BHRS

British Heart Rhythm Society

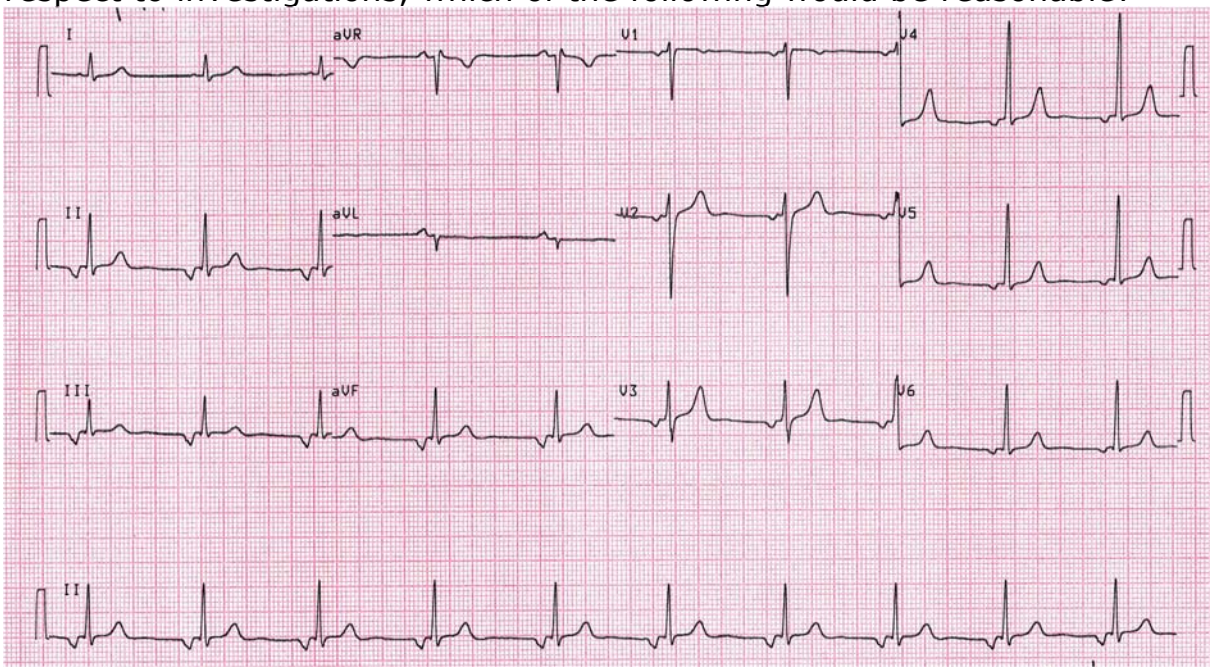
CERTIFICATION EXAMINATION©

50% OF QUESTIONS TAKEN FROM THE 2015 IN EACH SECTION

2015

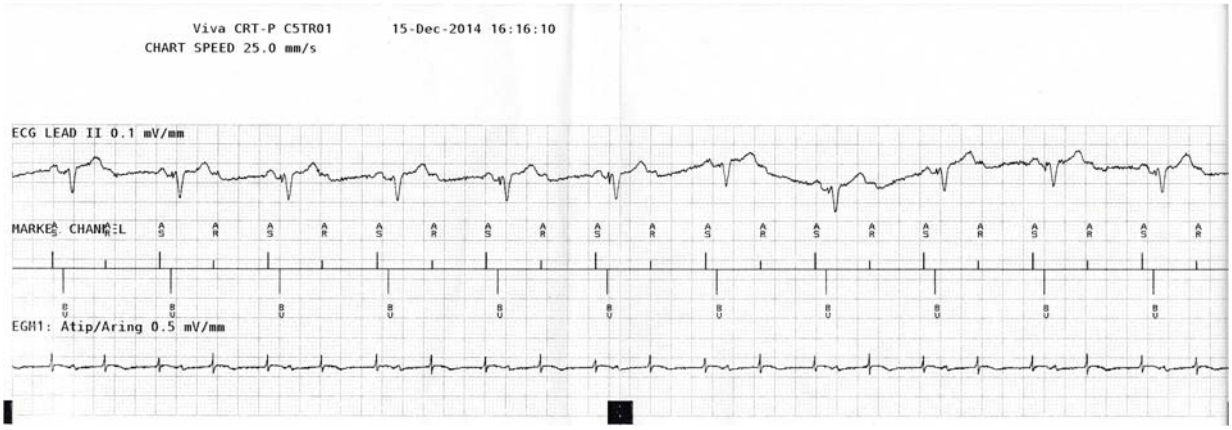
SECTION 1 – CORE QUESTIONS

1. A 23-year old woman was referred for investigation after having been found to have the below ECG at a routine employment medical. With respect to investigations, which of the following would be reasonable?



A. Cardiac MRI scan
B. Electrophysiology study
C. Implantation of a loop recorder
D. No further investigations are indicated
E. Signal averaged ECG

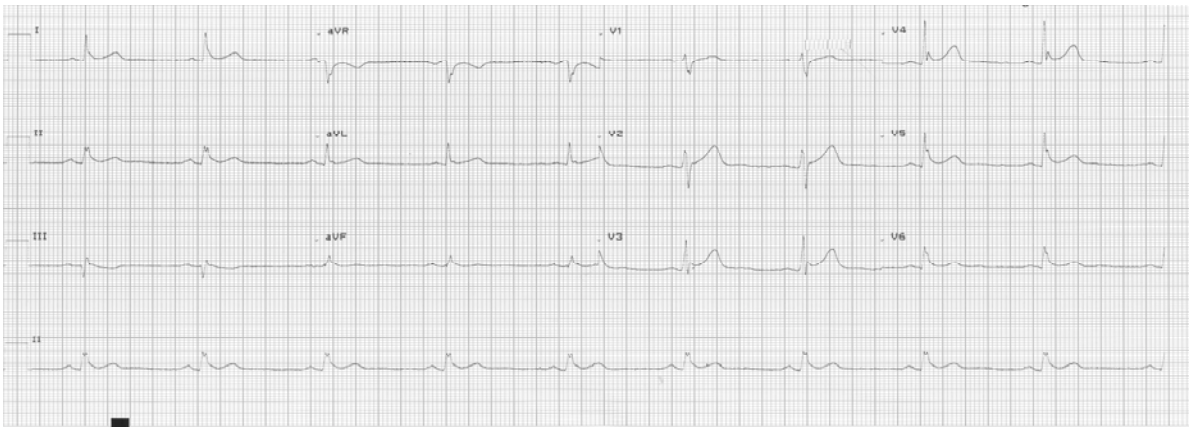
2. A 48-year old woman underwent upgrade from a dual chamber PPM to a CRT-P device. 2 weeks later she contacted the pacing clinic complaining of shortness of breath at moderate levels of exertion. The following EGM was obtained after exercise.



Which of the following would be a reasonable programming change?

A. Shorten PVARP
B. Shorten sensed AV interval
C. Shorten paced AV interval
D. Shorten upper rate interval
E. Shorten ventricular refractory period

3. The following ECG was recorded on a 35-year old asymptomatic man. The ECG diagnosis is:



A. Acute myocardial infarction
B. Acute pericarditis
C. Early repolarisation
D. Short QT syndrome
E. Ventricular pre-excitation

4. Prevention of cardiac implantable electronic device (CIED) infection is facilitated by which of the following perioperative measures?

A. Administration of intravenous antibiotics more than 1 hour prior to the implant procedure
B. Hair removal with razor rather than electric clippers
C. Skin decontamination with 2% chlorhexidine solution
D. Use of heparin in the perioperative period in patients requiring oral anticoagulation with warfarin
E. Use of multiple drapes

5. A 58-year old man undergoes elective insertion of a CRT-D device for dilated cardiomyopathy. During the procedure the patient receives intravenous midazolam and fentanyl as sedation, however her respiratory rate drops and the operator requests that the midazolam be reversed. Which agent should be administered?

A. Epinephrine
B. Flumazenil
C. Glucagon
D. Naloxone
E. Protamine

6. A 32-year old woman is admitted to the coronary care unit with a narrow complex tachycardia thought to be AVNRT. The patient is stable, vagal manoeuvres are ineffective and she is given intravenous adenosine. What is the maximum recommended dose of adenosine as per 2010 resuscitation council (UK) ALS guidelines?

A. 3mg
B. 6mg
C. 9mg
D. 12mg
E. 15mg

7. In relation to clinical trials, sensitivity is a measurement of?

   A. The number of new cases occurring in a population
   B. The proportion of actual positives that are correctly identified
   C. The proportion of negatives that are correctly identified
   D. The proportion of positive results that are true positives
   E. The proportion of negative results that are true negatives

8. A 77-year old woman undergoes an elective pacemaker generator replacement plus insertion of a new right ventricular lead. Prior to the procedure a venogram is performed using intravenous contrast media. Shortly after the injection of contrast the patient becomes acutely short of breath, hypotensive and tachycardic with increasing confusion and agitation. What is the most appropriate immediate treatment for this condition?

   A. Antihistamine
   B. Bronchodilators
   C. Epinephrine
   D. Fluid bolus
   E. Hydrocortisone

9. The British Society of Echocardiography (BSE) definition of severe left ventricular systolic dysfunction is an ejection fraction no greater than:

   A. 20%
   B. 25%
   C. 30%
   D. 35%
   E. 40%

10. In relation to venous anatomy and cardiac rhythm management procedures, which of the following statements is true?

    A. The cephalic vein is present in less than 60% of the population
    B. The common femoral vein lies lateral to the femoral artery
    C. The prevalence of a persistent left sided SVC is 5%
    D. The tendon of Todaro directs venous blood towards the intra-atrial septum
    E. The axillary vein is an extrathoracic structure

11. A 79-year old man attends for a routine pacemaker follow-up. A dual chamber pacemaker was implanted 1-year earlier for intermittent second degree AV block. The atrial lead impedance is <200 **Ω** (ohms). The most likely cause is?

    A. Insulation break
    B. Lead conductor fracture
    C. Lead – header mismatch
    D. Lead perforation
    E. Twiddler's syndrome

12. A 28-year old woman presented with recurrent syncope whilst undertaking exercise. She had no significant past medical history and took no regular medication. Her aunt died suddenly at the age of 28. Physical examination was normal. ECG recording revealed several episodes of non-sustained, regular broad complex tachycardia with a left bundle branch block morphology. A transthoracic echocardiogram suggested a structurally normal heart but the images were reported to have limited endocardial definition. What investigation is most likely to help in making the diagnosis?

A. Cardiac CT scan
B. Cardiac MRI scan
C. Contrast enhanced echocardiogram
D. Right and left heart catheterisation
E. Myocardial perfusion scan

13. If a pacemaker output voltage is 3.5V and the measured lead impedance is 350Ω, the current flow is:

A. 0.01mA
B. 0.1mA
C. 1mA
D. 10mA
E. 100mA

14. In relation to pacemaker lead insulation which of the following is an advantage of polyurethane over silicone rubber?

A. Low friction
B. Metal ion oxidation
C. Repairable
D. Subject to cold flow failure
E. Very flexible

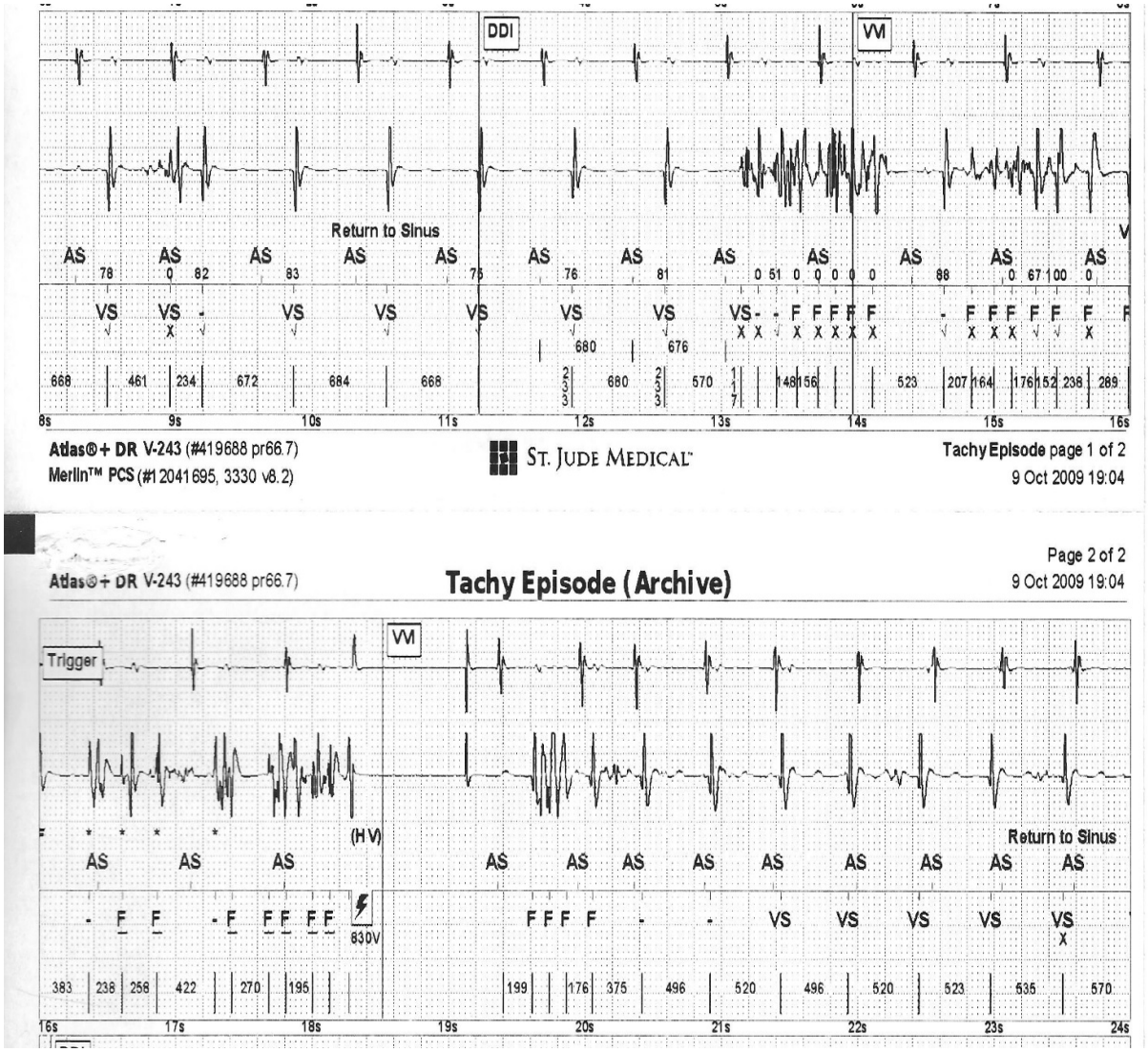
15. In relation to pacemaker timing cycles, which of the following is a derived variable?

A. Atrio-ventricular interval
B. Lower rate interval
C. Post-ventricular atrial refractory period
D. Total atrial refractory period
E. Ventricular refractory period

16. With regards to cardiac anatomy, Bachmann's bundle refers to which of the following?

A. An inter-atrial connection
B. Embryological remnant of left SVC
C. Fasciculo-ventricular fibres
D. Inferior border of triangle of Koch
E. Posterior fascicle of the left bundle branch

17. A 76-year old man with a dual chamber ICD presents to the emergency department. He reports experiencing a shock from his device. The following EGM was downloaded.



What does the electrogram show?

A. An appropriate shock for ventricular tachycardia.
B. Inappropriate shock for sinus tachycardia.
C. Non-sustained VT leading to an inappropriate shock
D. Oversensing resulting in an inappropriate shock
E. Undersensing resulting in a delayed shock

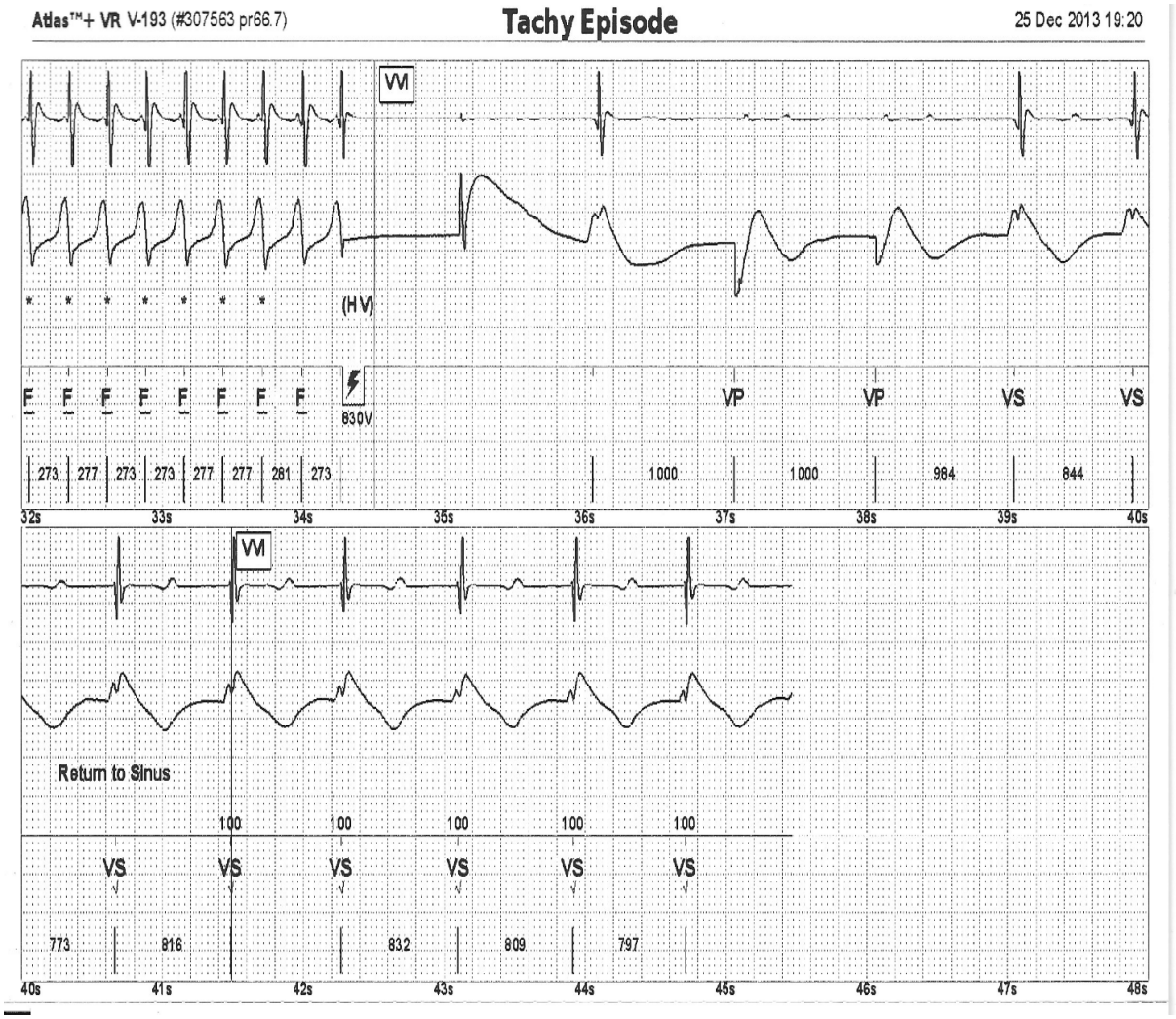
18. In an asymptomatic 27-year old woman, in which of the following situations would she need to inform the DVLA?

A. Arrhythmogenic right ventricular cardiomyopathy
B. Congenital complete heart block
C. Brugada syndrome
D. Dilated cardiomyopathy
E. Ventricular pre-excitation

19. A Farad is the unit of measurement of which of the following?

A. Capacitance
B. Energy
C. Frequency
D. Inductance
E. Resistance

20. A single chamber ICD was interrogated and the following EGM obtained. What does it demonstrate?



A. Acceleration of tachycardia following ATP
B. Failure to terminate ventricular tachycardia
C. Post shock pacing for bradycardia
D. Termination of ventricular tachycardia with burst of ATP
E. Inappropriate shock for atrial tachycardia

21. A 67-year old man undergoes implantation of a CRT pacemaker. How long following implantation must driving cease?

A. 1 day
B. 2 days
C. 1 week
D. 4 weeks
E. 6 weeks

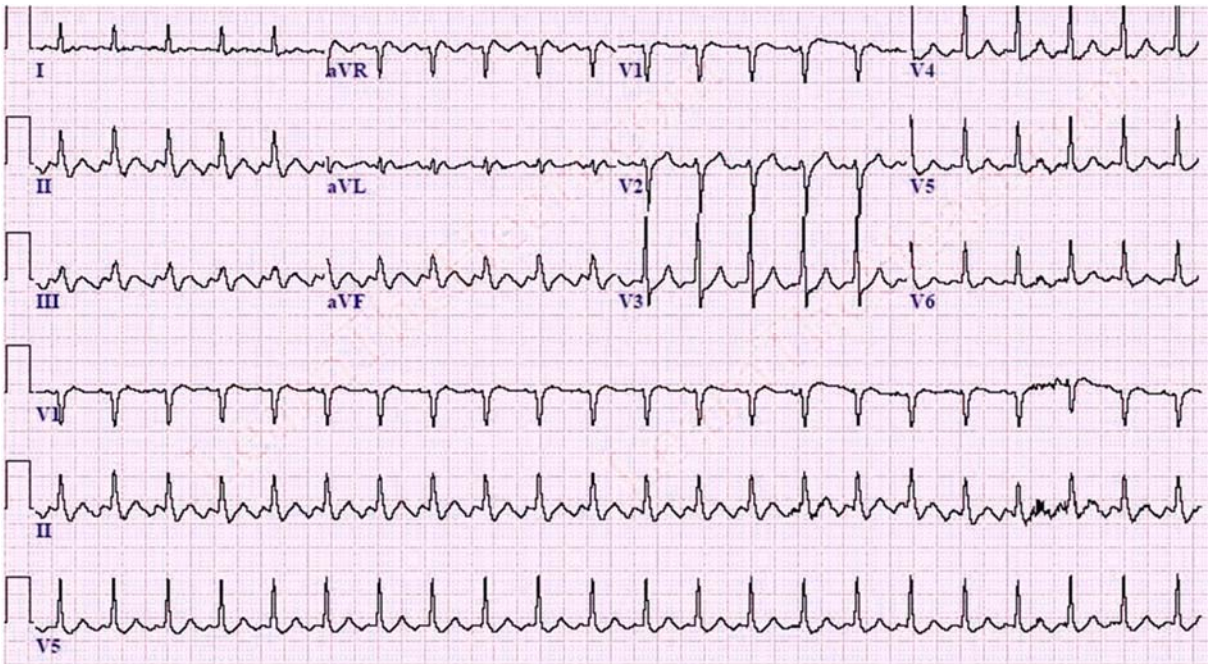
22. The normal HV interval is which of the following?

A. 20 – 40 ms
B. 35 – 55 ms
C. 30 – 70 ms
D. 50 – 85 ms
E. 80 – 100 ms

23. A 58-year old man attends the pre-admission clinic prior to implantation of a CRT-D device for ischaemic cardiomyopathy. His current medication includes bisoprolol, ramipril, epleronone, aspirin and atorvastatin. The patient is concerned that he has a dry tickling cough. What is the most likely cause of the cough?

A. Aspirin
B. Bisoprolol
C. Epleronone
D. Ramipril
E. Simvastatin

24. A 78-year old man presents to your clinic with a 7-day history of dyspnoea and profuse sweating. On examination he is found to be tachycardic and his blood pressure is 95/60mmHg. A 12 lead ECG is recorded and is shown below. What is the most likely ECG diagnosis?



A. Atrial fibrillation
B. Atrial flutter
C. Atrial tachycardia
D. AV nodal re-entrant tachycardia
E. AV re-entrant tachycardia

25. A 65-year old woman has a pacemaker inserted for symptomatic sinus node disease. She is commenced on Flecainide for the treatment of paroxysmal AF. What action should be taken with her pacemaker?

A. Decrease ventricular sensitivity
B. Increase base rate
C. Programmed to unipolar pacing mode
D. Reduce pulse width
E. Check pacing threshold

26. A 27-year old woman was admitted to the emergency department after a faint. Her 12-lead ECG showed sinus tachycardia at 100bpm with normal PR interval and QRS morphology. The QT intervals were measured by hand in each lead. It was not possible to measure the QT accurately in leads aVR and V6.

I:	300ms	aVR:	n/a	V1:	320ms	V4:	340ms
II:	320ms	aVL:	340ms	V2:	340ms	V5:	320ms
III:	320ms	aVF:	340ms	V3:	360ms	V6:	n/a

What is her (uncorrected) QT interval?

A. 300ms
B. 320ms
C. 340ms
D. 360ms
E. Unknown because of missing data

27. Patients taking amiodarone should avoid which of the following foods?

A. Broccoli
B. Celery
C. Cranberry juice
D. Grapefruit juice
E. Scallops

28. The most commonly used pacemaker power supply is which of the following?

A. Lithium iodine
B. Lithium cupric sulfide
C. Lithium lead
D. Lithium silver chromate
E. Lithium thionyl chloride

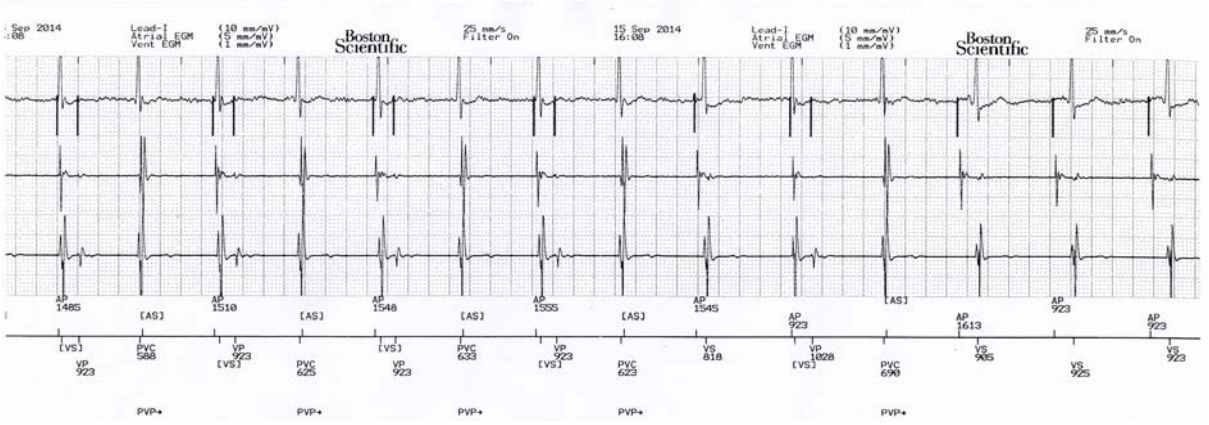
29. A patient with a CRT-D device implanted for primary prevention attends for follow-up. Interrogating the device, biventricular pacing is only documented 90% of the time. Which of the following would explain this finding?

A. Atrial undersensing
B. Frequent ventricular ectopy
C. LV offset programmed on
D. Rate drop programmed on
E. Short PVARP interval

SECTION 2 – DEVICES

ANSWER THIS SECTION, SECTION 3 OR SECTION 4 IN ADDITION TO SECTION 1 DO NOT ANSWER MORE THAN ONE SPECIALIST SECTION

30. A 58-year old woman with a dual chamber pacemaker implanted for sinus node dysfunction 6-months previously attended for review. She complained of intermittent episodes of breathlessness that were transient and tended to occur at rest. Her device was programmed DDDR with a lower rate of 65 beats per minute. What is shown by this EGM recorded during the pacing check?



A. Atrial undersensing
B. End of battery life pacemaker behaviour
C. Loss of ventricular capture
D. Normal pacemaker function
E. Ventricular undersensing

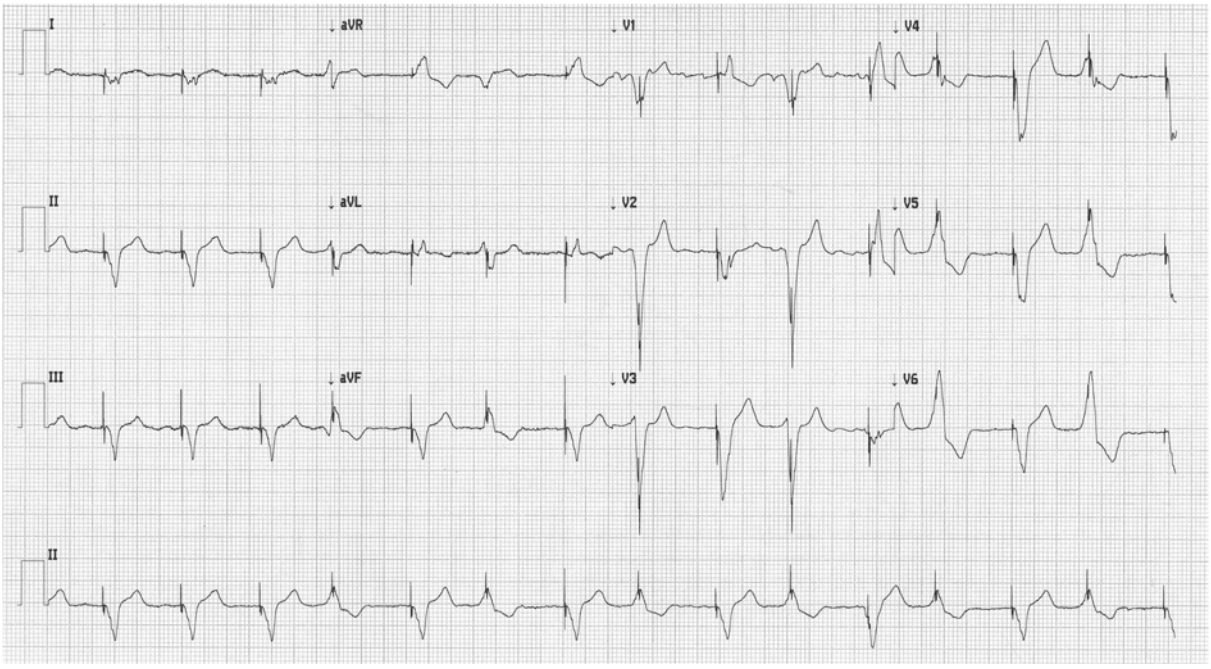
31. In a patient with severe LV impairment (EF<35%), NYHA functional class II and RBBB, according to NICE guidelines (June 2014) when is a CRT-D indicated?

A. If QRS duration is > 130ms
B. If QRS duration is > 150ms
C. If QRS duration is > 120ms and combined with prolonged PR interval
D. If QRS duration is > 120ms and combined with left anterior hemi-block
E. If QRS duration is > 130ms with positive VT stimulation study

32. A primary prevention ICD is indicated in a patient with an ischaemic aetiology after how many days following an acute myocardial infarction?

A. 5
B. 10
C. 20
D. 30
E. 40

33. The following ECG was obtained from a 54-year old man with idiopathic dilated cardiomyopathy who was under regular review following implantation of a CRT-P device 2-years previously. At his last pacing check 4-weeks prior he was documented as having 99.3% biventricular pacing. The ECG demonstrates?



A. BiV pacing with LV offset
B. Intermittent loss of LV capture
C. LV triggered pacing
D. Ventricular safety pacing
E. Ventricular undersensing

34. A 65-year old male attends pacing clinic complaining of feeling non-specifically unwell. He underwent an ICD generator replacement 7 months earlier complicated by a haematoma requiring evacuation. On examination there is evidence of device erosion and extraction is recommended. What is the likeliest organism causing the implantable cardiac electronic device infection?

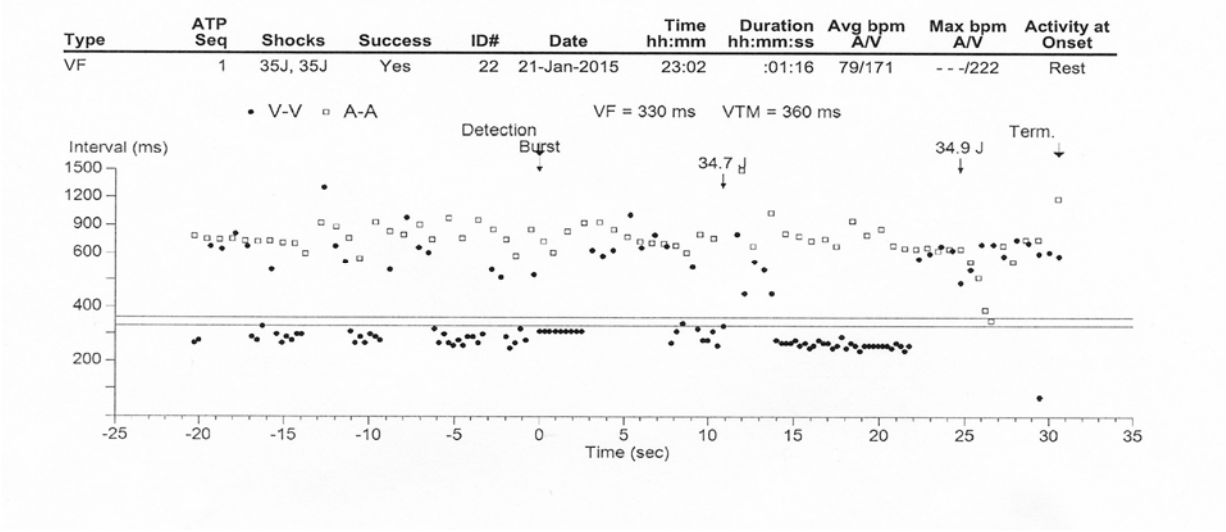
A. Coagulase-negative staphylococci
B. Enterococcus spp.
C. Gram-negative bacilli
D. Propionibacterium spp.
E. Streptococcus spp.

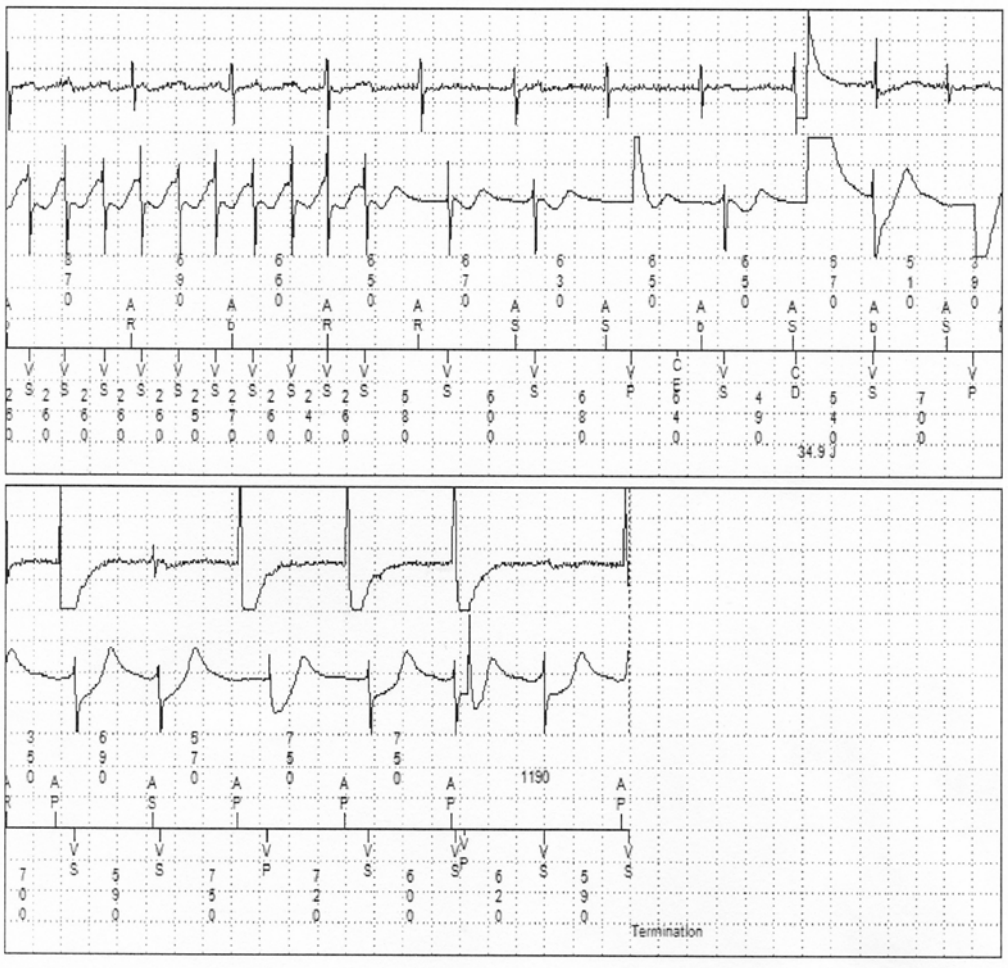
35. Which clinical factor is most predictive of a clinical response to CRT?

A. Atrial fibrillation
B. Dilated cardiomyopathy
C. Male gender
D. Narrow QRS morphology
E. Right Bundle branch block

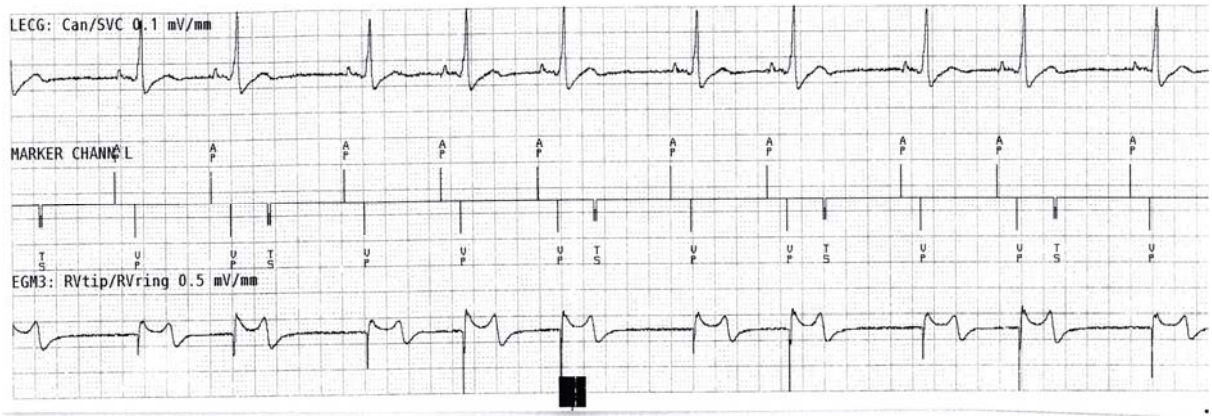
36. A 68-year old woman with severe LV impairment secondary to IHD had a dual chamber ICD implanted for primary prevention. A remote monitoring alert highlighted the fact that she had received 2 shocks from her device. The dot plot and EGM below were downloaded remotely. The EGM refers to the latter part of the dot plot. The likely reason for the second shock therapy is which of the following?

A. A committed second shock delivered
B. Appropriate shock delivered for VT/VF
C. Inappropriate shock for rapidly conducted atrial fibrillation
D. Shock delivered because confirmation criteria fulfilled
E. Shock delivered because of ventricular oversensing



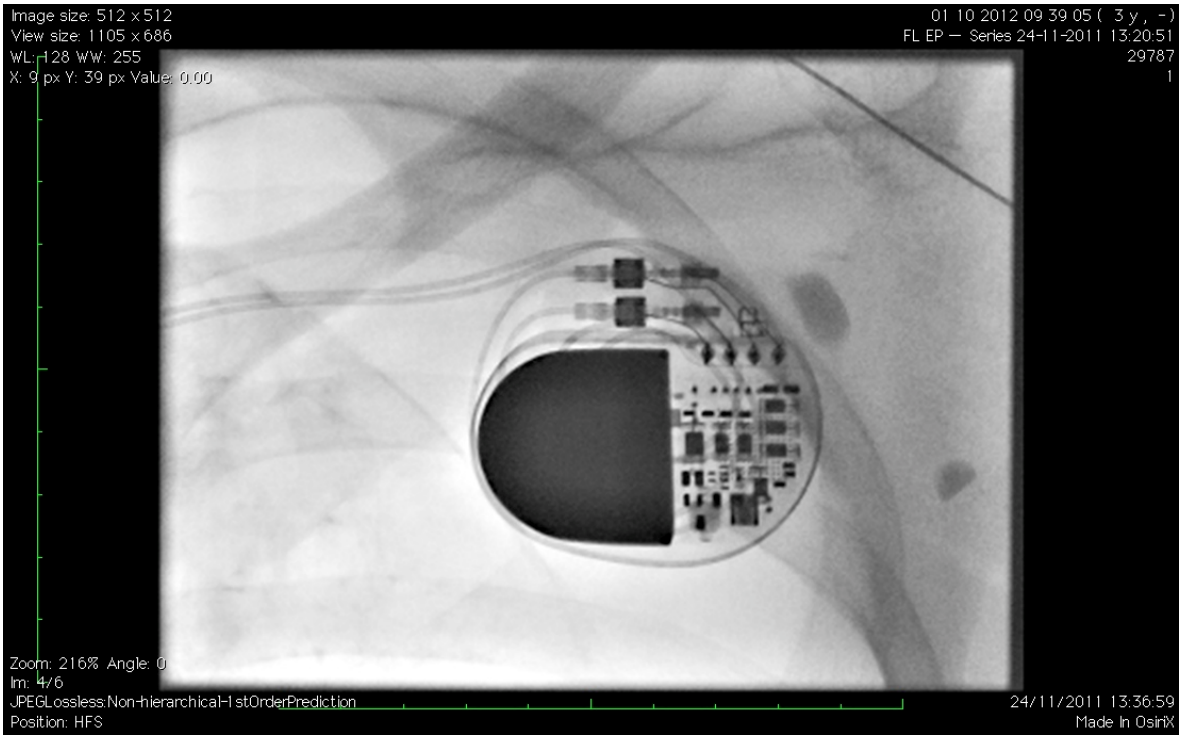


37. A 48-year old man with non ischaemic dilated cardiomyopathy and a strong family history of SCD had a CRT-D device implanted. The following EGM was obtained at his first post implant check. Which of the following programming changes would be the preferred first option



A. Decrease LV offset
B. Decrease RV lead sensitivity
C. Decrease RV output
D. Increase PVARP
E. Increase paced ventricular blanking period

38. The following image was acquired at the end of a left sided dual chamber pacemaker implant procedure. What complication has occurred?



A. Lead fracture
B. Lead connector pin displacement
C. Pneumothorax
D. Pocket haematoma
E. Swab retained in wound

39. A 72-year old man with an ICD implanted 4 years previously attended for routine review in the pacing clinic. His device had been implanted for primary prevention against sudden cardiac death (SCD) and was programmed with a single VF zone at 188 bpm. Interrogation of his device showed that all lead and battery parameters were satisfactory. However, he was found to have had an episode of VT at 192 bpm, which was successfully terminated by ATP delivered prior to charging. The patient was unaware of the event. According to DVLA guidelines he should be advised

A. No requirement to cease from driving
B. Not to drive for 1 week
C. Not to drive for 1 month
D. Not to drive or 6 months
E. Not to drive for 2 years

40. Which of the following is a class I indication for lead extraction?

A. Lead removal in patients if a CIED implantation would require more than 4 leads on one side or more than 5 leads through the SVC
B. Lead removal in patients that require specific imaging techniques (e.g., MRI) and cannot be imaged due to the presence of the CIED system for which there is not other available imaging alternative for the diagnosis.
C. Lead removal in patients with ipsilateral venous occlusion preventing access to the venous circulation for required placement of an additional lead, when there is no contraindication for using the contralateral side.
D. Lead removal in patients with clinically significant thromboembolic events associated with thrombosis on a lead or a lead fragment.
E. Patients with severe chronic pain at the device or lead insertion site

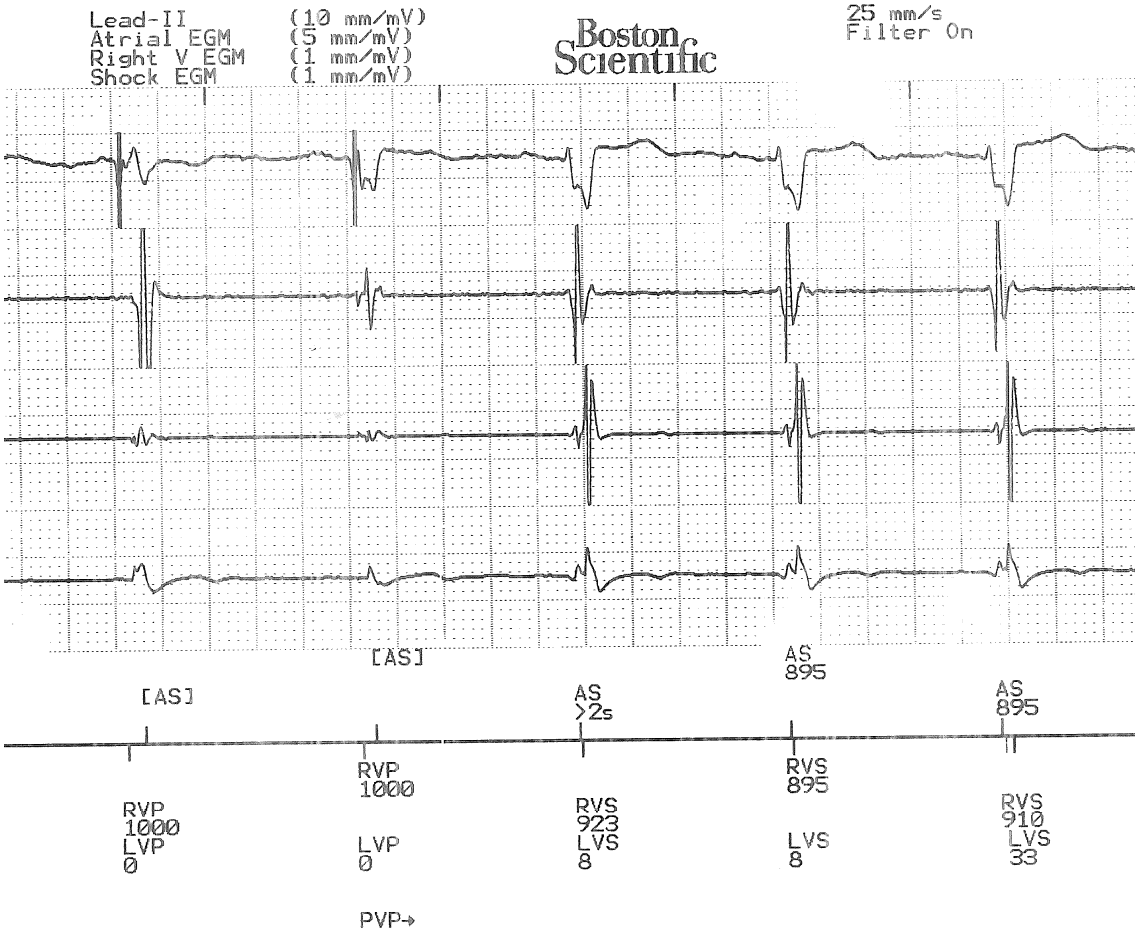
41. A 77-year old male with ischaemic cardiomyopathy, severe LV impairment, sinus rhythm, QRS 142ms and significant SOB is referred for consideration of complex device therapy. He is on optimal medical therapy. Which factor would favour CRT-D over CRT-P?

A. Older age
B. Life expectancy>1 year
C. NYHA class IV symptoms
D. Right bundle branch block
E. Severe renal insufficiency

42. The 2013 ESC guidelines on cardiac pacing and cardiac resynchronisation therapy state that pacing should be considered in patients with a history of syncope and documentation of asymptomatic pauses due to sinus arrest, sinus-atrial block or AV block. What is the minimum duration of pause (seconds) required?

A. 2
B. 3
C. 4
D. 5
E. 6

43. A 74-year old man reports initial improvement following implantation of a CRT-D device. He then developed shortness of breath. He is seen for his 6-week check and this EGM is recorded during testing in mode VDD 60ppm. The most likely cause of the recording is?



A. Atrial lead displacement
B. Development of junctional rhythm
C. Failure of LV capture
D. Functional atrial oversensing
E. T wave oversensing

44. Pacemaker lead electrodes are commonly coated with which of the following?
A. Copper
B. Nickel
C. Platinum
D. Silver
E. Zinc

45. Which of the following is true of subcutaneous ICDs:

A. Anti-tachycardia pacing is an option
B. Average battery longevity is 10 years
C. Do not require an electrode
D. Increased incidence of T wave oversensing compared to conventional ICDs
E. Lower defibrillation threshold than conventional ICD

46. A 65-year old man presented to the outpatient clinic with heart failure. He had a CRT-P implanted and attended pacing clinic for the first post implant check. The device was programmed with output 3.5V @ 0.5ms pulse duration on all channels. Which of the following is the most likely description of this EGM:

A. Anodal capture
B. Biventricular capture
C. Failure of LV capture
D. LV lead displacement
E. RV lead displacement

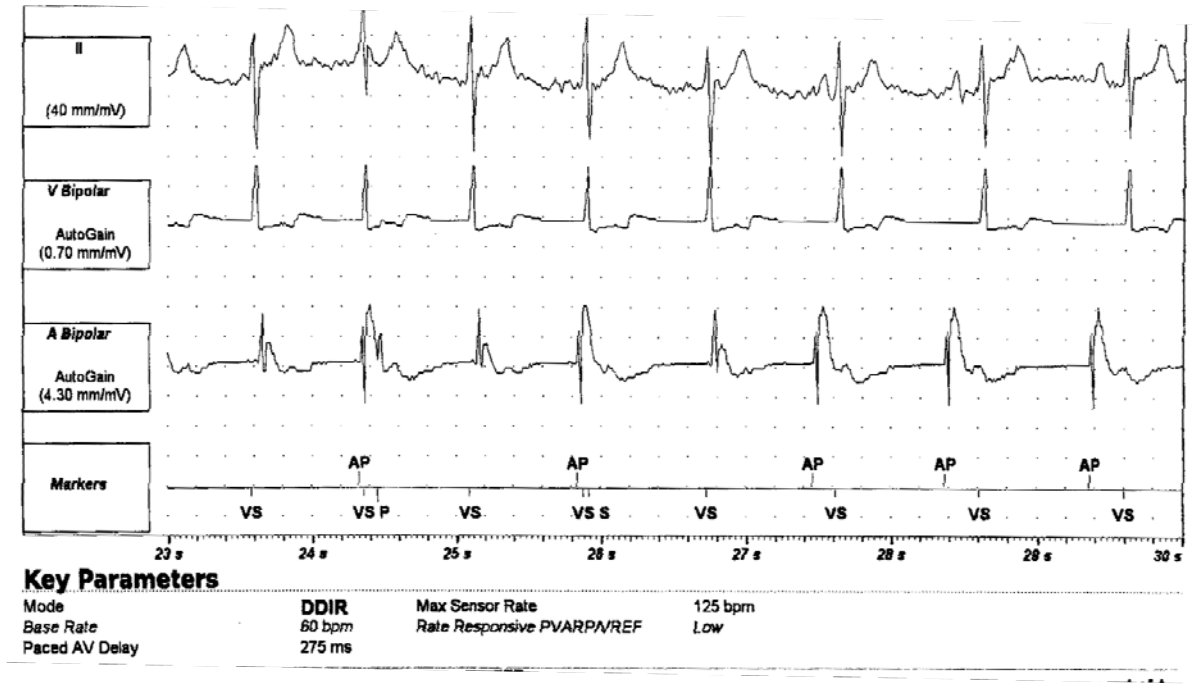
47. In terms of a pacing electrode, which of the following statements is true?

A. A porous layer increases the polarisation phenomenon
B. A Steroid-eluting electrode increases the risk of exit block
C. High impedance leads have a large electrode surface area
D. Lead efficiency is reduced by a porous electrode coating
E. The smaller the radius, the greater the current density

48. A 83-year old female undergoes TAVI (percutaneous Aortic valve replacement) for severe calcific aortic stenosis. Which pre-TAVI ECG abnormality is most predictive for the need for a PPM post procedure?

A. 1st degree AV block
B. Atrial fibrillation
C. Left axis deviation
D. Right bundle branch block
E. Sinus bradycardia

49. The EGM below was taken at routine follow-up of a dual chamber pacemaker. What is the explanation for the second complex seen?



A. Atrial fusion beat
B. Loss of ventricular sensing
C. Loss of atrial capture
D. Pseudo/pseudo fusion beat
E. Ventricular safety pacing

50. Which of the following management strategies will help reduce AV crosstalk?

A. Decrease the atrial output
B. Increase sensitivity of ventricular channel
C. Program ventricular safety pacing off
D. Shorten the post-atrial ventricular blanking period
E. Use unipolar pace sense configuration

51. A 67-year old bus driver undergoes implantation of a CRT pacemaker. He is unable to drive a bus for how long following implantation

A. 1 day
B. 2 days
C. 1 week
D. 4 weeks
E. 6 weeks

52. The 2015 BHRS standards for implantation of cardiac rhythm management devices states that for a centre implanting complex devices the minimum recommended number of implants per centre per year is:

A. 30
B. 40
C. 50
D. 60
E. 70

53. A 63-year old man is referred for consideration of CRT-D therapy. He has ischaemic cardiomyopathy, left bundle branch block (QRS 155ms, sinus rhythm) and has NYHA class II symptoms. A CRT-D is indicated based on which clinical trial?

A. CARE HF
B. COMPANION
C. MADIT-CRT
D. SCD-HeFT
E. RethinQ

54. A 64-year old woman undergoes elective dual chamber pacemaker implantation for the treatment for symptomatic sinus node disease. Post implant checks are satisfactory and CXR shows good lead position with no pneumothorax. The British Cardiovascular Society (BCS) guidance on fitness to fly for passengers with cardiovascular disease stipulates the patient can fly after how many days?

A. Immediately
B. 2 days
C. 1 week
D. 1 month
E. Following first post-implant check

55. A 45-year old woman is admitted following an out of hospital VF cardiac arrest. A transthoracic echocardiogram, cardiac MRI and diagnostic angiogram are normal as is her 12 lead ECG. The patient undergoes implantation of a subcutaneous ICD. The device is programmed with a maximum energy level output of

A. 35J
B. 40J
C. 65J
D. 75J
E. 80J

56. According to current NICE guidelines, an ICD without CRT is indicated for primary prevention against sudden cardiac death in which of the following cases?

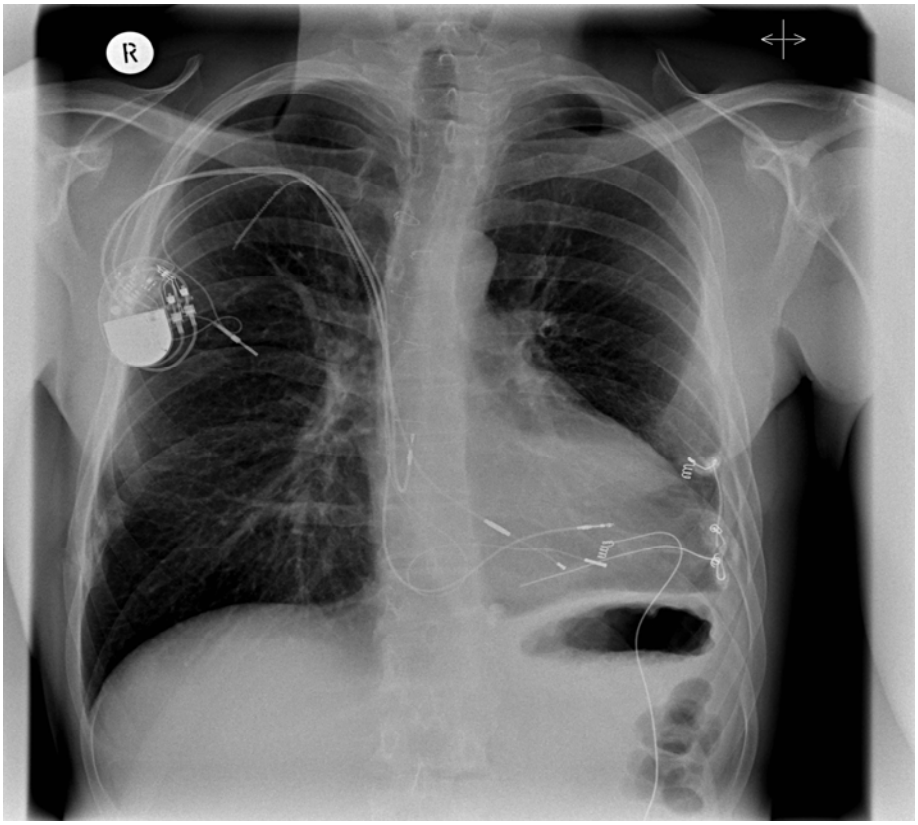
A. Left ventricular dysfunction with LVEF <35%, class I NYHA heart failure and a QRS duration of 150 ms
B. Left ventricular dysfunction with LVEF <35%, class II NYHA heart failure, and a QRS duration of 130ms (left bundle branch block)
C. Left ventricular dysfunction with LVEF <35%, class II NYHA heart failure, and a QRS duration of 130ms (right bundle branch block)
D. Left ventricular dysfunction with LVEF <35%, class III NYHA heart failure and a QRS duration of 145 ms (left bundle branch block)
E. Left ventricular dysfunction with LVEF <35%, class IV NYHA heart failure and a QRS duration of 110 ms

57. A 29-year old with hypertrophic cardiomyopathy undergoes screening for a primary prevention ICD. When the ESC risk tool (cut-off level of ≥4%

SCD risk in 5-years) is used, the number of patients needed to treat (NNT) with ICD therapy to postpone one SCD endpoint in 5 years is?

A. 4
B. 8
C. 12
D. 16
E. 20

58. A 35-year old man is reviewed in pacing clinic. No prior information is available. He has a chest X ray performed. This shows which of the following:

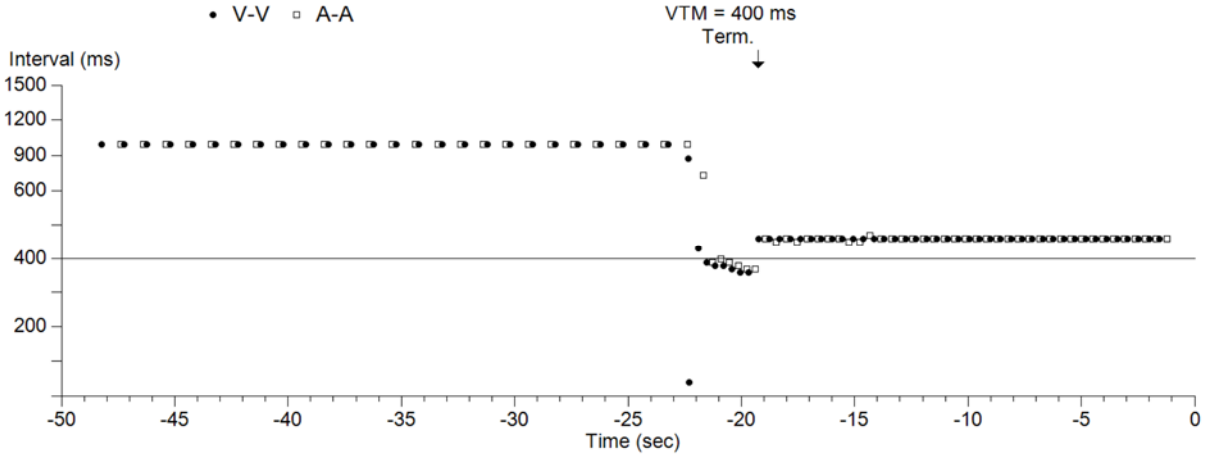


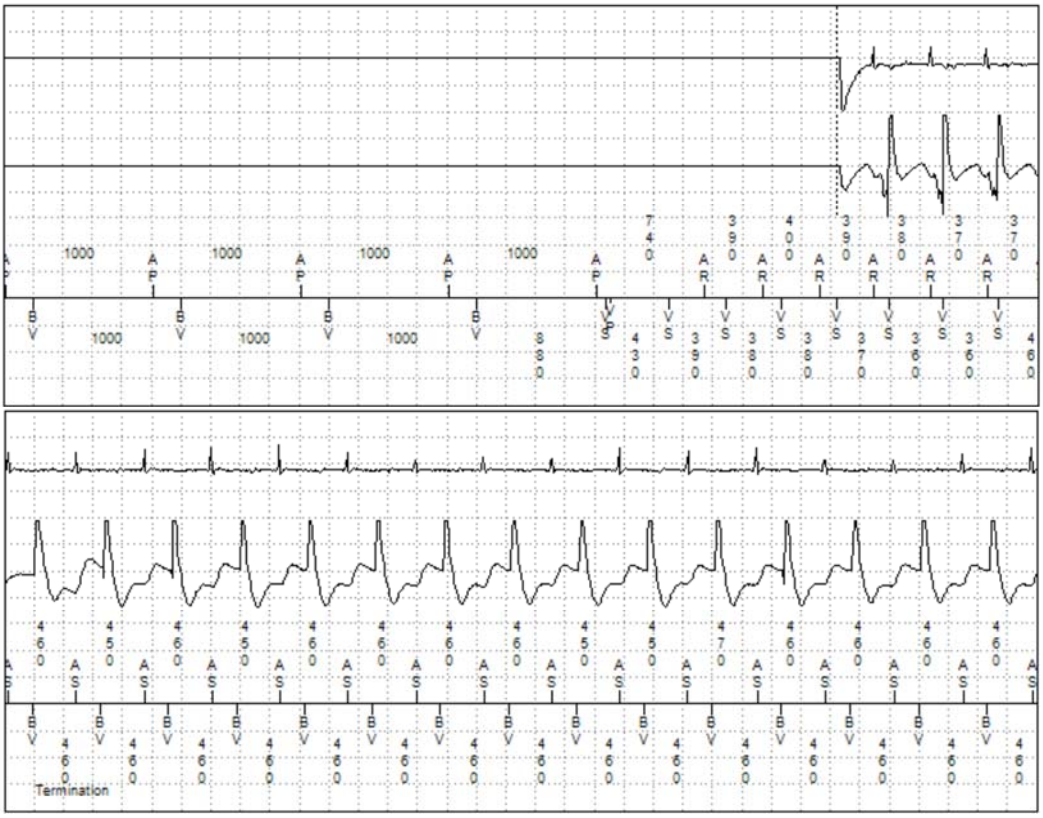
A. Biventricular ICD and epicardial temporary wires
B. Biventricular pacemaker and pericardial coils.
C. Dual chamber pacemaker and subcutaneous array
D. Dual chamber pacemaker with septal RV lead position
E. Unipolar atrial pacing system and previous epicardial system.

59. The ESC 2013 guidelines on cardiac pacing and resynchronisation therapy state the following about MRI scans in patients with non-MRI conditional devices:

A. A fixed programming mode must be used for all devices
B. ICDs in a femoral position can be scanned if the therapy is programmed off.
C. Patients with epicardial LV leads may be scanned with caution
D. Scans are contraindicated in patients with redundant leads.
E. Scans can take place on pacemakers after they are implanted for 1 week

60. This recording is picked up on a remote transmission for a patient with a primary prevention CRT-D.





The rhythm shown in this trace is most likely which of the following:

A. Atrial tachycardia initiating AVRT
B. Atrial tachycardia with biventricular tracking
C. Concurrent atrial tachycardia and ventricular tachycardia
D. Ventricular tachycardia and pacemaker mediated tachycardia
E. Ventricular tachycardia with two cycle lengths

SECTION 3 – ELECTROPHYSIOLOGY

ANSWER THIS SECTION, SECTION 2 OR SECTION 4
IN ADDITION TO SECTION 1
DO NOT ANSWER MORE THAN ONE SPECIALIST SECTION

61. The right atrial appendage is bordered by which structure?

A. The crista terminalis
B. The fibrous trigone
C. The fossa ovalis
D. The inferior vena cava
E. The triangle of Koch

62. Phase 3 block is seen in the setting of which of the following?

A. Beta-blocker treatment
B. Enhanced autonomic tone
C. Poor pacemaker programming
D. Tachycardia
E. Triggered activity

63. The functional refractory period of the AV node measured during anterograde testing is?

A. Best assessed during burst pacing at 300ms
B. Decreased by digoxin
C. The shortest A-A interval conducted through the AV node
D. The shortest His-His interval achievable
E. Unaffected by isoprenaline

64. A variable VA interval during a narrow complex tachycardia is characteristic of which tachycardia?

A. Antidromic tachycardia
B. Atrial tachycardia
C. Junctional ectopic tachycardia
D. Orthodromic reentrant tachycardia
E. Typical atrioventricular nodal reentrant tachycardia

65. Ventricular ectopics arising from the right ventricular outflow tract in a person with normal ventricular function are characteristically caused by?

A. Abnormal cellular potassium handling
B. Enhanced automaticity
C. Reentry
D. Retrograde concealed penetration
E. Triggered activity

66. Which of the following measurements would reflect a normal HV interval (in milliseconds)?

A. 15
B. 30
C. 45
D. 60
E. 75

67. Which of the following accessory pathways may pose a danger of rapidly conducted pre-excited atrial fibrillation?

A. Atrio-fascicular
B. Concealed right posteroseptal
C. Fasciculo-ventricular
D. Intermittently conducting right posteroseptal
E. Latent left free wall

68. Which of the following statements is characteristic of ventricular outflow tract ectopy?

A. An 'r' wave in ECG lead V1 suggests a focus in the right ventricular free wall
B. Have a large 'S' wave in aVF
C. Irrigated tip ablation catheter is required for ablation ectopics
D. Their frequency commonly varies with the menstrual cycle
E. When causing impaired left ventricular function characteristically arise from the left side

69. Which of the following features recorded from an ablation catheter suggest a good location for ablation of typical AV nodal re-entry tachycardia?

A. A His electrogram less than half the size of the electrogram recorded from an optimally positioned His bundle catheter
B. A sharp atrial electrogram with a far field ventricular electrogram
C. An atrial electrogram at least 20ms later than the atrial electrogram on the His catheter
D. An atrial electrogram at least twice as large as the ventricular electrogram
E. Equal sized atrial and ventricular electrograms

70. Earliest ventricular activation in a normal electrophysiological study is recorded from?

A. A catheter in the right ventricular outflow tract
B. A catheter positioned in the right atrial appendage
C. The distal coronary sinus
D. The His bundle catheter
E. The surface ECG

71. Which of the following statements are true regarding complications of ablation for atrial fibrillation?

A. Dysphagia is common for up to four weeks following ablation
B. Headache is uncommon during cryo-balloon ablation
C. Phrenic nerve palsy is more common with cryo-balloon ablation than radiofrequency ablation
D. Prothrombin complex concentrate should always be given following cardiac tamponade
E. Vagal nerve dysfunction is unusual following radiofrequency ablation

72. Which of the following features suggest a correctly placed decapolar coronary catheter during an electrophysiological study in a normal person?

A. A His electrogram visible on the proximal but not distal electrodes
B. Far-field atrial electrograms with sharp ventricular electrograms
C. No ventricular electrograms
D. Progressively smaller ventricular electrograms in the proximal compared to distal electrodes
E. Proximal to distal activation of both atrial and ventricular electrograms

73. Which of the following features is diagnostic of atrioventricular re-entrant tachycardia (AVRT)?

A. A long stimulus to atrial electrogram interval during ventricular entrainment (ipsilateral to the pathway)
B. A post pacing interval following entrainment more than 125ms longer than the tachycardia cycle length
C. A 'VAAV' response following ventricular entrainment
D. A VA time of less than 70ms
E. Termination of tachycardia with a His-synchronous ventricular premature beat

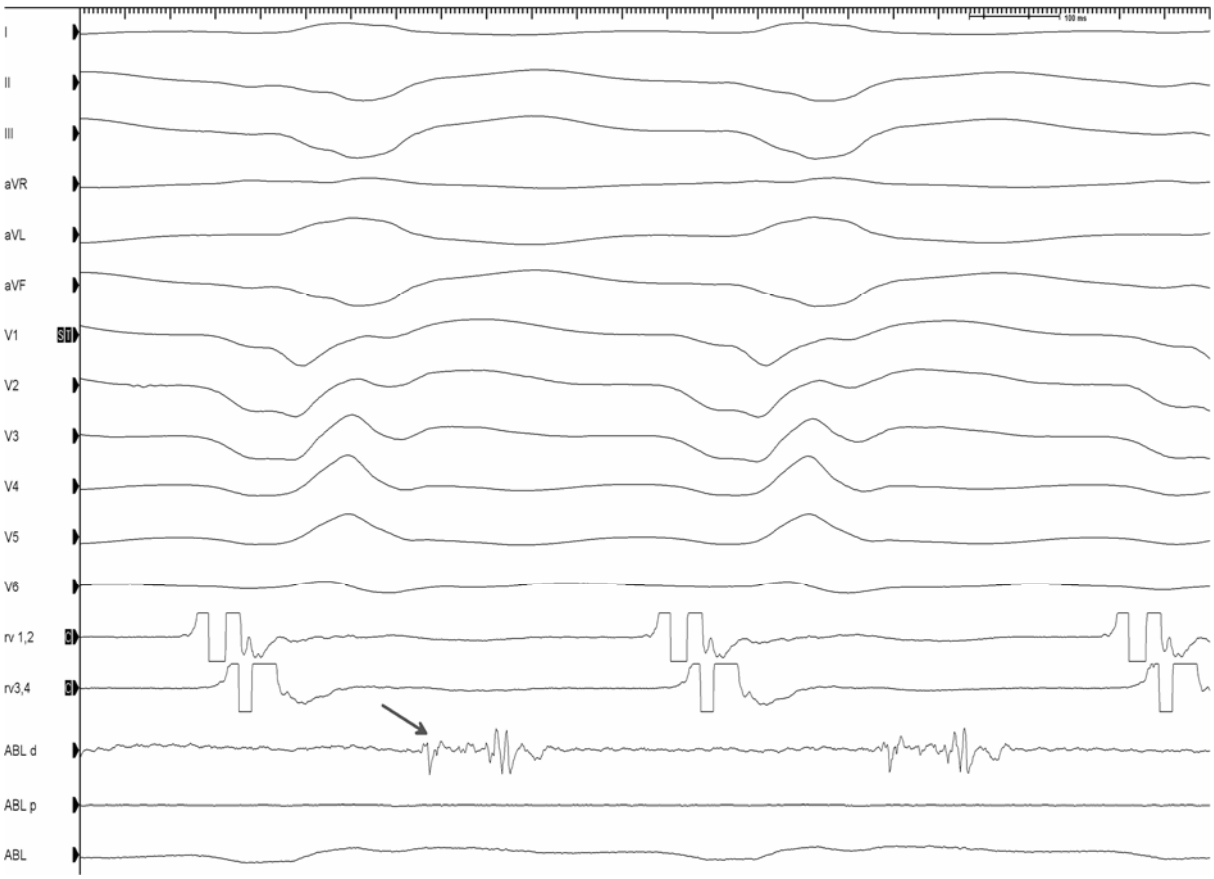
74. Which of the following make atrioventricular nodal re-entrant tachycardia unlikely?

A. A long post pacing interval following ventricular entrainment
B. A VA time of 10ms during tachycardia
C. A VAV response to ventricular entrainment
D. Delay of the next atrial activation following a His synchronous ventricular premature beat
E. His-His interval changes precede and predict A-A interval changes

75. Which of the following is true of irrigated ablation?

A. Allows smaller tip catheters to achieve higher powers
B. Flow rates should not exceed 17ml/min
C. Is contra-indicated for ablation in the coronary sinus
D. Is recommended for ablation of right ventricular outflow tract ectopic beats
E. Prevents steam pops

76. The following trace was obtained during ablation of a wide complex tachycardia in a patient with a remote history of myocardial infarction (rv = right ventricular apical catheter, Abl –ablation catheter).



What is the best interpretation of the electrogram identified by the arrow?

A. Complex fractionated atrial electrogram (CFAE)
B. Late abnormal ventricular activity (LAVA)
C. Left ventricular fascicular potential
D. Mid-diastolic potential
E. Slow pathway potential

77. Which of the following statements is correct regarding ablation for paroxysmal atrial fibrillation?

A. Ectopy arising from the superior vena cava is responsible for paroxysmal atrial fibrillation in approximately 30% of Caucasian patients
B. Facial swelling may complicate isolation of the superior vena cava
C. Isolation of the superior vena cava is associated with a significant risk of left phrenic nerve palsy
D. Pacing through the ablation catheter before isolation of the superior vena cava should be avoided to prevent diaphragmatic stimulation
E. The inferior vena cava has not been identified as a source ectopy triggering atrial fibrillation

78. The following trace was seen during an electrophysiological study. The response to atrial extrastimulus testing S1 400ms, S2 240ms is shown. (CS = coronary sinus (1,2 = distal, 9,10 = proximal), RV = right ventricular apical catheter).

What is the best interpretation of the trace?

A. A concealed right sided accessory pathway is present
B. Dual AV node physiology with two 'slow-fast' AV nodal echo beats
C. Manifest left sided accessory pathway conduction with block following the S2
D. Short run of atrial tachycardia
E. Two beats of AV re-entrant tachycardia

79. A 49-year old woman was referred for an electrophysiological study for infrequent short-lived severe dizziness in the setting of left bundle branch block and PR interval 220ms. She was on no rate limiting drugs and otherwise well, with no chest pain or exercise limitation. Stress echocardiography revealed an ejection fraction of 50% with no regional wall motion abnormality, normal valve function and no evidence of ischaemia. Baseline intervals at the time of EP study were AH 145ms and HV 60ms. VA block was demonstrated, but a normal anterograde study. Sinus node recovery time was within normal limits at three cycle lengths. What is the next most appropriate step in her management?

A. 48 hour Holter monitoring
B. Cardiac MRI
C. Coronary angiography
D. Dual chamber pacemaker implant
E. Implantation of a loop recorder

80. The response to ventricular pacing at 460ms during a narrow complex tachycardia is shown. (CS = coronary sinus (1,2 = distal, 3,4 = proximal), RV = right ventricular apical catheter).

Which of the following statements is true?

A. An atrial tachycardia can be excluded
B. Concealed left free wall accessory pathway conduction is confirmed
C. The long post pacing interval makes an atypical atrioventricular nodal reentrant tachycardia (AVNRT) likely
D. The long stimulus to atrial activation time is typical for atrio-ventricular reentrant tachycardia (AVRT)
E. The tachycardia is not entrained

81. A 21-year old man with palpitations and a structurally normal heart had an EP study. Atrioventricular reentrant tachycardia (AVRT) using a left-sided accessory pathway was induced. An increase in tachycardia cycle length occurs following a spontaneous ventricular premature beat (VPB). What is the most likely explanation for this phenomenon?

A. Change in AV node conduction time
B. Induction of ventricular tachycardia
C. Left bundle branch block has developed
D. There is more than one accessory pathway
E. The rhythm has changed to atrioventricular nodal reentrant tachycardia (AVNRT)

82. What is the overall risk of significant complications from a trans-septal puncture in the electrophysiology lab?

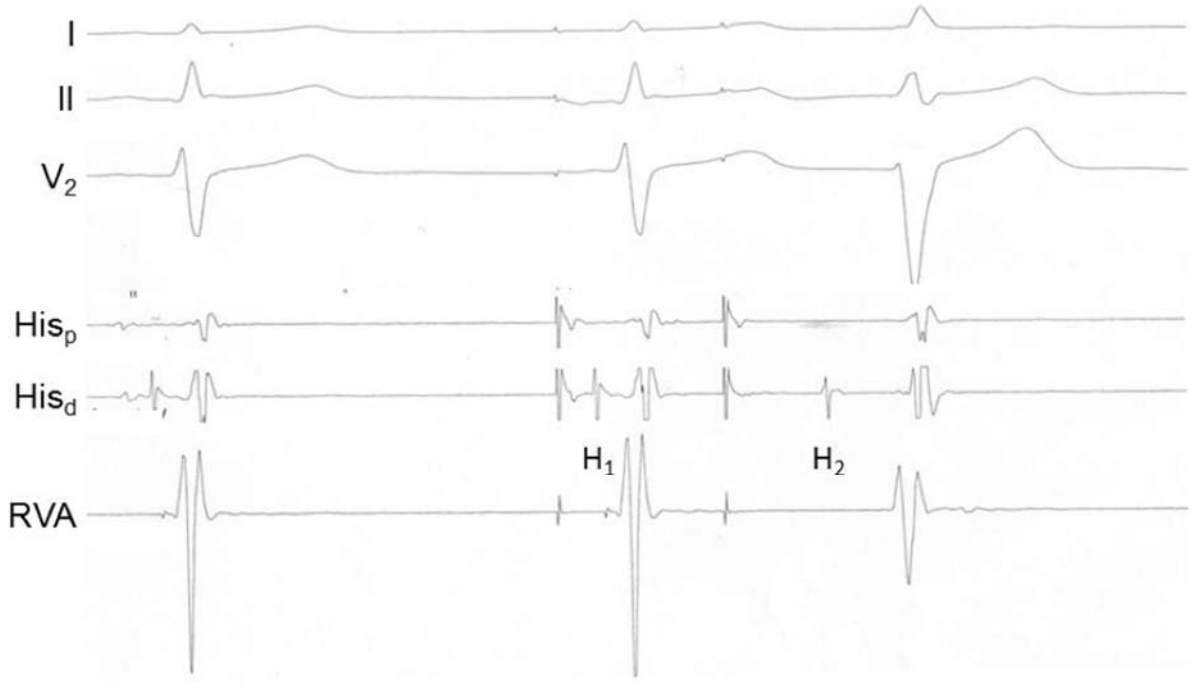
A. 0.2%
B. 1%
C. 3%
D. 5%
E. 7%

83. The following trace was obtained during an electrophysiological study. The resting 12-lead ECG was normal with baseline HV interval 30ms and a His bundle deflection visible during sinus rhythm. (CS = coronary sinus, HIS = His bundle catheter recording - (1,2 = distal, 3,4 = proximal)).

Which of the following is the most likely rhythm diagnosis?

A. Antidromic tachycardia via a left free wall accessory pathway
B. Atrial tachycardia arising from the left atrial appendage
C. Right ventricular outflow tract tachycardia
D. Tachycardia mediated by an atriofascicular accessory pathway
E. Ventricular tachycardia arising from the anterior left ventricle

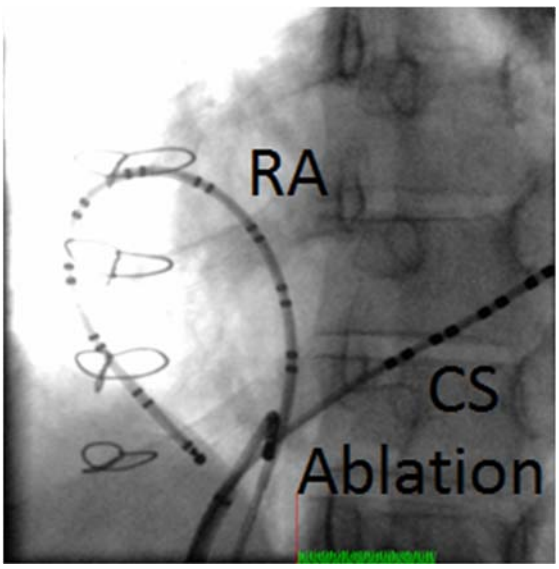
84. During programmed stimulation, the following phenomenon was noted. The H_1-H_2 interval is 300ms.

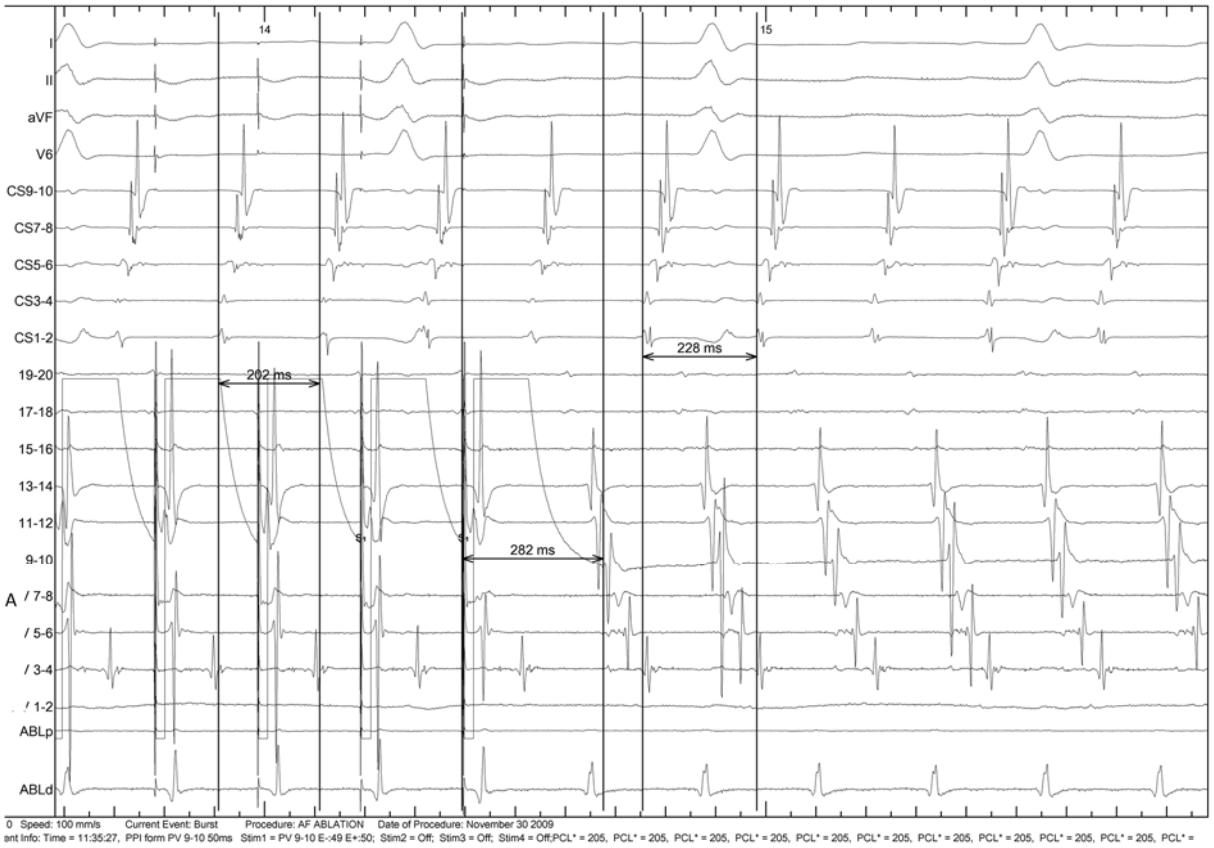


This can be best explained by which of the following?

A. Infra-Hisian conduction disease
B. Gap phenomenon
C. Normal conduction tissue physiology
D. Supernormal conduction
E. Supra-Hisian conduction disease

85. Burst pacing is performed from the high lateral right atrium during a tachycardia in a 50-year old man. Catheter positions are shown in the fluoroscopic image. (RA = multi-electrode circular catheter placed around the tricuspid annulus (1,2 = lateral tricuspid annulus, 19,20 = septal tricuspid annulus), CS = coronary sinus, (1,2 = distal, 9,10 = proximal).





Which of the following is true with regard to the trace?

A. Entrainment suggests the lateral right atrial wall is not part of the tachycardia circuit
B. Entrainment suggests typical cavo-tricuspid isthmus dependent tachycardia
C. The activation pattern on the right atrial duo-decapolar catheter suggests the tachycardia is arising from the low lateral right atrium
D. The coronary sinus activation pattern excludes a left atrial tachycardia
E. The tachycardia has not been successfully entrained

86. A 35-year old man with ventricular pre-excitation on his resting ECG underwent an electrophysiological study for palpitations. A trace showing ventricular pacing at a cycle length of 600ms is shown.

Which of the following is the best interpretation of the tracing?

A. Retrograde right sided accessory pathway conduction
B. Retrograde left sided accessory pathway conduction
C. Ventriculo-atrial isorrhythmic dissociation
D. Ventriculo-atrial block
E. Ventriculo-atrial Wenckebach

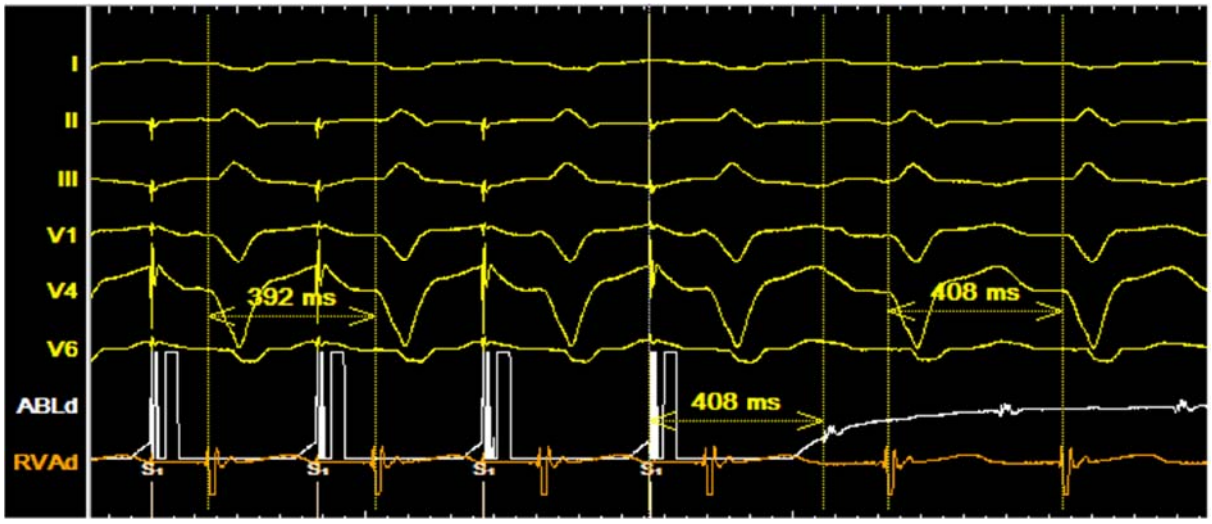
87. A 28-year old patient with a family history of premature sudden death underwent assessment for inherited cardiac conditions. During exercise testing marked QT prolongation was seen. What is the most likely diagnosis?

A. Long QT syndrome type 1
B. Long QT syndrome type 2
C. Long QT syndrome type 3
D. Long QT syndrome type 4
E. Long QT syndrome type 5

88. A 78-year old woman with history of hypertension and persistent AF with poor rate control is admitted for AV node ablation. Which of the following would be considered best practice for this patient?

A. Ablation at a mid-septal position on a balanced AV signal
B. Ablation on a good His signal with a dominant ventricular signal
C. Ablation on the left side of the septum
D. Discontinuation of warfarin post-procedure
E. Pacemaker programming to 60 beats per min post ablation

89. The trace below was reproducibly recorded during an ablation procedure on a 55-year old man.



It shows which of the following?

A. Entrainment of re-entrant VT from a bystander area
B. Entrainment of re-entrant VT from the outer loop
C. Entrainment of re-entrant VT from within the circuit
D. Entrainment of re-entrant VT with manifest fusion
E. Overdrive pacing of re-entrant VT without entrainment

90. A 55-year old man is admitted to hospital with pre-syncope. The ECG demonstrated a tachycardia at a rate of 195 beats per minute with a dominant R wave in V_1. He was taking no antiarrhythmic drugs. Which of the following features would point to a likely diagnosis of ventricular tachycardia

A. A monophasic R wave in V_1
B. A qRs morphology in V6
C. Mean frontal QRS axis of +85 degrees
D. QRS alternans
E. QRS width of 135ms

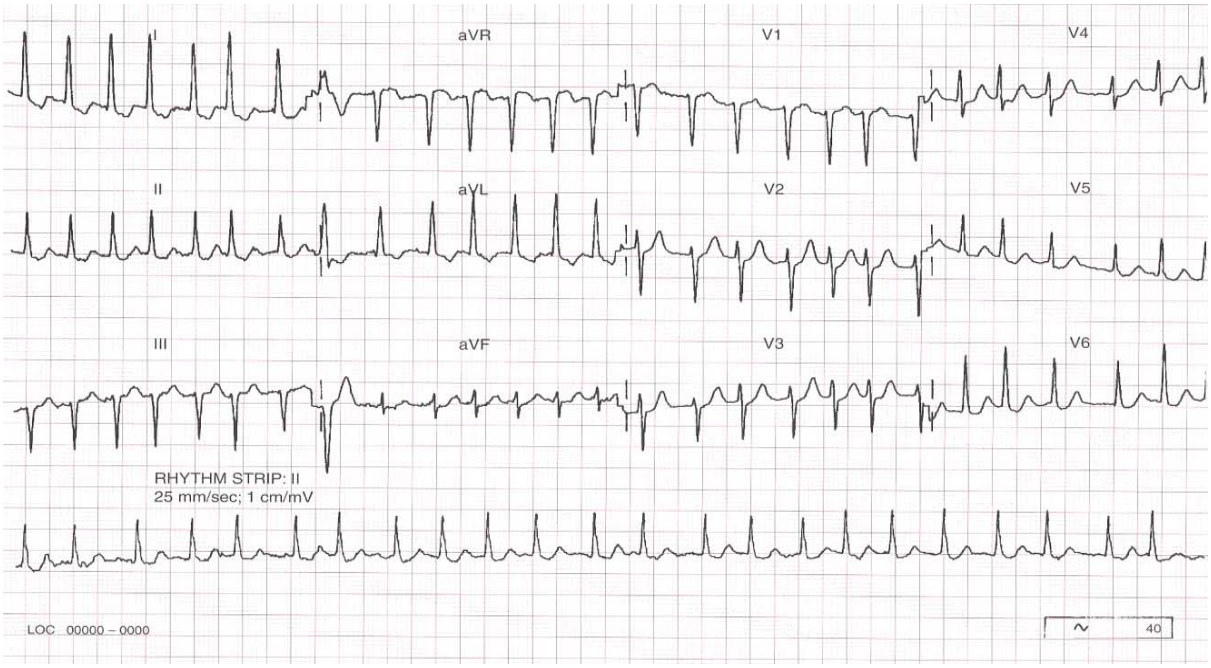
SECTION 4 – CLINICAL

ANSWER THIS SECTION, SECTION 2 OR SECTION 3
IN ADDITION TO SECTION 1
DO NOT ANSWER MORE THAN ONE SPECIALIST SECTION

91. Following radiofrequency ablation for AV re-entrant tachycardia a patient asked you about driving restrictions. According to the current DVLA guidelines for a group 1 licence, how long must they refrain from driving?

A. 1 month
B. 1 week
C. 48 hours
D. 5 days
E. 72 hours

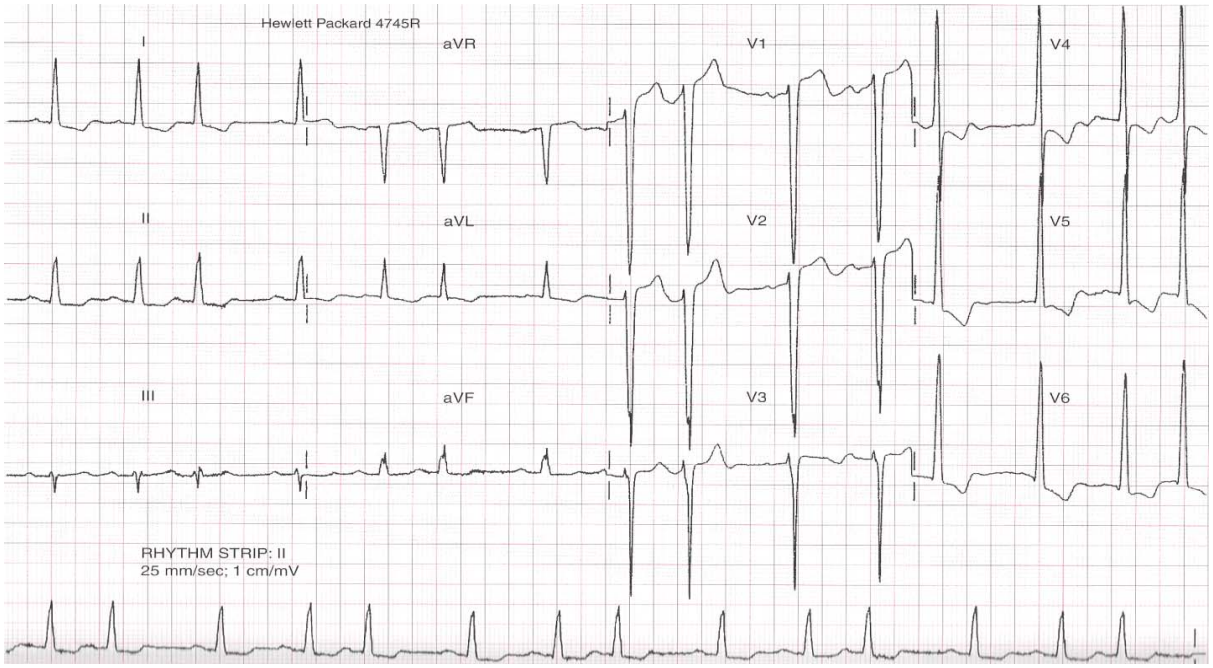
92. A 68-year old man was referred to the arrhythmia clinic with palpitations, shortness of breath, increasing lethargy and occasional dizziness. He had a history of hypertension and COPD. His ECG is shown.



What is the best description of his cardiac rhythm?
A. Atrial fibrillation
B. Atrial flutter
C. AV re-entrant tachycardia
D. Focal atrial tachycardia
E. Sinus tachycardia

93. A 22-year old woman was diagnosed with reflex vasovagal syncope with definite prodromal symptoms, which have not occurred whilst sitting or lying. After an episode of syncope, how long must she refrain from driving on a group 1 (car and motor cycle) licence?
A. 1 month
B. 24 hours
C. 48 hours
D. 7 days
E. No driving restrictions

94. A 54-year old woman was referred to the arrhythmia clinic after her GP detected an irregular pulse when performing an opportunistic pulse check. A following 12 lead ECG was recorded.



What is the most likely cause of her irregular pulse?

A. Atrial fibrillation
B. Atrial flutter
C. Atrial premature beats
D. Junctional premature beats
E. Sinus arrhythmia

95. A 72-year old man was referred with atrial fibrillation. His past medical history included hypertension and type 2 diabetes. Routine blood tests including FBC and renal function were within the normal range. He has a CHA_2DS_2-VASc score of 3 and a HAS-BLED score of 2. He was reluctant to take warfarin so it was decided to prescribe Apixaban. What is the most appropriate dose to prescribe?

A. 2.5mg once daily
B. 5mg twice daily
C. 15mg once daily
D. 110mg twice daily
E. 150mg twice daily

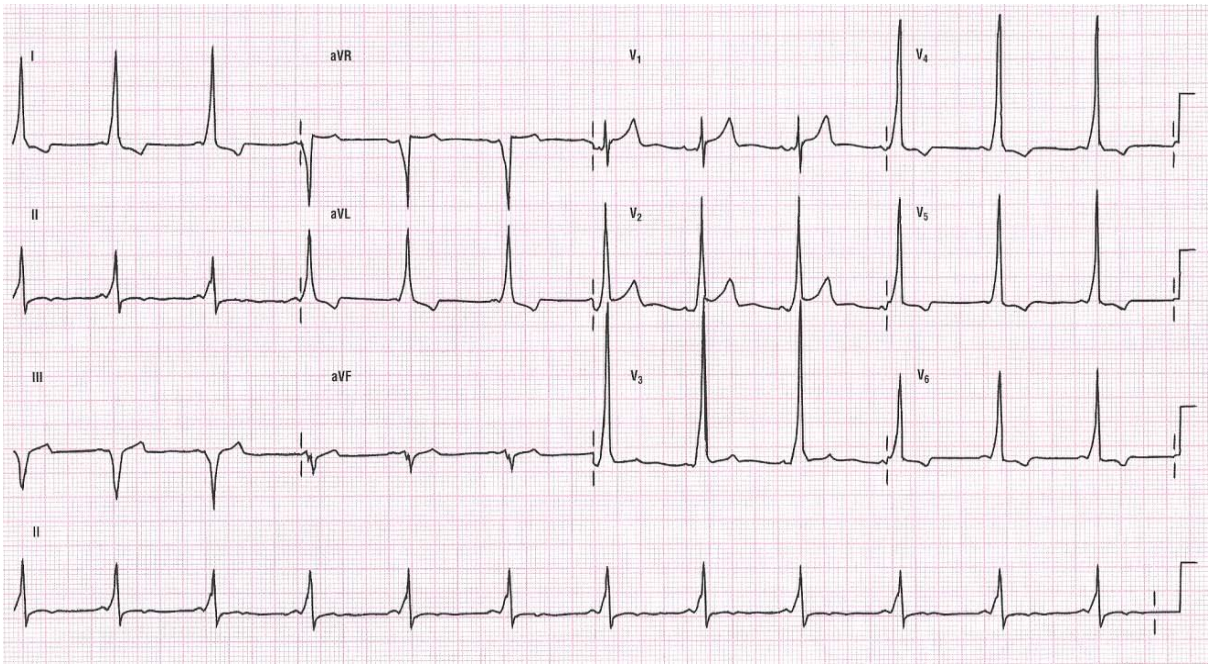
96. A 66-year old woman with a BMI of 23 was referred with atrial fibrillation. She has a history of hypertension but was otherwise fit and well. She required anticoagulation and she had a preference for a once daily dosing regimen. It was decided to prescribe Rivaroxaban. What is the most appropriate dose to prescribe?

A. 5mg twice daily
B. 10mg once daily
C. 15mg once daily
D. 20mg once daily
E. 30mg once daily

97. A 65-year old woman was referred with atrial fibrillation. She had a past medical history of diabetes, hypertension and renal dysfunction. Blood tests reveal a creatinine clearance of 20mL/min. Which anticoagulant is most dependent on renal elimination?

A. Apixaban
B. Dabigatran
C. Edoxaban
D. Rivaroxaban
E. Warfarin

98. A 24-year old man was referred with a history of palpitations lasting for up to three hours and occurring approximately twice monthly. A 12 lead ECG was recorded.



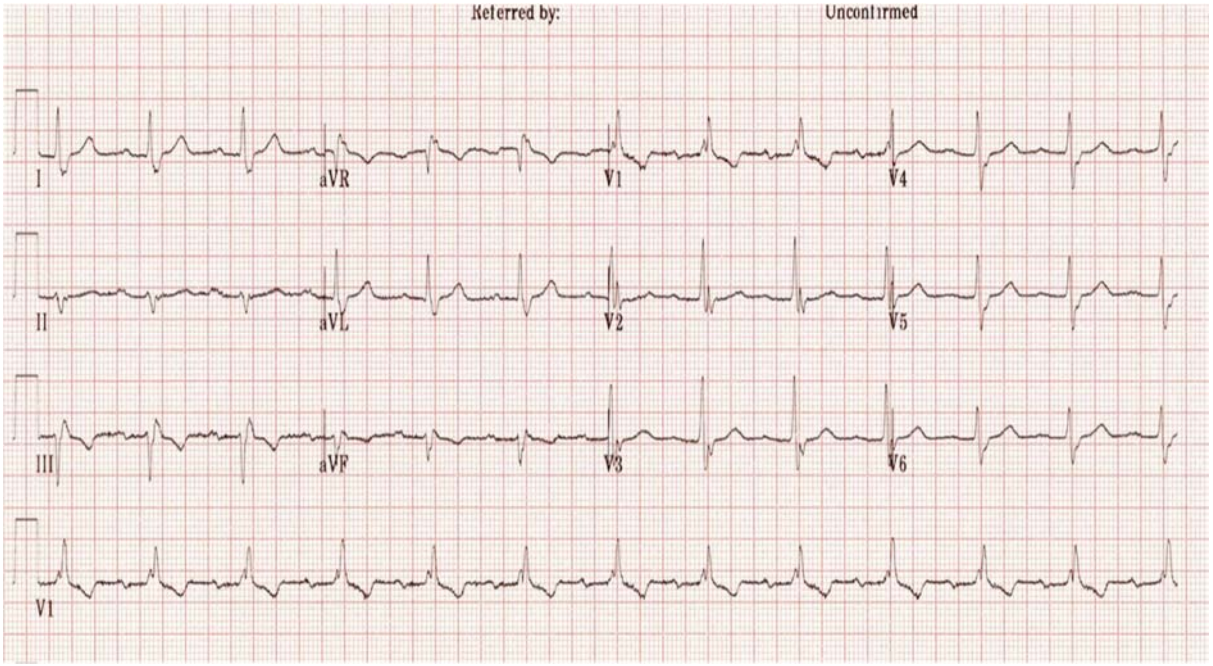
What is the most likely cause of his palpitations?
A. Atrial fibrillation
B. AV nodal re-entrant tachycardia
C. AV re-entrant tachycardia
D. Sinus tachycardia
E. Ventricular ectopic beats

99. A 60-year old man was referred to the clinic to discuss implantable device therapy. He was known to have ischaemic cardiomyopathy, NYHA class III symptoms, LVEF 25% with echocardiographic evidence of dyssynchrony, sinus bradycardia at 50bpm, QRS duration 125ms without LBBB. According to current NICE guidance (2014), what is the most appropriate device?

A. CRT-D
B. CRT-P
C. ICD
D. ILR
E. PPM

100. A 47-year old woman was due to undergo catheter ablation for AVNRT. In addition to AV block, what other complication is it most important to discuss?
A. Coronary sinus dissection
B. Oesophageal perforation
C. Pericardial Tamponade
D. Phrenic nerve palsy
E. Pulmonary embolism

101. A 70-year old woman presented following an episode of syncope. Her left ventricular function was normal on echocardiography. She was not on any rate-limiting medication. Carotid sinus massage did not reveal any abnormality of heart rate of blood pressure response. Her ECG is shown.



What is the most appropriate next step in her management?
A. Electrophysiology study
B. Exercise testing
C. Holter monitoring
D. Implantation of a loop recorder
E. Implantation of a permanent pacemaker

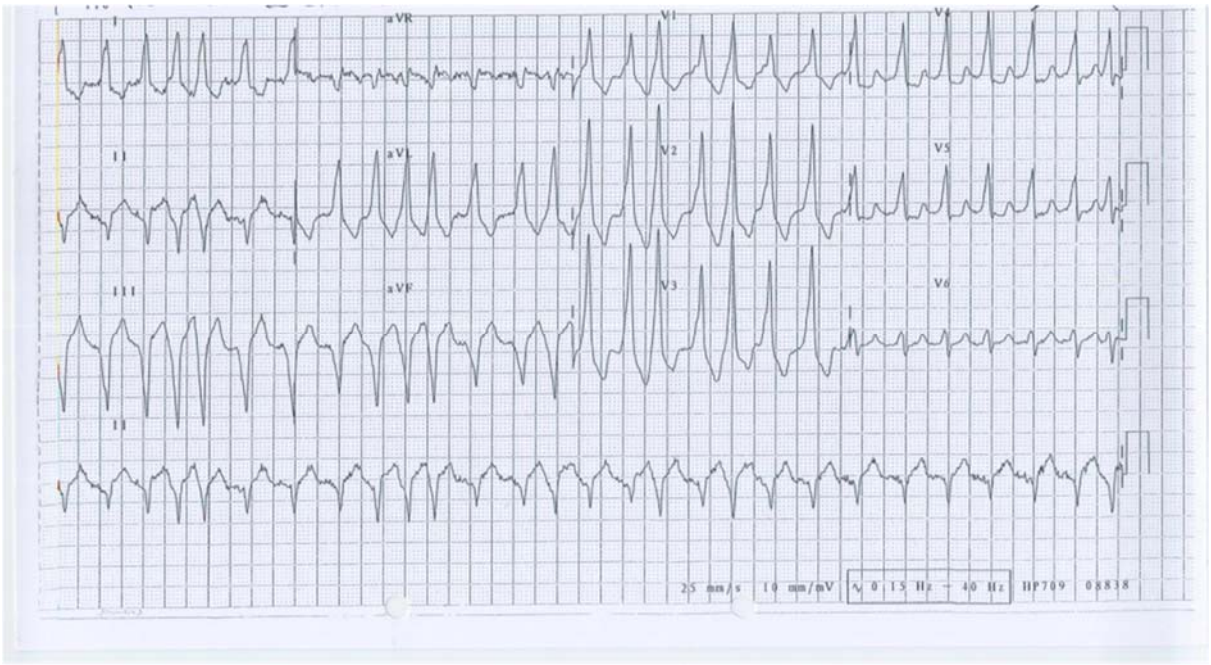
102. A 65-year old woman attended your clinic with a history of paroxysmal atrial fibrillation. She had a history of hypertension, and dyspepsia. She was taking Dronedarone. Her work required her to travel in remote areas for several months of the year. What is the most appropriate medication to reduce her risk of stroke?

A. Apixaban
B. Aspirin
C. Dabigatran
D. Rivaroxaban
E. Warfarin

103. A 53-year old woman with atrial tachycardia was reviewed in the clinic. Which of the following is most likely to be present during tachycardia?

A. An anti-clockwise circuit including the cavo-tricuspid isthmus
B. AV node dependence
C. More atrial than ventricular impulses
D. Retrograde P waves on the surface ECG
E. Termination with adenosine

104. A 28-year old man presented with a 24-hour history of palpitations and pre-syncope. The following ECG was recorded.



What is the most appropriate acute management?

A. anticoagulation
B. DC cardioversion
C. Intravenous amiodarone
D. Intravenous beta-blocker
E. Intravenous digoxin

105. A 72-year old man with a CRT-D implanted 3 years ago was seen in clinic with NYHA Class IV heart failure symptoms. His wife and son were with him and his son is concerned that he may have shocks from his device and asked about deactivation. What is the most appropriate strategy regarding deactivation?

A. Deactivation is not appropriate unless there have been previous shocks
B. The decision should be confirmed in writing by both patient and supervising doctor
C. His family can decide on his behalf
D. Deactivation is rarely necessary as ICD therapy occurs at the end of life <10% of the time
E. Patient can be overruled if the medical team think he has made an unwise decision

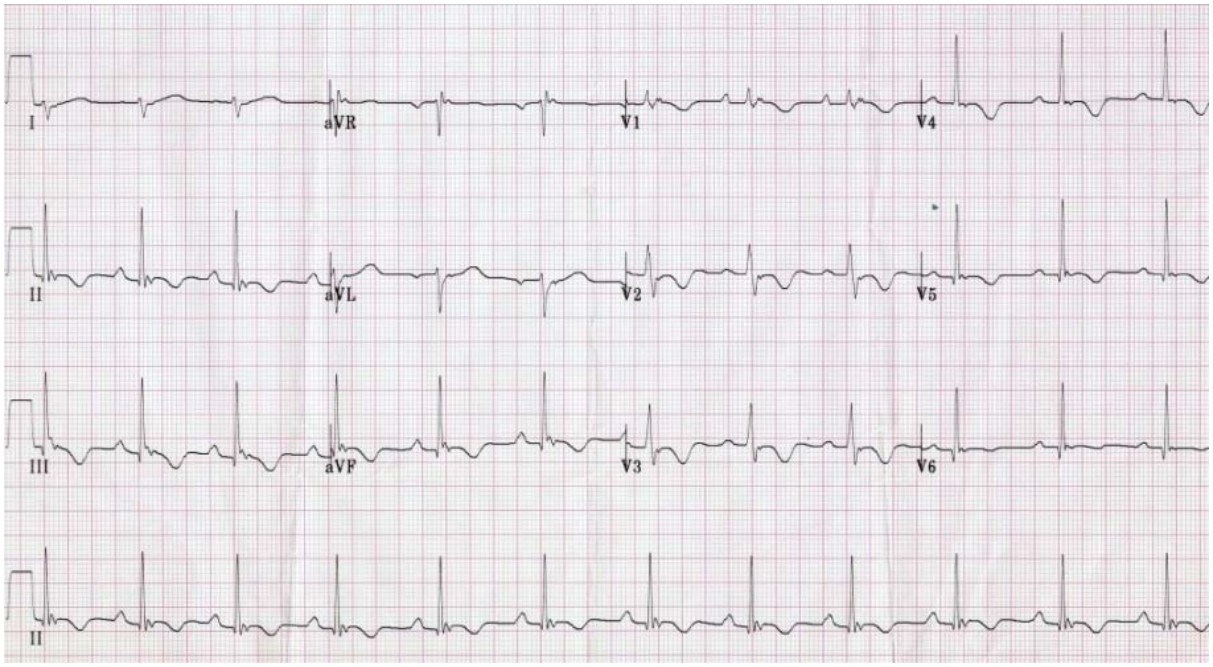
106. A 73-year old man receiving Dabigatran for stroke prophylaxis in paroxysmal atrial fibrillation was reviewed in the clinic. Which of the following is true regarding his medication?

A. The half-life of Dabigatran is 50% of the half-life of Rivaroxaban
B. Dabigatran is a factor Xa inhibitor
C. The dose of Dabigatran should be reduced if the eGFR is <100ml/kg/min
D. The dose of Dabigatran should be reduced if he is taking Verapamil
E. Dronedarone can be added to his treatment to reduce the frequency of AF episodes

107. A 50-year old man was referred to the arrhythmia clinic with paroxysmal atrial fibrillation. He had a structurally normal heart and no other past medical history. What is the most effective medication for rhythm control?

A. Bisoprolol
B. Digoxin
C. Flecainide
D. Nadolol
E. Verapamil

108. An 18-year old woman presented to the emergency department with syncope and a history of palpitation. Her ECG is shown.



What is the most likely diagnosis?

A. Arrhythmogenic right ventricular cardiomyopathy
B. Brugada syndrome
C. Hypertrophic cardiomyopathy
D. Long QT syndrome
E. Wolff-Parkinson-White syndrome

109. An 85-year old man underwent AV node ablation and pacemaker implantation. In order to avoid torsades de pointes what is most appropriate initial pacemaker base rate (beats per minute)?

A. 50
B. 55
C. 60
D. 90
E. 120

110. A 39-year old woman presented with palpitations and pre-excitation consistent with Wolff-Parkinson-White syndrome. What congenital abnormality is most commonly associated with this condition?

A. Ebstein's anomaly
B. Patent foramen ovale
C. Secundum atrial septal defect
D. Tetralogy of Fallot
E. Ventricular septal defect

111. A 34-year old man was admitted for Ajmaline challenge as part of investigations for Brugada syndrome. What is the best description of Ajmaline?

A. It has a half-life of 2 hours
B. It has a side effect of bradycardia
C. It acts on sodium channels
D. It should be administered as fast as possible through a large bore cannula
E. It should not be used in children under 16-years of age

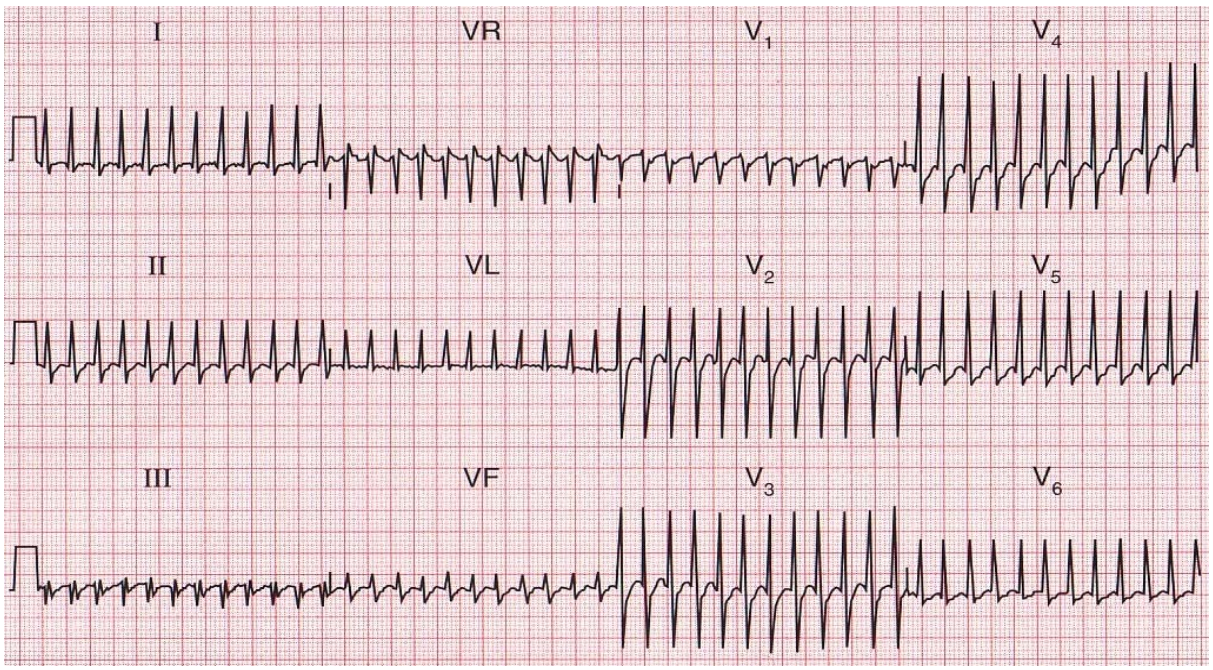
112. A 63-year old woman was admitted with fever and chest pain. She had undergone an ablation procedure for atrial fibrillation 3 weeks earlier. On examination she had a heart rate of 124bpm, respiratory rate 14 breaths per minute, BP 90/60mmHg and a temperature of 38.7C. What is the most likely cause of her symptoms?

A. Atrio-oesophageal fistula
B. Dresslers syndrome
C. Musculo-skeletal
D. Pneumothorax
E. Pulmonary embolus

113. A 47-year old woman was seen in the pre-admission clinic in preparation for SVT ablation. Which of her medications should she discontinue before the procedure?

A. Aspirin
B. Bisoprolol
C. Clopidogrel
D. Metformin
E. Ramipril

114. A 43-year old man was admitted to the emergency department with palpitations and pre-syncope. He had a history of AF and was taking Flecainide 100mg twice daily. His ECG in the cardiology outpatient clinic shows AF. The following ECG was recorded in the emergency department.



What cardiac rhythm is this most likely to represent?
A. Atrial fibrillation
B. Atrial flutter
C. AVNRT
D. AVRT
E. Focal atrial tachycardia

115. A 75-year old man was seen in the device clinic 8 weeks after pacemaker generator replacement. He had history of fevers and on examination he had swelling over his device. What is the most likely type of organism to be responsible for his presentation?

A. Enterococcus
B. Pneumococcus
C. Pseudomonas
D. Staphylococcus
E. Streptococcus

116. A 24-year old woman called the cardiology helpline because of palpitation and tiredness with a pulse rate of more than 100bpm. She had undergone dual chamber PPM implantation for congenital CHB 1 week earlier.

What is the most likely cause of her tachycardia?
A. Atrial fibrillation
B. Atrial flutter
C. Pacemaker mediated tachycardia
D. Sinus tachycardia
E. Ventricular tachycardia

117. A 66-year old man was admitted for pacemaker lead extraction for infection following a generator replacement for battery depletion 4-months earlier. What risk of peri-operative mortality is it appropriate to discuss with him?

A. 0.1%
B. 0.5%
C. 1%
D. 5%
E. 10%

118. Which of the following patient characteristic carries the greatest risk of developing a device related infection?

A. BMI >28
B. Diabetes
C. Impaired renal function
D. Previous generator replacement
E. Smoking

119. A 56-year old woman was reviewed in the pre-assessment clinic prior to SVT ablation. What characteristic constitutes an increased risk of an adverse event during sedation?

A. Female sex
B. Hyperlipidaemia
C. Hypertension
D. Obesity
E. Type 2 diabetes

120. A 68-year old man attended routine ICD clinic. He reported a shock a month earlier while sitting watching television. Interrogation of his device confirmed a shock for VT. He was started on Amiodarone and his ICD was reprogrammed. What is the duration of his driving ban?

A. 1 week
B. 1 month
C. 6 months
D. 12 months
E. 2 years