which is inserted into the pulmonary artery. The pressure measured is similar to that of the left atrium (normally 6-12 mmHg).

One of the main uses of measuring the PCWP is determining whether pulmonary oedema is caused by either heart failure or acute respiratory distress syndrome.

In many modern ITU departments PCWP measurement has been replaced by non-invasive techniques.

Q-83

A 55-year-old man is admitted with central chest pain. His ECG shows ST depression in the inferior leads and the chest pain requires intravenous morphine to settle. Past medical history includes a thrombolysed myocardial infarction 2 years ago, asthma and type 2 diabetes mellitus. Treatment with aspirin, clopidogrel and unfractionated heparin is commenced. Which one of the following factors should determine if an intravenous glycoprotein IIb/IIIa receptor antagonist is to be given?

A. High GRACE (Global Registry of Acute Cardiac Events) risk score + whether a percutaneous coronary intervention is to be performed
B. Degree of ST depression
C. High GRACE (Global Registry of Acute Cardiac Events) risk score
D. Presence of a left ventricular thrombus
E. The presence of recurrent cardiac chest pain

ANSWER:
High GRACE (Global Registry of Acute Cardiac Events) risk score + whether a percutaneous coronary intervention is to be performed

EXPLANATION:

Please see Q-2 for Acute Coronary Syndrome: management of NSTEMI

Q-84

A 76-year-old man is reviewed. He was recently admitted after being found to be in atrial fibrillation. This was his second episode of atrial fibrillation. He also takes ramipril for hypertension but has no other history of note. During admission he was warfarinised and discharged with planned follow-up in the cardiology clinic. However, on review today he is found to be in sinus rhythm. What should happen regarding anticoagulation?

A. Stop warfarin
B. Continue warfarin for 1 month
C. Stop warfarin + start aspirin
D. Continue lifelong warfarin
E. Continue warfarin for 6 months

ANSWER:
Continue lifelong warfarin

EXPLANATION:
Warfarin should be continued indefinitely as this is his second episode of atrial fibrillation and he has risk factors for stroke (age, hypertension)

Please see Q-8 for Atrial Fibrillation: Anticoagulation

Q-85

A 65-year-old man admitted to the Acute Medical Unit is noted to have cannon 'a' waves of his jugular venous pressure during cardiovascular examination. Which one of the following would not cause this finding?

A. Tricuspid stenosis
B. Complete heart block
C. Ventricular tachycardia
D. Single chamber ventricular pacing
E. Nodal rhythm

ANSWER:
Tricuspid stenosis

EXPLANATION:
Whilst tricuspid stenosis may cause large 'a' waves it does not cause cannon 'a' waves

Please see Q-18 for Jugular Venous Pulse

Q-86

A 51-year-old female presents to the Emergency Department following an episode of transient right sided weakness lasting 10-15 minutes. Examination reveals the patient to be in atrial fibrillation. If the patient remains in chronic atrial fibrillation what is the most suitable form of anticoagulation?

A. Aspirin
B. Warfarin, target INR 2-3
C. No anticoagulation
D. Warfarin, target INR 3-4
E. Warfarin, target INR 2-3 for six months then aspirin

ANSWER:
Warfarin, target INR 2-3

EXPLANATION:
The CHA2DS2-VASc for this patient is 3 - 2 for the transient ischaemic attack and 1 for being female. She should therefore be offered anticoagulation with warfarin.

Please see Q-8 for Atrial Fibrillation: Anticoagulation

Q-87

Where is the most common site for primary cardiac tumours to occur in adults?

A. Left atrium
B. Right ventricle
C. Right atrium
D. Left atrial appendage
E. Left ventricle

ANSWER:
Left atrium

EXPLANATION:
Atrial myxoma - commonest site = left atrium
The most common site of atrial myxomas is at the fossa ovalis border in the left atrium

ATRIAL MYXOMA
Overview
- 75% occur in left atrium
- more common in females

Features
- systemic: dyspnoea, fatigue, weight loss, fever, clubbing
- emboli
- atrial fibrillation
- mid-diastolic murmur, 'tumour plop'
- echo: pedunculated heterogeneous mass typically attached to the fossa ovalis region of the interatrial septum

Q-88

A 38-year-old lady presents to the emergency department with increased shortness of breath for the last 5 days. On full history taking, you find she has also recently had some episodes of chest pain on exertion. She is normally fit and well but does report generalised aching and a high temperature approximately 2 weeks ago.

On examination you find that she is haemodynamically stable with a blood pressure on 100/65mmHg in the right arm and a heart rate of 95bpm. The radial pulse on the right side is absent. Heart sounds are normal and the apex beat is non displaced. Her oxygen saturations are 95% on air and her respiratory rate at rest is 20 breaths per minute.

Given the history and examination findings given, what is the most likely diagnosis?

What is the most likely diagnosis?

A. Type B aortic dissection
B. Acute myocarditis
C. Community acquired pneumonia
D. Takayasu's arteritis
E. Peripheral arterial embolus

ANSWER:
Takayasu's arteritis

EXPLANATION:
The correct answer here is D: Takayasu's arteritis.

The key to this question is that all but this answer will give some features of history/examination mentioned but this is the only answer that explains all points.

Aortic dissection could have similar symptoms and if involving the subclavian could give an absent radial pulse, however a descending dissection (type B) would not normally do this. Community acquired pneumonia would explain the shortness of breath and perhaps chest pain secondary to pleurisy, but would not explain other findings. Acute myocarditis would explain shortness of breath and chest pain but not absent radial pulse. Whereas a peripheral arterial embolus would explain the absent radial pulse but not the other findings.

Takayasu's arteritis is therefore the only appropriate answer as it explains all findings.

Other causes of an absent radial pulse include: aortic dissection with subclavian involvement and peripheral arterial embolus (as mentioned above), trauma and iatrogenic (post-cath).

Please see Q-33 for Takayasu's Arteritis

Q-89

A 74-year-old man presents for a medication review. Blood pressure is recorded as 184/72 mmHg. This is confirmed on two further occasions. What is the most appropriate first line therapy?

A. **Ramipril**
B. **Losartan**
C. **Bendroflumethiazide**
D. **Amlodipine**
E. **Atenolol**

ANSWER:
Amlodipine

EXPLANATION:
The 2011 NICE guidelines recommended treating isolated systolic hypertension the same way as standard hypertension. In this age group calcium channel blockers would be first-line.

ISOLATED SYSTOLIC HYPERTENSION
Isolated systolic hypertension (ISH) is common in the elderly, affecting around 50% of people older than 70 years old. The Systolic Hypertension in the Elderly Program (SHEP) back in 1991 established that treating ISH reduced both strokes and ischaemic heart disease. Drugs such as thiazides were recommended as first line agents. This approach is contradicated by the 2011 NICE guidelines which recommends treating ISH in the same stepwise fashion as standard hypertension.

Q-90

A 54-year-old man is admitted to the Emergency Department (ED) after collapsing shortly after complaining of palpitations. On arrival in the ED he is found to be in ventricular tachycardia and is successfully cardioverted. Later investigations show that he has an underlying long QT syndrome. A implantable cardioverter-defibrillator (ICD) is inserted. He works as a heavy goods vehicle (HGV) driver. What is the most appropriate advice with regards to driving HGV vehicles?

A. **Permanent bar**
B. **Cannot drive for 12 months**
C. **Cannot drive for 6 months**
D. **Cannot drive for 4 weeks**
E. **Can drive straightaway**

ANSWER:
Permanent bar

EXPLANATION:
ICD means loss of HGV licence, regardless of the circumstances

DVLA: CARDIOVASCULAR DISORDERS
The guidelines below relate to car/motorcycle use unless specifically stated. For obvious reasons, the rules relating to drivers of heavy goods vehicles tend to be much stricter

Specific rules
- hypertension - can drive unless treatment causes unacceptable side effects, no need to notify DVLA. If Group 2 Entitlement the disqualifies from driving if resting BP consistently 180 mmHg systolic or more and/or 100 mm Hg diastolic or more
- angioplasty (elective) - 1 week off driving
- CABG - 4 weeks off driving
- acute coronary syndrome- 4 weeks off driving, 1 week if successfully treated by angioplasty
- angina - driving must cease if symptoms occur at rest/at the wheel
- pacemaker insertion - 1 week off driving
- implantable cardioverter-defibrillator (ICD): if implanted for sustained ventricular arrhythmia: cease driving for 6 months. If implanted prophylatically then cease driving for 1 month. Having an ICD results in a permanent bar for Group 2 drivers
- successful catheter ablation for an arrhythmia- 2 days off driving
- aortic aneurysm of 6cm or more - notify DVLA. Licensing will be permitted subject to annual review. An aortic diameter of 6.5 cm or more disqualifies patients from driving
- heart transplant: DVLA do not need to be notified

Q-91

You are the medical senior house officer on call in a busy tertiary hospital. It is 2am and you get called to see a 75-year-old gentleman on the coronary care unit (CCU). The nursing staff tell you that 2 days ago he underwent percutaneous coronary intervention with 2 drug eluting stents to his right coronary artery. He was admitted to CCU for monitoring following the procedure as he had had an earlier episode of ventricular tachycardia. You review his admission ECG which shows ST segment elevation in leads II, III and aVF.

Currently he is alert with no chest pain and is comfortable at rest. However, his cardiac monitor shows that his observations are: heart rate 28/min, blood pressure 83/65mmHg, respiratory rate of 18/min with oxygen saturations 94% on 1L via nasal cannulae.

Both his ECG, which was done shortly before you arrived, and the tracing on the cardiac monitor show no association between the P and QRS waves. His QRS breadth on ECG is 120ms.

Which of the following is the most appropriate management plan?

A. **A trial of atropine and isoprenaline with a view to permanent pacing if sinus rhythm has not been restored by day 5**
B. **Immediate pacing with a temporary wire until permanent pacing can be put in place**
C. **A trial of atropine and isoprenaline**
D. **Continue monitoring only as he is asymptomatic**
E. **Immediate pacing with a temporary pacing wire that can then be removed/discontinues if the patient stabilises**

ANSWER:
A trial of atropine and isoprenaline

EXPLANATION:
The answer to this question is based on NICE guidance and recognition of the fact that this is presentation would be classified as an inferior ST elevation myocardial infarction (STEMI) given the distribution of ST elevation on ECG and that the patient has now developed complete heart block.

NICE guidelines state that the management of complete heart block following an inferior STEMI depends on the patient's haemodynamic status. However, in the first instance they recommend a trial of atropine and isoprenaline prior to consideration of any form of pacing - therefore either A/C is the best answer. The second difficulty in this question is knowing when to consider permanent pacing if sinus rhythm has not returned: NICE states that patients should be observed for 7 days post MI before considering permanent pacing. Therefore answer A is incorrect and C is the only appropriate option.

PACEMAKERS: TEMPORARY
Indications for a temporary pacemaker
- symptomatic/haemodynamically unstable bradycardia, not responding to atropine
- post-ANTERIOR MI: type 2 or complete heart block*
- trifascicular block prior to surgery

*post-INFERIOR MI complete heart block is common and can be managed conservatively if asymptomatic and haemodynamically stable

Q-92

A 76-year-old woman is admitted with palpitations. During the cardiovascular examination you notice irregular cannon 'a' waves. Which one of the following would account for this finding?

A. Atrio-ventricular nodal re-entry tachycardia
B. Atrial fibrillation with tricuspid stenosis
C. Ventricular tachycardia with 1:1 ventricular-atrial conduction
D. Complete heart block
E. Tricuspid regurgitation

ANSWER:
Complete heart block

EXPLANATION:
JVP: CANNON WAVES
Caused by the right atrium contracting against a closed tricuspid valve. May be subdivided into regular or intermittent

Regular cannon waves
- ventricular tachycardia (with 1:1 ventricular-atrial conduction)
- atrio-ventricular nodal re-entry tachycardia (AVNRT)

Irregular cannon waves
- complete heart block

Q-93

A 79-year-old man is admitted with congestive cardiac failure. Bloods on admission show:

BNP 354 pg/ml

Which one of the following would result from elevated BNP levels?

A. Decreased sodium diuresis
B. Vasoconstriction of the coronary arteries
C. Inhibition of the renin-angiotensin-aldosterone system
D. Vasoconstriction of the pulmonary vessels
E. Increased sympathetic tone

ANSWER:
Inhibition of the renin-angiotensin-aldosterone system

EXPLANATION:
BNP - actions:
- ***vasodilator***
- ***diuretic and natriuretic***
- ***suppresses both sympathetic tone and the renin-angiotensin-aldosterone system***

Please see Q-40 for B-type natriuretic peptide

Q-94

Which one of the following conditions is most associated with aortic dissection?

A. Acromegaly
B. Actinomycosis
C. Sarcoidosis
D. Bicuspid aortic valve
E. Adult polycystic kidney disease

ANSWER:
Bicuspid aortic valve

EXPLANATION:
A bicuspid aortic valve increases the risk of aortic dissection six-fold

AORTIC DISSECTION
Aortic dissection is a rare but serious cause of chest pain.

Associations
- hypertension
- trauma
- bicuspid aortic valve
- collagens: Marfan's syndrome, Ehlers-Danlos syndrome
- Turner's and Noonan's syndrome
- pregnancy
- syphilis

Features:

- chest pain: typically severe, radiates through to the back and 'tearing' in nature
- aortic regurgitation
- hypertension
- other features may result from the involvement of specific arteries. For example coronary arteries → angina, spinal arteries → paraplegia, distal aorta → limb ischaemia

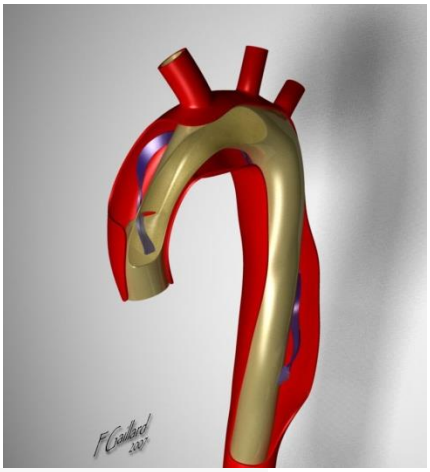
Classification

Stanford classification

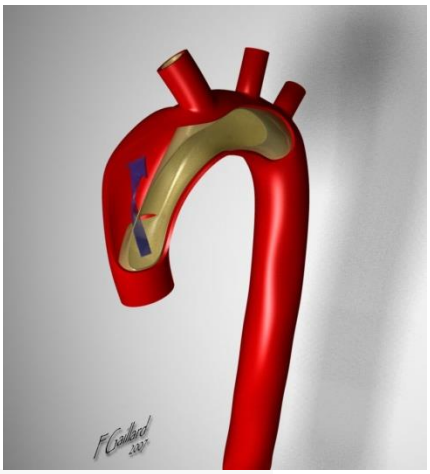
- type A - ascending aorta, 2/3 of cases
- type B - descending aorta, distal to left subclavian origin, 1/3 of cases

DeBakey classification

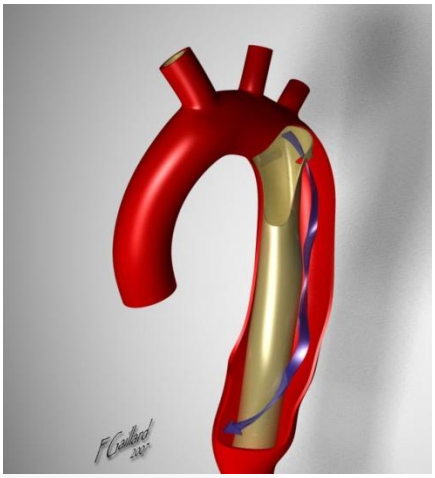
- type I - originates in ascending aorta, propagates to at least the aortic arch and possibly beyond it distally
- type II - originates in and is confined to the ascending aorta
- type III - originates in descending aorta, rarely extends proximally but will extend distally



Stanford type A / DeBakey type I



Stanford type A / DeBakey type II



Stanford type B / DeBakey type III

Q-95

Which one of the following ECG findings is least associated with digoxin use?

A. Bradycardia
B. Down-sloping ST depression
C. Flattened T waves
D. Prolonged QT interval
E. AV block

ANSWER:
Prolonged QT interval

EXPLANATION:
ECG: DIGOXIN
ECG features

- down-sloping ST depression ('reverse tick')
- flattened/inverted T waves
- short QT interval
- arrhythmias e.g. AV block, bradycardia

Q-96

A 67-year-old woman presents to the cardiology clinic for urgent review. She is known to have mitral stenosis, but feels like her exercise tolerance has deteriorated rapidly over the past few months. She is short of breath on minimal exercise and suffers from haemoptysis Current medication includes bisoprolol 10mg, isosorbide dinitrate 60mg, and furosemide 40mg daily. Her blood pressure is 105/88 mmHg, pulse is 62 (slow atrial fibrillation). There are crackles at both lung bases on auscultation of the chest.

Which of the following is the most appropriate next step?

A. Surgical valve replacement
B. Percutaneous mitral valvotomy
C. Digoxin
D. Increased furosemide dose
E. Ramipril

ANSWER:
Percutaneous mitral valvotomy

EXPLANATION:
Percutaneous mitral commissurotomy is the intervention of choice for severe mitral stenosis
At this point, with a narrow pulse pressure, resistant cardiac failure, and a narrow, low pulse pressure, it seems appropriate to move to percutaneous valvotomy.

Contra-indications to valvotomy include a mitral valve area >1.5 cm², presence of left atrial thrombus on ECHO, greater than mild mitral regurgitation, severe valve calcification, severe concomitant aortic valve disease, severe combined mixed tricuspid valve disease, and concomitant coronary artery disease requiring bypass surgery. In the event symptoms are not resolved by valvotomy, formal surgical valve replacement is indicated.

Surgical valve replacement is only indicated where valvotomy is contraindicated or is unsuccessful. There is very limited opportunity to increase medical therapy in this population, with systolic blood pressure only just above 100, and a heart rate of 62 beats per minute.

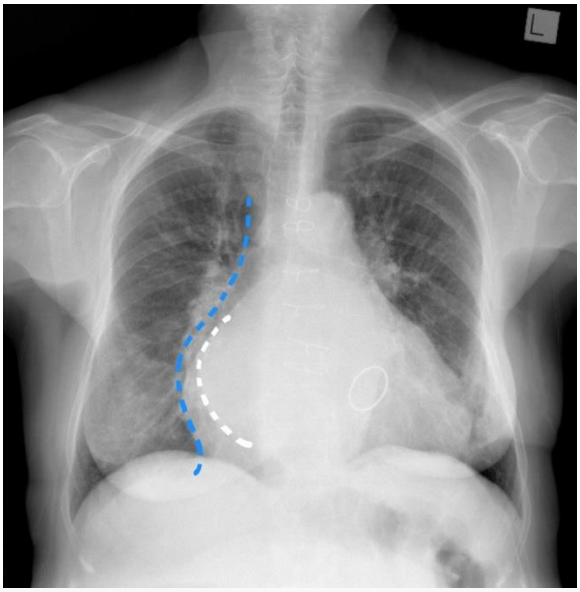
MITRAL STENOSIS
It is said that the causes of mitral stenosis are rheumatic fever, rheumatic fever and rheumatic fever. Rarer causes that may be seen in the exam include mucopolysaccharidoses, carcinoid and endocardial fibroelastosis

Features
- mid-late diastolic murmur (best heard in expiration)
- loud S1, opening snap
- low volume pulse
- malar flush
- atrial fibrillation

Features of severe MS
- length of murmur increases
- opening snap becomes closer to S2

Chest x-ray
- left atrial enlargement may be seen

Echocardiography
- the normal cross sectional area of the mitral valve is 4-6 sq cm. A 'tight' mitral stenosis implies a cross sectional area of < 1 sq cm



Chest x-ray from a patient with mitral stenosis. This patient has had a sternotomy and a prosthetic mitral valve. There is splaying of the carina with elevation of the left main bronchus, a double right heart border and cardiomegaly. The features are those of left atrial enlargement. Although the entire heart is enlarged, a double contour is seen through the right side of the heart. The more medial line is the enlarged left atrium (white dotted line) and the heart heart border is more lateral (blue dotted line).

Q-97

A 67-year-old man with a history of chronic obstructive pulmonary disease and ischaemic heart disease is taken to the Emergency Department with dyspnoea. On examination his respiratory rate is 24 / min, JVP is not elevated and crackles are heard in both lung bases. Which other finding would most strongly indicate that his dyspnoea is secondary to isolated left ventricular failure?

A. Pulsus paradoxus
B. Gallop rhythm
C. Tachycardia
D. Peripheral oedema
E. Cardiomegaly on chest x-ray

ANSWER:
Gallop rhythm

EXPLANATION:
Gallop rhythm (S3) is an early sign of LVF
Whilst all of the above features may be seen in patients with left ventricular failure a gallop rhythm is one of the most specific and early signs

Please see Q-62 for Heart Sounds

Q-98

A 66-year-old man with no past medical history of note presents with central chest pain to the Emergency Department. An ECG shows ST elevation in the anterior leads. He is given aspirin and ticagrelor before going for a percutaneous coronary intervention. What is the mechanism of action of ticagrelor?

A. **Inhibits ATP binding to its platelet receptor**
B. **Glycoprotein IIb/IIIa inhibitor**
C. **Phosphodiesterase V inhibitor**
D. **Non-selective phosphodiesterase inhibitor**
E. **Inhibits ADP binding to its platelet receptor**

ANSWER:
Inhibits ADP binding to its platelet receptor

EXPLANATION:
Ticagrelor has a similar mechanism of action to clopidogrel - inhibits ADP binding to platelet receptors

CLOPIDOGREL
Clopidogrel is an antiplatelet agent used in the management of cardiovascular disease. It was previously used when aspirin was not tolerated or contraindicated but there are now a number of conditions for which clopidogrel is used in addition to aspirin, for example in patients with an acute coronary syndrome. Following the 2010 NICE technology appraisal clopidogrel is also now first-line in patients following an ischaemic stroke and in patients with peripheral arterial disease.

Clopidogrel belongs to a class of drugs known as thienopyridines which have a similar mechanism of action. Other examples include:
- prasugrel
- ticagrelor
- ticlopidine

Mechanism
- antagonist of the P2Y12 adenosine diphosphate (ADP) receptor, inhibiting the activation of platelets

Interactions
- concurrent use of proton pump inhibitors (PPIs) may make clopidogrel less effective (MHRA July 2009)
- this advice was updated by the MHRA in April 2010, evidence seems inconsistent but omeprazole and esomeprazole still cause for concern. Other PPIs such as lansoprazole should be OK.

Q-99

A 76-year-old female is admitted after being found on the floor at her home. On examination she has a core temperature of 30ºC. Her serum electrolytes are within normal range. Which one of the ECG findings is most likely to be seen?

A. **Long QT interval**
B. **'U' waves**
C. **Short PR interval**
D. **Second degree heart block**
E. **Flattened T waves**

ANSWER:
Long QT interval

EXPLANATION:
ECG: HYPOTHERMIA
The following ECG changes may be seen in hypothermia
- bradycardia
- 'J' wave - small hump at the end of the QRS complex
- first degree heart block
- long QT interval
- atrial and ventricular arrhythmias

Q-100

A 60-year-old man is investigated for progressive shortness of breath. On examination a loud P2 is noted associated with a left parasternal heave. An ECG shows evidence of right ventricular strain and a diagnosis of pulmonary hypertension is suspected. Which one of the following is the single most important test to confirm the diagnosis?

A. **Echocardiography**
B. **High resolution CT thorax**
C. **Cardiac catheterisation**
D. **Pulmonary angiography**
E. **Ventilation perfusion scanning**

ANSWER:
Cardiac catheterisation

EXPLANATION:
Whilst echocardiography may strongly point towards a diagnosis of pulmonary hypertension all patients need to have right heart pressures measured. Cardiac catheterisation is therefore the single most important investigation. Please see the British Thoracic Society guidelines for more details.

Please see Q-44 for Pulmonary Arterial Hypertension

Q-101

A 25-year-old female patient with known Bartter's disease presents to the Emergency Department with severe muscle weakness. While awaiting a potassium result from the laboratory, which of the following ECG findings would be the most consistent with severe hypokalaemia?

A. **U waves, T-wave inversion, PR shortening**
B. **U waves, ST depression, T-wave inversion**
C. **U waves, PR shortening, ST depression**
D. **T-wave inversion, PR shortening, ST depression**
E. **T-wave inversion, PR lengthening, ST elevation**

ANSWER:
U waves, ST depression, T-wave inversion

EXPLANATION:
ECG changes in electrolyte abnormalities feature frequently in MRCP examinations.

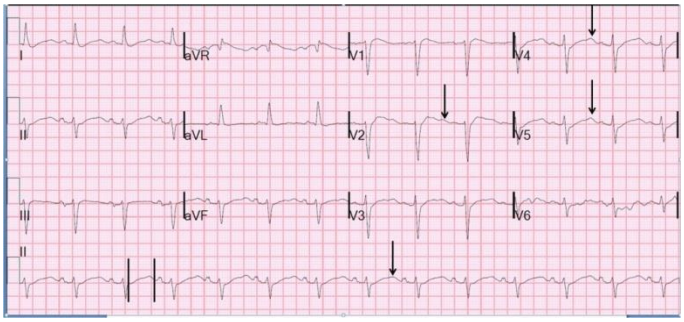
In hypokalaemia, the quoted figure is that ECG abnormalities begin to appear when K+ falls to below 2.7mmol/L.

ECG: HYPOKALAEMIA

ECG features of hypokalaemia

- U waves
- small or absent T waves (occasionally inversion)
- prolong PR interval
- ST depression
- long QT

The ECG below shows typical U waves. Note also the borderline PR interval.



One registered user suggests the following rhyme
In Hypokalaemia, U have no Pot and no T, but a long PR and a long QT

Q-102

A 62-year-old female with a known history of a sigmoid adenocarcinoma is admitted to hospital with shortness of breath and pyrexia. On examination a murmur is heard and an echo reveals a vegetation on the aortic valve. Which one of the following organisms is most characteristically associated with causing infective endocarditis in patients with colorectal cancer?

A. Escherichia coli
B. Enterococcus faecalis
C. Salmonella
D. Campylobacter
E. Streptococcus bovis

ANSWER:
Streptococcus bovis

EXPLANATION:
Streptococcus bovis endocarditis is associated with colorectal cancer

INFECTIVE ENDOCARDITIS

The strongest risk factor for developing infective endocarditis is a previous episode of endocarditis. The following types of patients are affected:

- previously normal valves (50%, typically acute presentation)
- rheumatic valve disease (30%)
- prosthetic valves
- congenital heart defects
- intravenous drug users (IVDUs, e.g. typically causing tricuspid lesion)

Causes

- historically Streptococcus viridans was the most common cause of infective endocarditis. This is no longer the case, except in developing countries. Staphylococcus aureus is now the most common cause of infective endocarditis. Staphylococcus aureus is also particularly common in acute presentation and IVDUs
- coagulase-negative Staphylococci such as Staphylococcus epidermidis commonly colonize indwelling lines and are the most cause of endocarditis in patients following prosthetic valve surgery, usually the result of perioperative contamination. After 2 months the spectrum of organisms which cause endocarditis return to normal (i.e. Staphylococcus aureus is the most common cause)
- Streptococcus viridans still accounts for around 20% of cases. Technically Streptococcus viridans is a pseudotaxonomic term, referring to viridans streptococci, rather than a particular organism. The two most notable viridans streptococci are Streptococcus mitis and Streptococcus sanguinis. They are both commonly found in the mouth and in particular dental plaque so endocarditis caused by these organisms is linked with poor dental hygiene or following a dental procedure
- Streptococcus bovis is associated with colorectal cancer
- non-infective: systemic lupus erythematosus (Libman-Sacks), malignancy: marantic endocarditis

Culture negative causes

- prior antibiotic therapy
- Coxiella burnetii
- Bartonella
- Brucella
- HACEK: Haemophilus, Actinobacillus, Cardiobacterium, Eikenella, Kingella)

Q-103

A 17-year-old girl is brought into resus in cardiac arrest. On admission she is in asystole and attempts to resuscitate are unsuccessful. She collapsed whilst competing in a 1,500m race at college. The only past medical of note was asthma for which she occasionally used a salbutamol inhaler. There is no relevant family history. What is the most likely underlying cause of death?

A. Long QT syndrome
B. Hypertrophic obstructive cardiomyopathy
C. Catecholaminergic polymorphic ventricular tachycardia
D. Brugada syndrome
E. Arrhythmogenic right ventricular dysplasia

ANSWER:
Hypertrophic obstructive cardiomyopathy

EXPLANATION:
HOCM is the most common cause of sudden cardiac death in the young
Hypertrophic obstructive cardiomyopathy (HOCM) is a more common cause of sudden cardiac death than arrhythmogenic right ventricular dysplasia (ARVD).

Catecholaminergic polymorphic ventricular tachycardia (CPVT) is a form of inherited cardiac disease which is also associated with sudden cardiac death. It is inherited in an autosomal dominant fashion and has a prevalence of around 1:10,000.

Brugada syndrome is a form of inherited cardiovascular disease which again may present with sudden cardiac death. It is inherited in an autosomal dominant fashion and has an estimated prevalence of 1:5,000-10,000. Brugada syndrome is more common in Asians.

Please see Q-16 for HOCM: Features

Q-104

A 64-year-old man with a history of ischaemic heart disease and poor left ventricular function presents with a broad complex tachycardia of 140 bpm. On examination blood pressure is 110/74 mmHg. Fusion and capture beats are seen on the 12 lead ECG. What is the first line drug management?

A. Sotalol
B. Amiodarone
C. Adenosine
D. Flecainide
E. Lidocaine

ANSWER:
Amiodarone

EXPLANATION:
The history of ischaemic heart disease combined with the presence of fusion and capture beats strongly suggests a diagnosis of ventricular tachycardia (VT). Whilst lidocaine can also be used in VT, amiodarone would be preferred given his history of poor left ventricular function. In the 2010 joint European Resuscitation Council and Resuscitation Council (UK) guidelines amiodarone is also considered first-line in a peri-arrest situation

Please see Q-79 for Ventricular Tachycardia: Management

Q-105

Which one of the following is least recognised as an adverse effect of taking bendroflumethiazide?

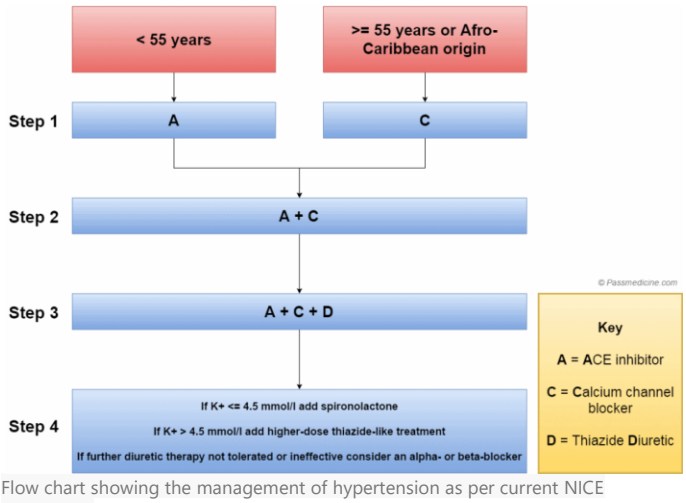
A. Photosensitivity rash
B. Agranulocytosis
C. Hypokalaemia
D. Pancreatitis
E. Hirsutism

ANSWER:
Hirsutism

EXPLANATION:
THIAZIDE DIURETICS
Thiazide diuretics work by inhibiting sodium reabsorption at the beginning of the distal convoluted tubule (DCT) by blocking the thiazide-sensitive Na+-Cl− symporter. Potassium is lost as a result of more sodium reaching the collecting ducts. Thiazide diuretics have a role in the treatment of mild heart failure although loop diuretics are better for reducing overload. The main use of bendroflumethiazide was in the management of hypertension but recent NICE guidelines now recommend other thiazide-like diuretics such as indapamide and chlortalidone.

Common adverse effects
- dehydration
- postural hypotension
- hyponatraemia, hypokalaemia, hypercalcaemia*
- gout
- impaired glucose tolerance
- impotence

Rare adverse effects
- thrombocytopaenia
- agranulocytosis
- photosensitivity rash
- pancreatitis



Flow chart showing the management of hypertension as per current NICE guideliness

*the flip side of this is hypocalciuria, which may be useful in reducing the incidence of renal stones

Q-106

A 48-year-old Asian lady was seen by her general practitioner (GP) with a 3-week history of fever, fatigue and night sweats. On examination, she was found to have absent limb pulses with blood tests revealing;

Hb 101 g/l
ESR 87 mm/hr

Her symptoms improved following a course of steroids. Which blood vessel is most likely to be affected by her condition?

A. Arteries of the hands and feet
B. Inferior vena cava (IVC)
C. Superior vena cava (SVC)
D. Renal arteries
E. Aorta

ANSWER:
Aorta

EXPLANATION:
Takayasu's arteritis is an obliterative arteritis affecting the aorta
Takayasu's arteritis is a large vessel vasculitis typically affecting the aorta and leads to absent limb pulses.

Arteries of the hands and feet - characteristic of Buerger disease

IVC and SVC - involved in venous return and do not belong to the arterial system

Renal arteries - a medium-sized vessel

Please see Q-33 for Takayasu's Arteritis

Q-107

A 70-year-old woman is prescribed bumetanide for congestive cardiac failure. Where is the site of action of bumetanide?

A. Descending loop of Henle
B. Macula densa
C. Ascending loop of Henle
D. Distal collecting duct
E. Proximal collecting duct

ANSWER:
Ascending loop of Henle

EXPLANATION:
Bumetanide, like furosemide, is a loop diuretic.

Please see Q-38 for Loop Diuretics

Q-108

A 69-year-old man who takes warfarin for atrial fibrillation asks for advice. He is due to have a tooth extraction at the dentist and is unsure what to do with regards to his 'blood-thinning' tablets. There is no other past medical history of note. The last INR was taken two weeks ago and reported as 2.8 with his target INR being 2.0-3.0. What is the most appropriate advice?

A. Admit to hospital + switch to subcutaneous low-molecular weight heparin prior to extraction
B. Switch to aspirin prior to extraction
C. Check INR 72 hours before procedure, proceed if INR < 4.0
D. Check INR 72 hours before procedure, proceed if INR < 2.5
E. Admit to hospital + switch to intravenous heparin prior to extraction

ANSWER:
Check INR 72 hours before procedure, proceed if INR < 4.0

EXPLANATION:
Dentistry in warfarinised patients - check INR 72 hours before procedure, proceed if INR < 4.0
The BNF gives specific advice with regards to this, in the section 'Prescribing in dental practice'. If a patient has a history of an unstable INR then it should be checked within 24 hours of the dental procedure.

Please see Q-4 for Warfarin

Q-109

A 71-year-old man who is known to have atrial fibrillation comes for review. He had a transient ischaemic attack two weeks ago and takes bendroflumethiazide for hypertension but is otherwise well. His latest blood pressure is 124/76 mmHg. You are discussing management options to try and reduce his future risk of having a stroke. What is his CHA2DS2-VASc score?

A. 1
B. 2
C. 3
D. 4
E. 5

ANSWER:
4

EXPLANATION:
One point for hypertension, one point for being over the age of 65 years (but under the age of 75 years) and two points ('S2') for the recent TIA.

Please see Q-8 for Atrial Fibrillation: Anticoagulation

Q-110

Where is the site of action of bendroflumethiazide?

A. **Proximal convoluted tubules**
B. **Ascending loop of Henle**
C. **Descending loop of Henle**
D. **Proximal part of the distal convoluted tubules**
E. **Distal part of the distal convoluted tubules**

ANSWER:
Proximal part of the distal convoluted tubules

EXPLANATION:
Bendroflumethiazide - site of action = proximal part of the distal convoluted tubules

Please see Q-105 for Thiazide Diuretics

Q-111

A 21-year-old man collapses whilst playing football with his friends at the weekend. By the time he is brought into the emergency department he is pronounced dead following cardiac arrest despite adequate life support being given. His family cannot understand how this has happened saying that he has always been fit and healthy and was a keen sportsman, they do however note that two other family members have died young in similar circumstances.

Which of the following methods of inheritance is correct for this condition?

A. **Autosomal dominant**
B. **Autosomal recessive**
C. **X-linked recessive**
D. **X-linked dominant**
E. **Mitochondrial**

ANSWER:
Autosomal dominant

EXPLANATION:
Given the circumstances in which this person has died and the family history, one can infer that hypertrophic cardiomyopathy may be a cause. In hypertrophic cardiomyopathy, the myocardium becomes thickened which can lead to functional impairment of cardiac muscle and sudden death, especially in young athletes.

It can often run in families and familial hypertrophic cardiomyopathy is inherited in an autosomal dominant pattern and is attributed to a mutation in one of the genes that encodes for a sarcomere protein.

Please see Q-16 for HOCM: Features

Q-112

An 84-year-old female with a background of osteoporosis is given an infusion of pamidronate. A week later she presents to her GP complaining of paraesthesia. On examination she has hyperreflexia and carpopedal spasm.

Given the electrolyte abnormality she is likely to have developed, what ECG abnormality is most associated with this?

A. **Atrioventricular node block**
B. **Delta waves**
C. **Tented T waves**
D. **Long QT**
E. **Atrial flutter**

ANSWER:
Long QT

EXPLANATION:
Long QT is associated with hypocalcaemia. Bisphosphonate infusions can lead to hypocalcaemia although it is more common when using larger doses in malignancy induced hypercalcaemia as oppose to the smaller dose used in osteoporosis.

A QT interval of greater than 0.44 seconds is associated with the development of ventricular arrhythmia, syncope and sudden cardiac death.

Long QT causes:

- ***electrolyte abnormalities: hypokalemia and hypocalcemia***
- ***drugs: tricyclic antidepressants, antihistamines, erythromycin, clarithromycin, amiodarone, haloperidol***
- ***congenital long QT syndromes: more than 10 different types recognised***
- ***myocardial infarction/significant active myocardial ischemia***
- ***cerebrovascular accident (subarachnoid haemorrhage)***
- ***hypothermia***

Hyperreflexia and carpopedal spasm indicate neuromuscular irritability which is a feature of hypocalcaemia. Chvostek's sign can also be elicited by tapping over the facial nerve at the angle of the jaw. A positive result would involve ipsilateral twitching of the muscles around the nose and lips.

Please see Q-55 for Long QT Syndrome

Q-113

A 68-year-old gentleman is brought into resus in your local emergency department after a syncopal episode. He is alert but clearly distressed.

The monitor above the bed showed a heart rate of 190bpm with a blood pressure of 85/50mmHg. His oxygen saturations

are 98% in high flow oxygen (15L per minute via non-rebreathe mask). You are awaiting a full 12 lead ECG to be performed but the trace on cardiac monitor appears to show a regular broad complex tachycardia. A formal ECG subsequently confirms that the arrhythmia is a ventricular tachycardia (VT) with a QRS complex duration of 150ms.

With regard to the JVP waveform, which of these features would you expect to see?

A. Giant v waves
B. Cannon a waves
C. Prominent x descent
D. Slow y descent
E. Large a waves

ANSWER:
Cannon a waves

EXPLANATION:
The correct answer is B: cannon a waves.

Cannon a waves result from atrial contraction against a closed tricuspid valve and therefore can be seen in VT when atrial and ventricular contraction is not co-ordinated. They can also be seen in complete/3rd degree heart block and atrial flutter for the same reason.

Giant V waves are a features of tricuspid regurgitation; prominent x descent is a feature of constrictive pericarditis; slow y descent is a feature of cardiac tamponade and tricuspid stenosis; and large a waves can be found in tricuspid stenosis, right heart failure and pulmonary hypertension.

Please see Q-18 for Jugular Venous Pulse

Q-114

Which one of the following is least associated with prolongation of the PR interval?

A. Digoxin toxicity
B. Hypocalcaemia
C. Lyme disease
D. Rheumatic fever
E. Ischaemic heart disease

ANSWER:
Hypocalcaemia

EXPLANATION:
Hypocalcaemia is associated with a prolonged QT interval. Hypokalaemia is associated with a prolonged PR interval

Please see Q-21 for ECG: PR Interval

Q-115

A 62-year-old man is reviewed. His blood pressure is poorly controlled at 152/90 mmHg despite treatment with ramipril 10mg od, bendroflumethiazide 2.5mg od and amlodipine 10mg od. In addition to the antihypertensives he also takes aspirin and simvastatin. His most recent blood tests show the following:

Na+	**139 mmol/l**
K+	**4.2 mmol/l**
Urea	**5.5 mmol/l**
Creatinine	**98 µmol/l**

What is the most appropriate change to his medication?

A. Add frusemide
B. Increase ramipril to 20mg od
C. Add spironolactone
D. Add candesartan
E. Add atenolol

ANSWER:
Add spironolactone

EXPLANATION:
Poorly controlled hypertension, already taking an ACE inhibitor, calcium channel blocker and a thiazide diuretic. K+ < 4.5mmol/l - add spironolactone
This patient has reached step 4 in the NICE hypertension guidelines. As their potassium is less than 4.5 mmol/l spironolactone 25mg od should be started.

Please see Q-6 for Hypertension: Management

Q-116

A 35-year-old man who is an intravenous drug user is admitted to hospital. He has had three previous admissions with infective endocarditis but presents on this occasion feeling generally unwell, complaining of upper abdominal discomfort and leg swelling. On examination he has an elevated jugular venous pressure, tender hepatomegaly and peripheral oedema. A diagnosis of tricuspid regurgitation is suspected. Which one of the following additional features would be most supportive of this diagnosis?

A. Split first heart sound
B. Early diastolic murmur
C. Left parasternal heave
D. Wide pulse pressure
E. Cannon 'a' waves

ANSWER:
Left parasternal heave

EXPLANATION:
TRICUSPID REGURGITATION
Signs
- pan-systolic murmur

- giant V waves in JVP
- pulsatile hepatomegaly
- left parasternal heave

Causes
- right ventricular dilation
- pulmonary hypertension e.g. COPD
- rheumatic heart disease
- infective endocarditis (especially intravenous drug users)
- Ebstein's anomaly
- carcinoid syndrome

Q-117

A 74-year-old man is admitted with chest pain associated with ECG changes. A troponin T taken 12 hours after admission indicates an acute myocardial infarction. Which one of the following is most likely to predict a poor prognosis?

A. History of diabetes mellitus
B. Loss of heart rate variability
C. Left ventricular ejection fraction of 40%
D. Diastolic blood pressure of 110 mmHg
E. Male sex

ANSWER:
Left ventricular ejection fraction of 40%

EXPLANATION:
ACUTE CORONARY SYNDROME: PROGNOSTIC FACTORS
The 2006 Global Registry of Acute Coronary Events (GRACE) study has been used to derive regression models to predict death in hospital and death after discharge in patients with acute coronary syndrome

Poor prognostic factors
- age
- development (or history) of heart failure
- peripheral vascular disease
- reduced systolic blood pressure
- Killip class*
- initial serum creatinine concentration
- elevated initial cardiac markers
- cardiac arrest on admission
- ST segment deviation

***Killip class** - system used to stratify risk post myocardial infarction

Killip class	Features	30 day mortality
I	No clinical signs heart failure	6%
II	Lung crackles, S3	17%
III	Frank pulmonary oedema	38%
IV	Cardiogenic shock	81%

Q-118

A 33-year-old male who is an ex-IV drug user on methadone collapses suddenly whilst out shopping. A paramedic crew are quickly on the scene. The patient remains conscious but whilst attached to the defibrillator multiple self-terminating runs of polymorphic ventricular tachycardia are seen. He is transferred urgently to the emergency department where torsades de points is confirmed. He is successfully treated with an infusion of IV magnesium. An ECG post infusion shows a QTc of 590ms and he tells you that he is currently on day five of a seven day course of erythromycin for a lower respiratory tract infection. You suspect drug induced QTc prolongation secondary to a combination of methadone and erythromycin predisposing him to torsades de points. Which cardiac ion channel is most likely to be affected?

A. Sodium channel
B. Magnesium channel
C. Calcium channel
D. Potassium channel
E. Chloride channel

ANSWER:
Potassium channel

EXPLANATION:
Several medications, including drugs prescribed for non-cardiac indications, have been associated with a prolongation of the QT interval on the surface ECG. Under certain circumstances, this clinical manifestation may reflect an increased risk for patients presenting with a polymorphic ventricular tachycardia known as torsade de pointes. Drugs that prolong the QT interval belong to several pharmacological classes, but most of them share one pharmacological effect: they lengthen cardiac re-polarisation mostly by blocking specific cardiac potassium channels. The potent blocking of cardiac potassium channels and excessive lengthening of cardiac re-polarisation favour the development of membrane oscillations (early after-depolarisation) due to calcium/sodium re-entry. Early after-depolarisation, when propagated, may trigger torsade de pointes. In addition to excessive lengthening of the QT interval, other predisposing factors to drug-induced torsade de pointes include bradycardia, electrolyte imbalance, female sex and genetic polymorphisms in various ion channel constituents.

TORSADES DE POINTES
Torsades de pointes ('twisting of the points') is a rare arrhythmia associated with a long QT interval. It may deteriorate into ventricular fibrillation and hence lead to sudden death

Causes of long QT interval
- congenital: Jervell-Lange-Nielsen syndrome, Romano-Ward syndrome
- antiarrhythmics: amiodarone, sotalol, class 1a antiarrhythmic drugs

- tricyclic antidepressants
- antipsychotics
- chloroquine
- terfenadine
- erythromycin
- electrolyte: hypocalcaemia, hypokalaemia, hypomagnesaemia
- myocarditis
- hypothermia
- subarachnoid haemorrhage

Management
- IV magnesium sulphate

Q-119

Which one of the following treatments have not been shown to improve mortality in patients with chronic heart failure?

A. Beta-blockers
B. Spironolactone
C. Furosemide
D. Nitrates and hydralazine
E. Enalapril

ANSWER:
Furosemide

EXPLANATION:
Whilst useful in managing the symptoms of acute and chronic heart failure furosemide offers no prognostic benefits.

Please see Q-52 for Heart Failure: Drug Management

Q-120

Where is the site of action of furosemide?

A. Proximal collecting duct
B. Ascending loop of Henle
C. Descending loop of Henle
D. Distal collecting duct
E. Macula densa

ANSWER:
Ascending loop of Henle

EXPLANATION:
Please see Q-38 for Loop Diuretics

Q-121

What is the initial physiological response to the Valsalva manoeuvre?

A. Reduction in cardiac output
B. Reduced mean arterial blood pressure
C. Reduced heart rate
D. Reduced venous return
E. Reduction in intrathoracic pressure

ANSWER:
Reduced venous return

EXPLANATION:
VALSALVA MANOEUVRE
The Valsalva manoeuvre describes a forced expiration against a closed glottis. This leads to increased intrathoracic pressure which in turn has a number of effects on the cardiovascular system.

Uses
- to terminate an episode of supraventricular tachycardia
- normalizing middle-ear pressures

Stages of the Valsalva manoeuvre
1. Increased intrathoracic pressure
2. Resultant increase in venous and right atrial pressure reduces venous return
3. The reduced preload leads to a fall in the cardiac output (Frank-Starling mechanism)
4. When the pressure is released there is a further slight fall in cardiac output due to increased aortic volume
5. Return of normal cardiac output

Q-122

A 56-year-old man with a past history of ischaemic heart disease is admitted with central chest pain radiating to his left arm associated with nausea. On arrival in the Coronary Care Unit he is noted to be in complete heart block. Which coronary artery is likely to be affected?

A. Circumflex
B. Right coronary
C. Obtuse marginal
D. Left anterior descending
E. Posterior descending

ANSWER:
Right coronary

EXPLANATION:
The right coronary artery supplies the atrioventricular node in 90% of patients

CORONARY CIRCULATION
Arterial supply of the heart
- left aortic sinus → left coronary artery (LCA)
- right aortic sinus → right coronary artery (RCA)
- LCA → LAD + circumflex
- RCA → posterior descending
- RCA supplies SA node in 60%, AV node in 90%

Venous drainage of the heart
- coronary sinus drains into the right atrium

Q-123

An elderly patient with a history of atrial fibrillation develops torsades de pointes shortly after being started on sotalol. What effect does sotalol have on the cardiac cell membrane to make this more likely?

A. Blockage of sodium channels
B. Opening of potassium channels
C. Blockage of potassium channels
D. Opening of calcium channels
E. Opening of sodium channels

ANSWER:
Blockage of potassium channels

EXPLANATION:
Long QT syndrome - usually due to loss-of-function/blockage of K+ channels
This patient is likely to have developed torsades de pointes secondary to a prolonged QT interval.

Please see Q-55 for Long QT Syndrome

Q-124

A 23-year-old man with a family history of sudden cardiac death is diagnosed as having hypertrophic obstructive cardiomyopathy. Which one of the following is the strongest marker of poor prognosis?

A. Mitral regurgitation
B. Apical hypertrophy
C. Systolic anterior motion of the anterior mitral valve leaflet
D. Septal wall thickness of > 3cm
E. Asymmetric hypertrophy

ANSWER:
Septal wall thickness of > 3cm

EXPLANATION:
HOCM - poor prognostic factor on echo = septal wall thickness of > 3cm

Please see Q-75 for HOCM: Prognostic Factors

Q-125

A 72-year-old man who is known to have chronic kidney disease stage 4 is admitted to the Emergency Department. Since yesterday he has felt short-of-breath on exertion and has been coughing up blood. On examination he tachycardic at 110/min with a normal chest examination. What is the most suitable initial imaging investigation to exclude a pulmonary embolism?

A. Ventilation-perfusion scan
B. Computed tomographic pulmonary angiography
C. Pulmonary angiography
D. MRI thorax
E. Echocardiogram

ANSWER:
Ventilation-perfusion scan

EXPLANATION:
Computed tomographic pulmonary angiography (CTPA) is now used first-line to investigate the possiblity of pulmonary embolism. Patients with renal impairment however should be offered Ventilation-perfusion (V/Q) scans as the contrast media used during CTPAs is nephrotoxic.

PULMONARY EMBOLISM: INVESTIGATION
We know from experience that few patients (around 10%) present with the medical student textbook triad of pleuritic chest pain, dyspnoea and haemoptysis. Pulmonary embolism can be difficult to diagnose as it can present with virtually any cardiorespiratory symptom/sign depending on it's location and size.

So which features make pulmonary embolism more likely?

The PIOPED study1 in 2007 looked at the frequency of different symptoms and signs in patients who were diagnosed with pulmonary embolism.

The relative frequency of common clinical signs is shown below:

- Tachypnea (respiratory rate >16/min) - 96%
- Crackles - 58%
- Tachycardia (heart rate >100/min) - 44%
- Fever (temperature >37.8°C) - 43%

It is interesting to note that the Well's criteria for diagnosing a PE use tachycardia rather than tachypnoea.

2012 NICE guidelines
All patients with symptoms or signs suggestive of a PE should have a history taken, examination performed and a chest x-ray to exclude other pathology.

If a PE is still suspected a two-level PE Wells score should be performed:

Clinical feature	Points
Clinical signs and symptoms of DVT (minimum of leg swelling and pain with palpation of the deep veins)	3
An alternative diagnosis is less likely than PE	3
Heart rate > 100 beats per minute	1.5
Immobilisation for more than 3 days or surgery in the previous 4 weeks	1.5
Previous DVT/PE	1.5
Haemoptysis	1
Malignancy (on treatment, treated in the last 6 months, or palliative)	1

Clinical probability simplified scores

- PE likely - more than 4 points
- PE unlikely - 4 points or less

If a PE is 'likely' (more than 4 points) arrange an immediate computed tomography pulmonary angiogram (CTPA). If there is a delay in getting the CTPA then give low-molecular weight heparin until the scan is performed.

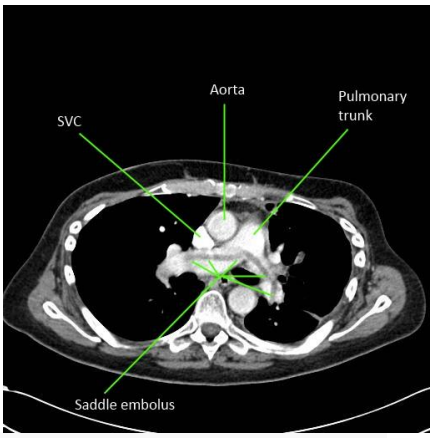
If a PE is 'unlikely' (4 points or less) arranged a D-dimer test. If this is positive arrange an immediate computed tomography pulmonary angiogram (CTPA). If there is a delay in getting the CTPA then give low-molecular weight heparin until the scan is performed.

If the patient has an allergy to contrast media or renal impairment a V/Q scan should be used instead of a CTPA.

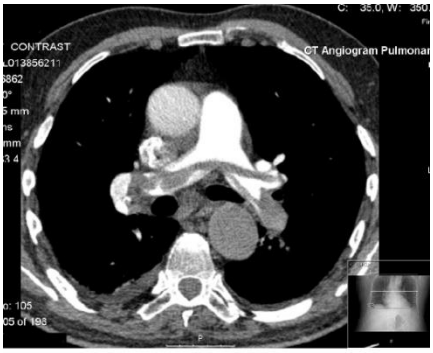
CTPA or V/Q scan?

The consensus view from the British Thoracic Society and NICE guidelines is as follows:

- computed tomographic pulmonary angiography (CTPA) is now the recommended initial lung-imaging modality for non-massive PE. Advantages compared to V/Q scans include speed, easier to perform out-of-hours, a reduced need for further imaging and the possibility of providing an alternative diagnosis if PE is excluded
- if the CTPA is negative then patients do not need further investigations or treatment for PE
- ventilation-perfusion scanning may be used initially if appropriate facilities exist, the chest x-ray is normal, and there is no significant symptomatic concurrent cardiopulmonary disease



Labelled CTPA showing a large saddle embolus



Further CTPA again showing a saddle embolus

Some other points

D-dimers

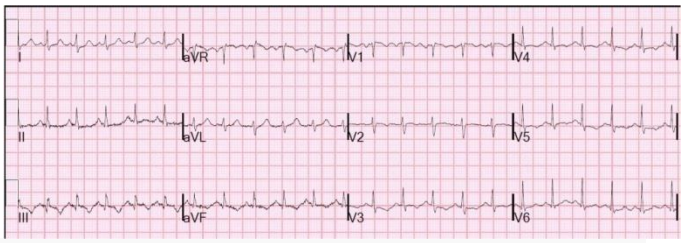
- sensitivity = 95-98%, but poor specificity

ECG

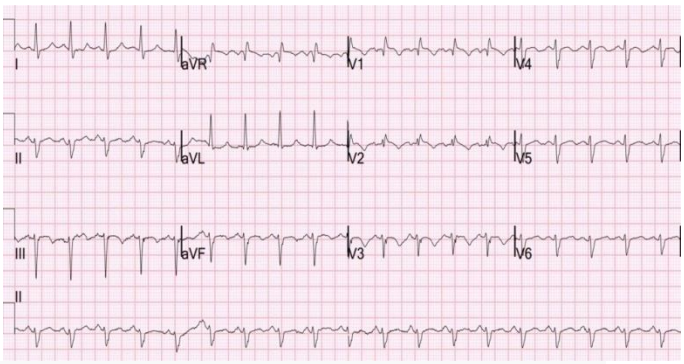
the classic ECG changes seen in PE are a large S wave in lead I, a large Q wave in lead III and an inverted T wave in lead III - 'S1Q3T3'. However this change is seen in no more than 20% of patients

right bundle branch block and right axis deviation are also associated with PE

sinus tachycardia may also be seen



ECG from a patient with a PE. Shows a sinus tachycardia and a partial S1Q3T3 - the S wave is not particularly convincing.



ECG of a patient with a PE. It shows some of the ECG features that may be associated with PE (sinus tachycardia, S1, T3 and T wave inversion in the precordial leads). Other features such as the left axis deviation are atypical.

V/Q scan

- sensitivity = 98%; specificity = 40% - high negative predictive value, i.e. if normal virtually excludes PE
- other causes of mismatch in V/Q include old pulmonary embolisms, AV malformations, vasculitis, previous radiotherapy
- COPD gives matched defects

CTPA

- peripheral emboli affecting subsegmental arteries may be missed

Pulmonary angiography

- the gold standard
- significant complication rate compared to other investigations

Q-126

A 47-year-old lady with a family history of sudden cardiac death developed palpitations while visiting a relative in the emergency department. When attached to a cardiac monitor her heart rate was 164/min and the rhythm strip showed a broad complex tachycardia. Which antiarrhythmic may precipitate ventricular fibrillation (VF) if used in such circumstances?

A. Verapamil
B. Amiodarone
C. Procainamide
D. Lidocaine
E. Flecainide

ANSWER:
Verapamil

EXPLANATION:
Patients with VT should not be prescribed verapamil
Verapamil should not be used in patients with Ventricular Tachycardia (VT) as they are class IV antiarrhythmic which only acts on nodal tissue and significantly increase the risk of ventricular fibrillation.

Amiodarone, Procainamide and Lidocaine - All can be used to treat VT.

Flecainide - Has a limited use in certain types of VT.

VENTRICULAR TACHYCARDIA
Ventricular tachycardia (VT) is broad-complex tachycardia originating from a ventricular ectopic focus. It has the potential to precipitate ventricular fibrillation and hence requires urgent treatment.

There are two main types of VT:
- monomorphic VT: most commonly caused by myocardial infarction
- polymorphic VT: A subtype of polymorphic VT is torsades de pointes which is precipitated by prolongation of the QT interval. The causes of a long QT interval are listed below

Causes of a prolonged QT interval

Congenital	Drugs	Other
• Jervell-Lange-Nielsen syndrome (includes deafness and is due to an abnormal potassium channel) • Romano-Ward syndrome (no deafness)	• amiodarone, sotalol, class 1a antiarrhythmic drugs • tricyclic antidepressants, fluoxetine • chloroquine • terfenadine • erythromycin	• electrolyte: hypocalcaemia, hypokalaemia, hypomagnesaemia • acute myocardial infarction • myocarditis • hypothermia • subarachnoid haemorrhage

Management
If the patient has adverse signs (systolic BP < 90 mmHg, chest pain, heart failure) then immediate cardioversion is indicated. In the absence of such signs antiarrhythmics may be used. If these fail, then electrical cardioversion may be needed with synchronised DC shocks

Drug therapy
- amiodarone: ideally administered through a central line
- lidocaine: use with caution in severe left ventricular impairment
- procainamide

Verapamil should NOT be used in VT

If drug therapy fails
- electrophysiological study (EPS)
- implant able cardioverter-defibrillator (ICD) - this is particularly indicated in patients with significantly impaired LV function

Q-127

Which one of the following cardiac conditions is most associated with a louder murmur following the Valsalva manoeuvre?

A. Mitral stenosis
B. Aortic stenosis
C. Ventricular septal defect
D. Hypertrophic obstructive cardiomyopathy
E. Aortic regurgitation

ANSWER:
Hypertrophic obstructive cardiomyopathy

EXPLANATION:
Please see Q-16 for HOCM: Features

Q-128

Which one of the following is not an indication for insertion of a temporary pacemaker?

A. Complete heart block following an inferior MI - blood pressure normal
B. Complete heart block following an anterior MI - blood pressure normal
C. Trifascicular block prior to surgery
D. Mobitz type II heart block following an anterior MI - blood pressure normal
E. Symptomatic bradycardia not responding to drug treatment

ANSWER:
Complete heart block following an inferior MI - blood pressure normal

EXPLANATION:

Complete heart block following an inferior MI is NOT an indication for pacing, unlike with an anterior MI
Post-inferior MI complete heart block is common and can be managed conservatively if the patient is asymptomatic and haemodynamically stable

Please see Q-91 for Pacemakers: Temporary

Q-129

A 65-year-old man with no significant past medical history is admitted to the Emergency Department. His ECG is consistent with an anterior myocardial infarction. Unfortunately he develops cardiac arrest shortly after arriving in the department. What is the most common cause of death in patients following a myocardial infarction?

A. Pulmonary embolism
B. Cardiogenic shock
C. Papillary muscle rupture
D. Ventricular fibrillation
E. Complete heart block

ANSWER:
Ventricular fibrillation

EXPLANATION:

MYOCARDIAL INFARCTION: COMPLICATIONS
Patients are at risk of a number of immediate, early and late complications following a myocardial infarction (MI).

Cardiac arrest
This most commonly occurs due to patients developing ventricular fibrillation and is the most common cause of death following a MI. Patients are managed as per the ALS protocol with defibrillation.

Cardiogenic shock
If a large part of the ventricular myocardium is damaged in the infarction the ejection fraction of the heart may decrease to the point that the patient develops cardiogenic shock. This is difficult to treat. Other causes of cardiogenic shock include the 'mechanical' complications such as left ventricular free wall rupture as listed below. Patients may require inotropic support and/or an intra-aortic balloon pump.

Chronic heart failure
As described above, if the patient survives the acute phase their ventricular myocardium may be dysfunctional resulting in chronic heart failure. Loop diuretics such as furosemide will decrease fluid overload. Both ACE-inhibitors and beta-blockers have been shown to improve the long-term prognosis of patients with chronic heart failure.

Tachyarrhythmias
Ventricular fibrillation, as mentioned above, is the most common cause of death following a MI. Other common arrhythmias including ventricular tachycardia.

Bradyarrhythmias
Atrioventricular block is more common following inferior myocardial infarctions.

Pericarditis
Pericarditis in the first 48 hours following a transmural MI is common (c. 10% of patients). The pain is typical for pericarditis (worse on lying flat etc), a pericardial rub may be heard and a pericardial effusion may be demonstrated with an echocardiogram.

Dressler's syndrome tends to occur around 2-6 weeks following a MI. The underlying pathophysiology is thought to be an autoimmune reaction against antigenic proteins formed as the myocardium recovers. It is characterised by a combination of fever, pleuritic pain, pericardial effusion and a raised ESR. It is treated with NSAIDs.

Left ventricular aneurysm
The ischaemic damage sustained may weaken the myocardium resulting in aneurysm formation. This is typically associated with persistent ST elevation and left ventricular failure. Thrombus may form within the aneurysm increasing the risk of stroke. Patients are therefore anticoagulated.

Left ventricular free wall rupture
This is seen in around 3% of MIs and occurs around 1-2 weeks afterwards. Patients present with acute heart failure secondary to cardiac tamponade (raised JVP, pulsus paradoxus, diminished heart sounds). Urgent pericardiocentesis and thoracotomy are required.

Ventricular septal defect
Rupture of the interventricular septum usually occurs in the first week and is seen in around 1-2% of patients. Features: acute heart failure associated with a pan-systolic murmur. An echocardiogram is diagnostic and will exclude acute mitral regurgitation which presents in a similar fashion. Urgent surgical correction is needed.

Acute mitral regurgitation
More common with infero-posterior infarction and may be due to ischaemia or rupture of the papillary muscle. An early-to-mid systolic murmur is typically heard. Patients are treated with vasodilator therapy but often require emergency surgical repair.

Q-130

A 52-year-old woman with a history of breast cancer is admitted with acute dyspnoea. Her respiratory rate on admission is 42 / min and her oxygen saturations are 87% on room air. A pulmonary embolism is suspected and she is transferred to the high dependency unit after being treated with oxygen and enoxaparin. Which one of the following would be strongest indication for thrombolysis?

A. **Extensive deep venous thrombosis**
B. **Hypotension**
C. **Patient choice following informed consent**
D. **Hypoxaemia despite high flow oxygen**
E. **ECG showing right ventricular strain**

ANSWER:
Hypotension

EXPLANATION:
Massive PE + hypotension - thrombolyse

Please see Q-12 for Pulmonary Embolism: Management

Q-131

A 60-year-old male has a past medical history of hypertension, type II diabetes and ischaemic heart disease. He has recently been started on a new medication. His GP notices that his HbA1c has increased significantly over the same period. Which medication is most likely to have adversely affected his glycaemic control?

A. **Alendronic acid**
B. **Amiodarone**
C. **Allopurinol**
D. **Bendroflumethiazide**
E. **Calcium carbonate and vitamin D3**

ANSWER:
Bendroflumethiazide

EXPLANATION:
Bendroflumethiazides can worsen glucose tolerance
The correct answer is bendroflumethiazide. Thiazides can worsen glycaemic control and increase urate levels which can worsen gout. The other drugs are not known to have an effect on glycaemic control.

Please see Q-105 for Thiazide Diuretics

Q-132

A 56-year-old gentleman is brought in by paramedics. The patient fainted this morning and has not regained consciousness. No injuries reported from his faint. On examination his heart rate is 37 beats/minute, respiratory rate is 16 breaths/minute, blood pressure is 105/70 mmHg. You order an ECG:

The ECG shows prolonged PR interval.

What would be the initial management?

A. **IV atropine**
B. **IV adenosine**
C. **External pacing**
D. **IM adrenaline**
E. **Oral atropine**

ANSWER:
IV atropine

EXPLANATION:
Symptomatic bradycardia is treated with atropine
This patient is suffering from bradycardia with adverse features (syncope) likely due to his first degree heart block (prolonged PR interval). Adverse features of bradycardia are shock, myocardial ischemia, heart failure and syncope. The initial treatment is IV atropine.

IV adenosine is not used in bradycardia, it is used in supraventricular tachycardias.

External pacing is only used if there is no improvement after six doses of atropine.

IM adrenaline is indicated for anaphylaxis

Oral atropine is only indicated for GI disorders caused by smooth muscle spasms.

PERI-ARREST RHYTHMS: BRADYCARDIA
The 2015 Resuscitation Council (UK) guidelines emphasise that the management of bradycardia depends on:
1. identifying the presence of signs indicating haemodynamic compromise - 'adverse signs'
2. identifying the potential risk of asystole

Adverse signs

The following factors indicate haemodynamic compromise and hence the need for treatment:

- shock: hypotension (systolic blood pressure < 90 mmHg), pallor, sweating, cold, clammy extremities, confusion or impaired consciousness
- syncope
- myocardial ischaemia
- heart failure

Atropine is the first line treatment in this situation. If this fails to work, or there is the potential risk of asystole then transvenous pacing is indicated

Potential risk of asystole

- The following indicate a potential risk of asystole and hence the need for treatment with transvenous pacing:
- complete heart block with broad complex QRS
- recent asystole
- Mobitz type II AV block
- ventricular pause > 3 seconds

If there is a delay in the provision of transvenous pacing the following interventions may be used:

- atropine, up to maximum of 3mg
- transcutaneous pacing
- isoprenaline/adrenaline infusion titrated to response

Q-133

In patients with atrial fibrillation (AF), which one of the following factors would make a rate control strategy, rather than rhythm control, more suitable?

A. Congestive heart failure
B. AF secondary to a corrected precipitant
C. Symptomatic
D. Age > 65 years
E. First presentation

ANSWER:
Age > 65 years

EXPLANATION:

Please see Q-29 for Atrial Fibrillation: Rate Control and Maintenance of Sinus Rhythm

Q-134

A 62-year-old man is reviewed two hours after a successful elective DC cardioversion for atrial fibrillation. Six weeks ago he presented in fast atrial fibrillation. A decision was made at the time to warfarinise him for six weeks after which he was to be cardioverted. During this time he had a normal transthoracic echocardiogram. He has no past medical history of note other than treatment for a basal cell carcinoma. What is the most appropriate plan regarding anticoagulation?

A. Can stop immediately
B. Continue warfarinisation for 1 week then review following
C. Lifelong warfarin
D. Lifelong aspirin
E. Continue warfarinisation for 4 weeks then review

ANSWER:
Continue warfarinisation for 4 weeks then review

EXPLANATION:
Please see Q-14 for Atrial Fibrillation: Cardioversion

Q-135

A 57-year-old man with NYHA class III heart failure is currently treated with furosemide and ramipril. What is the most suitable beta-blocker to add to improve his long-term prognosis?

A. Acebutolol
B. Labetalol
C. Bisoprolol
D. Sotalol
E. Esmolol

ANSWER:
Bisoprolol

EXPLANATION:
Both carvedilol and bisoprolol have been shown to reduce mortality in stable heart failure. The other beta-blockers have no evidence base to support their use

Please see Q-52 for Heart Failure: Drug Management

Q-136

A 75-year-old female presents diaphoretic and distressed with new onset sternal chest pain radiating through to the back. She has a past history of hypertension on lercanidipine. On examination her blood pressure is 190/70 mmHg and there is an early diastolic murmur heard best at the left sternal edge. Her ECG is unremarkable. What is the next best course of action?

A. Aspirin/clopidogrel/IV heparin
B. Cardiac catheterisation
C. CT chest with contrast
D. Urgent echocardiogram
E. Thrombolysis

ANSWER:
CT chest with contrast

EXPLANATION:
This is a classic example of an aortic dissection causing aortic regurgitation. The best investigation is going to be a CT chest with IV contrast because the IV contrast will be able to best demonstrate the size and extent of the false lumen.

The chest X-ray may show a widened mediastinum, but unfortunately it is not a sensitive or specific investigation as 20% of patients present with normal chest X-ray and there are many causes of a widened mediastinum. However, the chest X-ray is a useful first line investigation for this condition because of how readily available it is, and useful for ruling out many other conditions. Looking for a separation of the intimal calcification from the outer aortic soft tissue border by 10 mm is an indication of the presence of a dissection. The CT chest with contrast will provide the most amount of information by far, and can demonstrate the extent of the dissection.

An echo is a reasonable investigation, but will not demonstrate the extent of the vessel lesion, for which a CT of the chest will demonstrate the lesion much better.

The next step is for surgery after the initial CT chest with contrast is complete.

Please see Q-94 for Aortic Dissection

Q-137

A 55-year-old man who has a history of ischaemic heart disease presents with myalgia. His long-term medications include aspirin, simvastatin and atenolol. Given his statin use a creatine kinase is measured and reported as follows:

Creatine kinase 1,420 u/l (< 190 u/l)

His problems seem to have followed the prescription of a new medication. Which one of the following is most likely to have caused the elevation in creatine kinase?

A. Rifampicin
B. Felodipine
C. Clarithromycin
D. Ciprofloxacin
E. Amitriptyline

ANSWER:
Clarithromycin

EXPLANATION:
Statins + erythromycin/clarithromycin - an important and common interaction
This patient has developed statin-induced myopathy secondary to clarithromycin, which is a known inhibitor of the CYP3A4 enzyme system.

Whilst ciprofloxacin is a 'P450 inhibitor' it affects a different enzyme system and does not produce a clinically significant interaction. Also, in the BNF the interaction is not considered significant, unlike the interaction with macrolides.

Please see Q-37 for Statins

Q-138

A 62-year-old man is admitted with pyrexia and found to have infective endocarditis. Which one of the following is most associated with a good prognosis?

A. Staphylococcus aureus infection
B. Culture negative endocarditis
C. Streptococcus viridans infection
D. Low complement levels
E. Prosthetic valve endocarditis

Infective endocarditis - streptococcal infection carries a good prognosis

ANSWER:
Streptococcus viridans infection

EXPLANATION:
INFECTIVE ENDOCARDITIS: PROGNOSIS AND MANAGEMENT
Poor prognostic factors
- Staph aureus infection (see below)
- prosthetic valve (especially 'early', acquired during surgery)
- culture negative endocarditis
- low complement levels

Mortality according to organism
staphylococci - 30%
bowel organisms - 15%
streptococci - 5%

Current antibiotic guidelines (source: British National Formulary)

Scenario	Suggested antibiotic therapy
Initial blind therapy	Native valve • amoxicillin, consider adding low-dose gentamicin If penicillin allergic, MRSA or severe sepsis • vancomycin + low-dose gentamicin If prosthetic valve • vancomycin + rifampicin + low-dose gentamicin
Native valve endocarditis caused by staphylococci	Flucloxacillin If penicillin allergic or MRSA • vancomycin + rifampicin
Prosthetic valve endocarditis caused by staphylococci	Flucloxacillin + rifampicin + low-dose gentamicin If penicillin allergic or MRSA • vancomycin + rifampicin + low-dose gentamicin
Endocarditis caused by fully-sensitive streptococci (e.g. viridans)	Benzylpenicillin If penicillin allergic • vancomycin + low-dose gentamicin
Endocarditis caused by less sensitive streptococci	Benzylpenicillin + low-dose gentamicin If penicillin allergic • vancomycin + low-dose

Scenario	Suggested antibiotic therapy
	gentamicin

Indications for surgery

- severe valvular incompetence
- aortic abscess (often indicated by a lengthening PR interval)
- infections resistant to antibiotics/fungal infections
- cardiac failure refractory to standard medical treatment
- recurrent emboli after antibiotic therapy

Q-139

A 30-year-old female patient tells you that she is planning to become pregnant over the next year. You note from her records that she has a history of ventricular septal defect. Which one of the following would represent a contraindication to her becoming pregnant?

A. Aortic regurgitation
B. Having a perimembranous rather than a muscular defect
C. A previous episode of infective endocarditis
D. Pulmonary hypertension
E. A history of previous surgical repair

ANSWER:
Pulmonary hypertension

EXPLANATION:
Women with pulmonary hypertension should avoid becoming pregnant due to very high mortality levels

VENTRICULAR SEPTAL DEFECT
Ventricular septal defects (VSD) are the most common cause of congenital heart disease. They close spontaneously in around 50% of cases. Congenital VSDs are associated with chromosomal disorders (e.g. Down's syndrome, Edward's syndrome, Patau syndrome) and single gene disorders such as Non-congenital causes include post myocardial infarction

Features

- classically a pan-systolic murmur which is louder in smaller defects

Complications

- aortic regurgitation*
- infective endocarditis
- Eisenmenger's complex
- right heart failure
- pulmonary hypertension: pregnancy is contraindicated in women with pulmonary hypertension as it carries a 30-50% risk of mortality

*aortic regurgitation is due to a poorly supported right coronary cusp resulting in cusp prolapse

Q-140

A 70 year-old man presents with a history of chest pain on exertion. He is known to have hypertension, currently treated with amlodipine, and he is also on simvastatin for primary prevention. The chest pain is dull in nature and is relieved within a few minutes of rest. His symptoms have been relieved by the use of his wife's GTN.

Which additional medication would be indicated here?

A. Doxazosin
B. Verapamil
C. Isosorbide mononitrate
D. Atenolol
E. Ivabradine

ANSWER:
Atenolol

EXPLANATION:
This man presents with classic features of angina. He is already taking a calcium channel blocker for hypertension, so the next most appropriate treatment would be a beta blocker. Verapamil would be an alternative if he wasn't taking any other medications.

Doxazosin is an alpha blocker used in refractory hypertension. Isosorbide mononitrate and ivabradine are used in the management of angina, but not at this stage.

Please see Q-59 for Angina Pectoris: Drug Management

Q-141

Which one of the following is least recognised as an adverse effect of taking bendroflumethiazide?

A. Hypokalaemia
B. Pseudogout
C. Hypercalcaemia
D. Impotence
E. Impaired glucose tolerance

ANSWER:
Pseudogout

EXPLANATION:
Bendroflumethiazide predisposes to gout, rather than pseudogout

Please see Q-105 for Thiazide Diuretics

Q-142

A 42-year-old man of Afro-Caribbean origin is diagnosed as having hypertension. Secondary causes of hypertension have been excluded. What is the most appropriate initial drug therapy?

A. Losartan
B. Bisoprolol
C. Indapamide
D. Ramipril
E. Amlodipine

ACE inhibitors have reduced efficacy in black patients and are therefore not used first-line

ANSWER:
Amlodipine

EXPLANATION:
Please see Q-6 for Hypertension: Management

Q-143

A 57-year-old man presents to the Emergency Department with palpitations for the past 36 hours. He has no past history of note. There is no associated chest pain or shortness of breath. Clinical examination is unremarkable other than an irregular tachycardia. An ECG shows atrial fibrillation at a rate of 126 bpm with no other changes. What is the most appropriate management?

A. Beta-blocker + warfarin
B. Digoxin + aspirin
C. Heparinise + cardioversion in the Emergency Department
D. Beta-blocker + aspirin
E. Warfarinise + transthoracic echo with elective electrical cardioversion in 4 weeks

ANSWER:
Heparinise + cardioversion in the Emergency Department

EXPLANATION:
This patient is a good example of someone who would benefit from electrical cardioversion.

Please see Q-14 for Atrial Fibrillation: Cardioversion

Q-144

A 57-year-old female presents to the Emergency Department with shortness of breath and pleuritic chest pain. She has no past medical history of note and enjoys good health. Investigations reveal a non-massive pulmonary embolism. What is the recommended length of warfarinisation for this patient?

A. 6 weeks
B. 3 months
C. 6 months
D. 12 months
E. Life-long

ANSWER:
6 months

EXPLANATION:
There are no transient risk factors for venous thromboembolism therefore the patient should be anticoagulated for 6 months.

Recent NICE guidelines advise to 'offer a VKA* beyond 3 months to patients with an unprovoked PE'.

****vitamin K antagonsist, i.e. warfarin***

Please see Q-12 for Pulmonary Embolism: Management

Q-145

You are reviewing a 74-year-old man with hypertension, type 2 diabetes and osteoarthritis. He takes 10mg of ramipril once a day, 10mg of amlodipine once a day, indapamide 2.5 mg once a day, 500mg of Metformin twice a day, co-codamol PRN and atorvastatin 20mg at night.

His blood pressure (BP) is consistently raised on his home BP monitor and today in the clinic today is 158/95 mmHg. You would like to start a further medication to try and lower his BP. His K+ is 4.0 mmol/l.

What would be the most appropriate next medication to add according to the NICE guidelines?

A. Bendroflumethiazide
B. Chlortalidone
C. Candesartan
D. Spironolactone
E. Doxazosin

ANSWER:
Spironolactone

EXPLANATION:
Poorly controlled hypertension, already taking an ACE inhibitor, calcium channel blocker and a thiazide diuretic. K+ < 4.5mmol/l - add spironolactone
This patient has resistant hypertension as he is already on three agents to try and control his BP. He is already taking an ACE-inhibitor (ramipril) and a calcium channel blocker (amlodipine) at the maximum doses. He is also taking a thiazide-like diuretic (indapamide). The next step would be to add spironolactone if the K+ is <4.5 mmol/l. Therefore, option 4, spironolactone is the correct answer.

If his K+ was > 4.5 mmol/l, the next step would be to consider higher-dose thiazide-like diuretic treatment.

Bendroflumethiazide is a conventional thiazide diuretic which is inappropriate here as the patient is on indapamide. Chlortalidone is a thiazide-like diuretic (as is indapamide) so is inappropriate to add in. Candesartan is an angiotensin receptor blocker and shouldn't be used in combination with an ACE-inhibitor. Doxazosin is an alpha blocker which is used if further diuretic therapy is not tolerated.

Please see Q-6 for Hypertension: Management

Q-146

A 61-year-old woman is admitted to the Emergency Department with central chest pain. It feels like her previous angina but is not relieved by nitrates. She has a history of ischaemic heart disease and 4 weeks ago underwent a percutaneous coronary intervention during which a stent was placed. This is her first episode of angina since the procedure. What is the most likely diagnosis?

A. Pericarditis
B. Aortic dissection
C. Coronary artery dissection
D. Restenosis
E. Stent thrombosis

ANSWER:
Stent thrombosis

EXPLANATION:
PERCUTANEOUS CORONARY INTERVENTION
Percutaneous coronary intervention (PCI) is a technique used to restore myocardial perfusion in patients with ischaemic heart disease, both in patients with stable angina and acute coronary syndromes. Stents are implanted in around 95% of patients - it is now rare for just balloon angioplasty to be performed

Following stent insertion migration and proliferation of smooth muscle cells and fibroblasts occur to the treated segment. The stent struts eventually become covered by endothelium. Until this happens there is an increased risk of platelet aggregation leading to thrombosis.

Two main complications may occur
- stent thrombosis: due to platelet aggregation as above. Occurs in 1-2% of patients, most commonly in the first month. Usually presents with acute myocardial infarction
- restenosis: due to excessive tissue proliferation around stent. Occurs in around 5-20% of patients, most commonly in the first 3-6 months. Usually presents with the recurrence of angina symptoms. Risk factors include diabetes, renal impairment and stents in venous bypass grafts

Types of stent
- bare-metal stent (BMS)
- drug-eluting stents (DES): stent coated with paclitaxel or rapamycin which inhibit local tissue growth. Whilst this reduces restenosis rates the stent thrombosis rates are increased as the process of stent endothelisation is slowed

Following insertion the most important factor in preventing stent thrombosis is antiplatelet therapy. Aspirin should be continued indefinitely. The length of clopidogrel treatment depends on the type of stent, reason for insertion and consultant preference

Q-147

A 79-year-old female presents to the low-risk chest pain clinic with intermittent substernal chest pains. The pain typically comes on with exertion and improves with rest. A trial of GTN has been given by her GP which helps with her pain. She is a known ex-smoker of 30 pack-years. She has no diabetes, hyperlipidaemia, hypertension, and no family history of coronary artery disease.

On examination her observations are stable. On auscultations of her chest, her first and second heart sounds are audible with no added sounds and her lungs are clear.

A pre-test probability is calculated for coronary artery disease which gives a result of 45%.

What is the most important investigation to pursue given her risk for coronary artery disease?

A. CT calcium scoring
B. Coronary angiogram
C. Stress test ECG
D. Myocardial perfusion scintigraphy
E. No further investigations

ANSWER:
Myocardial perfusion scintigraphy

EXPLANATION:
The answer is myocardial perfusion scintigraphy which is appropriate for a pre-test coronary artery disease probability of between 30-60%. If the pre-test probability is above this, then invasive coronary angiography is appropriate, below this CT calcium scoring. Given this chest pain is typical for coronary artery disease, the no further investigations answer would be inappropriate.

The 2010 NICE guidance for patients presenting with chest pain recommends that neither exercise ECG nor MR coronary angiography should be used to diagnose or exclude stable angina for people without known CAD (Reference: Chest pain of recent onset; NICE Clinical Guideline (March 2010, updated Nov 2016)).

CARDIAC IMAGING: NON-INVASIVE TECHNIQUES EXCLUDING ECHOCARDIOGRAPHY
The ability to image the heart using non-invasive techniques such as MRI, CT and radionuclides has evolved rapidly over recent years.

Nuclear imaging
These techniques use radiotracers which are extracted by normal myocardium. Examples include:
- thallium
- technetium (99mTc) sestamibi: a coordination complex of the radioisotope technetium-99m with the ligand methoxyisobutyl isonitrile (MIBI), used in 'MIBI' or cardiac

Single Photon Emission Computed Tomography (SPECT) scans
- fluorodeoxyglucose (FDG): used in Positron Emission Tomography (PET) scans

The primary role of SPECT is to assess myocardial perfusion and myocardial viability. Two sets of images are usually acquired. First the myocardium at rest followed by images of the myocardium during stress (either exercise or following adenosine / dipyridamole). By comparing the rest with stress images any areas of ischaemia can classified as reversible or fixed (e.g. Following a myocardial infarction). Cardiac PET is predominately a research tool at the current time

MUGA
Multi Gated Acquisition Scan, also known as radionuclide angiography
radionuclide (technetium-99m) is injected intravenously
the patient is placed under a gamma camera
may be performed as a stress test
can accurately measure left ventricular ejection fraction.
Typically used before and after cardiotoxic drugs are used

Cardiac Computed Tomography (CT)
Cardiac CT is useful for assessing suspected ischaemic heart disease, using two main methods:
- calcium score: there is known to be a correlation between the amount of atherosclerotic plaque calcium and the risk of future ischaemic events. Cardiac CT can quantify the amount of calcium producing a 'calcium score'
- contrast enhanced CT: allows visualisation of the coronary artery lumen

If these two techniques are combined cardiac CT has a very high negative predictive value for ischaemic heart disease.

Cardiac MRI
Cardiac MRI (commonly termed CMR) has become the gold standard for providing structural images of the heart. It is particularly useful when assessing congenital heart disease, determining right and left ventricular mass and differentiating forms of cardiomyopathy. Myocardial perfusion can also be assessed following the administration of gadolinium. Currently CMR provides limited data on the extent of coronary artery disease.

Please also see the British Heart Foundation link for an excellent summary.

Q-148

Six weeks after having a prosthetic heart valve a patient develops infective endocarditis. What is the most likely causative organism?

A. Streptococcus viridans
B. Staphylococcus epidermidis
C. Staphylococcus aureus
D. Streptococcus bovis
E. One of the HACEK group

ANSWER:
Staphylococcus epidermidis

EXPLANATION:
Most common cause of endocarditis:
Staphylococcus aureus
Staphylococcus epidermidis if < 2 months post valve surgery
Coagulase-negative staphylococci such as Staphylococcus epidermidis are the most common causative organisms in the first 2 months following surgery. After this time the spectrum of organisms causing endocarditis returns to normal.

Please see Q-102 for Infective Endocarditis

Q-149

A 45-year-old woman suffered from sudden onset central crushing chest pain. Her electrocardiogram showed ST-segment elevation. Troponin is slightly raised. She was rushed for an emergency invasive angiogram but this revealed slight wall irregularities with no luminal obstruction. Subsequently, cardiovascular MR (CMR) showed an apical ballooning of the myocardium resembling an octopus pot.

She did not have any significant past medical history. There is a family history of premature coronary artery disease. Her partner recently passed away of prostate cancer.

What is the most likely cause of the ST-segment elevation?

A. Coronary artery disease
B. Takotsubo cardiomyopathy
C. Left ventricular aneurysm
D. Myocardial infarction
E. Hypertrophic cardiomyopathy

ANSWER:
Takotsubo cardiomyopathy

EXPLANATION:
Takotsubo cardiomyopathy is a differential for ST-elevation in someone with no obstructive coronary artery disease
The differential diagnosis for ST-elevation:
- ***myocardial infarction***
- ***pericarditis/myocarditis***
- ***normal variant - 'high take-off'***
- ***Takotsubo cardiomyopathy***
- ***Left ventricular aneurysm***
- ***Prinzmetal angina***
- ***Subarachnoid haemorrhage***

Takotsubo cardiomyopathy also known as 'Broken heart syndrome' and 'Takotsubo apical ballooning syndrome' describes a cardiomyopathy induced by severe stressful triggers (e.g. emotional upset). It is commoner in women. In

this scenario, we assume that the patient is in bereavement which precipitated the stress cardiomyopathy.

Takotsubo is a Japanese word that describes an octopus trap; this is used to describe the appearance of the heart on left ventriculogram, CMR or echocardiogram. This apical ballooning appearance occurs due to severe hypokinesis of the mid and apical segments with preservation of activity of the basal segments. In simple terms, the bottom of the heart (the apex) does not contract and therefore appears to balloon out. However, the area closer to the top (the base) continues to contract (creating the neck of the octopus trap).

Myocardial infarction and coronary artery disease are incorrect as it has been ruled out by the invasive coronary angiogram. Besides, CMR would show regional wall motion irregularities in infarcted area.

Left ventricular aneurysm is a possible complication of myocardial infarction (MI). Given that there is no past medical history of MI, this is unlikely. Besides, left ventricular aneurysms would be clearly visible as a discreet dyskinetic area

Hypertrophic cardiomyopathy would appear as asymmetric septal hypertrophy with systolic anterior movement (SAM) of the anterior leaflet of the mitral valve.

ECG: ST elevation

Causes of ST elevation

- myocardial infarction
- pericarditis/myocarditis
- normal variant - 'high take-off'
- left ventricular aneurysm
- Prinzmetal's angina (coronary artery spasm)
- Takotsubo cardiomyopathy
- rare: subarachnoid haemorrhage

Q-150

A 60-year-old man presents with increasing shortness-of-breath on exertion. During the examination a third heart sound is heard. Examination of the respiratory system is unremarkable. Which one of the following is most consistent with this finding?

A. Dilated cardiomyopathy
B. Hypertrophic obstructive cardiomyopathy
C. Atrial fibrillation
D. Mitral stenosis
E. Normal variant

ANSWER:
Dilated cardiomyopathy

EXPLANATION:
A third heart sound is only considered a normal variant in patients < 40 years of age.

Please see Q-62 for Heart Sounds

Q-151

What is the usual target INR for a patient with a mechanical mitral valve?

A. 2.0
B. 2.5
C. 3.0
D. 3.5
E. 4.0

ANSWER:
3.5

EXPLANATION:
Mechanical valves - target INR:

- *aortic: 3.0*
- *mitral: 3.5*

PROSTHETIC HEART VALVES

The most common valves which need replacing are the aortic and mitral valve. There are two main options for replacement: biological (bioprosthetic) or mechanical.

Biological (bioprosthetic) valves	Mechanical valves
Usually bovine or porcine in origin Major disadvantage is structural deterioration and calcification over time. Most older patients (> 65 years for aortic valves and > 70 years for mitral valves) receive a bioprosthetic valve Long-term anticoagulation not usually needed. Warfarin may be given for the first 3 months depending on patient factors. Low-dose aspirin is given long-term.	The most common type now implanted is the bileaflet valve. Ball-and-cage valves are rarely used nowadays Mechanical valves have a low failure rate Major disadvantage is the increased risk of thrombosis meaning long-term anticoagulation is needed. Following the 2017 European Society of Cardiology guidelines, aspirin is only normally given in addition if there is an additional indication, e.g. ischaemic heart disease. Target INR • aortic: 3.0 • mitral: 3.5

Following the 2008 NICE guidelines for prophylaxis of endocarditis antibiotics are no longer recommended for common procedures such as dental work.

Q-152

A 71-year-old man who had a bioprosthetic aortic valve replacement three years ago is reviewed. What antithrombotic therapy is he likely to be taking?

A. **Nothing**
B. **Aspirin**
C. **Warfarin: INR 2.0-3.0**
D. **Aspirin + clopidogrel**
E. **Warfarin: INR 3.0-4.0**

ANSWER:
Aspirin

EXPLANATION:
Prosthetic heart valves - antithrombotic therapy:
- ***bioprosthetic: aspirin***
- ***mechanical: warfarin + aspirin***

Please see Q-151 for Prosthetic Heart Valves

Q-153

You review a 51-year-old hypertensive patient who you started on 2.5mg of ramipril one month ago. He is complaining of a tickly cough since starting the medication which is keeping him awake at night. However, is blood pressure is now within normal limits.

What should you advise him?

A. **The cough is unlikely to be caused by the ramipril, continue the medication and review in a month**
B. **The cough should settle within the next month, continue the medication and review in a month**
C. **Stop the ramipril and prescribe a different ACE-inhibitor**
D. **Stop the ramipril and prescribe 5mg amlodipine**
E. **Stop the ramipril and prescribe candesartan**

ANSWER:
Stop the ramipril and prescribe candesartan

EXPLANATION:
For a patient under 55 who is intolerant to an ACE-i the next step would be to offer an angiotensin 2 receptor blocker (ARB)
ACE inhibitors are commonly associated with a dry, persistent cough. A cough is unlikely to settle without stopping the ACE-inhibitor and prescribing a different class of drug. For a patient under 55 who is intolerant to an ACE-inhibitor the next step would be to offer an angiotensin 2 receptor blocker (ARB), eg candesartan.

Please see Q-6 for Hypertension: Management

Q-154

A 34-year-old man is investigated following an unexplained collapse whilst at work. A resting ECG shows convex ST elevation in V1-V3 with a partial right bundle branch block pattern. What is the most likely diagnosis?

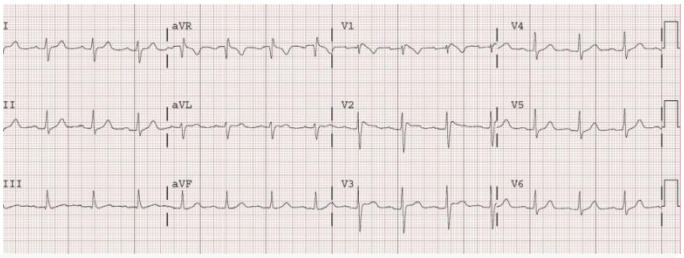
A. **Catecholaminergic polymorphic ventricular tachycardia**
B. **Hypertrophic obstructive cardiomyopathy**
C. **Arrhythmogenic right ventricular cardiomyopathy**
D. **Brugada syndrome**
E. **Normal variant**

ANSWER:
Brugada syndrome

EXPLANATION:
BRUGADA SYNDROME
Brugada syndrome is a form of inherited cardiovascular disease with may present with sudden cardiac death. It is inherited in an autosomal dominant fashion and has an estimated prevalence of 1:5,000-10,000. Brugada syndrome is more common in Asians.

Pathophysiology
- a large number of variants exist
- around 20-40% of cases are caused by a mutation in the SCN5A gene which encodes the myocardial sodium ion channel protein

ECG changes
- convex ST segment elevation > 2mm in > 1 of V1-V3 followed by a negative T wave
- partial right bundle branch block
- changes may be more apparent following flecainide



ECG showing Brugada pattern, most marked in V1, which has an incomplete RBBB, a downsloping ST segment and an inverted T wave

Management
- implantable cardioverter-defibrillator

Q-155

A 52-year-old female with a known history of systemic sclerosis presents for annual review to the rheumatology clinic. Which one of the following symptoms is most characteristic in patients who have developed pulmonary arterial hypertension?

A. **Exertional dyspnoea**
B. **Paroxysmal nocturnal dyspnoea**
C. **Cough**
D. **Early morning dyspnoea**
E. **Orthopnoea**

ANSWER:
Exertional dyspnoea

EXPLANATION:

Please see Q-44 for Pulmonary Arterial Hypertension

Q-156

A 72-years-old lady attends to her general practitioner with a history of diabetes mellitus, hyperlipidaemia, hypertension, hypertensive cardiomyopathy, atrial fibrillation and polymyalgia rheumatica. She had a non-displaced humeral shaft fracture 3 years ago treated non-operatively. She is currently taking atorvastatin, warfarin, furosemide, bendroflumethiazide and a low dose of prednisolone. Which of the following drugs can increase the osseous matter and decrease the further risk of fracture by decreasing the amount of calcium excreted by the kidneys?

A. Atorvastatin
B. Warfarin
C. Furosemide
D. Bendroflumethiazide
E. Prednisolone

ANSWER:

Bendroflumethiazide

EXPLANATION:

Thiazide diuretics can cause hyponatraemia, metabolic alkalosis, hypokalaemia and hypocalciuria
Thiazide diuretics can cause hyponatraemia, metabolic alkalosis, hypokalaemia and hypocalciuria. They can conserve calcium by decreasing its excretion by kidneys, whereas loop diuretics (such as furosemide) and cause increase calcium excretion and decrease serum calcium levels. Prednisolone as any other steroid can shift the calcium from the bone to the kidneys to be excreted, possibly causing steroid-induced osteoporosis. Atorvastatin and warfarin do not interfere with calcium homeostasis significantly.

Please see Q-105 for Thiazide Diuretics

Q-157

Which one of the following clinical features would be least consistent with a diagnosis of severe pre-eclampsia?

A. Headache
B. Epigastric pain
C. Reflexes difficult to elicit
D. Low platelet count
E. Papilloedema

ANSWER:

Reflexes difficult to elicit

EXPLANATION:

Severe pre-eclampsia is associated with hyperreflexia and clonus. A low platelet count may indicate the patient is developing HELLP syndrome

PRE-ECLAMPSIA

Pre-eclampsia is a condition seen after 20 weeks gestation characterised by pregnancy-induced hypertension in association with proteinuria (> 0.3g / 24 hours). Oedema used to be third element of the classic triad but is now often not included in the definition as it is not specific

Pre-eclampsia is important as it predisposes to the following problems

- fetal: prematurity, intrauterine growth retardation
- eclampsia
- haemorrhage: placental abruption, intra-abdominal, intra-cerebral
- cardiac failure
- multi-organ failure

NICE divide risk factors into high and moderate risk:

High risk factors	Moderate risk factors
• hypertensive disease in a previous pregnancy • chronic kidney disease • autoimmune disease, such as systemic lupus erythematosus or antiphospholipid syndrome • type 1 or type 2 diabetes • chronic hypertension	• first pregnancy • age 40 years or older • pregnancy interval of more than 10 years • body mass index (BMI) of 35 kg/m^2 or more at first visit • family history of pre-eclampsia • multiple pregnancy

Features of severe pre-eclampsia

- hypertension: typically > 170/110 mmHg and proteinuria as above
- proteinuria: dipstick ++/+++
- headache
- visual disturbance
- papilloedema
- RUQ/epigastric pain
- hyperreflexia
- platelet count < 100 * 106/l, abnormal liver enzymes or HELLP syndrome

Management

- consensus guidelines recommend treating blood pressure > 160/110 mmHg although many clinicians have a lower threshold
- oral labetalol is now first-line following the 2010 NICE guidelines. Nifedipine and hydralazine may also be used
- delivery of the baby is the most important and definitive management step. The timing depends on the individual clinical scenario

Q-158

Each one of the following may cause secondary hypertension, except:

A. **Patent ductus arteriosus**
B. **Cushing's syndrome**
C. **Liddle's syndrome**
D. **11-beta hydroxylase deficiency**
E. **Combined oral contraceptive pill**

ANSWER:
Patent ductus arteriosus

EXPLANATION:
HYPERTENSION: SECONDARY CAUSES
It is thought that between 5-10% of patients diagnosed with hypertension have primary hyperaldosteronism, including Conn's syndrome. This makes it the single most common cause of secondary hypertension.

Renal disease accounts for a large percentage of the other cases of secondary hypertension. Conditions which may increase the blood pressure include:
- glomerulonephritis
- pyelonephritis
- adult polycystic kidney disease
- renal artery stenosis

Endocrine disorders (other than primary hyperaldosteronism) may also result in increased blood pressure:
- phaeochromocytoma
- Cushing's syndrome
- Liddle's syndrome
- congenital adrenal hyperplasia (11-beta hydroxylase deficiency)
- acromegaly

Drug causes:
- steroids
- monoamine oxidase inhibitors
- the combined oral contraceptive pill
- NSAIDs
- leflunomide

Other causes include:
- pregnancy
- coarctation of the aorta

Q-159

A 28-year-old intravenous drug user is brought into the Emergency Department as a stand-by call following a cardiac arrest. He has been using methadone for the past 3 months. Unfortunately attempts to resuscitate him fail. Which one of following underlying problems is most likely to have caused his sudden death?

A. **Prolonged QT interval**
B. **Complete heart block**
C. **Pulmonary arterial hypertension**
D. **Cardiomyopathy**
E. **Hypokalaemia**

ANSWER:
Prolonged QT interval

EXPLANATION:
Methadone is a common cause of QT prolongation

Please see Q-55 for Long QT Syndrome

Q-160

An 85-year-old man is admitted on the medical take with a 4 day history of a productive cough, followed by 2 days of shortness of breath, fever and confusion. He has an obvious shadow over the lower zone of his left lung on chest x-ray which was not there on a routine x-ray one month earlier. He has a past medical history of asthma, ischaemic heart disease and gallstones. Which of the following is most strongly associated with a poor prognosis?

A. **CURB-65 score of 3**
B. **Past medical history of asthma**
C. **Ex-smoker**
D. **Patient meets criteria for sepsis**
E. **Saturations of 92% on 8 litres of oxygen via non-rebreathe mask**

ANSWER:
CURB-65 score of 3

EXPLANATION:
The CURB-65 score can be used for assessing the prognosis of a patient with community acquired pnuemonia
This patient has community-acquired pneumonia. The CURB-65 score is used to assess prognosis and risk of mortality in patients with community-acquired pneumonia. The full score can be found in the background notes. A higher score is linked to a higher risk of in-hospital mortality.

Having asthma, being an ex-smoker, being septic or having a significant oxygen requirement are likely all associated with worse prognosis but do not have the strength of evidence behind them to compare to the CURB-65 score.

SCORING SYSTEMS
There are now numerous scoring systems used in medicine. The table below lists some of the more common ones:

Scoring system	Notes
CHA_2DS_2-VASc	Used to determine the need to anticoagulate a patient in atrial fibrillation
ABCD2	Prognostic score for risk stratifying patients who've had a suspected TIA
NYHA	Heart failure severity scale
DAS28	Measure of disease activity in rheumatoid arthritis
Child-Pugh classification	A scoring system used to assess the severity of liver cirrhosis
Wells score	Helps estimate the risk of a patient having a deep vein thrombosis
MMSE	Mini-mental state examination - used to assess

Scoring system	Notes
	cognitive impairment
HAD	Hospital Anxiety and Depression (HAD) scale - assesses severity of anxiety and depression symptoms
PHQ-9	Patient Health Questionnaire - assesses severity of depression symptoms
GAD-7	Used as a screening tool and severity measure for generalised anxiety disorder
Edinburgh Postnatal Depression Score	Used to screen for postnatal depression
SCOFF	Questionnaire used to detect eating disorders and aid treatment
AUDIT	Alcohol screening tool
CAGE	Alcohol screening tool
FAST*	Alcohol screening tool
CURB-65	Used to assess the prognosis of a patient with pneumonia
Epworth Sleepiness Scale	Used in the assessment of suspected obstructive sleep apnoea
IPSS	International prostate symptom score
Gleason score	Indicates prognosis in prostate cancer
APGAR	Assesses the health of a newborn immediately after birth
Bishop score	Used to help assess the whether induction of labour will be required
Waterlow score	Assesses the risk of a patient developing a pressure sore
FRAX	Risk assessment tool developed by WHO which calculates a patients 10-year risk of developing an osteoporosis related fracture
Ranson criteria	Acute pancreatitis
MUST	Malnutrition

*FAST is also mnemonic to help patients/relatives identify the symptoms of a stroke

Q-161

A 55-year-old man presents with a 2-hour history palpitations. He has no other history of note and is generally fit and well. An ECG confirms fast atrial fibrillation with a rate of 140/min. He has a fear of sedation and requests pharmacological cardioversion. Which one of the following agents is most likely to cardiovert him into sinus rhythm?

A. Atenolol
B. Procainamide
C. Flecainide
D. Disopyramide
E. Digoxin

ANSWER:
Flecainide

EXPLANATION:
Atrial fibrillation - cardioversion: amiodarone + flecainide

ATRIAL FIBRILLATION: PHARMACOLOGICAL CARDIOVERSION

NICE published guidelines on the management of atrial fibrillation (AF) in 2014. The following is also based on the joint American Heart Association (AHA), American College of Cardiology (ACC) and European Society of Cardiology (ESC) 2016 guidelines

Agents with proven efficacy in the pharmacological cardioversion of atrial fibrillation

- amiodarone
- flecainide (if no structural heart disease)
- others (less commonly used in UK): quinidine, dofetilide, ibutilide, propafenone

Less effective agents

- beta-blockers (including sotalol)
- calcium channel blockers
- digoxin
- disopyramide
- procainamide

Q-162

Which part of the jugular venous waveform is associated with the fall in atrial pressure during ventricular systole?

A. y descent
B. v wave
C. x descent
D. c wave
E. a wave

ANSWER:
x descent

EXPLANATION:
JVP: x descent = fall in atrial pressure during ventricular systole

Please see Q-18 for Jugular Venous Pulse

Q-163

The neprilysin inhibitor, sacubitril, in combination with the angiotensin II receptor blocker, valsartan, has been shown to reduce mortality, reduce hospitalisations and improve symptoms in comparison to enalapril in the treatment of heart failure with reduced ejection fraction. What is its mechanism of action in heart failure?

A. Improves myocardial contraction
B. Prevents the degradation of natriuretic peptides such as BNP and ANP
C. Reduces heart rate
D. Multiple inhibition of renin, angiotensinogen and aldosterone
E. Inhibition of vasopressin release therefore promoting diuresis

ANSWER:
Prevents the degradation of natriuretic peptides such as BNP and ANP

EXPLANATION:
The correct answer is prevents the degradation of natriuretic peptides such as BNP and ANP.

The natriuretic peptide system regulates the detrimental effects of the upregulation of the renin-angiotensinogen-aldosterone system (RAAS) which occurs in heart failure. Sodium and water retention and vasoconstriction caused by activation of the RAAS, sympathetic nervous system and the action of vasopressin, lead to increased ventricular preload and afterload and elevated wall stress which in turn lead to production of BNP. BNP acts to promote natriuresis and vasodilation. Atrial stretch leads to the production of ANP which has similar biological properties to BNP. Two strategies have been employed to try and improve outcomes in heart failure via modulation of this pathway. The first is the administration of exogenous natriuretic peptides. Nesiritide, a recombinant human BNP, initially showed promising beneficial effects on haemodynamics and natriuresis in patients with HF. However, in a large-scale randomised controlled trial, it failed to improve outcomes though it did improve dyspnoea. The second strategy is to inhibit the breakdown of natriuretic peptides. ANP & BNP are inactivated by a membrane bound endopeptidase, neprilysin, which is found in a number of tissues but in especially high concentrations in the kidney. This led to the development of the neprilysin inhibitor, sacubitril. Given in combination with the angiotensin II receptor blocker, valsartan, it has been shown to reduce mortality, reduce hospitalisations and improve symptoms in comparison to enalapril in the treatment of heart failure with reduced ejection fraction.

Please see Q-52 for Heart Failure: Drug Management

Q-164

A 58-year-old man with no past medical history of note is admitted to hospital with crushing central chest pain. ECG on arrival shows anterior ST elevation and he is subsequently thrombolysed with a good resolution of symptoms and ECG changes. Four weeks following the event, which combination of drugs should he be taking?

A. ACE inhibitor + beta-blocker + statin + aspirin
B. Spironolactone + beta-blocker + statin + aspirin
C. ACE inhibitor + beta-blocker + statin + aspirin + clopidogrel
D. ACE inhibitor + statin + aspirin + clopidogrel
E. Beta-blocker + statin + aspirin + clopidogrel

ANSWER:
ACE inhibitor + beta-blocker + statin + aspirin + clopidogrel

EXPLANATION:
NICE made the following recommendation in 2013 relating to people who have had a STEMI and medical management with or without reperfusion treatment with a fibrinolytic agent

- ***offer clopidogrel as a treatment option for at least 1 month and consider continuing for up to 12 months***

MYOCARDIAL INFARCTION: SECONDARY PREVENTION
NICE produced guidelines on the management of patients following a myocardial infarction (MI) in 2013. Some key points are listed below

All patients should be offered the following drugs:

- dual antiplatelet therapy (aspirin plus a second antiplatelet agent)
- ACE inhibitor
- beta-blocker
- statin

Some selected lifestyle points:

- diet: advise a Mediterranean style diet, switch butter and cheese for plant oil based products. Do not recommend omega-3 supplements or eating oily fish
- exercise: advise 20-30 mins a day until patients are 'slightly breathless'
- sexual activity may resume 4 weeks after an uncomplicated MI. Reassure patients that sex does not increase their likelihood of a further MI. PDE5 inhibitors (e.g, sildenafil) may be used 6 months after a MI. They should however be avoided in patient prescribed either nitrates or nicorandil

Clopidogrel

- since clopidogrel came off patent it is now much more widely used post-MI
- STEMI: the European Society of Cardiology recommend dual antiplatelets for 12 months. In the UK this means aspirin + clopidogrel
- non-ST segment elevation myocardial infarction (NSTEMI): following the NICE 2013 Secondary prevention in primary and secondary care for patients following a myocardial infarction guidelines clopidogrel should be given for the first 12 months

Aldosterone antagonists

- patients who have had an acute MI and who have symptoms and/or signs of heart failure and left ventricular systolic dysfunction, treatment with an aldosterone antagonist licensed for post-MI treatment (e.g. eplerenone) should be initiated within 3-14 days of the MI, preferably after ACE inhibitor therapy

Q-165

A 70-year-old man with an existing diagnosis of 5.0 cm abdominal aortic aneurysm and atrial fibrillation presents with acute onset abdominal pain radiating to his back. He is still actively bleeding and his observations show the following:

Blood pressure 90/40 mmHg
Heart rate 140 beats per minute

The decision is made to proceed with emergency surgery within the next thirty minutes

Which of the following is the most appropriate management of warfarin therapy?

A. **Give 5 mg vitamin K intravenously**
B. **Stop warfarin and commence treatment dose enoxaparin only**
C. **Continue warfarin but bridge with enoxaparin immediately after surgery**
D. **Give four-factor prothrombin complex concentrate 25-50 units/kg**
E. **Begin dual therapy with warfarin and enoxaparin until INR is in range**

ANSWER:
Give four-factor prothrombin complex concentrate 25-50 units/kg

EXPLANATION:
Patients on warfarin undergoing emergency surgery - give four-factor prothrombin complex concentrate
British Journal of Haematology Guidelines in patients on warfarin having emergency surgery:

If surgery can wait for 6-8 hours - give 5 mg vitamin K IV
If surgery can't wait - 25-50 units/kg four-factor prothrombin complex
The guidance is to stop warfarin before elective or emergency surgery, so options 3 and 5 are incorrect
Because this is emergency surgery, reversal of anti-coagulation is necessary so option 2 is incorrect

Please see Q-4 for Warfarin

Q-166

Which one of the following diuretics works by inhibiting a transmembrane cotransporter protein?

A. **Indapamide**
B. **Eplerenone**
C. **Furosemide**
D. **Amiloride**
E. **Mannitol**

ANSWER:
Furosemide

EXPLANATION:
Please see Q-38 for Loop Diuretics

Q-167

A 70-year-old man is admitted to the Acute Medicine Unit as he is pyrexial and feeling generally unwell. He has a history of ischaemic heart disease and had a myocardial infarction 5 years ago. An echocardiogram is arranged which shows a small vegetation around the mitral valve. Blood cultures are taken which are reported as follows:

Streptococcus viridans

What is the most appropriate antibiotic therapy?

A. **IV benzylpenicillin**
B. **IV benzylpenicillin + ceftriaxone**
C. **IV flucloxacillin + gentamicin**
D. **IV vancomycin + rifampicin + gentamicin**
E. **IV vancomycin + benzylpenicillin**

ANSWER:
IV benzylpenicillin

EXPLANATION:
Please see Q-138 for Infective Endocarditis: Prognosis and Management

Q-168

Which one of the following would not be considered a normal variant on the ECG of an athletic 28-year-old man?

A. **Wenckebach phenomenon**
B. **Sinus bradycardia**
C. **Junctional rhythm**
D. **First degree heart block**
E. **Left bundle branch block**

ANSWER:
Left bundle branch block

EXPLANATION:
ECG: NORMAL VARIANTS
The following ECG changes are considered normal variants in an athlete:

- sinus bradycardia
- junctional rhythm
- first degree heart block
- Wenckebach phenomenon

Q-169

An elderly man with aortic stenosis is assessed. Which one of the following would make the ejection systolic murmur quieter?

A. **Left ventricular systolic dysfunction**
B. **Thyrotoxicosis**
C. **Mixed aortic valve disease**
D. **Expiration**
E. **Anaemia**

ANSWER:
Left ventricular systolic dysfunction

EXPLANATION:
Left ventricular systolic dysfunction will result in a decreased flow-rate across the aortic valve and hence a quieter murmur.

Please see Q-15 for Aortic Stenosis

Q-170

A 37-year-old woman presents for review. She is 26 weeks pregnant and has had no problems with her pregnancy to date. Blood pressure is 144/92 mmHg, a rise from her booking reading of 110/80 mmHg. Urine dipstick reveals the following:

Protein negative
Leucocytes negative
Blood negative

What is the most appropriate description of her condition?

A. Moderate pre-eclampsia
B. Mild pre-eclampsia
C. Gestational hypertension
D. Normal physiological change in blood pressure
E. Pre-existing hypertension

ANSWER:
Gestational hypertension

EXPLANATION:
HYPERTENSION IN PREGNANCY
NICE published guidance in 2010 on the management of hypertension in pregnancy. They also made recommendations on reducing the risk of hypertensive disorders developing in the first place. Women who are at high risk of developing pre-eclampsia should take aspirin 75mg od from 12 weeks until the birth of the baby. High risk groups include:

- hypertensive disease during previous pregnancies
- chronic kidney disease
- autoimmune disorders such as SLE or antiphospholipid syndrome
- type 1 or 2 diabetes mellitus

The classification of hypertension in pregnancy is complicated and varies. Remember, in normal pregnancy:

- blood pressure usually falls in the first trimester (particularly the diastolic), and continues to fall until 20-24 weeks
- after this time the blood pressure usually increases to pre-pregnancy levels by term

Hypertension in pregnancy in usually defined as:

- systolic > 140 mmHg or diastolic > 90 mmHg
- or an increase above booking readings of > 30 mmHg systolic or > 15 mmHg diastolic

After establishing that the patient is hypertensive they should be categorised into one of the following groups

Pre-existing hypertension	Pregnancy-induced hypertension (PIH, also known as gestational hypertension)	Pre-eclampsia
A history of hypertension before pregnancy or an elevated blood pressure > 140/90 mmHg before 20 weeks gestation No proteinuria, no oedema Occurs in 3-5% of pregnancies and is more common in older women	Hypertension (as defined above) occurring in the second half of pregnancy (i.e. after 20 weeks) No proteinuria, no oedema Occurs in around 5-7% of pregnancies Resolves following birth (typically after one month). Women with PIH are at increased risk of future pre-eclampsia or hypertension later in life	Pregnancy-induced hypertension in association with proteinuria (> 0.3g / 24 hours) Oedema may occur but is now less commonly used as a criteria Occurs in around 5% of pregnancies

Q-171

Which one of the following clinical signs would best indicate severe aortic stenosis?

A. Valvular gradient of less than 30 mmHg
B. Soft second heart sound
C. Quiet first heart sound
D. Development of an opening snap
E. Carotid radiation of ejection systolic murmur

ANSWER:
Soft second heart sound

EXPLANATION:
Questions may sometimes refer to a soft A2 rather than a soft S2 (second heart sound), specifically mentioning the aortic component.

Please see Q-15 for Aortic Stenosis

Q-172

A 51-year-old man presents four weeks after being discharged from hospital. He had been admitted with chest pain and thrombolysed for a myocardial infarction. This morning he developed marked tongue and facial swelling. Which one of the following drugs is most likely to be responsible?

A. Atorvastatin
B. Isosorbide mononitrate
C. Atenolol
D. Aspirin
E. Ramipril

ANSWER:
Ramipril

EXPLANATION:
ACE inhibitors are the most common cause of drug-induced angioedema.

Please see Q-69 for ACE Inhibitors

Q-173

A 65-year-old man is admitted to the Emergency Department with chest pain, nausea and feeling lethargic. He has a history of type 1 diabetes mellitus and is known to have chronic kidney disease stage 4 secondary to diabetic nephropathy. An ECG taken on admission shows widespread ST elevation. Bloods tests show the following:

Na+ 140 mmol/l
K+ 5.8 mmol/l
Urea 26 mmol/l
Creatinine 305 µmol/l

His renal function one month ago was as follows:

Na+ 142 mmol/l
K+ 4.9 mmol/l
Urea 7.9 mmol/l
Creatinine 199 µmol/l

An echocardiogram shows a small effusion. What is the most appropriate next step in management?

A. Oral colchicine
B. Pericardiectomy
C. Pericardiocentesis
D. Intravenous corticosteroids
E. Haemodialysis

ANSWER:
Haemodialysis

EXPLANATION:
This patient has uraemic pericarditis. Haemodialysis is urgently required to correct the uraemia which in turn will improve the symptoms of pericarditis.

Please see Q-10 for Acute Pericarditis

Q-174

A patient who takes bendroflumethiazide is noted to have a potassium of 3.1 mmol/l. What is the main mechanism causing hypokalaemia in patients taking bendroflumethiazide?

A. Decreased flow rate in the nephron resulting in a decreased potassium gradient
B. Increased sodium reaching the collecting ducts
C. Inhibition of renin-angiotensin-aldosterone system secondary to hypovolaemia
D. Decreased sodium reaching the distal convoluted tubule
E. Opening of potassium channel in proximal convoluted tubule

ANSWER:
Increased sodium reaching the collecting ducts

EXPLANATION:
Bendroflumethiazide - mechanism of hypokalaemia:
increased sodium reaching the collecting ducts
activation of the renin-angiotensin-aldosterone
Increased delivery of sodium to the collecting ducts causes the sodium-potassium exchanger to release more potassium into the urine. Another cause is activation of the renin-angiotensin-aldosterone system secondary to hypovolaemia

Please see Q-105 for Thiazide Diuretics

Q-175

A 54-year-old man with a history of ischaemic heart disease is currently taking atorvastatin 40mg at night. A repeat lipid profile is ordered:

Total cholesterol 3.9 mmol/l
HDL 0.7 mmol/l
LDL 2.6 mmol/l
Triglycerides 1.2 mmol/l

What would be the most effective way of increasing HDL levels?

A. Add nicotinic acid
B. Add ezetimibe
C. Switch atorvastatin to pravastatin
D. Add bezafibrate
E. Add colestyramine

ANSWER:
Add nicotinic acid

EXPLANATION:
Nicotinic acid increases HDL levels

NICOTINIC ACID
Nicotinic acid is used in the treatment of patients with hyperlipidaemia, although its use is limited by side-effects. As well as lowering cholesterol and triglyceride concentrations it also raises HDL levels

Adverse effects
- flushing
- impaired glucose tolerance
- myositis

Q-176

Which one of the following statements regarding warfarin is correct?

A. Warfarin can be used when breast-feeding
B. Hypothyroidism may develop in a small minority of patients
C. Aortic prosthetic valves generally require a higher INR than mitral valves
D. The target INR following a pulmonary embolism is 3.5
E. All patients with an INR of greater than 6.0 should be given vitamin K

ANSWER:
Warfarin can be used when breast-feeding

EXPLANATION:
Please see Q-4 for Warfarin

Q-177

You review a 34-year-old woman who is 13 weeks pregnant. During her previous pregnancy she developed pre-eclampsia and had to have a caesarean section at 36 weeks gestation. Her blood pressure both following the last pregnancy and today is normal. Which one of the following interventions should be offered to reduce the risk of developing pre-eclampsia again?

A. Prophylactic nifedipine therapy
B. Prophylactic labatelol therapy
C. Vitamin B6 supplementation
D. Extended folic acid supplementation
E. Low-dose aspirin

ANSWER:
Low-dose aspirin

EXPLANATION:
Please see Q-170 for Hypertension in Pregnancy

Q-178

A 72-year-old man is admitted to the Emergency Department with chest pain. On initial assessment he is noted to be pale, have a heart rate of 40/min and a blood pressure of 90/60 mmHg. Which one of the coronary arteries is most likely to be affected?

A. Posterior descending
B. Left anterior descending
C. Right coronary
D. Anterior interventricular
E. Left circumflex

ANSWER:
Right coronary

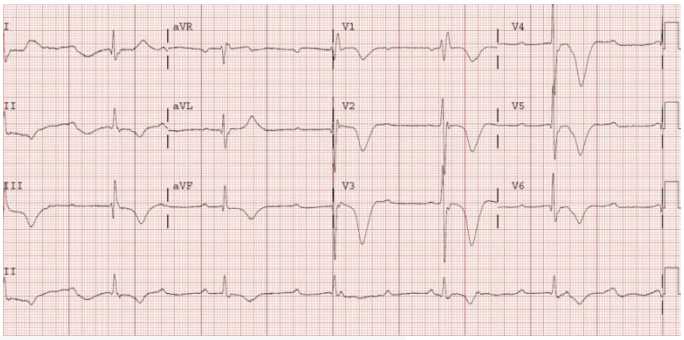
EXPLANATION:
Complete heart block following a MI? - right coronary artery lesion
This patient has developed complete heart block secondary to a right coronary artery (RCA) infarction. The atrioventricular node is supplied by the posterior interventricular artery, which in the majority of patients is a branch of the right coronary artery. In the remainder of patients the posterior interventricular artery is supplied by the left circumflex artery.

COMPLETE HEART BLOCK
Features
- syncope
- heart failure
- regular bradycardia (30-50 bpm)
- wide pulse pressure
- JVP: cannon waves in neck
- variable intensity of S1

Types of heart block
First degree heart block
- PR interval > 0.2 seconds

Second degree heart block
- type 1 (Mobitz I, Wenckebach): progressive prolongation of the PR interval until a dropped beat occurs
- type 2 (Mobitz II): PR interval is constant but the P wave is often not followed by a QRS complex

Third degree (complete) heart block
- there is no association between the P waves and QRS complexes



ECG showing third degree (complete) heart block

Q-179

Which one of the following is not a risk factor for the development of pre-eclampsia?

A. Previous history of pre-eclampsia
B. Body mass index of 34 kg/m^2
C. Age of 42 years
D. Multiple pregnancy
E. Multiparity

ANSWER:
Multiparity

EXPLANATION:
No previous pregnancies is a risk factor for pre-eclampsia. Questions on maternal health during pregnancy are now common in the MRCP

Please see Q-157 for Pre-Eclampsia

Q-180

A 62-year-old man who had a mechanical mitral valve replacement four years ago is reviewed. What long term antithrombotic therapy is he likely to be taking?

A. Nothing
B. Direct acting oral anticoagulants
C. Aspirin
D. Aspirin + clopidogrel for the first 12 months
E. Warfarin

ANSWER:
Warfarin

EXPLANATION:
Prosthetic heart valves - antithrombotic therapy:
- ***bioprosthetic: aspirin***
- ***mechanical: warfarin + aspirin***

Following the 2017 European Society of Cardiology guidelines, aspirin is only normally given in addition if there is an additional indication, e.g. ischaemic heart disease.

Direct acting oral anticoagulants are not used in patients with a mechanical heart valve.

Please see Q-151 for Prosthetic Heart Valves

Q-181

The most common cause of restrictive cardiomyopathy in the UK is:

A. Diabetes mellitus
B. Systemic lupus erythematous
C. Haemochromatosis
D. Tuberculosis
E. Amyloidosis

ANSWER:
Amyloidosis

EXPLANATION:
Restrictive cardiomyopathy: amyloid (most common), haemochromatosis, Loffler's syndrome, sarcoidosis, scleroderma

RESTRICTIVE CARDIOMYOPATHY
Features
similar to constrictive pericarditis

Features suggesting restrictive cardiomyopathy rather than constrictive pericarditis
- prominent apical pulse
- absence of pericardial calcification on CXR
- heart may be enlarged
- ECG abnormalities e.g. bundle branch block, Q waves

Causes
- amyloidosis (e.g. secondary to myeloma) - most common cause in UK
- haemochromatosis
- Loffler's syndrome
- sarcoidosis
- scleroderma

Q-182

A 74-year-old gentleman has been referred in by his GP with a one day history of shortness of breath. He has had a dry cough for one week, but denies any sputum production or fevers. His past medical history includes hypertension and a transurethral resection of the prostate 3 weeks ago. He takes ramipril and tamsulosin. He previously smoked 10 cigarettes per day for 20 years.

On examination his chest is clear but his respiratory rate is 24/min and his oxygen saturations are 91% on air. His heart rate is 105/min and blood pressure is 145/84mmHg. His ECG shows a sinus tachycardia. A chest x-ray is reported as normal. Blood results show:

Hb	**129 g/l**	**Na+**	**137 mmol/l**
Platelets	**250 * 109/l**	**K+**	**4.3 mmol/l**
WBC	**9.4 * 109/l**	**Urea**	**6.5 mmol/l**
Neuts	**6.8 * 109/l**	**Creatinine**	**84 µmol/l**
CRP	**29 mg/l**		

Venous blood gases:

pH	**7.41**
pCO2	**5.8kPa**
pO2	**6.1kPa**
Bicarbonate	**23 mmol/l**
Base excess	**-1.4 mEq/l**
Lactate	**1.8 mmol/l**

What is the next most appropriate investigation?

A. Blood cultures
B. D Dimer
C. Pulmonary function tests
D. CT-Pulmonary Angiogram
E. Arterial Blood Gas

ANSWER:
CT-Pulmonary Angiogram

EXPLANATION:
Here the correct answer is CT-Pulmonary Angiogram, as it is likely this gentleman has a pulmonary embolus (PE).

Given likelihood of PE, tachycardia and recent surgery he would have a high Wells score of 6.
Due to the high Wells score it would be inappropriate to perform a D Dimer, as a negative result would not be enough to exclude PE.

Whilst an arterial blood gas would provide useful information about this gentleman's level of hypoxia, you can already tell he is hypoxic via pulse oximetry. It may add to the weight of evidence suggesting this man has a PE, but you already have enough to warrant a CT-PA.

There is no significant evidence here to suggest that this man is septic or has pneumonia so blood cultures are unnecessary.

Please see Q-125 for Pulmonary Embolism: Investigation

Q-183

A 62-year-old female with a history of mitral regurgitation attends her dentist, who intends to perform dental polishing. She is known to be penicillin allergic. What prophylaxis against infective endocarditis should be given?

A. Oral doxycycline
B. Oral erythromycin
C. No antibiotic prophylaxis needed
D. Oral ofloxacin
E. Oral clindamycin

ANSWER:
No antibiotic prophylaxis needed

EXPLANATION:
Antibiotic prohylaxis to prevent infective endocarditis is not routinely recommended in the UK for dental and other procedures
The 2008 NICE guidelines have fundamentally changed the approach to infective endocarditis prophylaxis

Please see Q-34 for Infective Endocarditis: Prophylaxis

Q-184

A 58-year-old man presents to the Emergency Department following an episode of transient right-sided weakness which lasted approximately 20 minutes. He has had two previous episodes of a similar nature. On examination he is found to be in atrial fibrillation at a rate of 80 bpm.

CT head normal

He is started on aspirin 300mg od. Two days later he has a carotid doppler which is normal. What is the most appropriate management?

A. Start digoxin
B. Switch to aspirin 300mg od + dipyridamole 200mg bd long-term
C. Wait two weeks from the date of the last event then switch from aspirin to warfarin
D. Switch to aspirin 75mg od long-term
E. Start warfarin

ANSWER:
Start warfarin

EXPLANATION:
This patient has atrial fibrillation. As a consequence he has had a number of transient ischaemic attacks (TIAs) and hence needs to be anticoagulated with warfarin.

In patients who've had an ischaemic stroke the guidelines recommend waiting two weeks before anticoagulation is commenced to reduce the risk of haemorrhagic transformation. However, NICE recommend for TIA patients: 'in the absence of cerebral infarction or haemorrhage, anticoagulation therapy should begin as soon as possible.'

Please see Q-8 for Atrial Fibrillation: Anticoagulation

Q-185

A 61-year-old man with peripheral arterial disease is prescribed simvastatin. What is the most appropriate blood test monitoring?

A. LFTs + creatinine kinase at baseline, 1-3 months and at intervals of 6 months for 1 year
B. LFTs at baseline and every 3 months for first year
C. Routine blood tests not recommended
D. LFTs at baseline and annually
E. LFTs at baseline, 3 months and 12 months

ANSWER:
LFTs at baseline, 3 months and 12 months

EXPLANATION:
A fasting lipid profile may also be checked during monitoring to assess response to treatment.

Please see Q-37 for Statins

Q-186

A 37-year-old woman who was investigated for progressive shortness-of-breath is diagnosed with primary pulmonary hypertension and started on bosentan. What is the mechanism of action of bosentan?

A. Activator of soluble guanylate cyclase
B. Phosphodiesterase type 5 inhibitors
C. Endothelin receptor antagonist
D. Prostanoid
E. Slow calcium channel blocker

ANSWER:
Endothelin receptor antagonist

EXPLANATION:
Bosentan - endothelin-1 receptor antagonist

Please see Q-44 for Pulmonary Arterial Hypertension

Q-187

A 76-year-old woman is admitted to the resus department after collapsing whilst shopping. The paramedics report she is hypotensive and tachycardia. Initial observations include a heart rate of 160 bpm and a blood pressure of 98 / 60 mmHg. A 12 lead ECG shows a broad complex tachycardia. Which one of the following features on the ECG would suggest a ventricular tachycardia rather than a supraventricular tachycardia with aberrant conduction?

A. QRS < 160 ms
B. A corrected QT interval of 420ms
C. Atrioventricular dissociation
D. Marked right axis deviation
E. Heart rate of 160 bpm

ANSWER:
Atrioventricular dissociation

EXPLANATION:
BROAD COMPLEX TACHYCARDIA
Features suggesting VT rather than SVT with aberrant conduction

- AV dissociation
- fusion or capture beats
- positive QRS concordance in chest leads
- marked left axis deviation
- history of IHD
- lack of response to adenosine or carotid sinus massage
- QRS > 160 ms

Q-188

Which one of the following statements regarding percutaneous coronary intervention (PCI) is incorrect?

A. Stent thrombosis usually occurs in the first month
B. Restenosis is more common than stent thrombosis
C. Around 95% of patients have a stent fitted during a PCI
D. Renal impairment is a risk factor for restenosis
E. Patients with drug-eluting stents require a shorter duration of clopidogrel therapy

ANSWER:
Patients with drug-eluting stents require a shorter duration of clopidogrel therapy

EXPLANATION:
PCI - patients with drug-eluting stents require a longer duration of clopidogrel therapy

Please see Q-146 for Percutaneous Coronary Intervention

Q-189

A 72-year-old female is admitted for an elective abdominal aortic aneurysm repair. She has a past medical history of long-standing asthma and an undiagnosed peripheral neuropathy. On day 4 post-op, she develops a net-like rash over her torso with fevers, myalgias and discolouration of her toes.

Blood tests reveal:

Hb 128 g/l
Platelets 240 * 109/l
WBC 12.2 * 109/l
Eosinophils 2.3 * 109/l
Na+ 138 mmol/l
K+ 4.1 mmol/l
Urea 8.8 mmol/l
Creatinine 176 µmol/l

What is the most likely diagnosis?

A. DRESS syndrome
B. Cholesterol emboli
C. Churg-Strauss
D. Chronic eosinophilic syndrome
E. Arterial thromboembolism

ANSWER:
Cholesterol emboli

EXPLANATION:
The answer is cholesterol emboli which presents after a precipitating event such as angiography or abdominal aortic aneurysm repair. Clinical features include livedo reticularis, eosinophilia, purpura, and renal failure.

Churg-Strauss would be associated with late-onset asthma, chronic eosinophilic syndrome is a diagnosis of exclusion and is a more long-term event, and arterial thromboembolism would not be associated with eosinophilia. DRESS syndrome would be associated with a drug precipitant which is not mentioned in the question.

Please see Q-41 for Cholesterol Embolisation

Q-190

A 49-year-old female is admitted to the Emergency Department with shortness of breath. On examination the pulse is 114 bpm with blood pressure 106/66 mmHg, temperature 37.7ºC and respiratory rate 30/min. Examination of the cardiorespiratory system is unremarkable with a peak expiratory flow rate of 400 l/min. Arterial blood gases on air reveal:

pH **7.41**
pCO2 **4.0 kPa**
pO2 **7.2 kPa**

Following the initiation of oxygen therapy, what is the next most important step in management?

A. IV aminophylline
B. IV hydrocortisone
C. Low molecular weight heparin
D. IV fluids
E. IV co-trimoxazole

ANSWER:
Low molecular weight heparin

EXPLANATION:
Type 1 respiratory failure in a tachycardic, tachypnoeic female with an absence of chest signs points towards a diagnosis of pulmonary embolism.

Low-grade pyrexia is common in pulmonary embolism.

Please see Q-12 for Pulmonary Embolism: Management

Q-191

Symptom-limited treadmill exercise testing is often done before discharge after a STEMI. Which of the following parameters at exercise testing most strongly indicates a good prognosis with medical treatment?

A. Absence of ST depression
B. Percent (%) predicted maximal heart rate achieved
C. Absence of ventricular arrhythmia
D. Absence of chest pain
E. Above average exercise capacity

ANSWER:
Above average exercise capacity

EXPLANATION:
Essentially, the question asks: 'Which of the following is the best predictor of mortality post-STEMI?'

Above average exercise capacity performed before discharge is associated with a good prognosis after a STEMI. Exercise capacity has been repeatedly shown in studies of exercise testing to be the strongest predictor of mortality and cardiovascular events, particularly in elderly persons.

EXERCISE TOLERANCE TESTS
Exercise tolerance tests (ETT, also exercise ECG) are used for a variety of indications:

- assessing patients with suspected angina - however the 2010 NICE Chest pain of recent onset guidelines do not support the use of ETTs for all patients
- risk stratifying patients following a myocardial infarction
- assessing exercise tolerance
- risk stratifying patients with hypertrophic cardiomyopathy

ETT has a sensitivity of around 80% and a specificity of 70% for ischaemic heart disease.

Heart rate:

- maximum predicted heart rate = 220 - patient's age
- the target heart rate is at least 85% of maximum predicted to allow reasonable interpretation of
- a test as low-risk or negative

Contraindications

- myocardial infarction less than 7 days ago
- unstable angina
- uncontrolled hypertension (systolic BP > 180 mmHg) or hypotension (systolic BP < 90 mmHg)
- aortic stenosis
- left bundle branch block: this would make the ECG very difficult to interpret

Stop if:

- exhaustion / patient request
- 'severe', 'limiting' chest pain
- > 3mm ST depression
- > 2mm ST elevation.Stop if rapid ST elevation and pain
- systolic blood pressure > 230 mmHg
- systolic blood pressure falling > 20 mmHg
- attainment of maximum predicted heart rate
- heart rate falling > 20% of starting rate
- arrhythmia develops

Q-192

Your next patient is a 74-year-old woman who is known to have type 2 diabetes mellitus. Her blood pressure has been borderline for a number of weeks now but you have decided she would benefit from treatment. Her latest blood pressure is 146/88 mmHg, HbA1c is 7.5% and her BMI is 25 kg/m^2. What is the most appropriate drug to prescribe?

A. Bisoprolol
B. Bendroflumethiazide
C. Amlodipine
D. Ramipril
E. Orlistat

ANSWER:
Ramipril

EXPLANATION:
Hypertension in diabetics - ACE-inhibitors are first-line regardless of age

DIABETES MELLITUS: HYPERTENSION MANAGEMENT
NICE recommend the following blood pressure targets for diabetics:

- if end-organ damage (e.g. renal disease, retinopathy) < 130/80 mmHg
- otherwise < 140/80 mmHg

A 2013 Cochrane review casted doubt on the wisdom of lower blood pressure targets for patients with diabetes. It compared patients who had tight blood pressure control (targets < 130/85 mmHg) with more relaxed control (< 140-160/90-100 mmHg). Patients who were more tightly controlled had a slightly reduced rate of stroke but otherwise outcomes were not significantly different.

Because ACE-inhibitors have a renoprotective effect in diabetes they are the first-line antihypertensives recommended for NICE. Patients of African or Caribbean family origin should be offered an ACE-inhibitor plus either a thiazide diuretic or calcium channel blocker. Further management then reverts to that of non-diabetic patients, as discussed earlier in the module.

Remember than autonomic neuropathy may result in more postural symptoms in patients taking antihypertensive therapy.

The routine use of beta-blockers in uncomplicated hypertension should be avoided, particularly when given in combination with thiazides, as they may cause insulin resistance, impair insulin secretion and alter the autonomic response to hypoglycaemia.

Q-193

A 64-year-old man is admitted to the Emergency Department with chest pain radiating through to his back. On examination pulse 90 regular, BP 140/90. A CXR shows mediastinal widening. A CT shows dissection of the descending aorta. What is the most suitable initial management?

A. Observe only
B. IV labetalol
C. IV sodium nitroprusside
D. Immediate surgical referral
E. Oral verapamil

ANSWER:
IV labetalol

EXPLANATION:
Aortic dissection
- ***type A - ascending aorta - control BP(IV labetalol) + surgery***
- ***type B - descending aorta - control BP(IV labetalol)***

Dissection of the descending aorta indicates a type B dissection, which should be managed medically with IV labetalol

AORTIC DISSECTION: MANAGEMENT

Classification

Stanford classification
- type A - ascending aorta, 2/3 of cases
- type B - descending aorta, distal to left subclavian origin, 1/3 of cases

DeBakey classification
- type I - originates in ascending aorta, propagates to at least the aortic arch and possibly beyond it distally
- type II - originates in and is confined to the ascending aorta
- type III - originates in descending aorta, rarely extends proximally but will extend distally

Management

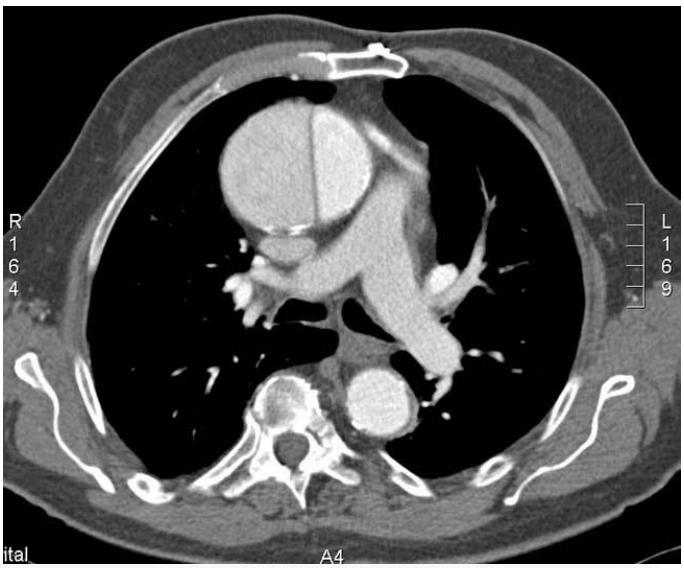
Type A
- surgical management, but blood pressure should be controlled to a target systolic of 100-120 mmHg whilst awaiting intervention

Type B*
- conservative management
- bed rest
- reduce blood pressure IV labetalol to prevent progression

Complications

Complications of backward tear
- aortic incompetence/regurgitation
- MI: inferior pattern often seen due to right coronary involvement

Complications of forward tear
- unequal arm pulses and BP
- stroke
- renal failure



An intraluminal tear has formed a 'flap' that can be clearly seen in the ascending aorta. This is a Stanford type A dissection

Stanford type B dissection, seen in the descending aorta

*endovascular repair of type B aortic dissection may have a role in the future.

Q-194

A 24-year-old female develops transient slurred speech following a flight from Australia to the United Kingdom. Both a CT head and ECG are normal. Which one of the following tests is most likely to reveal the underlying cause?

A. Transoesophageal echo
B. MRI brain
C. Carotid USS Doppler
D. Cerebral angiogram
E. Transthoracic echo

ANSWER:
Transoesophageal echo

EXPLANATION:
Paradoxical embolus - PFO most common cause - do TOE
Transesophageal echocardiography provides superior views of the atrial septum and therefore is preferred to transthoracic echocardiography for detecting patent foramen ovale

PARADOXICAL EMBOLISATION
For a right-sided thrombus (e.g. DVT) to cause a left-sided embolism (e.g. stroke) it must obviously pass from the right-to-left side of the heart

The following cardiac lesions may cause such events
- patent foramen ovale - present in around 20% of the population
- atrial septal defect - a much less common cause

Q-195

A 58-year-old man presents with breathlessness and chest discomfort. He has diet controlled diabetes, hypertension and hyperlipidaemia. He has a weak rapid, regular pulse of 160bpm, blood pressure is 80/50mmHg, he is cold peripherally and crepitations are heard bibasally on auscultation of the chest. An ECG shows a regular broad complex tachycardia.

What is the best initial management of this arrhythmia?

A. Adenosine
B. Amiodarone
C. Diltiazem
D. Electrical cardioversion
E. Vagal manoeuvres

ANSWER:
Electrical cardioversion

EXPLANATION:
This patient presents with a regular broad complex tachycardia with a palpable pulse and the adverse feature of shock (systolic blood pressure <90mmHg), therefore a synchronised DC cardioversion is indicated. If this patient had no adverse features an intravenous amiodarone infusion would be indicated.

Intravenous adenosine and vagal manoeuvres (e.g carotid massage, Valsalva manoeuvre) are indicated for the termination of a regular narrow complex tachycardias.

Diltiazem may be used for rate control in atrial fibrillation.

Please see Q-39 for Peri-Arrest Arrhythmias: Tachycardia

Q-196

A 72-year-old man presents to the Emergency Department with a broad complex tachycardia. Which of the following features would make it more likely that this was due to a supraventricular tachycardia rather than a ventricular tachycardia?

A. History of ischaemic heart disease
B. Left axis deviation
C. Capture beats
D. Absence of QRS concordance in chest leads
E. QRS complex greater than 160 ms

ANSWER:
Absence of QRS concordance in chest leads

EXPLANATION:
Positive QRS concordance in the chest leads is associated with ventricular tachycardia

Please see Q-187 for Broad Complex Tachycardia

Q-197

A 60-year-old man is admitted with palpitations to the Emergency Department. An ECG on admission shows a broad complex tachycardia at a rate of 150 bpm. His blood pressure is 124/82 mmHg and there is no evidence of heart failure. Which one of the following is it least appropriate to give?

A. Procainamide
B. Lidocaine
C. Synchronised DC shock
D. Adenosine
E. Verapamil

ANSWER:
Verapamil

EXPLANATION:
Ventricular tachycardia - verapamil is contraindicated
Verapamil should never be given to a patient with a broad complex tachycardia as it may precipitate ventricular fibrillation in patients with ventricular tachycardia.
Adenosine is sometimes given in this situation as a 'trial' if there is a strong suspicion the underlying rhythm is a supraventricular tachycardia with aberrant conduction

Please see Q-79 for Ventricular Tachycardia: Management

Q-198

Which one of the following is least associated with ST depression on ECG?

A. Myocardial ischaemia
B. Syndrome X
C. Acute pericarditis
D. Hypokalaemia
E. Digoxin

ANSWER:
Acute pericarditis

EXPLANATION:
ECG: ST DEPRESSION
Causes of ST depression

- secondary to abnormal QRS (LVH, LBBB, RBBB)
- ischaemia
- digoxin
- hypokalaemia
- syndrome X

Q-199

A 64-year-old man with a history of type 2 diabetes mellitus is admitted with chest pain to the Emergency Department. An ECG shows ST elevation in the anterior leads and he is thrombolysed and transferred to the Coronary Care Unit (CCU). His usual medication includes simvastatin, gliclazide and metformin. How should his diabetes be managed whilst in CCU?

A. Stop metformin. Continue gliclazide at a higher dose
B. Stop metformin & gliclazide. Start subcutaneous insulin (basal-bolus regime)
C. Continue metformin & gliclazide at same dose
D. Stop metformin & gliclazide. Start intravenous insulin infusion
E. Stop metformin & gliclazide. Start subcutaneous insulin (biphasic insulin regime)

ANSWER:
Stop metformin & gliclazide. Start intravenous insulin infusion

EXPLANATION:
The benefits of tight glycaemic control following a myocardial infarction were initially established by the DIGAMI study. These findings were not repeated in the later DIGAMI 2 study. However modern clinical practice is still that type 2 diabetics are converted to intravenous insulin in the immediate period following a myocardial infarction.

NICE in 2011 recommended the following: 'Manage hyperglycaemia in patients admitted to hospital for an acute coronary syndrome (ACS) by keeping blood glucose levels below 11.0 mmol/litre while avoiding hypoglycaemia. In the first instance, consider a dose-adjusted insulin infusion with regular monitoring of blood glucose levels.'

MYOCARDIAL INFARCTION: STEMI MANAGEMENT
A number of studies over the past 10 years have provided an evidence for the management of ST-elevation myocardial infarction (STEMI)

In the absence of contraindications, all patients should be given

- aspirin
- P2Y12-receptor antagonist. Clopidogrel was the first P2Y12-receptor antagonist to be widely used but now ticagrelor is often favoured as studies have shown improved outcomes compared to clopidogrel, but at the expense of slightly higher rates of bleeding. This approached is supported in SIGN's 2016 guidelines. They also recommend that prasugrel (another P2Y12-receptor antagonist) could be considered if the patient is going to have a percutaneous coronary intervention
- unfractionated heparin is usually given for patients who're are going to have a PCI. Alternatives include low-molecular weight heparin

NICE suggest the following in terms of oxygen therapy:

- do not routinely administer oxygen, but monitor oxygen saturation using pulse oximetry as soon as possible, ideally before hospital admission. Only offer supplemental oxygen to:
- people with oxygen saturation (SpO2) of less than 94% who are not at risk of hypercapnic respiratory failure, aiming for SpO2 of 94-98%

- people with chronic obstructive pulmonary disease who are at risk of hypercapnic respiratory failure, to achieve a target SpO2 of 88-92% until blood gas analysis is available.

Primary percutaneous coronary intervention (PCI) has emerged as the gold-standard treatment for STEMI but is not available in all centres. Thrombolysis should be performed in patients without access to primary PCI

With regards to thrombolysis:
- tissue plasminogen activator (tPA) has been shown to offer clear mortality benefits over streptokinase
- tenecteplase is easier to administer and has been shown to have non-inferior efficacy to alteplase with a similar adverse effect profile

An ECG should be performed 90 minutes following thrombolysis to assess whether there has been a greater than 50% resolution in the ST elevation
- if there has not been adequate resolution then rescue PCI is superior to repeat thrombolysis
- for patients successfully treated with thrombolysis PCI has been shown to be beneficial. The optimal timing of this is still under investigation

Glycaemic control in patients with diabetes mellitus
- in 2011 NICE issued guidance on the management of hyperglycaemia in acute coronary syndromes
- it recommends using a dose-adjusted insulin infusion with regular monitoring of blood glucose levels to glucose below 11.0 mmol/l
- intensive insulin therapy (an intravenous infusion of insulin and glucose with or without potassium, sometimes referred to as 'DIGAMI') regimes are not recommended routinely

Q-200

A 14-year-old boy is admitted with palpitations and is noted to have a long QT interval. His only past medical history is deafness. What is the likely diagnosis?

A. Leriche's syndrome
B. Wolff-Parkinson White syndrome
C. Jervell-Lange-Nielsen syndrome
D. Romano-Ward syndrome
E. Osler-Weber-Rendu syndrome

ANSWER:
Jervell-Lange-Nielsen syndrome

EXPLANATION:
Jervell-Lange-Nielsen syndrome is associated with profound deafness and a prolonged QT interval

Please see Q-55 for Long QT Syndrome

Q-201

An 89-year-old man attends your clinic, complaining of bright spots in his vision that come and go. He has a past medical history of asthma, triple vessel coronary artery disease opting for medical management of his anginal symptoms, and has just completed a course of itraconazole for a fungal infection. His heart rate is 60bpm and blood pressure 120/70mmHg.

Which of his regular medications is most likely responsible for his symptoms?

A. Amlodipine
B. Bezafibrate
C. Ivabradine
D. Ranolazine
E. Ventolin

ANSWER:
Ivabradine

EXPLANATION:
Ivabradine is indicated for the symptomatic relief of angina in patients with a heart rate >70, as an alternative to first line therapies. It is also indicated for the treatment of chronic heart failure (NYHA II-IV) in addition to standard therapy, in patients with a heart rate of >75.

The mode of action of ivabradine is by inhibition of If channels (known as funny channels), I = current, f =funny. These funny channels are so called because of their unusual features compared to other ion channels. They are mixed sodium and potassium channels found in spontaneously active regions of the heart such as the sinoatrial node and are triggered by hyperpolarisation. Activated funny channels allow an influx of positive ions, triggering depolarisation and are therefore responsible for the spontaneous activity of cardiac myocytes.

By inhibiting If channels ivabradine delays depolarisation in the sinoatrial node and therefore selectively slows heart rate.

The commonest side effect caused by ivabradine is transient luminous phenomenon (reported by up to 15% of patients), such as bright spots appearing in their field of vision. Less commonly blurred vision is reported. Patients should be informed of this common side effect before starting the medication. The visual side effects of ivabradine are likely to be mediated by inhibition of a channel similar to the If channel found in the retina called the Ih channel. The h = hyperpolarisation-activated, these channels were formerly called IQ channels, Q = queer, again for their unusual characteristics.

Ivabradine is metabolised by oxidation through cytochrome P450 3A4 (CYP3A4) only. Therefore drugs that induce (e.g

rifampicin) or inhibit (e.g erythromycin, itraconazole) CYP3A4, will decrease or increase the plasma concentration of ivabradine respectively. In this case the patient has been taking the potent CYP3A4 inhibitor Itraconazole, this would have increased the plasma concentration of ivabradine, resulting in the visual side effects experienced.

Please see Q-59 for Angina Pectoris: Drug Management

Q-202

A 62-year-old male is admitted with right sided hemiplegia. An MRI confirms a diagnosis of a left sided partial anterior circulating stroke. He is treated with high dose aspirin for 14 days. He is then started on clopidogrel which he was unfortunately intolerant of. You therefore start him on dual aspirin and dipyridamole.

What is the mechanism of action of dipyridamole?

A. Inhibition of production of factors II, VII, IX and X
B. Increases the effects of adenosine
C. Cyclooxygenase inhibitor
D. Glycoprotein IIb/IIIa inhibitor
E. Direct thrombin inhibitors

ANSWER:
Increases the effects of adenosine

EXPLANATION:
Dipyridamole increases the effects of adenosine
Dipyridamole increases the levels adenosine and inhibits the phosphodiesterase enzymes that normally break down cAMP. Exogenous use of adenosine (e.g. treatment of supraventricular tachycardia) is contraindicated in patients on dipyridamole for this reason.

Clopidogrel is an ADP receptor antagonist.

Aspirin is a cyclo-oxygenase inhibitor.

Dabigatran and bivalirudin are direct thrombin inhibitors.

Tirofiban and abciximab are glycoprotein IIb/IIIa inhibitors.

Warfarin inhibits the production of factors II, VII, IX and X

DIPYRIDAMOLE
Dipyridamole is an antiplatelet mainly used in combination with aspirin after an ischaemic stroke or transient ischaemic attack.

Mechanism of action
- inhibits phosphodiesterase, elevating platelet cAMP levels which in turn reduce intracellular calcium levels
- other actions include reducing cellular uptake of adenosine and inhibition of thromboxane synthase

Q-203

A 55-year-old man with a history of ischaemic heart disease presents to the Emergency Department with palpitations for the past 10 days. Examination of his pulse reveals a rate of 130 bpm which is irregularly irregular. He has had one previous episode of atrial fibrillation 3 months ago which was terminated by elective cardioversion following warfarinisation. What term best describes his arrhythmia?

A. Paroxysmal atrial fibrillation
B. Atrial flutter
C. Permanent atrial fibrillation
D. Persistent atrial fibrillation
E. Secondary atrial fibrillation

ANSWER:
Persistent atrial fibrillation

EXPLANATION:
ATRIAL FIBRILLATION: CLASSIFICATION
An attempt was made in the joint American Heart Association (AHA), American College of Cardiology (ACC) and European Society of Cardiology (ESC) 2012 guidelines to simplify and clarify the classification of atrial fibrillation (AF).

It is recommended that AF be classified into 3 patterns:
- first detected episode (irrespective of whether it is symptomatic or self-terminating)
- recurrent episodes, when a patient has 2 or more episodes of AF. If episodes of AF terminate spontaneously then the term paroxysmal AF is used. Such episodes last less than 7 days (typically < 24 hours). If the arrhythmia is not self-terminating then the term persistent AF is used. Such episodes usually last greater than 7 days
- in permanent AF there is continuous atrial fibrillation which cannot be cardioverted or if attempts to do so are deemed inappropriate. Treatment goals are therefore rate control and anticoagulation if appropriate

Q-204

A 70-year-old woman is brought to the Emergency Department by her relatives. For the past two hours she has experienced palpitations and 'tightness' in her chest. An ECG taken on arrival shows baseline atrial activity of around 300/min with a ventricular rate of 150/min. What is the most likely diagnosis?

A. Atrioventricular nodal re-entry tachycardia (AVNRT)
B. Atrial flutter
C. Atrioventricular re-entry tachycardia (AVRT)
D. Junctional tachycardia
E. Atrial fibrillation

ANSWER:
Atrial flutter

EXPLANATION:

Tachycardia with a rate of 150/min ?atrial flutter

ATRIAL FLUTTER

Atrial flutter is a form of supraventricular tachycardia characterised by a succession of rapid atrial depolarisation waves.

ECG findings

- 'sawtooth' appearance
- as the underlying atrial rate is often around 300/min the ventricular or heart rate is dependent on the degree of AV block. For example if there is 2:1 block the ventricular rate will be 150/min
- flutter waves may be visible following carotid sinus massage or adenosine

Management

- is similar to that of atrial fibrillation although medication may be less effective
- atrial flutter is more sensitive to cardioversion however so lower energy levels may be used
- radiofrequency ablation of the tricuspid valve isthmus is curative for most patients

Q-205

A 17-year-old male is taken to the Emergency Department due to alcohol intoxication. On examination he is noted to be tachycardic with a rate of 140bpm. An ECG shows atrial fibrillation. The following morning he is noted to be in sinus rhythm. What is the most appropriate management?

A. Sotalol and aspirin
B. Sotalol and warfarin
C. Refer for accessory pathway ablation
D. Amiodarone and aspirin
E. Discharge

ANSWER:

Discharge

EXPLANATION:

Supraventricular arrhythmias secondary to acute alcohol intake are well characterised and have been termed 'holiday heart syndrome'. No specific treatment is required

Please see Q-203 for Atrial Fibrillation: Classification

Q-206

A middle-aged woman is admitted to the Emergency Department with pleuritic chest pain ten days after having a hysterectomy. There is a clinical suspicion of pulmonary embolism. What is the most common chest x-ray finding in patients with pulmonary embolism?

A. Right heart enlargement
B. Normal
C. Pleural effusion
D. Linear atelectasis
E. Dilatation of the pulmonary vessels proximal to the embolism

ANSWER:

Normal

EXPLANATION:

Pulmonary embolism - normal CXR
The vast majority of patients with a pulmonary embolism have a normal chest x-ray.

Please see Q-125 for Pulmonary Embolism: Investigation

Q-207

What is the mechanism of action of nicorandil?

A. Fast-sodium channel antagonist
B. Nitric oxide reductase inhibitor
C. Acts on the If ion current in the sinoatrial node
D. Potassium-channel activator
E. Glutathione S-transferase inhibitor

ANSWER:

Potassium-channel activator

EXPLANATION:

Please see Q-59 for Angina Pectoris: Drug Management

Q-208

You have ordered a B-type natriuretic peptide (BNP) test on a patient with suspected heart failure. It has come back as being slightly elevated. Which one of the following factors may account for a falsely elevated BNP?

A. ACE inhibitor therapy
B. Beta-blocker therapy
C. Furosemide therapy
D. Obesity
E. COPD

ANSWER:

COPD

EXPLANATION:

HEART FAILURE: DIAGNOSIS

NICE issued updated guidelines on diagnosis and management in 2010. The choice of investigation is determined by whether the patient has previously had a myocardial infarction or not.

Previous myocardial infarction

- arrange echocardiogram within 2 weeks

No previous myocardial infarction

- measure serum natriuretic peptides (BNP)
- if levels are 'high' arrange echocardiogram within 2 weeks
- if levels are 'raised' arrange echocardiogram within 6 weeks

Serum natriuretic peptides

B-type natriuretic peptide (BNP) is a hormone produced mainly by the left ventricular myocardium in response to strain. Very high levels are associated with a poor prognosis.

	BNP	NTproBNP
High levels	> 400 pg/ml (116 pmol/litre)	> 2000 pg/ml (236 pmol/litre)
Raised levels	100-400 pg/ml (29-116 pmol/litre)	400-2000 pg/ml (47-236 pmol/litre)
Normal levels	< 100 pg/ml (29 pmol/litre)	< 400 pg/ml (47 pmol/litre)

Factors which alter the BNP level:

Increase BNP levels	Decrease BNP levels
Left ventricular hypertrophy	Obesity
Ischaemia	Diuretics
Tachycardia	ACE inhibitors
Right ventricular overload	Beta-blockers
Hypoxaemia (including pulmonary embolism)	Angiotensin 2 receptor blockers
GFR < 60 ml/min	Aldosterone antagonists
Sepsis	
COPD	
Diabetes	
Age > 70	
Liver cirrhosis	

Q-209

A 58-year-old man is admitted to the cardiology ward after presenting with fever, malaise and a new murmur. An echocardiogram has shown a vegetation on the aortic valve. Blood cultures are reported as follows:

Streptococcus sanguinis isolated

What is the most appropriate follow-up given the blood culture results?

A. Colonoscopy
B. HIV test
C. Dental review
D. High resolution CT of the chest
E. Complement levels

ANSWER:
Dental review

EXPLANATION:
Streptococcus sanguinis is one of the viridans group streptococci, or α-hemolytic streptococci, which are common causes of infective endocarditis. They are commensal in the mouth and invasive infection is associated with dental disease. The American Heart Association recommend:

'A thorough dental evaluation should be obtained and all active sources of oral infection should be eradicated.'

Please see Q-102 for Infective Endocarditis

Q-210

A 72-year-old man with a history of chronic heart failure secondary to ischaemic cardiomyopathy is reviewed. He was discharged two weeks ago from hospital following a myocardial infarction. An echocardiogram done during his admission showed a left ventricular ejection fraction of 40% but did not demonstrate any valvular problems.

Despite his current treatment with furosemide, ramipril, carvedilol, aspirin and simvastatin he remains short of breath on minimal exertion such as walking 30 metres. On examination his chest is clear and there is minimal peripheral oedema. What is the most appropriate next step in management?

A. Stop aspirin
B. Refer for cardiac resynchronisation therapy
C. Switch carvedilol to bisoprolol
D. Add angiotensin-2 receptor blocker
E. Add an aldosterone antagonist

ANSWER:
Add an aldosterone antagonist

EXPLANATION:
The updated 2010 NICE guidelines now suggest that in addition to aldosterone antagonists both angiotensin-2 receptor blockers and hydralazine in combination with a nitrate are suitable second-line treatments for heart failure. However, given that he has had a recent myocardial infarction the best choice is an aldosterone antagonist - please see the NICE guidelines for more details.

Please see Q-52 for Heart Failure: Drug Management

Q-211

Which one of the following features is not part of the modified Duke criteria used in the diagnosis of infective endocarditis?

A. Prolonged PR interval
B. Positive serology for Coxiella burnetii
C. Fever > 38ºC
D. Roth spots
E. Positive microbiology from embolic fragments

ANSWER:
Prolonged PR interval

EXPLANATION:

A prolonged PR interval is part of the diagnostic criteria of rheumatic fever. The modified Duke criteria have now been adopted in the latest guidelines from the European Society of Cardiology.

INFECTIVE ENDOCARDITIS: FEATURES

Modified Duke criteria

Infective endocarditis diagnosed if

- pathological criteria positive, or
- 2 major criteria, or
- 1 major and 3 minor criteria, or
- 5 minor criteria

Pathological criteria

Positive histology or microbiology of pathological material obtained at autopsy or cardiac surgery (valve tissue, vegetations, embolic fragments or intracardiac abscess content)

Major criteria

Positive blood cultures

- two positive blood cultures showing typical organisms consistent with infective endocarditis, such as Streptococcus viridans and the HACEK group, or
- persistent bacteraemia from two blood cultures taken > 12 hours apart or three or more positive blood cultures where the pathogen is less specific such as Staph aureus and Staph epidermidis, or
- positive serology for Coxiella burnetii, Bartonella species or Chlamydia psittaci, or
- positive molecular assays for specific gene targets

Evidence of endocardial involvement

- positive echocardiogram (oscillating structures, abscess formation, new valvular regurgitation or dehiscence of prosthetic valves), or
- new valvular regurgitation

Minor criteria

- predisposing heart condition or intravenous drug use
- microbiological evidence does not meet major criteria
- fever > 38ºC
- vascular phenomena: major emboli, splenomegaly, clubbing, splinter haemorrhages, Janeway lesions, petechiae or purpura
- immunological phenomena: glomerulonephritis, Osler's nodes, Roth spots

Q-212

Which one of the following drugs is most likely to cause a prolonged QT interval?

A. Metoclopramide
B. Verapamil
C. Ceftriaxone
D. Sotalol
E. Digoxin

ANSWER:

Sotalol

EXPLANATION:

Please see Q-55 for Long QT Syndrome

Q-213

A 70-year-old retired office worker is admitted to the medical unit with a 2 day history of shortness of breath and chest pain on inspiration. He has had a normal chest x-ray and ECG. Full blood count, C-reactive protein, urea and electrolytes are unremarkable. Observations are within normal levels. Which scoring system should be used to determine which investigation to perform next?

A. CHA2DS2-VASC score
B. Two level Wells score
C. CURB-65 score
D. Rockall score
E. PERC score

ANSWER:

Two level Wells score

EXPLANATION:

The two level Well's score can be used in patients presenting with signs and symptoms suggestive of PE to guide the next investigation

This patient has symptoms suggestive of PE but normal investigations and normal observations. The two-level Wells score for PE is designed to aid decision making in choosing investigations. The full Wells score can be found in the background notes. Patients in the 'PE likely' group with > 4 points should have an urgent CTPA. Patients in the 'PE unlikely' group should have a d-dimer. If the d-dimer is positive they should go on to have a CTPA. If the d-dimer is negative an alternative diagnosis should be considered for their symptoms.

1. CHA2DS2-VASC score - a scoring system for risk of stroke in AF

3. CURB-65 score - a scoring system for prognosis in community acquired pneumonia

4. Rockall score - scoring system for upper GI bleeds

5. P.E.R.C. score - can be used in patients presenting with symptoms which could be due to PE, whom the clinician has deemed to be low risk of PE based on their presentation and history, to define a group of patients with risk of PE < 1% who do not require any further investigation. Cannot be used in this patient because he is eliminated due to his age (>55).

Please see Q-125 for Pulmonary Embolism: Investigation

Q-214

A woman who is 34 weeks pregnant is admitted to the obstetric ward. She has been monitored for the past few weeks due to pregnancy-induced hypertension but has now developed proteinuria. Her blood pressure is 162/94 mmHg. Which one of the following antihypertensives is it most appropriate to commence?

A. Nifedipine
B. Atenolol
C. Labetalol
D. Losartan
E. Methyldopa

ANSWER:
Labetalol

EXPLANATION:
Labetalol is first-line for pregnancy-induced hypertension

Please see Q-157 for Pre-Eclampsia

Q-215

A 23-year-old woman presents to the Emergency Department with a friend from work. Around 30 minutes ago she developed a 'fluttering' in her chest. She reports feeling 'a bit faint' but denies any chest pain or shortness of breath. An ECG shows a regular tachycardia of 166 bpm with a QRS duration of 0.11s. Blood pressure is 102/68 mmHg and oxygen saturations are 99% on room air. What is the most appropriate management?

A. Intravenous magnesium sulphate
B. Direct current cardioversion
C. Intravenous adenosine 3mg
D. Intravenous adenosine 6mg
E. Carotid sinus massage

ANSWER:
Carotid sinus massage

EXPLANATION:
The first-line management of supraventricular tachycardia are vagal manoeuvres such as carotid sinus massage. Only if these fail should adenosine be given. There are no indications for direct current cardioversion as per the ALS guidelines.

Please see Q-65 for Supraventricular Tachycardia

Q-216

Each one of the following is an indication for an implantable cardiac defibrillator, except:

A. Previous myocardial infarction with non-sustained VT on 24 hr monitoring
B. Wolff-Parkinson White syndrome
C. Hypertrophic obstructive cardiomyopathy
D. Previous cardiac arrest due to VF
E. Long QT syndrome

ANSWER:
Wolff-Parkinson White syndrome

EXPLANATION:
IMPLANTABLE CARDIAC DEFIBRILLATORS
Indications

- long QT syndrome
- hypertrophic obstructive cardiomyopathy
- previous cardiac arrest due to VT/VF
- previous myocardial infarction with non-sustained VT on 24 hr monitoring, inducible VT on electrophysiology testing and ejection fraction < 35%
- Brugada syndrome

Q-217

A 61-year-old man with a history of hypertension presents with central chest pain. Acute coronary syndrome is diagnosed and conventional management is given. A few days later a diagnostic coronary angiogram is performed. The following week a deteriorating of renal function is noted associated with a purpuric rash on his feet. What is the most likely diagnosis?

A. Aspirin-induced interstitial nephritis
B. Heparin-induced thrombocytopaenia
C. Renal artery stenosis
D. Cholesterol embolisation
E. Antiphospholipid syndrome

ANSWER:
Cholesterol embolisation

EXPLANATION:
Cholesterol embolisation is a well-documented complication of coronary angiography

Please see Q-41 for Cholesterol Embolisation

Q-218

Which of the following conditions is not associated with the development of aortic regurgitation?

A. Rheumatic fever
B. Ankylosing spondylitis
C. Marfan's syndrome
D. Syphilis
E. Dilated cardiomyopathy

ANSWER:
Dilated cardiomyopathy

EXPLANATION:
Dilated cardiomyopathy is associated with the development of mitral regurgitation, not aortic regurgitation

Please see Q-17 for Aortic Regurgitation

Q-219

Which of the following factors is most strongly associated with risk of sudden death in the first six months after myocardial infarction?

A. Ventricular ectopics
B. Cigarette smoking
C. 3-vessel coronary disease at angiography
D. Low left ventricular ejection fraction
E. High LDL (low density lipoprotein) cholesterol

ANSWER:
Low left ventricular ejection fraction

EXPLANATION:
The most important factor predicting outcomes post-STEMI is the presence of new systolic heart failure. It suggests that a large amount of myocardial damage. Those with systolic heart failure post MI can be up to 10x more likely to die than those that do not have an MI.

Please see Q-129 for Myocardial Infarction: Complications

Q-220

Where is B-type natriuretic peptide mainly secreted from?

A. Atrial myocardium
B. Juxtaglomerular cells
C. Zona glomerulosa
D. Ventricular myocardium
E. Hypothalamus

ANSWER:
Ventricular myocardium

EXPLANATION:
B-type natriuretic peptide is mainly secreted by the ventricular myocardium

Please see Q-40 for B-type natriuretic peptide

Q-221

A 45-year-old man presents with palpitations that began around 40 minutes ago. Other than having a stressful day at work there appears to have been no obvious trigger. He denies any chest pain or dyspnoea. An ECG shows a regular tachycardia of 180 bpm with a QRS duration of 0.10s. Blood pressure is 106/70 mmHg and oxygen saturations are 98% on room air. You ask him to perform the Valsava manoeuvre but this has no effect on the rhythm. What is the most appropriate next course of action?

A. Electrical cardioversion
B. Intravenous labetalol
C. Intravenous adenosine
D. Intravenous amiodarone
E. Re-attempt Valsava manoeuvre in 5 minutes

ANSWER:
Intravenous adenosine

EXPLANATION:
This patient has a supraventricular tachycardia with no adverse signs (e.g. shock, myocardial ischaemia etc). If vagal manoeuvres fail intravenous adenosine should be given.

Please see Q-65 for Supraventricular Tachycardia

Q-222

A 63-year-old female is brought to the Emergency Department due to a decreased level of consciousness. An urgent CT head is performed as she takes warfarin for atrial fibrillation and shows an intracranial haemorrhage. What is the most appropriate management?

Protamine sulphate
IV vitamin K alone
IV vitamin K + prothrombin complex concentrate
Fresh frozen plasma alone
IV vitamin K + fresh frozen plasma

ANSWER:
IV vitamin K + prothrombin complex concentrate

EXPLANATION:
As fresh frozen plasma takes time to defrost prothrombin complex concentrate (PCC) should be used in such an urgent situation. The use of PCC is currently limited by availability

Please see Q-19 for Warfarin: Management of High INR

Q-223

A 45-year-old man presents with chest pain and breathlessness on exertion. On examination, he is bradycardic with a rate of 31 bpm. You notice irregular canon 'a' waves in the JVP.

What underlying diagnosis is associated with this JVP waveform pattern?

A. Complete heart block
B. Ventricular tachycardia
C. Atrio-ventricular nodal re-entry tachycardia
D. Tricuspid stenosis
E. Atrial flutter

ANSWER:
Complete heart block

EXPLANATION:
Irregular cannon 'a' waves points towards complete heart block
Once the JVP waveform pattern is identified as canon 'a' waves, irregularity can identify the underlying rhythm.

Please see Q-92 for JVP: Cannon Waves

Q-224

A 62-year-old man is admitted with to the cardiology ward with infective endocarditis. Blood cultures grow Streptococcus bovis. What is the most appropriate investigation given the blood culture findings?

A. Small bowel meal
B. Bronchoscopy
C. Cystoscopy
D. Gastroscopy
E. Colonoscopy

ANSWER:
Colonoscopy

EXPLANATION:
Streptococcus bovis endocarditis is associated with colorectal cancer

Please see Q-102 for Infective Endocarditis

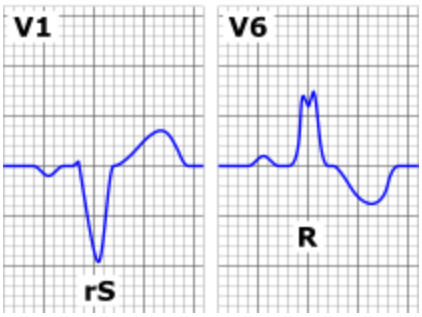
Q-225

Each one of the following may cause left bundle branch block, except:

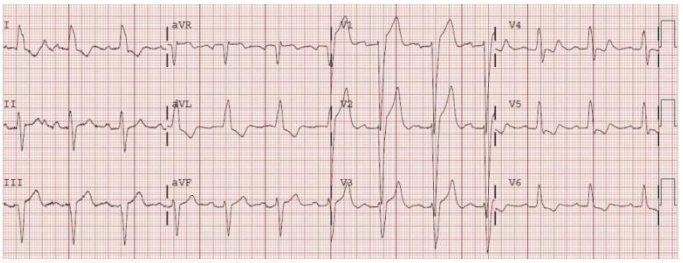
A. Cardiomyopathy
B. Atrial septal defect (ostium secundum)
C. Hypertension
D. Idiopathic fibrosis
E. Ischaemic heart disease

ANSWER:
Atrial septal defect (ostium secundum)

EXPLANATION:
ECG: LEFT BUNDLE BRANCH BLOCK
The diagram below shows the typical features of left bundle branch block (LBBB):



One of the most common ways to remember the difference between LBBB and RBBB is WiLLiaM MaRRoW
in LBBB there is a 'W' in V1 and a 'M' in V6
in RBBB there is a 'M' in V1 and a 'W' in V6



ECG showing typical features of LBBB

Causes of LBBB
- ischaemic heart disease
- hypertension
- aortic stenosis
- cardiomyopathy
- rare: idiopathic fibrosis, digoxin toxicity, hyperkalaemia

New LBBB is always pathological and may be a sign of a myocardial infarction. Diagnosing a myocardial infarction for patients with existing LBBB is difficult. The Sgarbossa criteria can help with this. Please see the link for more details.

Q-226

A 72-year-old man is prescribed a dipyridamole in addition to aspirin following an ischaemic stroke. What is the mechanism of action of dipyridamole?

A. Phosphodiesterase inhibitor
B. Glycoprotein IIb/IIIa inhibitor
C. Inhibits ADP binding to its platelet receptor
D. Agonist of thromboxane synthase
E. Irreversibly acetylating cyclooxygenase

ANSWER:
Phosphodiesterase inhibitor

EXPLANATION:
Dipyridamole is a non-specific phosphodiesterase inhibitor and decreases cellular uptake of adenosine
Dipyridamole is generally described as a non-specific phosphodiesterase (PDE) inhibitor but it is known to be particularly active against PDE5 (like sildenafil) and PDE6.

Please see Q-202 for Dipyridamole

Q-227

A 24-year-old male is admitted with difficulties breathing. He states that he was at a restaurant having dinner when he noticed a rash on his arms, followed by nausea and difficulties with taking in a breath. On examination, there is generalised urticaria and swelling of his tongue and pharynx. There is audible inspiratory stridor. You treat him with intramuscular adrenaline, intravenous hydrocortisone, and intravenous chlorphenamine. He responds well to treatment.

You decide to monitor him on the ward thereafter. How long will you monitor the patient for?

A. **1 hour**
B. **2 hours**
C. **8 hours**
D. **48 hours**
E. **1 week**

ANSWER:
8 hours

EXPLANATION:
In anaphylaxis, biphasic reactions can occur in up to 20% of patients
The patient has clearly had an anaphylactic reaction which has been treated appropriately. A biphasic reaction includes a recurrence of symptoms that develops after apparent resolution of the initial reaction. Biphasic reactions have been reported to occur in 1%-20% of anaphylaxis episodes and typically occur about 8 hours after the first reaction, although recurrences have been reported up to 72 hours later.

Although there is no definite consensus on monitoring post anaphylaxis, most clinicians and local policies advise monitoring for a period of 6-8 hours after resolution of symptoms. Patients should be advised of the possibility of biphasic reactions and told to seem emergency medical care if they develop any of the symptoms or signs.

ANAPHYLAXIS
Anaphylaxis may be defined as a severe, life-threatening, generalised or systemic hypersensitivity reaction.

Anaphylaxis is one of the few times when you would not have time to look up the dose of a medication. The Resuscitation Council guidelines on anaphylaxis have recently been updated. Adrenaline is by far the most important drug in anaphylaxis and should be given as soon as possible. The recommended doses for adrenaline, hydrocortisone and chlorphenamine are as follows:

	Adrenaline	Hydrocortisone	Chlorphenamine
< 6 months	150 micrograms (0.15ml 1 in 1,000)	25 mg	250 micrograms/kg
6 months - 6 years	150 micrograms (0.15ml 1 in 1,000)	50 mg	2.5 mg
6-12 years	300 micrograms (0.3ml 1 in 1,000)	100 mg	5 mg
Adult and child > 12 years	500 micrograms (0.5ml 1 in 1,000)	200 mg	10 mg

Adrenaline can be repeated every 5 minutes if necessary. The best site for IM injection is the anterolateral aspect of the middle third of the thigh.

Common identified causes of anaphylaxis
- food (e.g. Nuts) - the most common cause in children
- drugs
- venom (e.g. Wasp sting)

Sometimes it can be difficult to establish whether a patient had a true episode of anaphylaxis. Serum tryptase levels are sometimes taken in such patients as they remain elevated for up to 12 hours following an acute episode of anaphylaxis.

Q-228

What is the main reason for checking the urea and electrolytes prior to commencing a patient on amiodarone?

A. **To detect hyponatraemia**
B. **To detect impaired renal function**
C. **To detect a metabolic acidosis**
D. **To detect hyperkalaemia**
E. **To detect hypokalaemia**

ANSWER:
To detect hypokalaemia

EXPLANATION:
All antiarrhythmic drugs have the potential to cause arrhythmias. Coexistent hypokalaemia significantly increases this risk.

Please see Q-54 for Amiodarone

Q-229

You are reviewing a 75-year-old male patient with hypertension. He takes 10mg once a day of ramipril and 10mg once a day of amlodipine. His blood pressure remains uncontrolled and you want to start a third agent. His K+is 4.3 mmol/l.

According to the NICE guidelines, what would be the most appropriate third-line agent for this man?

A. **Bendroflumethiazide**
B. **Candesartan**
C. **Hydrochlorothiazide**
D. **Spironolactone**
E. **Indapamide**

ANSWER:
Indapamide

EXPLANATION:
In a hypertensive patient on an ACE-i and calcium channel blocker who requires a third agent, thiazide-type diuretics are next line
This patient is >55 years old and is already on an ACE-inhibitor (ramipril) at the maximum dose and a calcium channel blocker (amlodipine) at the maximum dose.

According to the NICE guidelines, thiazide-like diuretics are the next line therapy eg chlortalidone (12.5–25.0 mg once daily) or indapamide (1.5 mg modified-release once daily or 2.5 mg once daily). Therefore, the correct answer here is 5, indapamide.

NICE state that a thiazide-like diuretic should be used in preference to a conventional thiazide diuretic such as bendroflumethiazide or hydrochlorothiazide. Therefore, these two answers are wrong. Candesartan is an angiotensin receptor blocker (ARB) and should not be used in conjunction with an ACE-inhibitor. Spironolactone is used as a fourth agent in resistant hypertension if the K+ is <4.5 mmol/l.

Please see Q-6 for Hypertension: Management

Q-230

You review a 62-year-old man who has recently been discharged from hospital in Hungary following a myocardial infarction. He brings a copy of an echocardiogram report which shows his left ventricular ejection fraction is 38%. On examination his pulse is 78 / min and regular, blood pressure is 124 / 72 mmHg and his chest is clear. His current medications include aspirin, simvastatin and lisinopril. What is the most appropriate next step in terms of his medication?

A. Add atenolol
B. Add furosemide
C. Add bisoprolol
D. Add isosorbide mononitrate
E. Make no changes

ANSWER:
Add bisoprolol

EXPLANATION:
Both carvedilol and bisoprolol have been shown to reduce mortality in stable heart failure. The other beta-blockers have no evidence base to support their use.

NICE recommend that all heart failure patients should take both an ACE-inhibitor and a beta-blocker.

Please see Q-52 for Heart Failure: Drug Management

Q-231

A 57-year-old man comes to the emergency department with severe, central, crushing chest pain. By the time he arrives on the medical admissions unit he is pain-free.

He had a myocardial infarction (MI) two years ago; additionally he has type 2 diabetes mellitus, hypertension and hypercholesterolaemia. His brother died of a MI at a similar age. His repeat prescriptions include aspirin, metformin, ramipril, amlodipine and atorvastatin.

On examination he looks pale and sweaty. On auscultation he has vesicular breathing and normal heart sounds. He is overweight.

His oxygen saturations are 98% on air; respiratory rate 14 breaths per minute; blood pressure 150/88 mmHg, heart rate 90 beats per minute. His blood sugar (BM) is 22.5.

There are no ischaemic changes on his ECG; however a 12 hour troponin is elevated. The admitting doctor has already given aspirin, clopidogrel and fondaparinux.

What is the next step in the management of this patient?

A. IV GTN infusion
B. 15L oxygen via non-rebreathe mask
C. Primary PCI within 4 hours
D. Additional dose metformin
E. Angiography within 96 hours

ANSWER:
Angiography within 96 hours

EXPLANATION:
This man is having a NSTEMI. His myriad risk factors him categorise him as high risk, and therefore he should have definitive angiography +/- stenting within 96 hours. He is maintaining his oxygen saturations, is pain free and has no ST elevation, making the other options incorrect. Metformin is actually best avoided in acute tissue ischaemia due to its association with lactic acidosis.

Please see Q-2 for Acute Coronary Syndrome: management of NSTEMI

Q-232

A 26-year-old female is admitted to hospital with palpitations. ECG shows a shortened PR interval and wide QRS complexes associated with a slurred upstroke seen in lead II. What is the definitive management of this condition?

A. Accessory pathway ablation
B. Lifelong aspirin
C. AV node ablation
D. Lifelong amiodarone
E. Permanent pacemaker

ANSWER:
Accessory pathway ablation

EXPLANATION:
This patient has Wolff-Parkinson White syndrome, with accessory pathway ablation being the definitive treatment.

Please see Q-46 for Wolff-Parkinson-White

Q-233

A 28-year-old man with hypertrophic obstructive cardiomyopathy is investigated for palpitations. A 24 hour ECG reveals runs of non-sustained ventricular tachycardia. What is the most appropriate management?

A. **AV node ablation**
B. **Accessory pathway ablation**
C. **Amiodarone**
D. **Implantable cardioverter defibrillator**
E. **Sotalol**

ANSWER:
Implantable cardioverter defibrillator

EXPLANATION:
Most cardiologists would now proceed to inserting an implantable cardioverter defibrillator to lower the risk of sudden cardiac death

HOCM: MANAGEMENT
Hypertrophic obstructive cardiomyopathy (HOCM) is an autosomal dominant disorder of muscle tissue caused by defects in the genes encoding contractile proteins. The estimated prevalence is 1 in 500.

Management
- Amiodarone
- Beta-blockers or verapamil for symptoms
- Cardioverter defibrillator
- Dual chamber pacemaker
- Endocarditis prophylaxis*

Drugs to avoid
- nitrates
- ACE-inhibitors
- inotropes

*although see the 2008 NICE guidelines on infective endocarditis prophylaxis

Q-234

A 57-year-old man who had a prosthetic mitral valve replacement 7 years ago presents with fever. An urgent echocardiogram shows features consistent with endocarditis. What is the most suitable antibiotic therapy until blood culture results are known?

A. **IV ceftriaxone + benzylpenicillin**
B. **IV vancomycin + rifampicin + gentamicin**
C. **IV benzylpenicillin + gentamicin**
D. **IV flucloxacillin + gentamicin**
E. **IV vancomycin + benzylpenicillin**

ANSWER:
IV vancomycin + rifampicin + gentamicin

EXPLANATION:
If the patient has a prosthetic valve and endocarditis is suspected the initial therapy should consist of intravenous vancomycin + rifampicin + gentamicin. Please see the current BNF for more information.

Please see Q-138 for Infective Endocarditis: Prognosis and Management

Q-235

You review a 60-year-old man who had a drug-eluting stent inserted 6 months ago for ischaemic heart disease. His current medication includes aspirin, clopidogrel, atorvastatin, ramipril and bisoprolol. He has developed an inguinal hernia and is keen for surgical repair. The cardiologists plan was to continue clopidogrel for 12 months following stent insertion. What is the most appropriate course of action?

A. **Stop clopidogrel the day before the operation**
B. **Stop clopidogrel 7 days before the operation**
C. **Continue clopidogrel as normal**
D. **Delay operation for 6 months**
E. **Stop clopidogrel the day before the operation and start low-molecular weight heparin (prophylaxis dose)**

ANSWER:
Delay operation for 6 months

EXPLANATION:
The AHA/ACC/SCAI/ACS/ADA published recommendations in 2007 stressed the importance of 12 months of dual antiplatelet therapy after placement of a drug-eluting stent (DES).

Please see Q-98 for Clopidogrel

Q-236

A 52-year-old man is admitted to the Emergency Department. He was found collapsed by neighbours. An ECG on arrival shows torsades de pointes. Which one of his medications is most likely to have contributed to this presentation?

A. **Bisoprolol**
B. **Cimetidine**
C. **Risperidone**
D. **Phenytoin**
E. **Doxycycline**

ANSWER:
Risperidone

EXPLANATION:
Please see Q-118 for Torsades de Pointes

Q-237

Which one of the following is an example of a centrally acting antihypertensive?

A. **Minoxidil**
B. **Hydralazine**
C. **Sodium nitroprusside**
D. **Moxonidine**
E. **Diazoxide**

ANSWER:
Monoxidine

EXPLANATION:
CENTRALLY ACTING ANTIHYPERTENSIVES
Examples of centrally acting antihypertensives include:

- methyldopa: used in the management of hypertension during pregnancy
- moxonidine: used in the management of essential hypertension when conventional antihypertensives have failed to control blood pressure
- clonidine: the antihypertensive effect is mediated through stimulating alpha-2 adrenoceptors in the vasomotor centre

Q-238

Which one of the following complications is least associated with ventricular septal defects?

A. Right heart failure
B. Aortic regurgitation
C. Eisenmenger's complex
D. Infective endocarditis
E. Atrial fibrillation

ANSWER:
Atrial fibrillation

EXPLANATION:
Atrial fibrillation is associated more with atrial septal defects

Please see Q-139 for Ventricular Septal Defect

Q-239

A 61-year-old man is admitted with central crushing chest pain to the Emergency Department. An ECG taken immediately on arrival shows ST-elevation in leads II, III and aVF. His only past medical history of note is hypertension for which he takes ramipril, aspirin and simvastatin. What is the optimum management of this patient?

(LMWH = low-molecular weight heparin)

A. Aspirin + clopidogrel + LMWH + repeat ECG in 20 minutes
B. Clopidogrel + LMWH + alteplase
C. Aspirin + clopidogrel + LMWH + tenecteplase
D. Aspirin + clopidogrel + LMWH + alteplase
E. Aspirin + clopidogrel + IV heparin + immediate percutaneous coronary intervention

ANSWER:
Aspirin + clopidogrel + IV heparin + immediate percutaneous coronary intervention

EXPLANATION:
Primary percutaneous coronary intervention is the gold-standard treatment for ST-elevation myocardial infarction

Please see Q-199 for Myocardial Infarction: STEMI Management

Q-240

A 62-year-old man is referred from the Emergency Department with a pulse of 40 beats/min. Which one of the following factors carries the least risk of asystole when risk stratifying the patient?

A. Ventricular pause of 5 seconds
B. Recent asystole
C. Complete heart block with a narrow complex QRS
D. Mobitz type II AV block
E. Complete heart block with a broad complex QRS

ANSWER:
Complete heart block with a narrow complex QRS

EXPLANATION:
Complete heart block with a narrow complex QRS complex carries the least risk of asystole as the atrioventricular junctional pacemaker may provide an haemodynamically acceptable and stable heart rate. The other four factors are indications for transvenous pacing

Please see Q-132 for Peri-Arrest Arrhythmias: Bradycardia

Q-241

A 13-year-old male immigrant from India presents to his primary care physician with a gradually worsening shortness of breath worse on physical exertion as well as widespread joint pain. His past medical history includes a severe throat infection which was untreated. His vaccination record is complete. On physical examination, there is a high-pitch holosystolic murmur loudest at the apex with radiation to the axilla.

Hb 135 g/l
Platelets 150 * 109/l
WBC 9.5 * 109/l
Anti-streptolysin O titres >200units/mL

What is the most likely histological finding in his heart?

A. Aschoff bodies
B. Councilman bodies
C. Mallory bodies
D. Call-Exner bodies
E. Schiller-Duval bodies

ANSWER:
Aschoff bodies

EXPLANATION:
Rheumatic fever cardiac histology: Aschoff bodies (granuloma with giant cells), Anitschkow cells (enlarged macrophages with ovoid, wavy, rod-like nucleus

This patient has rheumatic heart disease. Mitral valve is the most common valve to be affected. ASO titre indicates exposure to group A streptococcus bacteria.

Aschoff bodies (granuloma with giant cells) and Anitschkow cells (enlarged macrophages with ovoid, wavy, rod-like nucleus) are seen in rheumatic heart disease.

Other answers:

- *Councilman bodies -> hepatitis C, yellow fever*
- *Mallory bodies -> alcoholism (hepatocytes)*
- *Call-Exner bodies-> granulosa cell tumour*
- *Schiller-Duval bodies -> yolk-sac tumour*

RHEUMATIC FEVER: FEATURES

Rheumatic fever develops following an immunological reaction to recent (2-6 weeks ago) Streptococcus pyogenes infection. Diagnosis is based on evidence of recent streptococcal infection accompanied by:

- 2 major criteria
- 1 major with 2 minor criteria

Evidence of recent streptococcal infection

- raised or rising streptococci antibodies,
- positive throat swab
- positive rapid group A streptococcal antigen test

Major criteria

- erythema marginatum
- Sydenham's chorea
- polyarthritis
- carditis and valvulitis (eg, pancarditis)*
- subcutaneous nodules

Minor criteria

- raised ESR or CRP
- pyrexia
- arthralgia (not if arthritis a major criteria)
- prolonged PR interval

Erythema marginatum is seen in around 10% of children with rheumatic fever. It is rare in adults

*The latest iteration of the Jones criteria (published in 2015) state that rheumatic carditis cannot be based on pericarditis or myocarditis alone and that there must be evidence of endocarditis (the clinical correlate of which is valvulitis which manifests as a regurgitant murmur).

Q-242

A 47-year-old man is admitted to hospital following an acute coronary syndrome. He has a history peptic ulcer disease and his cardiologist decides to use clopidogrel. What is the mechanism of action of clopidogrel?

A. Non-selective phosphodiesterase inhibitor
B. Phosphodiesterase V inhibitor
C. Inhibits ATP binding to its platelet receptor
D. Inhibits ADP binding to its platelet receptor
E. Glycoprotein IIb/IIIa inhibitor

ANSWER:
Inhibits ADP binding to its platelet receptor

EXPLANATION:
Clopidogrel inhibits ADP binding to platelet receptors

Please see Q-98 for Clopidogrel

Q-243

A 55-year-old man is admitted to the Emergency Department with 'tearing' chest pain radiating through to his back. Examination reveals a pulse of 96 / min regular, blood pressure of 130/85 mmHg and oxygen saturations of 97% on room air. A chest x-ray shows mediastinal widening. A CT shows dissection of the ascending aorta. What is the most suitable initial management?

A. IV sodium nitroprusside
B. Oral verapamil
C. Observe only
D. IV labetalol
E. Surgical repair

ANSWER:
IV labetalol

EXPLANATION:
Aortic dissection

- *type A - ascending aorta - control BP(IV labetalol) + surgery*
- *type B - descending aorta - control BP(IV labetalol)*

The question tests ability to apply textbook knowledge to real world situations. Whilst surgical referral should be made as soon as possible definite surgery will inevitably take time and the blood pressure should be controlled in the meantime

Please see Q-193 for Aortic Dissection: Management

Q-244

A 34-year-old man is seen in the cardiology clinic. He has been referred by his GP with a history of increasing dyspnoea and exercise-related syncope. His father died suddenly when at the age of 42-years-old. An ECG attached to the admission letter shows left ventricular hypertrophy with widespread T wave inversion. Given the likely diagnosis, what is the most appropriate next investigation?

A. **Cardiac angiogram**
B. **Transthoracic echo**
C. **Transoesophageal echo**
D. **Exercise ECG**
E. **24-hour ECG**

ANSWER:
Transthoracic echo

EXPLANATION:
The likely diagnosis is hypertrophic obstructive cardiomyopathy which should be investigated with a transthoracic echocardiogram, as recommended by the 2011 American College of Cardiology Foundation (ACCF) and the American Heart Association (AHA) guidelines.

Please see Q-16 for HOCM: Features

Q-245

A 23-year-old woman presents to the emergency department with palpitations. She is 26 weeks pregnant. Investigations are undertaken and she is treated for Supraventricular Tachycardia (SVT). She explains this is her 3rd presentation of this.

Which anti-arrhythmic should be used as prophylaxis for SVT?

A. **Metoprolol**
B. **Amiodarone**
C. **Adenosine**
D. **Flecainide**
E. **Verapamil**

ANSWER:
Metoprolol

EXPLANATION:
Although all of the above could be considered as prophylaxis, many are unsuitable in pregnancy.

Amiodarone is contra-indicated due to the risk of teratogenicity and neonatal goitres. Adenosine and Verapamil can cause decreased uterine blood flow, particularly in higher doses, thus are often avoided. Flecainide can be used, but is initiated in specialist care due to the association with foetal toxicity and hyperbilirubinaemia. Metoprolol, although can cause intra-uterine growth restriction, is seen as the safest as toxicity is usually associated with higher doses in treatment of gestational hypertension.

Please see Q-65 for Supraventricular Tachycardia

Q-246

Which of the following conditions is least associated with coarctation of the aorta?

A. **Neurofibromatosis**
B. **Bicuspid aortic valve**
C. **Prader-Willi syndrome**
D. **Turner's syndrome**
E. **Berry aneurysms**

ANSWER:
Prader-Willi syndrome

EXPLANATION:
COARCTATION OF THE AORTA
Coarctation of the aorta describes a congenital narrowing of the descending aorta.

Overview
- more common in males (despite association with Turner's syndrome)

Features
- infancy: heart failure
- adult: hypertension
- radio-femoral delay
- mid systolic murmur, maximal over back
- apical click from the aortic valve
- notching of the inferior border of the ribs (due to collateral vessels) is not seen in young children

Associations
- Turner's syndrome
- bicuspid aortic valve
- berry aneurysms
- neurofibromatosis

Q-246

A 71-year-old woman is reviewed in the falls clinic. Her blood pressure is 146/ 94 mmHg. This is confirmed on a second reading. In line with recent NICE guidance, what is the most appropriate next-step?

A. **Ask her to come back in 6 months for a blood pressure check**
B. **Arrange 3 blood pressure checks with the practice nurse over the next 2 weeks with medical review following**
C. **Arrange ambulatory blood pressure monitoring**
D. **Reassure her this is acceptable for her age**
E. **Start treatment with a calcium channel blocker**

ANSWER:
Arrange ambulatory blood pressure monitoring

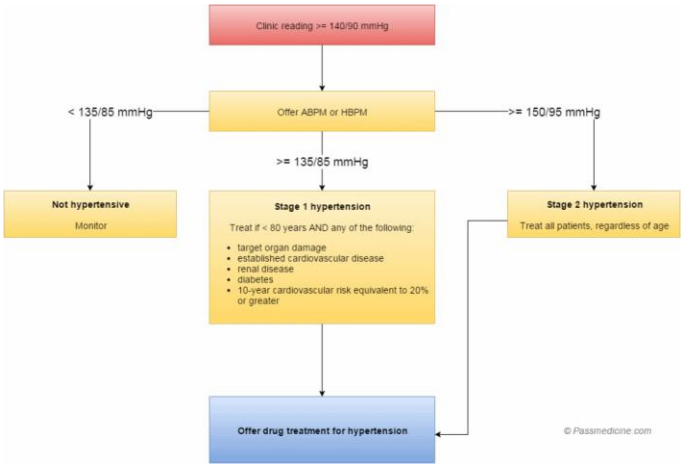
EXPLANATION:
Hypertension - NICE now recommend ambulatory blood pressure monitoring to aid diagnosis

The 2011 NICE guidelines recognise that in the past there was overtreatment of 'white coat' hypertension. The use of ambulatory blood pressure monitoring (ABPM) aims to reduce this. There is also good evidence that ABPM is a better predictor of cardiovascular risk than clinic blood pressure readings.

HYPERTENSION: DIAGNOSIS

NICE published updated guidelines for the management of hypertension in 2011. Some of the key changes include:

- classifying hypertension into stages
- recommending the use of ambulatory blood pressure monitoring (ABPM) and home blood pressure monitoring (HBPM)



Why were these guidelines needed?

It has long been recognised by doctors that there is a subgroup of patients whose blood pressure climbs 20 mmHg whenever they enter a clinical setting, so called 'white coat hypertension'. If we just rely on clinic readings then such patients may be diagnosed as having hypertension when, the vast majority of the time, their blood pressure is normal.

This has led to the use of both ambulatory blood pressure monitoring (ABPM) and home blood pressure monitoring (HBPM) to confirm the diagnosis of hypertension. These techniques allow a more accurate assessment of a patients' overall blood pressure. Not only does this help prevent overdiagnosis of hypertension - ABPM has been shown to be a more accurate predictor of cardiovascular events than clinic readings.

Blood pressure classification

This becomes relevant later in some of the management decisions that NICE advocate.

Stage	Criteria
Stage 1 hypertension	Clinic BP >= 140/90 mmHg and subsequent ABPM daytime average or HBPM average BP >= 135/85 mmHg
Stage 2 hypertension	Clinic BP >= 160/100 mmHg and subsequent ABPM daytime average or HBPM average BP >= 150/95 mmHg
Severe hypertension	Clinic systolic BP >= 180 mmHg, or clinic diastolic BP >= 110 mmHg

Diagnosing hypertension

Firstly, NICE recommend measuring blood pressure in both arms when considering a diagnosis of hypertension.

If the difference in readings between arms is more than 20 mmHg then the measurements should be repeated. If the difference remains > 20 mmHg then subsequent blood pressures should be recorded from the arm with the higher reading.

It should of course be remember that there are pathological causes of unequal blood pressure readings from the arms, such as supravalvular aortic stenosis. It is therefore prudent to listen to the heart sounds if a difference exists and further investigation if a very large difference is noted.

NICE also recommend taking a second reading during the consultation, if the first reading is > 140/90 mmHg. The lower reading of the two should determine further management.

NICE suggest offering ABPM or HBPM to any patient with a blood pressure >= 140/90 mmHg.

If however the blood pressure is >= 180/110 mmHg:

- immediate treatment should be considered
- if there are signs of papilloedema or retinal haemorrhages NICE recommend same day assessment by a specialist
- NICE also recommend referral if a phaeochromocytoma is suspected (labile or postural hypotension, headache, palpitations, pallor and diaphoresis)

Ambulatory blood pressure monitoring (ABPM)

- at least 2 measurements per hour during the person's usual waking hours (for example, between 08:00 and 22:00)
- use the average value of at least 14 measurements

If ABPM is not tolerated or declined HBPM should be offered.

Home blood pressure monitoring (HBPM)

- for each BP recording, two consecutive measurements need to be taken, at least 1 minute apart and with the person seated
- BP should be recorded twice daily, ideally in the morning and evening
- BP should be recorded for at least 4 days, ideally for 7 days
- discard the measurements taken on the first day and use the average value of all the remaining measurements

Interpreting the results

- ABPM/HBPM >= 135/85 mmHg (i.e. stage 1 hypertension)
- treat if < 80 years of age AND any of the following apply; target organ damage, established cardiovascular disease, renal disease, diabetes or a 10-year cardiovascular risk equivalent to 20% or greater

ABPM/HBPM >= 150/95 mmHg (i.e. stage 2 hypertension)

- offer drug treatment regardless of age

Q-247

A 65-year-old man is admitted with palpitations. The ECG shows a ventricular rate of 150/min with an underlying atrial rate of 300/min. A diagnosis of atrial flutter is suspected. What is the treatment of choice to permanently restore sinus rhythm?

A. Radiofrequency ablation of the accessory pathway
B. Radiofrequency ablation of the AV node
C. Radiofrequency ablation of the tricuspid valve isthmus
D. Lifelong amiodarone
E. Permanent pacemaker

ANSWER:
Radiofrequency ablation of the tricuspid valve isthmus

EXPLANATION:
Please see Q-204 for Atrial Flutter

Q-248

A 60-year-old man is admitted following an acute coronary syndrome. He receives aspirin, clopidogrel, nitrates and morphine. His 6-month risk score is high and percutaneous coronary intervention is planned. He is therefore given intravenous tirofiban. What is the mechanism of action of this drug?

A. Inhibits the production of thromboxane A2
B. Activates antithrombin III
C. Coronary vasodilator
D. Glycoprotein IIb/IIIa receptor antagonist
E. Reversible direct thrombin inhibitor

ANSWER:
Glycoprotein IIb/IIIa receptor antagonist

EXPLANATION:
Please see Q-2 for Acute Coronary Syndrome: management of NSTEMI

Q-249

A 29-year-old woman is investigated for increasing dyspnoea and feeling generally weak and lethargic. Over the past few months, she has had five episodes of syncope, some of which occurred following exercise. There is no prior medical history of note although her grandmother died aged 44 years after suffering increasing shortness-of-breath and syncope. On examination her oxygen saturations are 98% on room air and the pulse is 78 / min. The second heart sound is loud but no murmurs are heard. Auscultation of the chest is unremarkable.

What is the most likely diagnosis?

A. Pulmonary arterial hypertension
B. Familial pulmonary stenosis
C. Hypertrophic obstructive cardiomyopathy
D. Catecholaminergic polymorphic ventricular tachycardia
E. Arrhythmogenic right ventricular dysplasia

ANSWER:
Pulmonary arterial hypertension

EXPLANATION:
Please see Q-44 for Pulmonary Arterial Hypertension

Q-250

Which one of the following clinical signs would best indicate severe calcified aortic stenosis?

A. Loudness of murmur
B. Loud second heart sound
C. Radiation to the carotids
D. Hypertension
E. Displaced apex beat

ANSWER:
Displaced apex beat

EXPLANATION:
The apex beat is not normally displaced in aortic stenosis. Displacement would indicate left ventricular dilatation and hence severe disease

Please see Q-15 for Aortic Stenosis

Q-251

You review a 24-year-old woman with a history of asthma in the Emergency Department. She has been admitted with acute shortness of breath associated with tongue tingling and an urticarial rash after eating a meal containing shellfish. Her symptoms settle with nebulised salbutamol and intravenous hydrocortisone. What is the most useful test to establish whether this episode was due to anaphylaxis?

A. Serum tryptase
B. Serum IgE
C. Plasma histamine
D. Eosinophil count
E. C-reactive protein

ANSWER:
Serum tryptase

EXPLANATION:
Anaphylaxis - serum tryptase levels rise following an acute episode
Serum tryptase levels may remain elevated for up to 12 hours following an acute episode of anaphylaxis.

Please see Q-227 for Anaphylaxis

Q-252

An 84-year-old female has become progressively more short of breath over the past 2 months. She is finding it difficult to breathe when lying down and so has been sleeping upright in her chair for the past two weeks. She also has a cough productive of frothy sputum and swollen legs. What is the most likely description of her pulse?

A. Pulsus alternans
B. Collapsing
C. Jerky
D. Slow rising
E. Pulsus bisferiens

ANSWER:
Pulsus alternans

EXPLANATION:
Pulsus alternans is when the upstroke of the pulse alternatives between strong and weak. It indicates systolic dysfunction and is seen in patients with heart failure.

A collapsing pulse has a forceful rapid upstroke AND descent.

A jerky pulse is characterised by a rapid forceful upstroke.

A slow-rising pulse has a slow upstroke.

A bisferiens pulse occurs when there are two sharp upstrokes during systole.

Please see Q-58 for Pulses

Q-253

A 36-year-old woman presents for a routine antenatal review. She is now 15 weeks pregnant. Her blood pressure in clinic is 154/94 mmHg. This is confirmed with ambulatory blood pressure monitoring. On reviewing the notes it appears her blood pressure four weeks ago was 146/88 mmHg. A urine dipstick shows is normal. There is no significant past medical history of note. What is the most likely diagnosis?

A. Pre-eclampsia
B. Pregnancy-induced hypertension
C. White-coat hypertension
D. Normal physiological change
E. Pre-existing hypertension

ANSWER:
Pre-existing hypertension

EXPLANATION:
This lady has pre-existing hypertension. Pregnancy-related blood pressure problems (such as pregnancy-induced hypertension or pre-eclampsia) do not occur before 20 weeks. The raised ambulatory blood pressure readings exclude a diagnosis of white-coat hypertension.

Note the use of the term 'pre-existing hypertension' rather than essential hypertension. Raised blood pressure in a 36-year-old female is not that common and raises the possibility of secondary hypertension.

Please see Q-170 for Hypertension in Pregnancy

Q-254

A 43-year-old man who is known to have Wolff-Parkinson White syndrome presents to the Emergency Department with palpitations. He has no other significant history of note. The palpitations started around 4 hours ago and are not associated with chest pain or shortness of breath. On examination blood pressure is 124/80 mmHg and the chest is clear on auscultation. An ECG show atrial fibrillation at a rate of 154 bpm. Of the following options, what is the most appropriate management?

A. Adenosine
B. Flecainide
C. Verapamil
D. Digoxin
E. Sotalol

ANSWER:
Flecainide

EXPLANATION:
Adenosine should be avoided as blocking the AV node can paradoxically increase ventricular rate resulting in fall in cardiac output. Verapamil and digoxin should also be avoided in patients with Wolff-Parkinson White as they may precipitate VT or VF.

Another option to consider in this situation would be DC cardioversion

Please see Q-46 for Wolff-Parkinson-White

Q-255

A 54-year-old man is diagnosed with type 2 diabetes mellitus. A decision is made to start simvastatin 40mg. What is the ideal time to advise patients to take this medication?

A. After breakfast
B. Last thing in the evening
C. After evening meal
D. Just before evening meal
E. First thing in the morning

ANSWER:
Last thing in the evening

EXPLANATION:
Taking simvastatin at night improves efficacy

Please see Q-37 for Statins

Q-256

A 64-year-old man who is known to have ischaemic heart disease is due to start a chemotherapy regime which includes doxorubicin. His cardiologist wants to accurately assess his left ventricular function as he is concerned the doxorubicin may damage his myocardium. Which one of the following is the most accurate method to determine his left ventricular function?

A. Cardiac computed tomography
B. Echocardiography
C. Exercise ECG
D. MUGA scan
E. Coronary angiography

ANSWER:
MUGA scan

EXPLANATION:
Please see Q-147 for Cardiac Imaging: Non-Invasive Techniques Excluding Echocardiography

Q-257

A 54-year-old man is admitted with suspected pulmonary embolism. He has no past medical history of note. Blood pressure is 120/80 mmHg with a pulse of 90/min. The chest x-ray is normal. Following treatment with low-molecular weight heparin, what is the most appropriate initial lung imaging investigation to perform?

A. Pulmonary angiography
B. Echocardiogram
C. MRI thorax
D. Ventilation-perfusion scan
E. Computed tomographic pulmonary angiography

ANSWER:
Computed tomographic pulmonary angiography

EXPLANATION:
CTPA is the first line investigation for PE according to current BTS guidelines
This is a difficult question to answer as both computed tomographic pulmonary angiography (CTPA) and ventilation-perfusion scanning are commonly used in UK clinical practice. The 2003 British Thoracic Society (BTS) guidelines, however, recommended that CTPA is now used as the initial lung imaging modality of choice. Pulmonary angiography is of course the 'gold standard' but this is not what the question asks for

Please see Q-125 for Pulmonary Embolism: Investigation

Q-258

An 11-year-old boy who is known to have Down's syndrome is reviewed in the cardiology clinic. Over the past year his parents report that he is more tired and breathless when he plays with his peers and siblings.

On examination he appears cyanosed at rest. His pulse is 90/min with no radio-femoral delay. There is a systolic murmur and a loud second heart sound. A right ventricular heave is noted and the JVP is elevated.

What is the most likely diagnosis?

A. Eisenmenger's syndrome
B. Fulminant patent ductus arteriosus
C. Fulminant transposition of the great arteries
D. Ebstein's anomaly
E. Tetralogy of Fallot with pulmonary atresia

ANSWER:
Eisenmenger's syndrome

EXPLANATION:
This boy is likely to have been born with a atrioventricular septal defect. Over time the shunt is likely to have reversed resulting in Eisenmenger's syndrome.

Please see Q-36 for Eisenmenger's Syndrome

Q-259

A 24-year-old woman who is 34 weeks pregnant presents with pleuritic chest pain and shortness of breath. She has noticed some pain in her left calf for the past 3 days and on examination she has clinical signs consistent with a left calf deep vein thrombosis. What is the most appropriate investigation?

A. D-dimer
B. Compression duplex Doppler
C. Computed tomographic pulmonary angiography
D. Venogram
E. Ventilation-perfusion scan

ANSWER:
Compression duplex Doppler

EXPLANATION:
Confirming a DVT is the first step as this may provide indirect evidence of a pulmonary embolism. As both conditions require anticoagulation this may negate the need for further radiation exposure.

PREGNANCY: DVT/PE INVESTIGATION
Guidelines were updated in 2015 by the Royal College of Obstetricians.

For patients with a suspected deep vein thrombosis (DVT):
Compression duplex ultrasound should be undertaken where there is clinical suspicion of DVT

For patients with a suspected pulmonary embolism (PE):
- ECG and chest x-ray should be performed in all patients
- In women who also have symptoms and signs of DVT, compression duplex ultrasound should be performed. If

compression ultrasonography confirms the presence of DVT, no further investigation is necessary and treatment for VTE should continue
- the decision to perform a V/Q or CTPA should be taken at a local level after discussion with the patient and radiologist

Comparing CTPA to V/Q scanning in pregnancy

CTPA	V/Q scanning
CTPA slightly increases the lifetime risk of **maternal breast cancer** (increased by up to 13.6%, background risk of 1/200 for study population). Pregnancy makes breast tissue particularly sensitive to the effects of radiation	V/Q scanning carries a slightly increased risk of **childhood cancer** compared with CTPA (1/50,000 versus less than 1/1,000,000)

D-dimer is of limited use in the investigation of thromboembolism as it often raised in pregnancy.

Q-260

A 46-year-old female is brought to the hospital after experiencing a headache and blurry vision which began two hours ago. She appears drowsy but is orientated to time, place and person.She has never had a similar episode before and does not remember the last time she has seen a doctor. She denies any chest pain or shortness of breath. She has a respiratory rate of 16 breaths per minute, heart rate of 91 beats per minute and blood pressure of 185/118 mmHg. A random blood glucose was 6.1 mmol/l. The attending doctor decides to begin treatment with hydralazine as it was the only drug available to him at that time. Which of the following best describes the way this medication works in this patient?

A. It elevates the levels of cyclic GMP leading to a relaxation of the smooth muscle to a greater extent in the veins than the arterioles
B. It elevates the levels of cyclic AMP leading to a relaxation of the smooth muscle to a greater extent in the arterioles than the veins
C. It blocks the opening of the voltage-depending calcium channels in the smooth muscle leader to a decrease in the peripheral vascular resistance
D. It elevates the levels of cyclic GMP leading to a relaxation of the smooth muscle to a greater extent in the arterioles than the veins
E. It elevates the levels of cyclic GMP by causing a release of nitric oxide which then produce a relaxation of the smooth muscle

ANSWER:
It elevates the levels of cyclic GMP leading to a relaxation of the smooth muscle to a greater extent in the arterioles than the veins

EXPLANATION:

This patient has presented with the signs and symptoms of a hypertensive emergency. She had severe hypertension which is defined as a systolic blood pressure of more than 180mmHg and/or diastolic blood pressure of more than 120 mmHg. She also has evidence of end-organ damage characterized by being drowsy (possible encephalopathy) and blurry vision (papilloedema, retinal hemorrhages). Hydralazine is a blood pressure lowering agent commonly used in the acute setting.

1: This correctly describes the mechanism of action of hydralazine. However, the vasodilating effect of hydralazine tends to be more pronounced in the arterioles than the veins.
2: Hydralazine increases the levels of cyclic GMP and not cyclic AMP.
3: This describes the mechanism of action of calcium channel blockers such as amlodipine.
4: This describes the mechanism of action of hydralazine. Increased levels of cyclic GMP cause the activation of protein kinase G which in turns phosphorylates and activates myosin light chain phosphatase. This dephosphorylates myosin light chains and prevents their binding to actin and therefore prevents the smooth muscle from contracting. This happens to a greater extent in the arterioles than the veins.
5: This would occur if nitroprusside was used. Nitroprusside is degraded into nitric oxide after its administration and the nitric oxide activates the enzyme guanylate cyclase which catalyzes the conversion of GTP to cyclic GMP. Nitroprusside is the preferred drug in a hypertensive emergency. However, in this question, it is mentioned that hydralazine was the only drug available to lower the blood pressure of this patient.

HYDRALAZINE
Hydralazine is one of the 'older' antihypertensives and is not commonly used nowadays. It is still sometimes used for hypertension in pregnancy and for severe hypertension.

Mechanism of action
- increases cGMP leading to smooth muscle relaxation

Contraindications
- systemic lupus erythematous
- ischaemic heart disease

Adverse effects
- tachycardia
- palpitations
- flushing
- fluid retention
- headache
- drug-induced lupus

Q-261

Which one of the following types of hyperlipidaemia are eruptive xanthoma most commonly associated with?

A. **Familial hypertriglyceridaemia**
B. **Familial hypercholesterolaemia**
C. **Familial combined hyperlipidaemia**
D. **Remnant hyperlipidaemia**
E. **Hyperlipidaemia secondary to nephrotic syndrome**

ANSWER:
Familial hypertriglyceridaemia

EXPLANATION:
HYPERLIPIDAEMIA: XANTHOMATA
Characteristic xanthomata seen in hyperlipidaemia:

Palmar xanthoma
- remnant hyperlipidaemia
- may less commonly be seen in familial hypercholesterolaemia

Eruptive xanthoma are due to high triglyceride levels and present as multiple red/yellow vesicles on the extensor surfaces (e.g. elbows, knees)

Causes of eruptive xanthoma
- familial hypertriglyceridaemia
- lipoprotein lipase deficiency

Tendon xanthoma, tuberous xanthoma, xanthelasma
- familial hypercholesterolaemia
- remnant hyperlipidaemia

Xanthelasma are also seen without lipid abnormalities

Management of xanthelasma, options include:
- surgical excision
- topical trichloroacetic acid
- laser therapy
- electrodesiccation

Q-262

A 62-year-old patient presents to the Emergency Department with a 25 minute history of crushing central chest pain. ECG shows ST elevation in leads I and aVL. Which coronary territory is likely to be affected?

A. **Lateral**
B. **Posterior**
C. **Anteroseptal**
D. **Anterolateral**
E. **Inferior**

ANSWER:
Lateral

EXPLANATION:
These ECG changes are most consistent with a lateral myocardial infarction. An anterolateral infarction is more likely to have changes in the chest leads.

Please see Q-3 for ECG: Coronary Territories

Q-263

Which one of the following drugs is best avoided in patients with hypertrophic obstructive cardiomyopathy?

A. **Amiodarone**
B. **Verapamil**
C. **Ramipril**
D. **Amoxicillin**
E. **Atenolol**

ANSWER:
Ramipril

EXPLANATION:
HOCM - drugs to avoid: nitrates, ACE-inhibitors, inotropes Verapamil should however be avoided in patients with coexistent Wolff-Parkinson White as it may precipitate VT or VF

Please see Q-233 for HOCM: Management

Q-264

An 82-year-old man is referred to cardiology by his GP with increasing dyspnoea or exertion and a systolic murmur. Examination demonstrates a blood pressure of 100/80 mmHg and a slow rising pulse. What is the most likely cause of his underlying condition?

A. **Bicuspid aortic valve**
B. **Ventricular septal defect**
C. **Post rheumatic fever**
D. **Calcification of the aortic valve**
E. **Hypertrophic obstructive cardiomyopathy**

ANSWER:
Calcification of the aortic valve

EXPLANATION:
Aortic stenosis - most common cause:
- ***younger patients < 65 years: bicuspid aortic valve***
- ***older patients > 65 years: calcification***

This patient has aortic stenosis.

Please see Q-15 for Aortic Stenosis

Q-265

A 72-year-old man is investigated for exertional chest pain and has a positive exercise tolerance test. He declines an angiogram and is discharged on a combination of aspirin 75mg od, simvastatin 40mg on, atenolol 50mg od and a GTN spray prn. Examination reveals a pulse of 72 bpm and a blood pressure of 130/80 mmHg. On review he is still regularly using his GTN spray. What is the most appropriate next step in management?

A. **Add nifedipine MR 30mg od**
B. **Add isosorbide mononitrate 30mg bd**
C. **Increase atenolol to 100mg od**
D. **Add nicorandil 10mg bd**
E. **Add verapamil 80mg tds**

ANSWER:
Increase atenolol to 100mg od

EXPLANATION:
The BNF recommends an atenolol dose of 100mg daily in 1 or 2 doses for angina. The starting dose of isosorbide mononitrate is 10mg bd.

Please see Q-59 for Angina Pectoris: Drug Management

Q-266

A 72-year-old man presents with lethargy and palpitations for the past four or five days. On examination his pulse is 123 bpm irregularly irregular, blood pressure is 118/70 mmHg and his chest is clear. An ECG confirms atrial fibrillation. What is the appropriate drug to control his heart rate?

A. **Amiodarone**
B. **Bisoprolol**
C. **Digoxin**
D. **Amlodipine**
E. **Flecainide**

ANSWER:
Bisoprolol

EXPLANATION:
Atrial fibrillation: rate control - beta blockers preferable to digoxin
A number of factors including age and symptoms would favour a rate control strategy. The NICE guidelines suggest either a beta-blocker or a rate limiting calcium channel blocker (i.e. Not amlodipine) in this situation.

Please see Q-29 for Atrial Fibrillation: Rate Control and Maintenance of Sinus Rhythm

Q-267

You are the ST1 working on cardiology. The nurses have asked you to review a 56-year-old man complaining of dyspnoea which is limiting his mobility.

He presented three days ago with an inferior STEMI. He was loaded with 300mg aspirin and 180mg ticagrelor before being taken to the cath-lab where he underwent primary PCI with a drug eluting stent for a sub-total occlusion of the right coronary artery. He was subsequently commenced on aspirin 100mg od, ticagrelor 90mg bd, atorvastatin 80mg od, bisoprolol 5mg od and perindopril 5mg od. His echo demonstrated only mildly reduced LV systolic function (LVEF 50%).

His vital signs are stable with a blood pressure 125/70mmHg, heart rate 64bpm, oxygen saturations 98% on room air and temperature 36.5ºC. Examination reveals dual heart sounds with no murmurs and his chest is clear on auscultation with no wheeze. JVP is +2cm and there is no peripheral oedema. His calves are soft and non tender. A Chest X-Ray shows mild atelectasis at the bases. His bloods are unremarkable. His ecg shows normal sinus rhythm with inferior q waves.

With respect to his dyspnoea, what would be the next best step in his management?

A. **Cease bisoprolol**
B. **Substitute ticagrelor for clopidogrel**
C. **Order an urgent repeat echo**
D. **Cease ticagrelor and continue aspirin only**
E. **Start antibiotics for a nosocomial pneumonia**

ANSWER:
Substitute ticagrelor for clopidogrel

EXPLANATION:
Dyspnoea is a common side effect of ticagrelor and is estimated to occur in up to 15% of patients started on this medication. It is hypothesised that the sensation of dyspnoea in ticagrelor-treated patients is triggered by adenosine, because ticagrelor inhibits its clearance (by inhibiting the enzyme adenosine deaminase), thereby increasing its concentration in the circulation. It is important to be aware of this side effect in order to avoid unnecessary treatment and/or investigation, as it is easily remedied by switching the patient to clopidogrel.

With respect to the other options, in this scenario there are no clinical features to suggest intolerance to a beta-blocker or heart failure. There are also no clinical signs to suggest a hospital acquired pneumonia with basal atelectasis a not uncommon finding in previously ambient patients who are hospitalised. It is important to be aware of the possibility of acute mitral regurgitation or a ventral sepal defect post STEMI as these require urgent diagnostic echo and surgical repair; however, given the fact that this patient is otherwise clinically well apart from subjective dyspnoea, has no murmurs on examination or signs of heart failure, this option is an unlikely cause of his dyspnoea. Whilst ticagrelor is associated with dyspnoea and cessation of this medication will most likely result in cessation of his symptoms, it is not appropriate to continue on single agent anti-platelet therapy in the setting of a drug eluting stent having been recently inserted due to the unacceptably high risk of in-stent thrombosis. Given that an alternative diagnosis is more likely this is not the best answer here. Hence the best step in management is to change the ticagrelor to clopidogrel and see if his dyspnoea improves.

ANTIPLATELETS: SUMMARY OF LATEST GUIDANCE
The table below summarises the most recent guidelines regarding antiplatelets:

Diagnosis	1st line	2nd line
NSTEMI	Aspirin (lifelong) & clopidogrel or ticagrelor (12 months)	If aspirin contraindicated, clopidogrel (lifelong)
STEMI	Aspirin (lifelong) & clopidogrel or ticagrelor (1m if no/bare stent, 12 m if drug-eluting stent)	If aspirin contraindicated, clopidogrel (lifelong)
TIA*	Clopidogrel (lifelong)	Aspirin (lifelong) & dipyridamole (lifelong)
Ischaemic stroke	Clopidogrel (lifelong)	Aspirin (lifelong) & dipyridamole (lifelong)
Peripheral arterial disease	Clopidogrel (lifelong)	Asprin (lifelong)

*the guidelines for TIA are based on the 2016 Royal College of Physicians National clinical guideline for stroke. These guidelines corrected the anomaly where patients who've had a stroke were given clopidogrel, but those who'd suffered a TIA were given aspirin + dipyridamole.

Q-268

A 30-year-old woman is admitted to the Emergency Department following a suspected peanut allergy. On examination she has gross facial and tongue oedema. Her oxygen saturations are 97% on room air, pulse is 96 / min and blood pressure is 90/62 mmHg. The paramedics have already gained intravenous access. What is the most appropriate way to give adrenaline in this situation?

A. Nebulised
B. Subdermally
C. Intramuscularly
D. Intravenously
E. Subcutaenously

ANSWER:
Intramuscularly

EXPLANATION:
The Resuscitation Council guidelines only recommend giving adrenaline intramuscularly, regardless of whether the patient has intravenous access or not.

Please see Q-227 for Anaphylaxis

Q-269

Which one of the following conditions is most associated with a bisferiens pulse?

A. Cardiac tamponade
B. Severe left ventricular failure
C. Aortic stenosis
D. Patent ductus arteriosus
E. Mixed aortic valve disease

ANSWER:
Mixed aortic valve disease

EXPLANATION:
Please see Q-58 for Pulses

Q-270

A 51-year-old male represents with chest pain, eighteen days after he was diagnosed with a non-ST elevation myocardial infarction. It is severe, central chest pain with radiations to the left shoulder and worse with deep inspiration. The pain woke him from sleep at 03:00 and has improved slightly after getting up out of bed. Findings on examination include reduced air entry to both bases coupled with fine basal crepitations. Observations show:

Heart rate 105bpm
Blood pressure 130/78mmHg
Respiratory rate 22bpm
Temperature 37.8 celsius
Oxygen saturations 97%

An initial ECG shows diffuse saddle-shaped ST elevation. An echocardiogram shows a small rim of fluid outside the pericardium. What is the most likely diagnosis?

A. Second myocardial infarction
B. Pulmonary embolism
C. Dressler's syndrome
D. Costochondritis
E. Unstable angina

ANSWER:
Dressler's syndrome

EXPLANATION:
The correct answer is Dressler's syndrome given the recent history of MI, description of pain (pleuritic, left shoulder radiation, worse lying down), low-grade temperature, ECG changes and pericardial effusion.

It is treated with NSAIDs preferably or a prolonged course of colchicine or steroids.

Please see Q-129 for Myocardial Infarction: Complications

Q-271

Which of the following is least associated with a poor prognosis in hypertrophic cardiomyopathy?

A. Non-sustained ventricular tachycardia on 24 or 48-hour Holter monitoring
B. Reduced left ventricular outflow gradient
C. Family history of sudden death
D. Syncope
E. Early age at presentation

ANSWER:
Reduced left ventricular outflow gradient

EXPLANATION:
There is no recognised prognostic association with left ventricular outflow gradient

Please see Q-75 for HOCM: Prognostic Factors

Q-272

Each one of the following physiological changes occur during exercise, except:

A. Increased myocardial contractibility
B. 50% increase in stroke volume
C. Up to 3-fold increase in heart rate
D. Rise in diastolic blood pressure
E. Venous constriction

ANSWER:
Rise in diastolic blood pressure

EXPLANATION:
EXERCISE: PHYSIOLOGICAL CHANGES

Blood pressure
- systolic increases, diastolic decreases
- leads to increased pulse pressure
- in healthy young people the increase in MABP is only slight

Cardiac output
- increase in cardiac output may be 3-5 fold
- results from venous constriction, vasodilation and increased myocardial contractibility, as well as from the maintenance of right atrial pressure by an increase in venous return
- heart rate up to 3-fold increase
- stroke volume up to 1.5-fold increase

Q-273

A 65-year-old woman complains of chest pain on exertion such as when walking up the stairs or doing housework. She describes the pain as a constricting discomfort in front of the chest. The pain typically radiates to the left shoulder and disappears on resting.

She suffers from severe osteoarthritis of the left knee, which limits her mobility. She also suffers from brittle asthma and high blood pressure. Her last cholesterol check was 4 years ago and this was normal. She is a non-smoker. On examination, she appears well and pain-free. Heart sounds were normal with no murmur. Resting ECG is normal.

What is the next step in the investigation of this lady's symptoms?

A. Check her cholesterol level to determine the investigation of choice
B. Exercise (stress) echocardiogram
C. Contrast-enhanced coronary CT angiography
D. Adenosine stress-CMR
E. Invasive coronary angiography

ANSWER:
Contrast-enhanced coronary CT angiography

EXPLANATION:
Contrast-enhanced CT coronary angiogram is the first line investigation for stable chest pain of suspected coronary artery disease aetiology
This lady chest pain characteristics are consistent with typical angina. The first-line investigation recommended by NICE is contrast-enhanced CT coronary angiogram cCTA. The new NICE guideline no longer recommends using pre-test likelihood of the CAD to determine the appropriate first-line investigation.

This lady may not be suitable for exercise (stress) echocardiogram as she suffers from severe osteoarthritis of the knee. Stress echocardiogram with dobutamine may be appropriate but is less sensitive than cCTA (and is not an option for this question). Adenosine stress-CMR is very sensitive in detecting CAD but the use of adenosine in someone with asthma is contraindicated due to the risk of bronchospasm. Immediate invasive coronary angiography is typically not the first-line investigation method due to the cost and possible complications. The use of invasive angiography without a 'gatekeeper' non-invasive test is not recommended by NICE but is still recommended by ESC and AHA in patients with very high pre-test likelihood of CAD. Other than her age and hypertension, she does not have other cardiovascular risk factors e.g. smoking, diabetes, etc.

CHEST PAIN: ASSESSMENT OF PATIENTS WITH SUSPECTED CARDIAC CHEST PAIN

NICE updated it's guidelines in 2016 on the 'Assessment and diagnosis of recent onset chest pain or discomfort of suspected cardiac origin'.

Below is a brief summary of the key points. Please see the link for more details.

Patients presenting with acute chest pain

Immediate management of suspected acute coronary syndrome (ACS)
- glyceryl trinitrate
- aspirin 300mg. NICE do not recommend giving other antiplatelet agents (i.e. Clopidogrel) outside of hospital
- do not routinely give oxygen, only give if sats < 94%*
- perform an ECG as soon as possible but do not delay transfer to hospital. A normal ECG does not exclude ACS

Referral

- current chest pain or chest pain in the last 12 hours with an abnormal ECG: emergency admission
- chest pain 12-72 hours ago: refer to hospital the same-day for assessment
- chest pain > 72 hours ago: perform full assessment with ECG and troponin measurement before deciding upon further action

*NICE suggest the following in terms of oxygen therapy:

- do not routinely administer oxygen, but monitor oxygen saturation using pulse oximetry as soon as possible, ideally before hospital admission. Only offer supplemental oxygen to:
- people with oxygen saturation (SpO2) of less than 94% who are not at risk of hypercapnic respiratory failure, aiming for SpO2 of 94-98%
- people with chronic obstructive pulmonary disease who are at risk of hypercapnic respiratory failure, to achieve a target SpO2 of 88-92% until blood gas analysis is available.

Patients presenting with stable chest pain

NICE define anginal pain as the following:
1. constricting discomfort in the front of the chest, or in the neck, shoulders, jaw or arms
2. precipitated by physical exertion
3. relieved by rest or GTN in about 5 minutes

- patients with all 3 features have typical angina
- patients with 2 of the above features have atypical angina
- patients with 1 or none of the above features have non-anginal chest pain

For patients in whom stable angina cannot be excluded by clinical assessment alone NICE recommend the following (e.g. symptoms consistent with typical/atypical angina OR ECG changes):

- 1st line: CT coronary angiography
- 2nd line: non-invasive functional imaging (looking for reversible myocardial ischaemia)
- 3rd line: invasive coronary angiography

Examples of non-invasive functional imaging:

- myocardial perfusion scintigraphy with single photon emission computed tomography (MPS with SPECT) or
- stress echocardiography or
- first-pass contrast-enhanced magnetic resonance (MR) perfusion or
- MR imaging for stress-induced wall motion abnormalities

Q-274

A 50-year-old man is admitted to Resus with a suspected anterior myocardial infarction. An ECG on arrival confirms the diagnosis and thrombolysis is prepared. The patient is stable and his pain is well controlled with intravenous morphine. Clinical examination shows a blood pressure of 140/84 mmHg, pulse 90 bpm and oxygen saturations on room air of 97%. What is the most appropriate management with regards to oxygen therapy?

A. 2-4 l/min via nasal cannulae
B. No oxygen therapy
C. 15 l/min via reservoir mask
D. 28% via Venturi mask
E. 35% via Venturi mask

ANSWER:
No oxygen therapy

EXPLANATION:
Please see the note below and provided link - there are now specific guidelines relating to the use of oxygen in emergency situations.

Please see Q-2 for Acute Coronary Syndrome: management of NSTEMI

Q-275

A 72-year-old man is started on amlodipine 5mg od for hypertension. He has no other past medical history of note and routine bloods (including fasting glucose) and ECG were normal. What should his target blood pressure (based on clinic readings) be once on treatment?

A. 130/80 mmHg
B. 140/80 mmHg
C. 140/85 mmHg
D. 140/90 mmHg
E. 150/90 mmHg

ANSWER:
140/90 mmHg

EXPLANATION:
Blood pressure target (< 80 years, clinic reading) - 140/90 mmHg

Please see Q-6 for Hypertension: Management

Q-276

A 71-year-old man who had rheumatic fever as a child is admitted to the cardiology ward with suspected infective endocarditis. This is confirmed by blood cultures and echocardiography. Which one of the following is most likely to be represent a need for surgical intervention?

A. A septic embolism in the right kidney
B. Persistent pyrexia after 48 hours of antibiotics
C. Lengthening of the PR interval on ECG
D. Pre-existing left ventricular impairment
E. Streptococcus viridans isolated on blood cultures

ANSWER:
Lengthening of the PR interval on ECG

EXPLANATION:
Infective endocarditis - indications for surgery:

- ***severe valvular incompetence***
- ***aortic abscess (often indicated by a lengthening PR interval)***
- ***infections resistant to antibiotics/fungal infections***
- ***cardiac failure refractory to standard medical treatment***
- ***recurrent emboli after antibiotic therapy***

Lengthening of the PR interval is likely to represent an aortic root abscess which will require surgical intervention.

Please see Q-138 for Infective Endocarditis: Prognosis and Management

Q-277

Which of the following is not true regarding B-type natriuretic peptide?

A. Secreted mainly by the ventricles
B. Acts as a diuretic
C. Acts as a vasoconstrictor
D. Levels rise in left ventricular failure
E. Reduces sympathetic tone

ANSWER:
Acts as a vasoconstrictor

EXPLANATION:
BNP - actions:

- ***vasodilator***
- ***diuretic and natriuretic***
- ***suppresses both sympathetic tone and the renin-angiotensin-aldosterone system***

Please see Q-40 for B-type natriuretic peptide

Q-278

You are a new speciality trainee in cardiology and in the middle of a busy outpatient clinic. Your next patient is a 27-year-old female with Arrhythmogenic Right Ventricular Dysplasia (ARVD) who is attending today for counselling/planning of prophylactic ICD insertion. She was diagnosed with this condition following the sudden death of her brother 2 years ago but has no history of problems herself.

Her echocardiogram (ECHO) done earlier today shows a moderately dilated and dyskinetic right ventricle with a mildly reduced ejection fraction which is similar to her last ECHO done around 18 months ago.

She is concerned as she drives to work every day and wants to know if there will be any restrictions to this.

What is the most appropriate thing to tell her?

A. She will not be permitted to drive again with an ICD
B. She will have to stop driving for 1 month only
C. There are no restrictions so she can drive again immediately
D. As she has had an ICD inserted she needs to wait 6 months before driving again
E. She must have another ECHO after 1 month and if this is satisfactory can drive again

ANSWER:
She will have to stop driving for 1 month only

EXPLANATION:
The answer to this question relies on knowledge of DVLA guidelines but also in recognising that this is a prophylactic ICD not one for secondary prevention. The ECHO findings are a red herring as these are not actually mentioned in the guidance for this situation.

The correct answer is 1 month (B): E is incorrect as she is not required to have a further ECHO (unless concern) prior to driving again. If this was a secondary preventative ICD or following ICD shock therapy then the correct answer would be 6 months. A lifelong ban applies only to group 2 drivers.

Please see Q-90 for DVLA: Cardiovascular Disorders

Q-279

A 24-year-old female who is 10 weeks in to her first pregnancy presents for review. Her blood pressure today is 126/82 mmHg. What normally happens to blood pressure during pregnancy?

A. Falls in first half of pregnancy before rising to pre-pregnancy levels before term
B. Systolic + diastolic rises by < 10 mmHg
C. Systolic + diastolic falls by < 10 mmHg
D. Rise in first half of pregnancy before falling to pre-pregnancy levels before term
E. Doesn't change

ANSWER:
Falls in first half of pregnancy before rising to pre-pregnancy levels before term

EXPLANATION:
Please see Q-170 for Hypertension in Pregnancy

Q-280

Which one of the following radiotracers is used during cardiac Positron Emission Tomography (PET) scans?

A. Gallium
B. Fluorodeoxyglucose
C. Technetium (99mTc)
D. Thallium
E. Fluorine-18

ANSWER:
Fluorodeoxyglucose

EXPLANATION:
Please see Q-147 for Cardiac Imaging: Non-Invasive Techniques Excluding Echocardiography

Q-281

Which one of the following patients should not automatically be prescribed a statin in the absence of any contraindication?

A. A 51-year-old man who had a myocardial infarction 4 years ago and is now asymptomatic
B. A 57-year-old female smoker with a 10-year cardiovascular risk of 23%
C. A 53-year-old man with intermittent claudication
D. A 62-year-old man who had a transient ischaemic attack 10 months ago
E. A 57-year-old man with well controlled diabetes mellitus type 2 with a 10-year cardiovascular risk of 8%

ANSWER:
A 57-year-old man with well controlled diabetes mellitus type 2 with a 10-year cardiovascular risk of 8%

EXPLANATION:
Please see Q-37 for Statins

Q-282

A 71-year-old man with a four-month history of exertional chest pain is reviewed. The pain typically comes on when he is walking up a hill, is centrally located and radiates to the left arm. It then settles with rest after about 2-3 minutes. Clinical examination and a resting 12 lead ECG are normal. Following NICE guidelines, what is the most appropriate diagnostic strategy?

A. CT coronary angiography
B. Manage as angina, no further diagnostic tests required
C. Exercise tolerance test
D. MPS with SPECT
E. Invasive coronary angiography

ANSWER:
CT coronary angiography

EXPLANATION:
Please see Q-273 for Chest Pain: Assessment of Patients with Suspected Cardiac Chest Pain

Q-283

Which one of the following treatments is not appropriate in the management of Wolff-Parkinson White?

A. Verapamil
B. Sotalol
C. Amiodarone
D. Flecainide
E. Radiofrequency ablation of the accessory pathway

ANSWER:
Verapamil

EXPLANATION:
Verapamil and digoxin should be avoided in patients with Wolff-Parkinson White as they may precipitate VT or VF

Please see Q-46 for Wolff-Parkinson-White

Q-284

A 65-year-old man is found to have an ejection systolic murmur and narrow pulse pressure on examination. He has experienced no chest pain, breathlessness or syncope. An echo confirms aortic stenosis and shows an aortic valve gradient of 36 mmHg. How should this patient be managed?

A. Routine aortic valve replacement
B. Urgent aortic valve replacement
C. Anticoagulation
D. Aortic valvuloplasty
E. Regular cardiology outpatient review

ANSWER:
Regular cardiology outpatient review

EXPLANATION:
Aortic stenosis management: AVR if symptomatic, otherwise cut-off is gradient of 40 mmHg
No action should be taken at present as he is currently asymptomatic. If the aortic valve gradient > 40 mmHg or there is evidence of significant left ventricular dysfunction then surgery is sometimes considered in selected asymptomatic patients

Please see Q-15 for Aortic Stenosis

Q-285

A 54-year-old man is admitted following a myocardial infarction associated with ST elevation. He is treated with thrombolysis and does not undergo angioplasty. What advice should he be given regarding driving?

Can continue driving but must inform DVLA
Cannot drive until an angiogram has been performed and reviewed by a cardiologist
Cannot drive for 1 week
Cannot drive for 4 weeks

Cannot drive for 12 weeks

ANSWER:
Cannot drive for 4 weeks

EXPLANATION:
DVLA advice post MI - cannot drive for 4 weeks

Please see Q-90 for DVLA: Cardiovascular Disorders

Q-286

A 57-year-old man presents to the Emergency Department with a 15 minute history of severe central chest pain radiating to his left arm. ECG shows T-wave inversion in leads I, V5 and V6. Which coronary artery is most likely to be affected?

A. Left circumflex
B. Posterior interventricular
C. Left main stem
D. Right coronary
E. Left anterior descending

ANSWER:
Left circumflex

EXPLANATION:
This is most typical of a left circumflex occlusion although may rarely be seen if the left anterior descending is affected

Please see Q-3 for ECG: Coronary Territories

Q-287

A 32-year-old female patient presents with an 8-month history of progressively worsening shortness of breath, general fatigue and weight gain. There is no significant past medical history. In particular, there is no history of cardiorespiratory conditions. On examination, the patient is tachycardic with central cyanosis and general oedema. A chest radiograph shows cardiomegaly and dilatation of the pulmonary arteries. An echocardiogram suggests a raised pulmonary arterial pressure.

Which of the following is the mainstay treatment used for this condition?

A. Bendroflumethiazide
B. Aspirin
C. Ramipril
D. Prostacyclin
E. Bisoprolol

ANSWER:
Prostacyclin

EXPLANATION:
Prostacyclins is used in the treatment of primary pulmonary hypertension

Prostacyclins are used in the treatment of primary pulmonary hypertension(PAH).

Bendroflumethiazide is not used to treat PAH but it can be used to treat heart failure and hypertension although not first-line for either.

Aspirin has no effect on PAH.

Ramipril and bisoprolol are not used to treat PAH but they are the first line treatments for heart failure.

Please see Q-44 for Pulmonary Arterial Hypertension

Q-288

A 28-year-old woman presents with palpitations. Her heart rate is 160/min and irregular. Her blood pressure is 123/65 mmHg, and her oxygen saturation is 97% on breathing room air. Her chest is clear on auscultation. Her ECG shows irregular broad complex monomorphic tachycardia with a stable axis. She has no previous medical history and has never been to a hospital before. What is the most appropriate treatment?

A. Diltiazem
B. Bisoprolol
C. Amiodarone
D. Magnesium
E. Adenosine

ANSWER:
Amiodarone

EXPLANATION:
The correct answer is amiodarone. This a haemodynamically stable patient with irregular broad complex tachycardia. As the broad-complex tachycardia is irregular it is most likely atrial fibrillation with left bundle branch block or an alternative aberrant conduction pathway such as Wolff-Parkinson-White syndrome. Diltiazem, bisoprolol and adenosine are all contraindicated as they could enhance the aberrant pathway leading to ventricular fibrillation. Magnesium would be appropriate for torsades de pointes but is unlikely as the rhythm is monomorphic.

Please see Q-187 for Broad Complex Tachycardia

Q-289

A 34-year-old man is noted to have a pan-systolic murmur associated with large V waves in the JVP and pulsatile hepatomegaly. Which one of the following types of congenital heart disease is most associated with tricuspid regurgitation?

A. Atrial septal defect
B. Ebstein's anomaly
C. Coarctation of the aorta
D. Patent ductus arteriosus
E. Ventricular septal defect

ANSWER:
Ebstein's anomaly

EXPLANATION:
Please see Q-116 for Tricuspid Regurgitation

Q-290

A 71-year-old woman presents with palpitations and 'lightheadedness'. An ECG shows that she is in atrial fibrillation with a rate of 130 / min. Her blood pressure is normal and examination of her cardiorespiratory system is otherwise unremarkable. Her past medical history includes well controlled asthma (salbutamol & beclomethasone) and depression (citalopram). Her symptoms have been present for around three days. What is the most appropriate medication to use for rate control?

A. Diltiazem
B. Sotalol
C. Digoxin
D. Atenolol
E. Amiodarone

ANSWER:
Diltiazem

EXPLANATION:
Her history of asthma is a contraindication to the prescription of a beta-blocker. NICE therefore recommend a rate-limiting calcium channel blocker.

Consideration should also be given to antithrombotic therapy.

Please see Q-29 for Atrial Fibrillation: Rate Control and Maintenance of Sinus Rhythm

Q-291

A 59-year-old female is admitted to the Emergency Department with a 30 minute history of central chest pain radiating to her left arm. An ECG shows ST elevation in leads II, III, aVF. Which coronary artery is most likely to be affected?

A. Right coronary
B. Left anterior descending
C. Left main stem
D. Left circumflex
E. Anterior interventricular

ANSWER:
Right coronary

EXPLANATION:
Inferior MI - right coronary artery lesion

Please see Q-3 for ECG: Coronary Territories

Q-292

Eight months after having a prosthetic heart valve a patient develops infective endocarditis. What is the most likely causative organism?

A. Streptococcus viridans
B. Staphylococcus aureus
C. Staphylococcus epidermidis
D. Coxiella burnetii
E. One of the HACEK group

ANSWER:
Staphylococcus aureus

EXPLANATION:
Most common cause of endocarditis:
Staphylococcus aureus
Staphylococcus epidermidis if < 2 months post valve surgery
Coagulase-negative staphylococci such as Staphylococcus epidermidis are the most common causative organisms in the first 2 months following surgery. After this time the spectrum of organisms causing endocarditis returns to normal.

Please see Q-102 for Infective Endocarditis

Q-293

A 34-year-old woman attends a routine antenatal clinic at 16 weeks gestation.
She has no significant past medical history but suffers with occasional frontal headaches.

She is noted to have a blood pressure of 148/76mmHg.

Urinalysis reveals;

pH	**6.5**
Protein	**+1**
Nitrates	**0**
Leuc	**0**
Blood	**0**

What is the most likely diagnosis?

A. Gestational hypertension
B. Pre-eclampsia
C. HELLP
D. Nephrotic syndrome
E. Chronic hypertension

ANSWER:
Chronic hypertension

EXPLANATION:
The answer here is chronic hypertension.

At 16 weeks gestation, this lady is too early into her pregnancy to have developed any of the pregnancy related

causes of hypertension. The small amount of protein in her urine may also indicate relatively long standing hypertension. Intermittent frontal headaches are a common occurrence and are not a sign of pre-eclampsia in this case.

Pre-eclampsia and gestational hypertension would only occur after 20 weeks gestation. Pre-eclampsia with significant proteinuria, gestational hypertension without.

Nephrotic syndrome would be associated with a larger degree of proteinuria.

Please see Q-170 for Hypertension in Pregnancy

Q-294

Which one of the following is not a risk factor for the development of pre-eclampsia?

A. Body mass index of 38 kg/m^2
B. Smoking
C. A woman carrying twins
D. Nulliparity
E. Diabetes mellitus

ANSWER:
Smoking

EXPLANATION:
There is some evidence to suggest that pre-eclampsia is actually less common in smokers

Please see Q-157 for Pre-Eclampsia

Q-295

Which one of the following statements regarding statin-induced myopathy is incorrect?

A. Rhabdomyolysis may cause renal failure
B. Patients with an elevated creatine kinase often have no symptoms
C. Female sex is a risk factor
D. Creatine kinase does not need to be routinely checked prior to commencing a statin
E. Pravastatin is more likely to cause myopathy than simvastatin

ANSWER:
Pravastatin is more likely to cause myopathy than simvastatin

EXPLANATION:
Myopathy is more common in lipophilic statins (simvastatin, atorvastatin) than relatively hydrophilic statins (rosuvastatin, pravastatin, fluvastatin)

Please see Q-37 for Statins

Q-296

You review a patient who has been admitted with a non-ST elevation myocardial infarction in the Emergency Department. They have so far been treated with aspirin 300mg stat and glyceryl trinitrate spray (2 puffs). Following recent NICE guidance, which patients should receive clopidogrel?

A. Patients < 75 years of age
B. Patients who have a history of hypertension, ischaemic heart disease or diabetes mellitus
C. Those who have a predicted 12 month mortality > 10%
D. Those who have a predicted 6 month mortality < 10%
E. All patients

ANSWER:
All patients

EXPLANATION:
The 2013 NICE myocardial infarction guidelines replaced the 2010 advice - risk scores are no longer needed to determine whether clopidogrel is given.

Please see Q-2 for Acute Coronary Syndrome: management of NSTEMI

Q-297

Each one of the following is associated with left axis deviation on ECG, except:

A. Left anterior hemiblock
B. Ostium primum ASD
C. Left posterior hemiblock
D. Obesity
E. Left bundle branch block

ANSWER:
Left posterior hemiblock

EXPLANATION:
ECG: AXIS DEVIATION

Causes of left axis deviation (LAD)
- left anterior hemiblock
- left bundle branch block
- Wolff-Parkinson-White syndrome* - right-sided accessory pathway
- hyperkalaemia
- congenital: ostium primum ASD, tricuspid atresia
- minor LAD in obese people

Causes of right axis deviation (RAD)
- right ventricular hypertrophy
- left posterior hemiblock
- chronic lung disease → cor pulmonale
- pulmonary embolism
- ostium secundum ASD

- Wolff-Parkinson-White syndrome* - left-sided accessory pathway
- normal in infant < 1 years old
- minor RAD in tall people

*in the majority of cases, or in a question without qualification, Wolff-Parkinson-White syndrome is associated with left axis deviation

Q-298

Which of the following is a cause of a loud second heart sound?

A. Aortic regurgitation
B. Ventricular septal defect
C. Systemic hypertension
D. Aortic stenosis
E. Mitral stenosis

Second heart sound (S2)
- **loud: hypertension**
- **soft: AS**
- **fixed split: ASD**
- **reversed split: LBBB**

ANSWER:
Systemic hypertension

EXPLANATION:
Please see Q-5 for Heart Sounds: S2

Q-299

Which one of the following is a cause of a soft second heart sound?

A. Aortic stenosis
B. Aortic regurgitation
C. Mitral stenosis
D. Mitral regurgitation
E. Pulmonary hypertension

ANSWER:
Aortic stenosis

EXPLANATION:
Second heart sound (S2)
- ***loud: hypertension***
- ***soft: AS***
- ***fixed split: ASD***
- ***reversed split: LBBB***

Please see Q-5 for Heart Sounds: S2

Q-300

Which one of the following is least associated with myocarditis?

A. Chagas' disease
B. Lyme disease
C. Leishmaniasis
D. Coxsackie virus
E. Toxoplasmosis

ANSWER:
Leishmaniasis

EXPLANATION:
Myocarditis

Causes
- viral: coxsackie, HIV
- bacteria: diphtheria, clostridia
- spirochaetes: Lyme disease
- protozoa: Chagas' disease, toxoplasmosis
- autoimmune
- drugs: doxorubicin

Presentation
- usually young patient with acute history
- chest pain, SOB

Q-301

A 53-year-old man presents as he is worried about palpitations. These are described as fast and irregular and typically occur twice a day. They seem to be more common after drinking alcohol. There is no history of chest pain or syncope. Examination of his cardiovascular symptoms is normal with a pulse of 72/min and a blood pressure of 116/78 mmHg. Blood tests and a 12-lead ECG are unremarkable. What is the most appropriate next step in management?

A. Reassure and repeat 12-lead ECG in 3 months time
B. Request a troponin I
C. Arrange an echocardiogram
D. Arrange a Holter monitor
E. Arrange an external loop recorder

ANSWER:
Arrange a Holter monitor

EXPLANATION:
Palpitations should first be investigated with a Holter monitor after initial bloods/ECG
These episodes are characteristic of an arrhythmia, possibly atrial fibrillation. First-line investigations are normal and it is appropriate to investigate further to exclude an arrhythmia.

Holter monitoring should be arranged to try and capture such an episode. Given the episodes occur daily it is reasonable to do this over a 24 hour period initially.

A troponin is not indicated given the absence of chest pain and there is no suggestion of heart failure to warrant an echocardiogram.

An external loop recorder should only be considered if the Holter monitoring is normal and the patient continues to have symptoms.

INVESTIGATING PALPITATIONS
Palpitations are a common presenting symptom.

Possible causes include
- arrhythmias
- stress
- increased awareness of normal heart beat / extrasystoles

First-line investigations include:
- 12-lead ECG: this will only capture the heart rhythm for a few seconds and hence is likely to miss episodic arrhythmias. However, other abnormalities linked to the underlying arrhythmia (for example a prolonged QT interval or PR interval, or changes suggesting recent myocardial ischaemia) may be seen.
- thyroid function tests: thyrotoxicosis may precipitate atrial fibrillation and other arrhythmias
- urea and electrolytes: looking for disturbances such as a low potassium
- full blood count

Capturing episodic arrhythmias
First-line investigations are often normal in patients complaining of palpitations. The next step is to exclude an episode arrhythmia.

The most common investigation is Holter monitoring
- portable battery operated device
- continuously records ECG from 2-3 leads
- usually done for 24 hours but may be used for longer if symptoms are less than daily
- patients are asked to keep a diary to record any symptomatic palpitations. This can later be compared to the rhythm strip at the time of the symptoms
- at the end of the monitoring a report is generated summarising a number of parameters including heart rate, arrhythmias and changes in ECG waveform

If no abnormality is found on the Holter monitor, and symptoms continue, other options include:
- external loop recorder
- implantable loop recorder

Q-302

Which one of the following statements regarding prosthetic heart valves is correct?

A. Antibiotic prophylaxis is still recommended for patients with mechanical valves who have dental procedures
B. The majority of mechanical valves are of the ball-and-cage type
C. Bioprosthetic valves are now usually obtained from human cadavers
D. The target INR for patients with mechanical aortic valves is 3.0-4.0
E. Mechanical valves have a lower failure rate than bioprosthetic valves

ANSWER:
Mechanical valves have a lower failure rate than bioprosthetic valves

EXPLANATION:
Please see Q-151 for Prosthetic Heart Valves

Q-303

A 37-year-old who is 38 weeks pregnancy is an inpatient on the obstetric ward for the management of pre-eclampsia. Blood pressure is 172/114 mmHg and urine dipstick shows proteinuria +++. A decision has been made to start magnesium sulphate therapy as she is deemed at risk of eclampsia. Of the following options, which are the most important parameters to monitor whilst the patient is receiving magnesium?

A. Blood sugar + pulse rate
B. Reflexes + respiratory rate
C. Blood sugar + respiratory rate
D. Reflexes + pulse rate
E. Glasgow coma scale + pulse rate

ANSWER:
Reflexes + respiratory rate

EXPLANATION:
ECLAMPSIA
Eclampsia may be defined as the development of seizures in association pre-eclampsia. To recap, pre-eclampsia is defined as:
- condition seen after 20 weeks gestation
- pregnancy-induced hypertension
- proteinuria

Magnesium sulphate is used to both prevent seizures in patients with severe pre-eclampsia and treat seizures once they develop. Guidelines on its use suggest the following:
- should be given once a decision to deliver has been made
- in eclampsia an IV bolus of 4g over 5-10 minutes should be given followed by an infusion of 1g / hour
- urine output, reflexes, respiratory rate and oxygen saturations should be monitored during treatment
- treatment should continue for 24 hours after last seizure or delivery (around 40% of seizures occur post-partum)

Other important aspects of treating severe pre-eclampsia/eclampsia include fluid restriction to avoid the potentially serious consequences of fluid overload

Q-304

How long should a patient stop driving for following an elective cardiac angioplasty?

A. No restriction
B. 1 week
C. 2 weeks
D. 4 weeks
E. 8 weeks

ANSWER:
1 week

EXPLANATION:
DVLA advice following angioplasty - cannot drive for 1 week

Please see Q-90 for DVLA: Cardiovascular Disorders

Q-305

A 40-year-old woman who is being treated for refractory hypertension undergoes a coronary angiogram after developing non-specific chest pains. The cardiologist takes a number of measurements during the procedure:

	Pressure (mmHg)
Right femoral artery	122/68
Left ventricle	202/104
Aorta	194/84

The blood pressure in her left arm taking during the procedure was 188/74 mmHg. What is the most likely underlying diagnosis?

A. Left subclavian artery stenosis
B. Renal artery stenosis
C. Coarctation of the aorta
D. Aortic stenosis
E. Results consistent with essential hypertension

ANSWER:
Coarctation of the aorta

EXPLANATION:
The most common type of coarctation of the aorta seen in adults is the postductal variety, i.e. the aortic narrowing is distal to the ductus arteriosus. This means that the upper limb blood pressure is greater than that in the lower limbs as the narrowing occurs after the left subclavian artery branches from the aorta.

Another approach to answering this question is to look at the history. A young person with refractory hypertension raises the possibility of secondary, rather than essential (primary) hypertension. The only two diagnoses listed above which cause hypertension are coarctation and renal artery stenosis. This narrows the diagnositic possibilities and makes the question easier to answer.

Please see Q-246for Coarctation of the Aorta

Q-306

A 55-year-old female presents to the emergency department with an eight-hour history of heart palpitations. She has a heart rate of 200 beats per minute and an ECG shows regular QRS complexes of 0.08 seconds. She has not had any chest pain or episodes of syncope and has no signs of heart failure. Her blood pressure is 130/90 mmHg and her oxygen saturations are 97% on air. What should you do first?

A. Carotid sinus massage
B. Adenosine 6mg
C. Adenosine 12mg
D. Amiodarone 300mg
E. Atropine 0.5mg

ANSWER:
Carotid sinus massage

EXPLANATION:
This female has a regular narrow complex tachycardia with no adverse features. The first step in this instance would, therefore, be to try vagal manoeuvres, for example, a carotid sinus massage. If this is unsuccessful, IV adenosine should be given (6mg at first, followed by 12mg if no response, and then by a further 12mg if again no response). If this is unsuccessful consider atrial flutter as the diagnosis and treat as appropriate.

Amiodarone can be used for rhythm control if the patients' narrow complex tachycardia is due to atrial fibrillation or atrial flutter. It could also be used in the management of broad complex tachycardia.

Atropine is used in the management of bradycardia.

Please see Q-39 for Peri-Arrest Arrhythmias: Tachycardia

Q-307

A patient who was commenced on a simvastatin six months ago presents with generalised muscles aches. Which one of the following is not a risk factor for statin-induced myopathy?

A. Female gender
B. Large fall in LDL-cholesterol
C. Low body mass index
D. Advanced age
E. History of diabetes mellitus

ANSWER:
Large fall in LDL cholesterol

EXPLANATION:

Please see Q-37 for Statins

Q-308

A 65-year-old man is discharged from hospital following a thrombolysed ST-elevation myocardial infarction. Other than a history of depression he has no past medical history of note. Examination of his cardiorespiratory system today was normal. His stay on the coronary care unit was complicated by the development of dyspnoea and an echo show a reduced left ventricular ejection fraction. Other than standard treatment with an ACE inhibitor, beta-blocker, aspirin, clopidogrel and statin, what other type of drug should he be taking?

A. Angiotensin 2 receptor antagonist
B. Potassium channel activator
C. Aldosterone antagonist
D. Thiazide diuretic
E. Loop diuretic

ANSWER:
Aldosterone antagonist

EXPLANATION:
An aldosterone antagonist is recommended by current NICE guidelines as the patient has a reduced left ventricular ejection fraction. A loop diuretic is not indicated unless there is evidence of fluid overload.

Please see Q-164 for Myocardial Infarction: Secondary Prevention

Q-309

A 76-year-old man with a history of ischaemic heart disease and hypertension presents for review. He had a myocardial infarction 20 years ago but has had no problems since. His current medication is clopidogrel, atorvastatin, ramipril and bisoprolol. He has recently been feeling light-headed an ECG shows atrial fibrillation.

What antithrombotic medication should he now be taking?

A. Continue clopidogrel monotherapy
B. Switch to aspirin + clopidogrel
C. Switch to an oral anticoagulant + clopidogrel
D. Switch to an oral anticoagulant
E. Switch to long-term low molecular weight heparin

ANSWER:
Switch to an oral anticoagulant

EXPLANATION:
Patients with stable CVD who have AF are generally managed on an anticoagulant and the antiplatelets stopped This patient is at risk of stroke given his CHADS-VASC score (cardiovascular disease, hypertension, age etc). He, therefore, requires treatment. As his cardiovascular disease is stable, he should stop his antiplatelet and switch to oral anticoagulant monotherapy.

COMBINATION ANTIPLATELET AND ANTICOAGULANT THERAPY

With the increase in comorbidity, it is now common to find that a patient has an indication for both an antiplatelet (e.g. established cardiovascular disease) and an anticoagulant (e.g. atrial fibrillation, venous thromboembolism or valvular heart disease). However, combination therapy increases the risk of bleeding and may not be needed in all cases. How should this be managed?

Whilst there are not guidelines to cover every scenario a recent review in the BMJ offered an expert opinion outlining the approach in common scenarios.

Secondary prevention of stable cardiovascular disease with an indication for an anticoagulant

- normally in this situation, all patients are recommended to be prescribed an antiplatelet
- if an indication for anticoagulant exists (for example atrial fibrillation) it is indicated that anticoagulant monotherapy is given without the addition of antiplatelets

Post-acute coronary syndrome/percutaneous coronary intervention

- in these patients, there is a much stronger indication for antiplatelet therapy
- generally patients are given triple therapy (2 antiplatelets + 1 anticoagulant) for 4 weeks-6 months after the event and dual therapy (1 antiplatelet + 1 anticoagulant) to complete 12 months
- there is variation from patient to patient however given that the stroke risk in atrial fibrillation varies according to risk factors.

Venous thromboembolism (VTE)

- if a patient on antiplatelets develops a VTE they are likely to be prescribed anticoagulants for 3-6 months
- a HAS-BLED score should be calculated. Those with a low risk of bleeding may continue antiplatelets. In patients with an intermediate or high risk of bleeding consideration should be given to stopping the antiplatelets

Q-310

Which of the following statements concerning the third heart sound is correct?

A. Caused by systolic filling of the ventricle
B. May be heard in constrictive pericarditis
C. Associated with atrial septal defects
D. Is characteristically soft in aortic stenosis
E. Caused by atrial contraction against a stiff ventricle

ANSWER:
May be heard in constrictive pericarditis

EXPLANATION:

A third heart sound is often heard in left ventricular failure and constrictive pericarditis

Please see Q-62 for Heart Sounds

Q-311

A 74-year-old man with symptomatic aortic stenosis is reviewed in the cardiology clinic. He is otherwise fit and well and keen for intervention if possible. What type of intervention is he most likely to be offered?

A. Annual echocardiography, intervention when valve gradient > 75 mmHg
B. Aortic bypass graft
C. Bioprosthetic aortic valve replacement
D. Balloon valvuloplasty
E. Mechanical aortic valve replacement

ANSWER:

Bioprosthetic aortic valve replacement

EXPLANATION:

Prosthetic heart valves - mechanical valves last longer and tend to be given to younger patients

Please see Q-151 for Prosthetic Heart Valves

Q-312

An 82-year-old man is reviewed. He is known to have ischaemic heart disease and is still getting regular attacks of angina despite taking atenolol 100mg od. Examination of his cardiovascular system is unremarkable with a pulse of 72 bpm and a blood pressure of 148/92 mmHg. What is the most appropriate next step in management?

A. Add verapamil 80mg tds
B. Add nicorandil 10mg bd
C. Add diltiazem 60mg tds
D. Add nifedipine MR 30mg od
E. Add isosorbide mononitrate 30mg bd

ANSWER:

Add nifedipine MR 30mg od

EXPLANATION:

NICE guidelines recommend adding a calcium channel blocker for angina which is not adequately controlled with beta-blocker monotherapy. Verapamil is contraindicated whilst taking a beta-blocker and diltiazem should be used with caution due to the risk of bradycardia.

The starting dose of isosorbide mononitrate is 10mg bd.

Please see Q-59 for Angina Pectoris: Drug Management

Q-313

Which one of the following clotting factors is not affected by warfarin?

A. Factor II
B. Factor VII
C. Factor XII
D. Factor IX
E. Factor X

ANSWER:

Factor XII

EXPLANATION:

Warfarin - clotting factors affected mnemonic - 1972 (10, 9, 7, 2)
Factor XII is not affected by warfarin

Please see Q-4 for Warfarin

Q-314

A 65-year-old female with a history of chronic obstructive pulmonary disease (COPD) is reviewed in the Emergency Department. She has presented with a sudden worsening of her dyspnoea associated with haemoptysis. What is the most suitable initial imaging investigation to exclude a pulmonary embolism?

A. Ventilation-perfusion scan
B. Echocardiogram
C. Pulmonary angiography
D. Computed tomographic pulmonary angiography
E. MRI thorax

ANSWER:

Computed tomographic pulmonary angiography

EXPLANATION:

Pulmonary embolism - CTPA is first-line investigation
It is still common in UK hospitals, despite guidelines, for a ventilation-perfusion scan to be done first-line

Please see Q-125 for Pulmonary Embolism: Investigation

Q-315

Each one of the following is associated with right axis deviation on ECG, except:

A. Right ventricular hypertrophy
B. Pulmonary embolism
C. Wolf-Parkinson-White syndrome with right-sided accessory pathway
D. Chronic lung disease
E. Left posterior hemiblock

ANSWER:

Wolf-Parkinson-White syndrome with right-sided accessory pathway

EXPLANATION:

Wolff-Parkinson-White syndrome is associated with a short PR interval and a wide QRS complex with a slurred upstroke, termed a delta wave. Axis deviation depends on the position of the accessory pathway

Please see Q-297 for ECG: Axis Deviation

Q-316

A 67-year-old man is admitted with palpitations. During examination of his JVP he is noted to have regular cannon waves. Which one of the following arrhythmias is most likely to be responsible for this finding?

Atrio-ventricular nodal re-entry tachycardia
Atrial fibrillation
Atrial flutter
Complete heart block
Ventricular fibrillation

ANSWER:

Atrio-ventricular nodal re-entry tachycardia

EXPLANATION:

Atrio-ventricular nodal re-entry tachycardia and ventricular tachycardia with 1:1 ventricular-atrial conduction may produce regular cannon waves. Complete heart block causes irregular cannon waves

Please see Q-92 for JVP: Cannon Waves

Q-317

A 45-year-old man presents with pleuritic central chest pain and flu-like symptoms to the Emergency Department. The pain started yesterday and is worse at night when he lies flat. Which one of the following ECG findings is most specific for the likely diagnosis?

A. PR depression
B. T wave inversion
C. Short PR interval
D. U waves
E. ST elevation

ANSWER:

PR depression

EXPLANATION:

ST elevation is seen but is not specific as it may also indicate ischaemia

Please see Q-10 for Acute Pericarditis

Q-318

A 54-year-old man with angina has a percutaneous coronary intervention with insertion of a drug-eluting stent. What is the single most important risk factor for stent thrombosis?

A. Age of patient
B. Premature withdrawal of antiplatelet therapy
C. Failing to adhere to cardiac rehabilitation program
D. Duration of procedure
E. History of diabetes mellitus

ANSWER:

Premature withdrawal of antiplatelet therapy

EXPLANATION:

PCI: stent thrombosis - withdrawal of antiplatelets biggest risk factor
Diabetes mellitus is a risk factor for restenosis rather than stent thrombosis

Please see Q-146 for Percutaneous Coronary Intervention

Q-319

A 44-year-old female is investigated for suspected idiopathic pulmonary hypertension. Which one of the following is the best method for deciding upon management strategy?

A. Genetic testing
B. Acute vasodilator testing
C. Trial of endothelin receptor antagonists
D. Serial echocardiography
E. Trial of calcium channel blockers

ANSWER:

Acute vasodilator testing

EXPLANATION:

Please see Q-44 for Pulmonary Arterial Hypertension

Q-320

Which one of the following statements regarding arrhythmogenic right ventricular cardiomyopathy is correct?

A. Inherited in an autosomal recessive pattern
B. It is now the most common cause of sudden cardiac death in the UK
C. All patients should have an implantable cardioverter defibrillator fitted
D. It is characterised by fibrofatty infiltration of the right ventricular myocardium
E. Naxos disease is the association of arrhythmogenic right ventricular cardiomyopathy with deafness

ANSWER:

It is characterised by fibrofatty infiltration of the right ventricular myocardium

EXPLANATION:

Drug therapy is used in patients with well tolerated or non life-threatening ventricular arrhythmias.

Please see Q-9 for Arrhythmogenic Right Ventricular Cardiomyopathy

Q-321

A 54-year-old man is admitted to the Emergency Department with a 15 minute history of crushing central chest pain. Which one of the following rises first following a myocardial infarction?

A. AST
B. Troponin I
C. CK
D. CK-MB
E. Myoglobin

ANSWER:
Myoglobin

EXPLANATION:
Myoglobin rises first following a myocardial infarction

Please see Q-1 for Cardiac Enzymes and Protein Markers

Q-322

What is the mechanism of action of bivalirudin in acute coronary syndrome?

A. Activates antithrombin III
B. Inhibits the production of thromboxane A2
C. Coronary vasodilator
D. Reversible direct thrombin inhibitor
E. Glycoprotein IIb/IIIa receptor antagonist

ANSWER:
Reversible direct thrombin inhibitor

EXPLANATION:
Please see Q-2 for Acute Coronary Syndrome: management of NSTEMI

Q-323

An 82-year-old lady is brought into the emergency department by the paramedics. She has been off her feet for the last week in her care home and is now unresponsive. When she arrives her temperature is recorded and found to be 28ºC.

Given her presentation what changes would you expect to see on an ECG?

A. Q-waves
B. Delta waves
C. Saddle ST-elevation
D. Sinus tachycardia
E. J-waves

ANSWER:
J-waves

EXPLANATION:
J-waves are associated with hypothermia
This question is asking about an 82-year-old lady presenting with hypothermia and asking for ECG changes you would expect to see. Therefore the correct answer is J-waves. These are small bumps at the end of the QRS complex.

Q-waves are associated with a previous myocardial infarction
Delta waves are associated with Wolff-Parkinson-White Syndrome
Saddle ST elevation is associated with pericarditis
Sinus tachycardia would not be expected as patients with hypothermia are often bradycardic

Please see Q-99 for ECG: Hypothermia

Q-324

Which part of the jugular venous waveform is associated with the closure of the tricuspid valve?

A. a wave
B. c wave
C. x descent
D. y descent
E. v wave

ANSWER:
c wave

EXPLANATION:
JVP: C wave - closure of the tricuspid valve
The c wave of the jugular venous waveform is associated with the closure of the tricuspid valve

Please see Q-18 for Jugular Venous Pulse

Q-325

A 34-year-old woman has emergency surgery after a ruptured ectopic pregnancy. She is recovering in ITU when her blood pressure suddenly rises to 210/170 mmHg and her heart rate to 120 bpm. Which of her regular medications is most likely to have caused the hypertensive crisis?

A. Clomifene
B. Esomeprazole
C. Phenelzine
D. Sertraline
E. Levonorgestrel

ANSWER:
Phenelzine

EXPLANATION:

Phenelzine is a monoamine oxidase inhibitor (MAOI), a class of drugs rarely used now in part due to the risk of hypertensive crises. In emergency settings like this scenario, there is a substantial elevation of that risk due to interactions with vasopressors used to treat hypotension.

Please see Q-158 for Hypertension: Secondary Causes

Q-326

You are clerking a 67-year-old man who has been admitted with chest pain. His past medical history includes hypertension, angina and he continues to smoke 20 cigarettes / day. Blood tests done in the Emergency Department show the following:

Na+	**133 mmol/l**
K+	**3.3 mmol/l**
Urea	**4.5 mmol/l**
Creatinine	**90 µmol/l**

Which one of the following factors is most likely to explain the abnormalities seen in the electrolytes?

A. Enalapril therapy
B. Felodipine therapy
C. Bendroflumethiazide therapy
D. His smoking history
E. Spironolactone therapy

ANSWER:
Bendroflumethiazide therapy

EXPLANATION:

Bendroflumethiazide causes both hyponatraemia and hypokalaemia. Spironolactone is associated with hyperkalaemia. His smoking would only be relevant if he had lung cancer cause syndrome of inappropriate ADH secretion - there is no indication of this from the question.

Please see Q-105 for Thiazide Diuretics

Q-327

A 72-year-old male is admitted to the Emergency Room following a collapse at church. ECG reveals dissociation between the P and QRS complexes with a rate of 40 / minute. Which one of the following clinical findings may also be found?

A. Loud S1
B. Narrow pulse pressure
C. Giant v waveforms in the JVP
D. Variable intensity of S1
E. Soft S2

ANSWER:
Variable intensity of S1

EXPLANATION:

Complete heart block causes a variable intensity of S1

Please see Q-178 for Complete Heart Block

Q-328

Which one of the following features is not part of the modified Duke criteria used in the diagnosis of infective endocarditis?

A. Fever > 38ºC
B. Positive molecular assays for specific gene targets
C. Indwelling central line
D. Intravenous drug use
E. Janeway lesions

ANSWER:
Indwelling central line

EXPLANATION:

The modified Duke criteria have now been adopted in the latest guidelines from the European Society of Cardiology.

Please see Q-211 for Infective Endocarditis: Features

Q-329

Which of the following congenital heart defects may progress to Eisenmenger's syndrome?

A. Tetralogy of Fallot
B. Coarctation of the aorta
C. Patent ductus arteriosus
D. Tricuspid atresia
E. Transposition of the great arteries

ANSWER:
Patent ductus arteriosus

EXPLANATION:

Although patients with tetralogy of Fallot have, by definition, a ventricular septal defect they do not go on to develop Eisenmenger's syndrome

Please see Q-36 for Eisenmenger's Syndrome

Q-330

A 70-year-old female presents to the Emergency Department (ED) with fever, tachycardia and hypotension. She has no significant past medical history. On examination, there is a loud systolic murmur in the mitral region which was not documented in an attendance to the ED the previous month. She reports previous rash and lip swelling with penicillin. Which of the following empirical antibiotic therapies is the most appropriate?

A. **Intravenous ceftriaxone + gentamicin**
B. **Intravenous teicoplanin + streptomycin**
C. **Intravenous vancomycin + gentamicin**
D. **Intravenous teicoplanin + gentamicin + rifampicin**
E. **Intravenous vancomycin + meropenem**

ANSWER:
Intravenous vancomycin + gentamicin

EXPLANATION:
This patient has presented with severe sepsis as evidenced by the fever, tachycardia, and hypotension. The question states that she has no significant past medical history, so it can be assumed that she has native valves and is not at increased risk of pseudomonal or enterococcal infections.

Current guidelines suggest that presenting with severe sepsis increases the probability that the causative organism is S. aureus, and therefore the treatment regimen needs to cover MRSA. The recommended treatment for this is vancomycin + low-dose gentamicin. This is of course safe to use in penicillin allergy.

Please see Q-138 for Infective Endocarditis: Prognosis and Management

Q-331

Which one of the following is the strongest risk factor for developing infective endocarditis?

A. **Previous episode of infective endocarditis**
B. **Intravenous drug use**
C. **Previous rheumatic fever**
D. **Permanent central venous access line**
E. **Recent dental surgery**

ANSWER:
Previous episode of infective endocarditis

EXPLANATION:
Infective endocarditis - strongest risk factor is previous episode of infective endocarditis

Please see Q-102 for Infective Endocarditis

Q-332

You are called to the coronary care unit. A patient who has been admitted following a myocardial infarction has developed a broad complex tachycardia. You suspect a diagnosis of polymorphic ventricular tachycardia. Which one of the following factors is most likely to have precipitated this?

A. **Hypoglycaemia**
B. **Bisoprolol**
C. **Hypomagnesaemia**
D. **Dehydration**
E. **Hyperkalaemia**

ANSWER:
Hypomagnesaemia

EXPLANATION:
Hypokalemia is the most important cause of ventricular tachycardia (VT) clinically, followed by hypomagnesaemia. Severe hyperkalaemia may cause VT in certain circumstances, for example in patients with structural heart disease, but it is not as common a cause as hypomagnesaemia.

Please see Q-126 for Ventricular Tachycardia

Q-333

A 60-year-old man is transferred from the local psychiatric unit to the Emergency Department. Throughout the day he has complained of palpitations and feeling light-headed. The psychiatry consultant noted he was tachycardic and requested a transfer. An ECG taken following admission shows a broad complex tachycardia consistent with torsardes de pointes, rate 120/min. His blood pressure is 122/80 mmHg and there are no signs of heart failure. What is the most appropriate management?

A. **Intravenous naloxone**
B. **Intravenous magnesium sulphate**
C. **DC cardioversion**
D. **Intravenous amiodarone**
E. **Intravenous verapamil**

ANSWER:
Intravenous magnesium sulphate

EXPLANATION:
Please see Q-118 for Torsades de Pointes

Q-334

Which of the following congenital heart defects is associated with a bicuspid aortic valve

A. **Tetralogy of Fallot**
B. **Ventricular septal defect**
C. **Atrial septal defect**
D. **Coarctation of the aorta**
E. **Transposition of the great arteries**

ANSWER:
Coarctation of the aorta

EXPLANATION:
BICUSPID AORTIC VALVE
Overview
- occurs in 1-2% of the population
- usually asymptomatic in childhood
- the majority eventually develop aortic stenosis or regurgitation

- associated with a left dominant coronary circulation (the posterior descending artery arises from the circumflex instead of the right coronary artery) and Turner's syndrome
- around 5% of patients also have coarctation of the aorta

Complications
- aortic stenosis/regurgitation as above
- higher risk for aortic dissection and aneurysm formation of the ascending aorta

Q-335

A 54-year-old man with atypical chest pain is referred to cardiology. An exercise ECG shows non-specific ST and T wave changes. Following this an coronary angiogram is performed which demonstrates no evidence of atherosclerosis. A diagnosis of Prinzmetal's angina is suspected. What is the most appropriate first-line treatment?

A. Nicorandil
B. Atenolol
C. Felodipine
D. Fluoxetine
E. Isosorbide mononitrate

ANSWER:
Felodipine

EXPLANATION:
Prinzmetal angina - treatment = dihydropyridine calcium channel blocker
See the SIGN guidelines for more details.

Please see Q-59 for Angina Pectoris: Drug Management

Q-336

A 60-year-old heavy goods vehicle (HGV) driver with a one month history of ankle swelling and orthopnoea presents to clinic for review. His departmental echocardiogram shows he has a left ventricular ejection fraction (LVEF) of 35%. Which of the following statements most accurately counsels this patient as regard to his driving?

A. An LVEF of < 40% bars him from driving a lorry, even if he becomes asymptomatic with treatment
B. His symptoms bar him from driving both a lorry and a car
C. The implantation of a CRT-defibrillator would allow him to drive in 6 weeks' time
D. He does not need to inform the DVLA
E. An LVEF of < 40% bars him from driving a lorry only if associated with incapacity

ANSWER:
An LVEF of < 40% bars him from driving a lorry, even if he becomes asymptomatic with treatment

EXPLANATION:
Heart failure is very commonly encountered in clinical practice. DVLA guidance for Group 2 entitlements (HGVs and buses) is much more strict than Group 1 entitlements (cars and vans).

Symptomatic heart failure will lead to revocation of a Group 2 licence, regardless of whether the symptoms lead to incapacity. If a patient on treatment becomes asymptomatic, then they may be relicensed only if their LVEF is >= 40%.

For Group 1 entitlements, the DVLA does not need to be informed of symptomatic heart failure if it does not lead to distracting or incapacitating symptoms.

Any form of defibrillator is a bar to a Group 2 entitlement.

Please see Q-90 for DVLA: Cardiovascular Disorders

Q-337

Which one of the following features would best indicate severe aortic stenosis?

A. Valvular gradient of 35 mmHg
B. Quiet first heart sound
C. Loudness of ejection systolic murmur
D. Fourth heart sound
E. Development of an opening snap

ANSWER:
Fourth heart sound

EXPLANATION:
Aortic stenosis - S4 is a marker of severity

Please see Q-15 for Aortic Stenosis

Q-338

A 74-year-old woman is reviewed. She recently had ambulatory blood pressure monitoring that showed an average reading of 142/90 mmHg. There is no significant past medical history of note other than hypothyroidism. Her 10-year cardiovascular risk score is 23%. What is the most appropriate management?

A. Start amlodipine
B. Start bendroflumethiazide
C. No treatment required - monitor blood pressure every year
D. Start ramipril
E. Repeat ambulatory blood pressure monitoring

ANSWER:
Start amlodipine

EXPLANATION:

Newly diagnosed patient with hypertension (> 55 years) - add a calcium channel blocker

The average reading is above the treatment threshold for patients below the age of 80 years. Treatment with a calcium channel blocker should therefore be started.

Please see Q-6 for Hypertension: Management

Q-339

A 72-year-old man presents to the Emergency Department with a broad complex tachycardia. Which of the following features would make it more likely that this was due to a supraventricular tachycardia rather than a ventricular tachycardia?

A. History of ischaemic heart disease
B. Left axis deviation
C. Capture beats
D. Absence of QRS concordance in chest leads
E. QRS complex greater than 160 ms

ANSWER:
Absence of QRS concordance in chest leads

EXPLANATION:

Positive QRS concordance in the chest leads is associated with ventricular tachycardia

Please see Q-187 for Broad Complex Tachycardia

Q-340

Which one of the following may reduce the effects of adenosine?

A. Dipyridamole
B. Diltiazem
C. Clopidogrel
D. Amiodarone
E. Aminophylline

ANSWER:
Aminophylline

EXPLANATION:

Adenosine

- ***dipyridamole enhances effect***
- ***aminophylline reduces effect***

Please see Q-25 for Adenosine

Q-341

A 60-year-old man is admitted with severe central chest pain to the resus department. The admission ECG shows ST elevation in leads V1-V4 with reciprocal changes in the inferior leads. Which one of the following is most likely to account for these findings?

A. 75% occlusion of the left anterior descending artery
B. 75% occlusion of the left circumflex artery
C. 75% occlusion of the right coronary artery
D. 100% occlusion of the left circumflex artery
E. 100% occlusion of the left anterior descending artery

ANSWER:
100% occlusion of the left anterior descending artery

EXPLANATION:

Widespread ST elevation in this territory implies a complete occlusion of the left anterior descending artery.

Please see Q-149 for ECG: ST Elevation

Q-342

A 52-year-old female with an acute presentation of chest pain undergoes an angiogram to look for coronary artery disease. During the procedure, she has a run of ventricular tachycardia which self-resolves.

The report of the angiogram revealed normal coronary arteries. All other cardiac investigations were normal. What is the most likely follow-up plan?

A. Insert internal cardiac defibrillator
B. Perform an exercise stress test
C. Discharge from cardiology when medically fit
D. Commence amiodarone
E. Repeat the angiogram

ANSWER:
Discharge from cardiology when medically fit

EXPLANATION:

An uncommon complication of a coronary angiogram is a ventricular arrhythmia secondary to irritation of the myocardium. When present, the offending catheter must be pulled back immediately to restore normal sinus rhythm.

Given the context of this question, this is likely a transient complication of the procedure rather than a patient factor. If all other cardiac investigations are normal and the patient is medically fit, then it would be safe for her to be discharged.

Please see Q-273 for Chest Pain: Assessment of Patients with Suspected Cardiac Chest Pain

Q-343

A 34-year-old woman is admitted to the Emergency Department following a collapse. An ECG shows a polymorphic ventricular tachycardia. Which one of the following is not associated with an increased risk of developing torsade de pointes?

A. Tricyclic antidepressants
B. Subarachnoid haemorrhage
C. Hypercalcaemia
D. Romano-Ward syndrome
E. Hypothermia

ANSWER:
Hypercalcaemia

EXPLANATION:
Hypocalcaemia, not hypercalcaemia, causes prolongation of the QT interval and hence may predispose to the development of torsade de pointes

Please see Q-55 for Long QT Syndrome

Q-344

A patient who is intolerant of aspirin is started on clopidogrel for the secondary prevention of ischaemic heart disease. Concurrent use of which one of the following drugs may make clopidogrel less effective?

A. Warfarin
B. Omeprazole
C. Codeine
D. Long-term tetracycline use (e.g. For acne rosacea)
E. Selective serotonin reuptake inhibitors

ANSWER:
Omeprazole

EXPLANATION:
Please see Q-98 for Clopidogrel

Q-345

A 71-year-old man is reviewed in the coronary care unit. He was admitted with an anterior ST-elevation myocardial infarction and received thrombolysis with alteplase. Ninety minutes following this an ECG shows a 30-40% resolution in the ST elevation. What is the most appropriate management?

A. Percutaneous coronary intervention
B. Repeat ECG in 4 hours, if still not a 50% resolution in ST elevation then proceed to percutaneous coronary intervention
C. Repeat thrombolysis with alteplase
D. Start a nitrate infusion
E. Inform his relatives that further intervention is futile and ensure adequate pain relief

ANSWER:
Percutaneous coronary intervention

EXPLANATION:
Please see Q-199 for Myocardial Infarction: STEMI Management

Q-346

A 63-year-old female on long-term warfarin for atrial fibrillation attends the anticoagulation clinic. Despite having a stable INR for the past 4 years on the same dose of warfarin her INR is measured at 5.4. Which one of the following is most likely to be responsible?

A. St John's Wort
B. Smoking
C. Carrot juice
D. Cranberry juice
E. Camomile tea

ANSWER:
Cranberry juice

EXPLANATION:
St John's Wort is an inducer of the P450 enzyme system so would cause the INR to decrease, rather than increase.

Please see Q-4 for Warfarin

Q-347

A 45-year-old man presents with fever. On examination he is noted to have a pan-systolic murmur and splinter haemorrhages. He is generally unwell with a blood pressure of 100/60 mmHg and a temperature of 38.8ºC. What is the most suitable antibiotic therapy until blood culture results are known?

A. IV amoxicillin + gentamicin
B. IV benzylpenicillin + gentamicin
C. IV vancomycin + gentamicin
D. IV vancomycin + benzylpenicillin
E. IV ceftriaxone + benzylpenicillin

ANSWER:
IV amoxicillin + gentamicin

EXPLANATION:
Please see Q-138 for Infective Endocarditis: Prognosis and Management

Q-348

Dilated cardiomyopathy may be caused by deficiency of which one of the following:

A. Chromium
B. Magnesium
C. Pyridoxine
D. Molybdenum
E. Selenium

ANSWER:
Selenium

EXPLANATION:
Please see Q-26 for Dilated Cardiomyopathy

Q-349

Which one of the following statements regarding catecholaminergic polymorphic ventricular tachycardia (CPVT) is correct?

A. Resting ECG typically shows T wave inversion in leads V1-V3
B. Beta-blockers are contraindicated in patients with CPVT
C. Is associated with cleft palate
D. In the majority of cases is due to a defect in the potassium channel
E. Symptoms generally develop before the age of 20 years

ANSWER:
Symptoms generally develop before the age of 20 years

EXPLANATION:
CATECHOLAMINERGIC POLYMORPHIC VENTRICULAR TACHYCARDIA
Catecholaminergic polymorphic ventricular tachycardia (CPVT) is a form of inherited cardiac disease associated with sudden cardiac death. It is inherited in an autosomal dominant fashion and has a prevalence of around 1:10,000.

Pathophysiology
- the most common cause is a defect in the ryanodine receptor (RYR2) which is found in the myocardial sarcoplasmic reticulum

Features
- exercise or emotion induced polymorphic ventricular tachycardia resulting in syncope
- sudden cardiac death
- symptoms generally develop before the age of 20 years

Management
- beta-blockers
- implantable cardioverter-defibrillator

Q-350

You are called to the obstetric ward to see a woman who is fitting. She is 34-weeks pregnant and currently an inpatient for the treatment of severe pre-eclampsia. The anaesthetist has secured the airway and is giving 100% oxygen. What is the most appropriate next step?

A. IV calcium gluconate
B. IV labetalol
C. IV methyldopa
D. IV lorazepam
E. IV magnesium sulphate

ANSWER:
IV magnesium sulphate

EXPLANATION:
Eclampsia - give magnesium sulphate first-line

Please see Q-303 for Eclampsia

Q-351

Each one of the following is associated with aortic dissection, except:

A. Ventricular septal defect
B. Turner's syndrome
C. Noonan's syndrome
D. Pregnancy
E. Marfan's syndrome

ANSWER:
Ventricular septal defect

EXPLANATION:
Please see Q-94 for Aortic Dissection

Q-352

A 68-year-old woman is admitted to hospital with complete heart block. After initially being treated with a temporary pacing wire she goes on to have a permanent pacemaker fitted. How soon after the procedure can she drive again?

A. Immediately
B. 24 hours
C. 3 days
D. 1 week
E. 4 weeks

ANSWER:
1 week

EXPLANATION:
Please see Q-90 for DVLA: Cardiovascular Disorders

Q-353

Which of the following physiological effects would be expected following administration of atropine?

A. Bradycardia + mydriasis
B. Tachycardia + miosis
C. Bradycardia + salivation
D. Bradycardia + miosis
E. Tachycardia + mydriasis

ANSWER:
Tachycardia + mydriasis

EXPLANATION:
ATROPINE
Atropine is an antagonist of the muscarinic acetylcholine receptor

Uses*
- treatment of organophosphate poisoning

Physiological effects

- tachycardia
- mydriasis

*atropine is no longer used in resuscitation

Q-354

A 64-year-old man with a history of type 2 diabetes mellitus is admitted with chest pain to the Emergency Department. An ECG shows ST elevation in the anterior leads and he is thrombolysed and transferred to the Coronary Care Unit (CCU). His usual medication includes simvastatin, gliclazide and metformin. How should his diabetes be managed whilst in CCU?

A. Stop metformin. Continue gliclazide at a higher dose
B. Stop metformin & gliclazide. Start subcutaneous insulin (basal-bolus regime)
C. Continue metformin & gliclazide at same dose
D. Stop metformin & gliclazide. Start intravenous insulin infusion
E. Stop metformin & gliclazide. Start subcutaneous insulin (biphasic insulin regime)

ANSWER:
Stop metformin & gliclazide. Start intravenous insulin infusion

EXPLANATION:
The benefits of tight glycaemic control following a myocardial infarction were initially established by the DIGAMI study. These findings were not repeated in the later DIGAMI 2 study. However modern clinical practice is still that type 2 diabetics are converted to intravenous insulin in the immediate period following a myocardial infarction.

NICE in 2011 recommended the following: 'Manage hyperglycaemia in patients admitted to hospital for an acute coronary syndrome (ACS) by keeping blood glucose levels below 11.0 mmol/litre while avoiding hypoglycaemia. In the first instance, consider a dose-adjusted insulin infusion with regular monitoring of blood glucose levels.'

Please see Q-199 for Myocardial Infarction: STEMI Management

Q-355

A 67-year-old diabetic gentleman who recently underwent aortic valve replacement presented with a fever, raised inflammatory markers and deranged renal function. Which one of the following organisms contribute to the highest rate of mortality in patients with his condition?

A. Enterococci
B. Streptococci
C. Staphylococci
D. Pseudomonas
E. HACEK Organisms

ANSWER:
Staphylococci

EXPLANATION:
Staphylococci is the leading organism contributing to mortality in infective endocarditis
Staph aureus followed by coagulase-negative staphylococci are two of the most common organisms causing infective endocarditis.

Enterococci - Belongs to the bowel organisms group and contributes to only 15% of mortality.

Streptococci - Only contribute to around 5% of mortality.

Pseudomonas - Rare cause of endocarditis, occurs when infected water enters the bloodstream.

HACEK Organisms - Lives on dental gums and are more common in intravenous drug users.

Please see Q-138 for Infective Endocarditis: Prognosis and Management

Q-356

A 64-year-old man is having a dual chamber pacemaker inserted. The ventricular lead is to be inserted via the coronary sinus. Where does the coronary sinus drain into?

A. Right atrium
B. Left ventricle
C. Right ventricle
D. Inferior vena cava
E. Left atrium

ANSWER:
Right atrium

EXPLANATION:
Please see Q-122 for Coronary Circulation

Q-357

A 75-year-old gentleman presents to outpatient clinic. He has recently been referred by his general practitioner (GP) after being diagnosed with a left femoral deep vein thrombosis (DVT) 2 weeks ago. In addition to this, he had a metallic aortic valve replacement (AVR) 3 months ago for critical aortic stenosis and has been on warfarin since. As far as you are aware, his international normalised ration (INR) has been reliably in the target range for this period of time. His other past medical history includes a previous DVT 30 years ago that was unprovoked.

He asks you more about anticoagulation treatment. What is the most appropriate thing to tell him about the duration of therapy required and target INR?

A. **It would be advisable to switch him to rivaroxaban as this is the easier alternative to warfarin**
B. **Lifelong anticoagulation with a target INR of 3.5**
C. **Lifelong anticoagulation with a target INR 3.0**
D. **Anticoagulation for 6 months with a target INR of 3.0**
E. **Lifelong anticoagulation with a target INR of 2.5**

ANSWER:
Lifelong anticoagulation with a target INR of 3.5

EXPLANATION:
There are a number of factors to consider in this case: a metallic aortic valve replacement requires lifelong anticoagulation but the incidence of recurrent DVT while on anticoagulation is the factor that really determines the correct target INR. NICE guidelines state that for recurrent DVT (while on anticoagulation) the target INR should be 3.5. The target INR for a metallic aortic valve alone is 3.0, while for a prosthetic valve with history of systemic embolism (DVT) the target would be 2.5. Therefore the former option is the most appropriate in this gentleman given the history of recurrent DVT which in this case has more influence than the presence of metallic AVR.

Please see Q-4 for Warfarin

Q-358

Which one of the following non-invasive methods provides the most accurate assessment of whether a patient has coronary artery disease?

A. **Contrast enhanced cardiac CT**
B. **Cardiac MRI with gadolinium**
C. **Exercise ECG**
D. **Cardiac SPECT with reversibility studies**
E. **Transoesophageal echocardiography**

ANSWER:
Contrast enhanced cardiac CT

EXPLANATION:
Please see Q-147 for Cardiac Imaging: Non-Invasive Techniques Excluding Echocardiography

Q-359

Which one of the following statements regarding the management of pregnant women with severe pre-eclampsia and eclampsia is incorrect?

A. **Intravenous fluids should be given to prevent renal failure**
B. **Magnesium sulphate treatment should continue for 24 hours post-partum**
C. **Problems are only seen after 20 weeks gestation**
D. **Reflexes should be monitored during magnesium sulphate infusion**
E. **Magnesium sulphate is given to both prevent and treat seizures**

ANSWER:
Intravenous fluids should be given to prevent renal failure

EXPLANATION:
Severe pre-eclampsia - restrict fluids
Pulmonary and cerebral oedema are important causes of morbidity and mortality in severe pre-eclampsia

Please see Q-303 for Eclampsia

Q-360

A 72-year-old woman who takes bendroflumethiazide for hypertension is admitted to the Emergency Department. Admission bloods show the following:

Na+	**131 mmol/l**
K+	**2.2 mmol/l**
Urea	**3.1 mmol/l**
Creatinine	**56 µmol/l**
Glucose	**4.3 mmol/l**

Which one of the following ECG features is most likely to be seen?

A. **Short PR interval**
B. **Short QT interval**
C. **Flattened P waves**
D. **J waves**
E. **U waves**

ANSWER:
U waves

EXPLANATION:
Hypokalaemia - U waves on ECG
J waves are seen in hypothermia whilst delta waves are associated with Wolff Parkinson White syndrome.

Please see Q-101 for ECG: Hypokaleima

Q-361

A 29-year-old man, with no past history, presents with a left middle cerebral artery (MCA) territory stroke. He reports trouble sleeping and laying flat at night that began after a flu-like illness 3 months ago, and reports some exertional dyspnoea. His left ventricular ejection fraction is 15% on a cardiac echocardiogram. Which of the following is the most likely factor which contributed to the cause of his stroke?

A. **Epstein-Barr virus**
B. **Stenosed carotid arteries**
C. **Coxsackie virus**
D. **Influenza virus**
E. **Parvovirus B19**

ANSWER:
Parvovirus B19

EXPLANATION:

The underlying diagnosis is a viral myocarditis precipitating a dilated cardiomyopathy and causing a cardioembolic stroke. Previously, the enteroviruses (including coxsackievirus) were the most common identified viruses in the 1990's. Currently, parvovirus B-19 and human herpes virus 6 are considered the most common causes of viral myocarditis. The echo may show reduced left ventricular ejection fraction, myocardial dyssynchrony (myocardial segments contract at different points in time), thinning of the left ventricular wall and a dilated left ventricle. Trouble sleeping and laying flat at night and the exertional dyspnoea after a flu-like illness are key features suggestive of a viral myocarditis.

The cause of the stroke is cardioembolic and not from carotid stenosis.

Viral Causes of Myocarditis:

- ***Parvovirus B19***
- ***Human herpes virus 6***
- ***Coxsackie B virus***
- ***Adenovirus***
- ***Hepatitis C***
- ***Cytomegalovirus***
- ***Echovirus***
- ***Influenza virus***
- ***Epstein-Barr virus***

Please see Q-26 for Dilated Cardiomyopathy

Q-362

You are called to review a 78-year-old man on the surgical wards. He is three days post-op following a colectomy. He was recently diagnosed with colon cancer (Duke's C) and has a history of polymyalgia rheumatica. Current medications include co-codamol 30/500, prednisolone and prophylactic dose low-molecular weight heparin. Five minutes ago he started to complain of severe central chest pain. An ECG performed by the nurses shows ST elevation in the anterior leads. Aspirin and oxygen have been given by the Foundation 1 doctor. What is the most appropriate treatment?

A. IV diamorphine + increase low-molecular weight heparin to treatment dose + double his prednisolone dose
B. IV diamorphine + arrange echocardiogram urgently to exclude pericardial tamponade
C. IV diamorphine + call the family in to discuss withdrawal of treatment
D. IV diamorphine + arrange percutaneous coronary intervention
E. IV diamorphine + thrombolysis

ANSWER:
IV diamorphine + arrange percutaneous coronary intervention

EXPLANATION:

Primary percutaneous coronary intervention is the most appropriate treatment given his recent operation and associated risk of bleeding.

Please see Q-199 for Myocardial Infarction: STEMI Management

Q-363

Each one of the following is associated with atrial myxoma, except:

A. Clubbing
B. Mid-diastolic murmur
C. Pyrexia
D. 'J' wave on ECG
E. Atrial fibrillation

ANSWER:
'J' wave on ECG

EXPLANATION:

A 'J' wave is seen in hypothermia

Please see Q-87 for Atrial Myxoma

Q-364

Which one of the following is the most common underlying mechanism causing prolongation of the QT segment?

A. Opening of calcium channels
B. Blockage of sodium channels
C. Opening of sodium channels
D. Blockage of potassium channels
E. Opening of potassium channels

ANSWER:
Blockage of potassium channels

EXPLANATION:

Long QT syndrome - usually due to loss-of-function/blockage of K+ channels
In long QT syndrome QT prolongation is due to overload of myocardial cells with positively charged ions during ventricular repolarisation. Around 90-95% of inherited causes are due to defects in potassium channels

Please see Q-55 for Long QT Syndrome

Q-365

A 19-year-old man collapses and dies whilst playing rugby at university. At post-mortem asymmetrical ventricular septal hypertrophy is noted. Analysis of the cardiac tissue is most likely to demonstrate a defect in which one of the following?

A. Tropomyosin
B. Myosin light-chain kinase
C. Calmodulin
D. Troponin C
E. Beta-myosin heavy chain protein

ANSWER:
Beta-myosin heavy chain protein

EXPLANATION:
Please see Q-16 for HOCM: Features

Q-366

Which one of the following agents is most useful in the maintenance of sinus rhythm in patients with atrial fibrillation?

A. Verapamil
B. Diltiazem
C. Ibutilide
D. Amiodarone
E. Digoxin

ANSWER:
Amiodarone

EXPLANATION:
Please see Q-29 for Atrial Fibrillation: Rate Control and Maintenance of Sinus Rhythm

Q-367

Which part of the jugular venous waveform may be exaggerated in tricuspid regurgitation?

A. x descent
B. v wave
C. y descent
D. a wave
E. c wave

ANSWER:
v wave

EXPLANATION:
JVP: giant v waves in tricuspid regurgitation

Please see Q-18 for Jugular Venous Pulse

Q-368

A 52-year-old man is admitted to the Emergency Department. He was found collapsed by neighbours. An ECG on arrival shows torsades de pointes. Which one of his medications is most likely to have contributed to this presentation?

A. Bisoprolol
B. Cimetidine
C. Risperidone
D. Phenytoin
E. Doxycycline

ANSWER:
Risperidone

EXPLANATION:
Please see Q-118 for Torsades de Pointes

Q-369

Which one of the following statements regarding Brugada syndrome is correct?

A. Usually inherited as an autosomal recessive disease
B. Is associated with left bundle branch block
C. Most common presentation is dilated cardiomyopathy
D. Management is with beta-blockers
E. More common in Asians

ANSWER:
More common in Asians

EXPLANATION:
Please see Q-154 for Brugada Syndrome

Q-370

Which one of the following is least associated with Wolff-Parkinson White syndrome?

A. Mitral valve prolapse
B. Ebstein's anomaly
C. Thyrotoxicosis
D. Coarctation of the aorta
E. Hypertrophic cardiomyopathy

ANSWER:
Coarctation of the aorta

EXPLANATION:
Please see Q-46 for Wolff-Parkinson-White

Q-371

A 25-year-old woman is brought to the Emergency Department by a friend. She developed palpitations around 30 minutes ago whilst drinking a cup of coffee. Her only past medical history of note is asthma and menorrhagia for which she uses a salbutamol inhaler and takes tranexamic acid respectively. The admission ECG shows a supraventricular tachycardia at a rate of 160 bpm. Vagal manoeuvres are unsuccessful. What is the most appropriate next step in her management?

A. Intravenous verapamil
B. Intravenous amiodarone
C. Intravenous adenosine
D. Electrical cardioversion
E. Intravenous esmolol

ANSWER:
Intravenous verapamil

EXPLANATION:
The administration of adenosine is contraindicated by her history of asthma. Verapamil should therefore be given.

Please see Q-65 for Supraventricular Tachycardia

Q-372

Which one of the following statements regarding B-type natriuretic peptide is incorrect?

A. Effective treatment for heart failure lowers a patients BNP level
B. Acts as a diuretic
C. A hormone produced mainly by the left ventricular myocardium in response to strain
D. Is a good marker of prognosis in patients with chronic heart failure
E. The positive predictive value of BNP is greater than the negative predictive value

ANSWER:
The positive predictive value of BNP is greater than the negative predictive value

EXPLANATION:
BNP has a good negative predictive value rather than positive predictive value

Please see Q-40 for B-type natriuretic peptide

Q-373

A 75-year-old woman was admitted to the Acute Medical Unit with pneumonia. Her only past medical history of note is transient ischaemic attack 2 months previously. On initial assessment, ECG revealed atrial fibrillation with a ventricular rate of 103. She was treated with intravenous fluids and antibiotics. She improved significantly. Two further ECGs overnight revealed normal sinus rhythm. The following day, she was deemed medically fit for discharge.

What is the single most appropriate management option regarding her episode of atrial fibrillation?

A. No follow-up required
B. Repeat ECG in two weeks
C. Oral anticoagulation
D. Aspirin
E. 24-hour tape and consider oral anticoagulation

ANSWER:
Oral anticoagulation

EXPLANATION:
A single episode of paroxysmal atrial fibrillation, even if provoked, should still prompt consideration of anticoagulation
This patient has a CHADSVASC score of three therefore initiating anticoagulation would be appropriate. Despite being provoked by pneumonia, this patient is at high risk of having further episodes of atrial fibrillation. Aspirin is no longer recommended. A 24-hour tape is useful in patients with symptomatic palpitations, or those who have experienced a thrombo-embolic event without known AF. In this example we have already 'found' atrial fibrillation, and we should initiate treatment. While some studies have linked paroxysmal AF 'burden' on cardiac monitoring to stroke risk, this is not currently in guidelines. We know from the CHADSVASC score that on average, the risk is likely to be high (approximately 3.2% per year) regardless of burden. A 24-hour tape may be useful when considering an ablation, or assessing the response to rhythm control medication. Repeating the ECG in two weeks is not an unreasonable suggestion, but should not preclude initiation of anticoagulation.

Please see Q-8 for Atrial Fibrillation: Anticoagulation

Q-374

A 24-year-old male is diagnosed as having hypertrophic obstructive cardiomyopathy. Which one of the following markers is most useful in assessing risk of sudden death?

A. Abnormal blood pressure changes on exercise
B. Left ventricular outflow tract gradient
C. QT interval
D. Right atrial diameter
E. QRS duration

ANSWER:
Abnormal blood pressure changes on exercise

EXPLANATION:
Please see Q-75 for HOCM: Prognostic Factors

Q-375

Which one of the following statements is not correct regarding hypertension in pregnancy?

A. An increase above booking readings of > 30 mmHg systolic or > 15 mmHg diastolic suggests hypertension
B. Pre-eclampsia occurs in around 5% of pregnancies
C. Urine dipstick showing protein + is consistent with gestational hypertension
D. A rise in blood pressure before 20 weeks suggests pre-existing hypertension
E. With gestational hypertension the blood pressure rises in the second half of pregnancy

ANSWER:
Urine dipstick showing protein + is consistent with gestational hypertension

EXPLANATION:
Proteinuria suggests pre-eclampsia

Please see Q-170 for Hypertension in Pregnancy

Q-376

A 79-year-old man is referred to the acute medical unit following a fall. He is unsure why he collapsed but is now fully alert. He is complaining of abdominal pain but his bowel habits are unchanged.

He has a past medical history of prostatism and hypertension. He tells you he doesn't take any medication.

On examination he has a Glasgow coma scale score of 15, a blood pressure of 98/46 mmHg and a heart rate of 98beats per minute.

Hb	**115 g/l**
Platelets	**321 * 109/l**
WBC	**6.6 * 109/l**

His radiology results are reported as follows:

Chest	**PA film, lung fields clear, widened mediastinum**
Abdomen	**normal bowel gas pattern**

Which of the following is the next most appropriate step in this man's management?

A. Urgent echocardiogram
B. CT aortic angiogram
C. Start IV labetalol
D. Bronchoscopy with pleural biopsy
E. Pericardiocentesis

ANSWER:
CT aortic angiogram

EXPLANATION:
In a man with low blood pressure and vague abdominal pain, always be mindful of the possibility of dissection or aneurysmal rupture. CT imaging with arterial contrast is the gold standard for diagnosis. Whilst an echocardiogram might identify disruption of the aortic root in a backwards tear, it would not identify more distal aortic pathology.