ACCREDITATION EXAMINATION

20th February 2009

PLEASE READ THESE INSTRUCTIONS CAREFULLY BEFORE COMMENCING THE EXAMINATION. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN YOUR DISQUALIFICATION

THE EXAMINATION CONSISTS OF 140 QUESTIONS DIVIDED INTO 3 SECTIONS, OF WHICH YOU SHOULD ANSWER 100

THERE ARE 60 CORE QUESTIONS (SECTION 1) WHICH YOU MUST ANSWER

THERE ARE 2 FURTHER SECTIONS EACH CONSISTING OF 40 QUESTIONS. SECTION 2 HAS SPECIALIST QUESTIONS RELATING TO DEVICES (PACEMAKERS, ICDs AND CRT). SECTION 3 HAS SPECIALIST QUESTIONS RELATING TO ELECTROPHYSIOLOGY

YOU MUST ONLY COMPLETE ONE OF THESE SECTIONS. DO NOT ANSWER QUESTIONS IN BOTH SECTIONS 2 AND SECTION 3. THIS WILL MAKE YOUR PAPER INVALID

TO PASS THE EXAMINATION YOU WILL NEED TO ACHIEVE SATISFACTORY MARKS IN BOTH THE CORE SECTION AND YOUR CHOSEN SPECIALIST SECTION

ALL QUESTIONS CONSIST OF A STATEMENT OR QUESTION FOLLOWED BY FIVE ANSWERS (A – E)

ONLY ONE OF THESE ANSWERS IS CORRECT

MARK THE CORRECT ANSWER BY FILLING IN THE APPROPRIATE CIRCLE (O ➔ ●) ON THE ANSWER PAPER

YOU MAY USE A BASIC CALCULATOR, RULERS AND MAGNIFYING GLASS BUT NOT ECG RULERS OR ANY OTHER DEVICES. MOBILE PHONES ARE NOT ALLOWED

1. Which of the following is a clinical sign suggestive of a diagnosis of ventricular tachycardia rather than supraventricular tachycardia?

   A. A soft first heart sound
   B. Pulsus alternans
   C. Hyperkinetic left ventricular impulse
   D. Canon waves seen in the internal jugular vein
   E. A soft second heart sound

2. Which of the following statements regarding automaticity is true?

   A. Automaticity is due to phase 0 activity
   B. Automaticity accounts for 50% of tachyarrythmias
   C. Automaticity can be easily investigated within the electrophysiology lab
   D. Triggered activity is the mechanism by which the heart rhythm is generated
   E. Sick sinus syndrome is a disorder of automaticity

3. Which of the following is not an ECG feature of constrictive pericarditis?

   A. Ventricular tachycardia
   B. Normal ECG
   C. Atrial fibrillation
   D. T wave changes
   E. Low voltage QRS complexes

4. NSF Chapter 8 recommends urgent (in-patient) assessment of the following patients by a heart rhythm specialist:

   A. Patients with Wolff-Parkinson-White (WPW) syndrome or asymptomatic pre-excitation
   B. First degree relatives of victims of sudden cardiac death who died below the age of 40 years
   C. Patients with symptomatic regular recurrent supraventricular tachycardia which is unsuccessfully treated with one type of medication or who would prefer not to take long-term medication
   D. Patients with a presumed diagnosis of ventricular tachycardia
   E. Patients with documented 3rd degree AV block (not associated with acute MI)

5. Which of the following statements regarding the action potential is true?

   A. The normal transmembrane potential is –40mV
   B. There are 4 phases to the action potential
   C. Cardiac cells are non-excitable cells
   D. Depolarisation is dependent on rapidly opening Na^+ channels
   E. Depolarisation is represented by phase 1 of the action potential

6. In the CARE-HF study, which of the following statements is incorrect?

A. Patients were included if they had NYHA class III – IV heart failure
B. The study concluded that both CRT-P and CRT-D therapies reduced the risk of death compared to optimal medical therapy
C. The left ventricular ejection fraction had to be ≤35%
D. If the QRS duration was 120 – 149ms the patients were required to have additional criteria of dyssynchrony
E. Patients were randomised equally to optimal medical therapy alone or optimal medical therapy plus cardiac resynchronisation therapy

7. Which of the following statements regarding the sino-atrial (SA) node is true?

A. Sino-atrial cells lack Na^+ channels
B. The SA node does not form the cardiac electrical impulse
C. The SA node is a sub-epicardial structure located within the left atrium
D. Sino-atrial cells have the lowest rates of automaticity
E. The SA node is innervated by parasympathetic but not sympathetic fibres

8. Which of the following was not a criterion for inclusion in the Multicenter Automatic Defibrillator Implantation Trial (MADIT)?

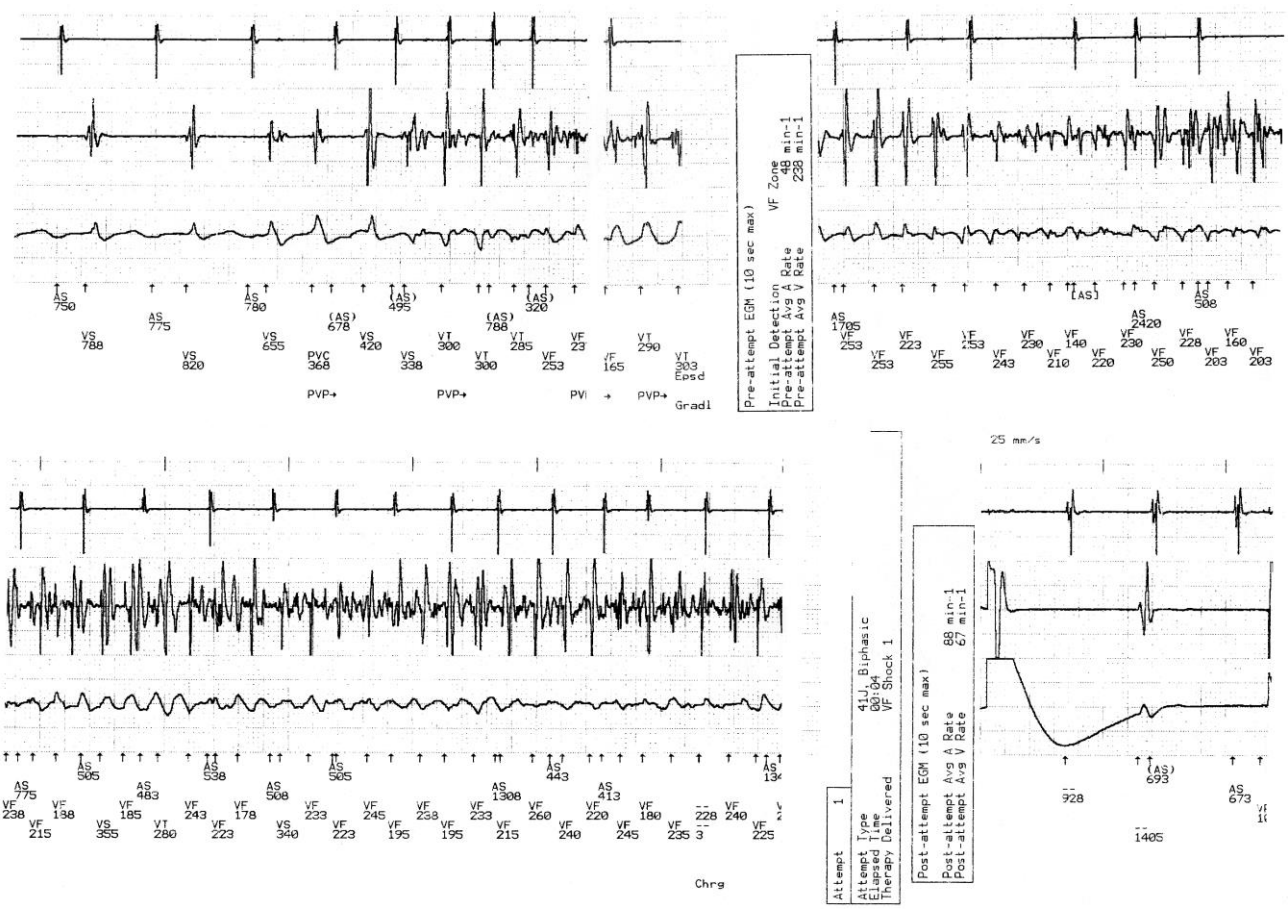
A. A Q-wave or enzyme-positive myocardial infarction three weeks or more before entry
B. Documented asymptomatic, non-sustained ventricular tachycardia
C. NYHA class I, II, or III
D. Reproducibly induced sustained ventricular tachycardia or fibrillation at EP study
E. A left ventricular ejection fraction of less than 35% as assessed by angiography, radionuclide scanning or echocardiography

9. A patient is referred for insertion of a permanent pacemaker. The referring cardiologist comments on the presence of a left sided superior vena cava (SVC). Which of the following statements regarding a left sided superior vena cava is true?

A. The prevalence of a left sided SVC in the general population is 3%
B. The finding of a left sided SVC is associated with cardiac impulse and conduction abnormalities
C. In fewer than 50% of cases of a left SVC, drainage into the right atrium occurs via the coronary sinus
D. The presence of a left sided SVC is a contraindication to left sided transvenous permanent pacemaker insertion
E. The diagnosis of a left SVC cannot be made by echocardiography

10. Which of the following statements is false? The following drugs prolong the JT interval on ECG:

A. Flecainide
B. Quinidine
C. Terfenadine plus erythromycin
D. Sotalol
E. Amiodarone



11. What does the printout above show?

A. Spontaneous VF with unsuccessful cardioversion
B. VF induction with unsuccessful cardioversion
C. Spontaneous VF with successful cardioversion
D. VF induction with successful cardioversion
E. VF induction with spontaneous termination

12. The purpose of the drive train in programmed stimulation is:

A. To ensure the extrastimuli will capture
B. To terminate arrhythmias
C. To stabilise refractoriness prior to the extrastimuli
D. To induce arrhythmias
E. To increase cardiac output

13. Which of the following statements regarding the Triangle of Koch is true?

A. The triangle of Koch is an anatomical area lying within the base of the left atrium
B. The Tendon of Todaro, crista terminalis and septal tricuspid valve leaflet form the landmarks of the triangle of Koch
C. The triangle of Koch helps position the fast and slow pathways of a patient with dual AV nodal physiology
D. The compact AV node lies at the base of the triangle of Koch
E. The size of the triangle of Koch is constant between patients

14. Which of the following detection enhancements are available to improve the function of a single chamber ICD?

A. Sudden onset, morphology and atrial high rate detection
B. Sudden onset, stability and atrial high rate detection
C. Sudden onset, morphology and stability
D. Sudden onset, ventricular rate and atrial high rate detection
E. All of the above

15. Which of the following tests would you not be required to perform before commencing amiodarone in a patient with ventricular tachycardia?

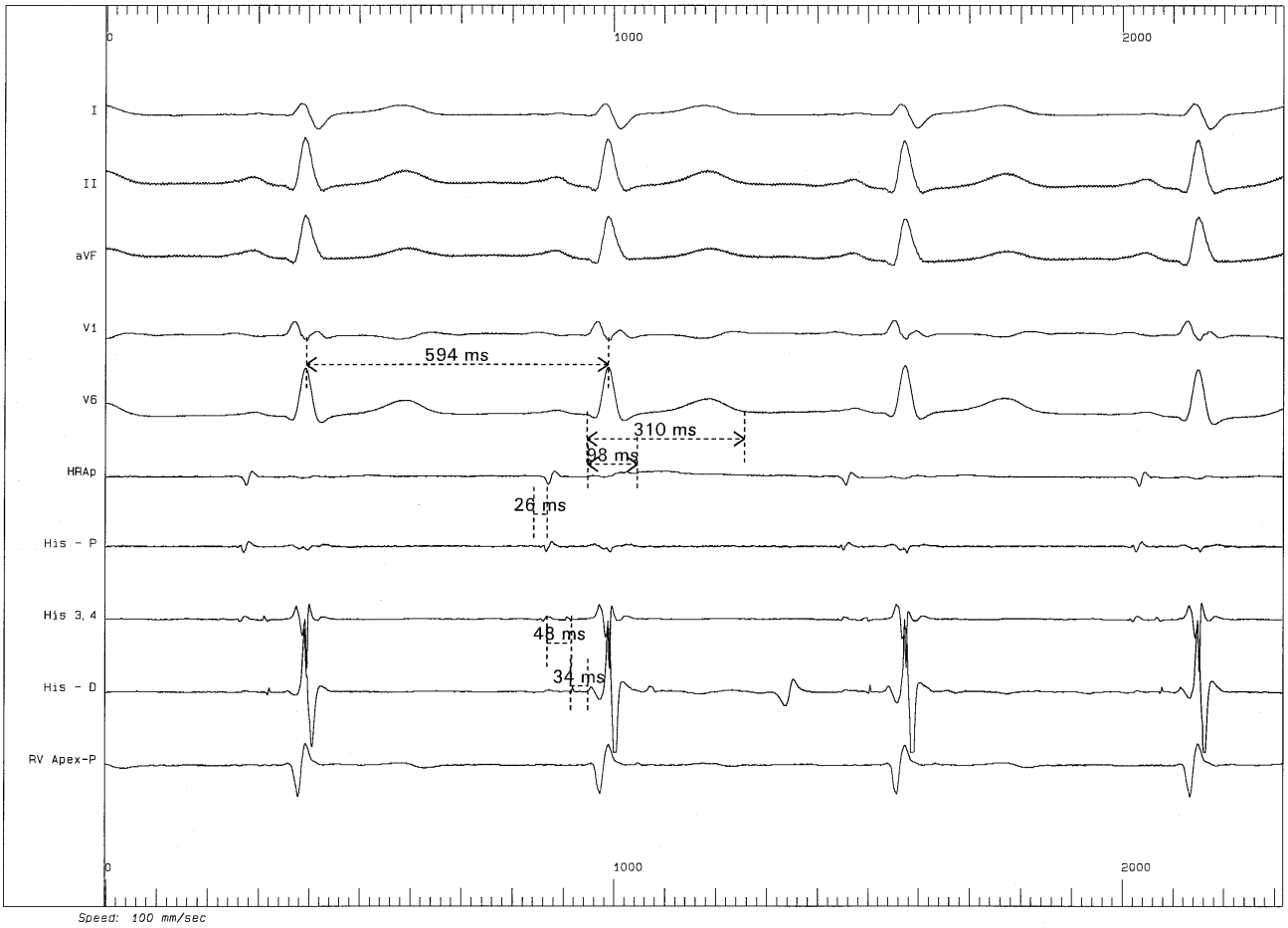
A. ECG
B. Thyroid function tests
C. Renal function tests
D. Chest X-ray
E. Liver function tests

16. Which of the following statements regarding cardiac venous anatomy is true?

A. The opening of the coronary venous system into the right atrium is known as the fossa ovalis
B. The Thebesian valve is located within the right atrium and directs blood from the inferior vena cava towards the fossa ovalis
C. The ligament of Marshall is an embryological arterial remnant
D. The valves of Vieussen cover the ostium of the great cardiac vein
E. It is not possible to pace the left ventricle transvenously through the coronary sinus and its tributaries

17. Which of the following statements is not true in relation to adenosine?

A. It may result in slowing of the ventricular rate in atrial flutter
B. The half life is approximately 10 seconds
C. It may cause block in the His-Purkinje system
D. It should be given by rapid bolus injection
E. It should be used with caution in asthma



18. In the above trace, what is the AH interval?

A. 310 ms
B. 48 ms
C. 26 ms
D. 34 ms
E. 98 ms

19. Which of the following statements regarding cardiac anatomy is true?

A. The AV node is positioned at the base of the left atrium
B. The right atrial appendage is often excised during cardiopulmonary bypass which aids positioning of atrial pacing leads
C. Typical isthmus dependent atrial flutter is a macro re-entry circuit arising within the left atrium
D. The four pulmonary veins drain into the right atrium
E. The crista terminalis is a smooth muscular ridge in the superior portion of right atrium that separates the trabeculated from non-trabeculated portion of the right atrium

20. A 31-year old female, who had previously been fit and well, was admitted to the coronary care unit with a 2-hour history of regular palpitations. They were of a sudden onset, regular in nature and with no associated symptoms. The above ECG was recorded. The patient received a bolus of intravenous adenosine, which converted her back to sinus rhythm. The most likely mechanism for the arrhythmia is.

A. AV nodal (junctional) tachycardia
B. AV re-entry tachycardia
C. Automaticity
D. Triggered activity
E. None of the above

21. Which of the following characteristics is a diagnostic criterion for left anterior hemiblock on the ECG?

A. Right axis deviation
B. Initial Q waves in leads II, III and aVF
C. Normal QRS duration
D. RsR pattern in lead V_1
E. RsR pattern in lead V_6

22. What pacemaker function is being tested in the above strip?

    A. Atrial pacing threshold with loss of capture at 0.4V
    B. Ventricular pacing threshold with fusion throughout
    C. Ventricular pacing threshold with loss of capture at 0.4V
    D. Atrial pacing threshold in AAI mode
    E. None of the above

23. Which of the following statements about re-entry arrhythmias is true?

    A. Re-entry arrhythmias cannot be initiated in the EP lab
    B. To establish a re-entry arrhythmia a patient needs two pathways connected proximally and distally with different refractory periods
    C. To establish a re-entry arrhythmia a patient needs two pathways with the same refractory periods
    D. The pathway with the shortest refractory period conducts slowest
    E. Torsade de pointes is an example of a re-entry tachycardia

24. The effective refractory period (ERP) is defined as:

    A. The shortest coupling interval between S_1 and S_2 that fails to capture
    B. The shortest coupling interval between S_1 and S_2 that captures
    C. The longest coupling interval between S_1 and S_2 that fails to capture
    D. The longest coupling interval between S_1 and S_2 that captures
    E. None of the above

25. Which of the following is a property of scar related VT?

    A. The underlying electrophysiological mechanism is triggered activity
    B. Scar tissue forms the fast pathway
    C. Ablation therapy is more successful than ablation of normal heart VT
    D. The aetiology can be fibro-fatty infiltration of the myocardium
    E. Scar related VT cannot be induced by programmed electrical stimulation

Boston Scientific — ALTRUA 60

07-NOV-2008 14:28

Institution
Patient
Model S602 Serial S73582 — Programmer 2892 Software 052442 4.00

Brady Parameters

		Initial Value		Present Value
Mode		DDD -->		DDDR
Lower Rate Limit		60		60 min-1
Max Tracking Rate		150		150 min-1
Max Sensor Rate		130		130 min-1
AV Delay (paced)	DYN	--	DYN	-- ms
Atrial				
Pulse Width		0.40		0.40 ms
Amplitude		2.0		2.0 V
Sensitivity		0.50		0.50 mV
Refractory (PVARP)	DYN	--	DYN	-- ms
Ventricular				
Pulse Width		1.00		1.00 ms
Amplitude		3.0		3.0 V
Sensitivity		0.50		0.50 mV
Refractory		250		250 ms

AV Delay

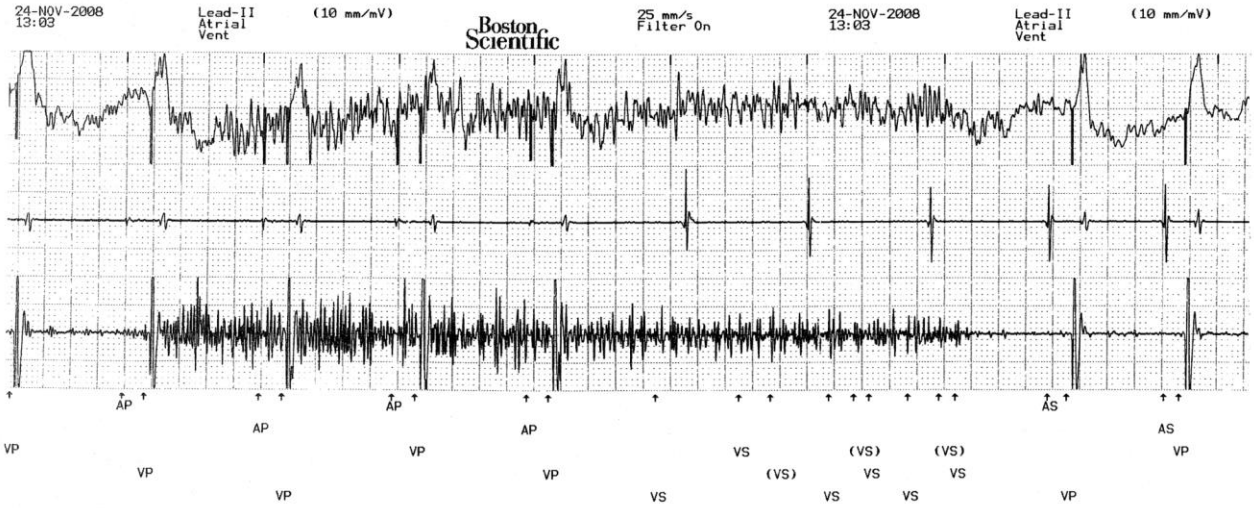
	Initial Value	Present Value
Dynamic AV Delay	On	On
Maximum Delay	170	170 ms
Minimum Delay	80	80 ms
Sensed AV Offset	-30	-30 ms
AV Search Hysteresis		
Search Interval	Off	Off cycles
AV Increase	--	-- %

Sensor(s)

	Initial Value	Present Value
Accelerometer	ATR Only -->	On
Activity Threshold	Medium	Medium
Reaction Time	30	30 sec
Response Factor	8	8
Recovery Time	2	2 min
Minute Ventilation	-- -->	Off
MV Lead	--	--
Response Factor	--	--
High Rate Response Factor	--	-- %
High Rate Break Point	--	-- min-1
Age	60	60
AutoLifestyle	--	--
with Exercise	--	--
Time Dependent Blend	--	--

Refractory

	Initial Value	Present Value
Dynamic PVARP	On	On
Maximum PVARP	250	250 ms
Minimum PVARP	240	240 ms
PVARP after PVC/PAC	400	400 ms
V-Blanking after A-Pace	40	40 ms
A-Blanking after V-Pace	130 -->	120 ms



26. The above printout is from a pacemaker follow-up on a patient who presented to the clinic complaining of dizziness and pre-syncope. How would you correct this?

A. Increase the ventricular output
B. Replace the ventricular lead
C. Increase the PVARP
D. Reduce the ventricular sensitivity
E. Increase the ventricular sensitivity

27. An ECG showing a superior quadrant axis could be

A. +30°
B. -30°
C. +135°
D. 0°
E. -100°

28. Which of the following statements is incorrect with regards to the United Kingdom Pacing and Cardiovascular Events (UKPACE) trial?

A. Patients with sinus node disease or high grade AV block were randomised to single chamber or dual chamber pacing
B. In the single chamber group, patients were randomly assigned to receive either fixed-rate pacing or rate-adaptive pacing
C. The primary end-point was all cause mortality
D. There was no significant difference in mortality between the patients with single-chamber pacing and those with dual-chamber pacing
E. There was no significant difference in the proportion of patients with atrial fibrillation between those with single-chamber pacing and those with dual-chamber pacing

29. Complete right bundle branch block is not characterised on the ECG by which of the following?

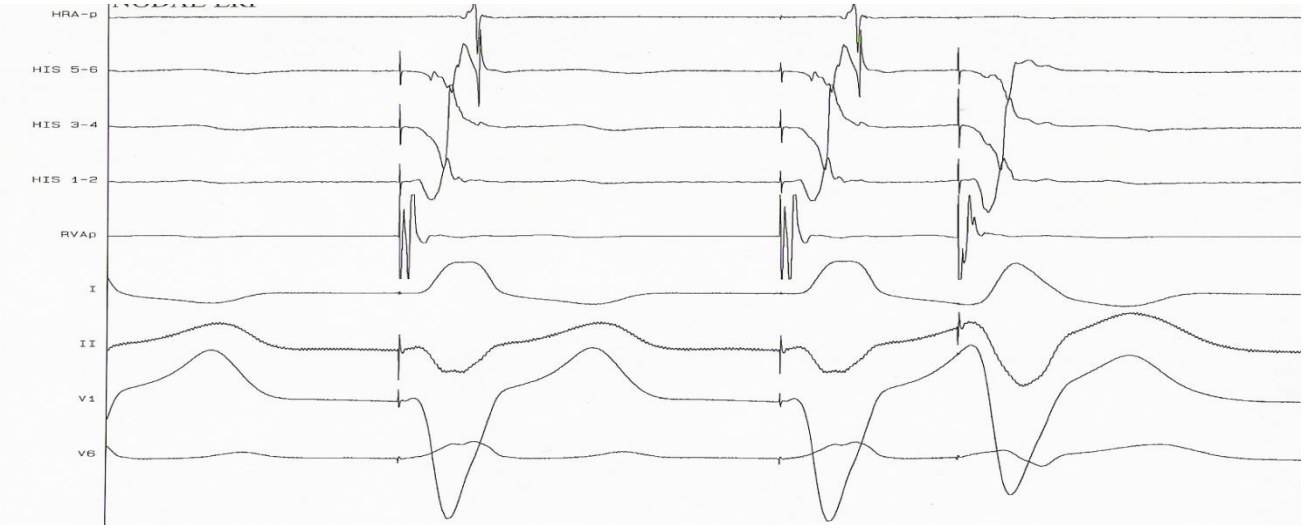
A. QRS duration of 0.14 s or longer
B. Prominent S wave in V_5 & V_6
C. Delayed & widened S wave in lead I
D. RSR complex in V_1
E. Loss of septal Q wave in V_6

30. Which of the following statements is not true with respect to flecainide?

A. It can be proarrhythmic
B. It can increase ventricular rates during atrial flutter
C. It slows conduction in the atria and His-Purkinje systems
D. It binds to sodium channels and increases the speed of depolarisation
E. It can cause prolongation of the QRS complex

31. Which of the following is not a feature of idiopathic left ventricular tachycardia arising from the left posterior fascicle (as opposed to the left anterior fascicle)?

A. Right bundle branch block appearance on ECG
B. Right axis deviation on ECG
C. Can be readily initiated in the EP lab
D. Can be terminated with intravenous verapamil
E. Can be successfully treated with radio-frequency ablation



32. What is shown in the above trace?

A. Retrograde curve with VA dissociation
B. Retrograde curve with VA decrement
C. Retrograde curve with V ERP
D. Retrograde curve with eccentric atrial activation
E. None of the above

33. Which of the following is in favour of a diagnosis of supraventricular tachycardia rather than ventricular tachycardia?

A. Presence of fusion or capture beats
B. Negative concordance of the QRS complex across the precordial leads
C. RsR pattern in lead V_1 with the secondary R wave taller than the primary R wave
D. RsR pattern in lead V_1 with the primary R wave taller than the secondary R wave
E. Change in mean frontal plane QRS axis during tachycardia when compared to sinus rhythm

34. Which of the following is not a medical device covered by the Medical Devices Directives:

A. Cardiac ablation catheter
B. Fluoroscopy screening unit
C. The operating software controlling an implantable cardiac defibrillator
D. The hospital trolley used for moving patients in and out of the catheter laboratory
E. The lead apron worn by the radiographer during x-ray screening procedures

35. Which of the following features are demonstrative of triggered activity?

A. Late after-depolarisation
B. Unidirectional block
C. Responds to calcium channel blockers
D. Critical prematurity
E. Amenable to termination by programmed electrical stimulation

36. Atypical atrial flutter seen post AF ablation often arises from

A. Left atrial appendage
B. Mitral isthmus
C. Left atrial roof
D. Left superior pulmonary vein
E. Right inferior pulmonary vein

37. Which of the following ECG features is not consistent with serum potassium abnormalities?

A. Widening of the QRS complex
B. First or second degree AV block
C. ST elevation
D. Diminution of the P wave
E. increased amplitude of the U wave

38. Which of the following specifications determines if a pacing lead is designed to provide high impedance and thus prolong battery longevity?

A. Diameter
B. Insulation material
C. Anode surface area
D. Tip to ring spacing
E. None of the above

39. The AV node is said to demonstrate:

A. Poor autonomic control
B. Rapid conduction
C. Eccentric conduction
D. Decremental conduction
E. None of the above

Tachy Episode 7 of 7 | Date/Time: Dec 5, 2008 6:24 pm | Type: VT (Therapy Delivered) | Episode Duration: 0:46

Diagnosis: VT

Time to Diagnosis: 7.25 sec CL 350 ms/171 bpm

Rate Branch:
Classification: Sinus Tach (V = A) Rate Branch
Morphology:
Programmed: On, ≥ 45% is a match,
≥ 5 of 8 matches indicate SVT
Template Updated: Dec 4, 2008 8:38 am
Measured:
Min Match Score: N/A
Max Non-Match Score: N/A
No. Template Matches: N/A **(VT Indicated)**
Sudden Onset:
Programmed: Passive, <100 ms indicates SVT
Measured Max Delta: 25 ms **(Passive: SVT Indicated)**
Bigeminal rhythm detected, VT diagnosis aborted.

Alerts: 1

ATP therapy unsuccessful

Therapy:	Results:
ATP x 4	VT
CVRT 22.5 J / 656V	Below Rate Detection (CL 380 ms)

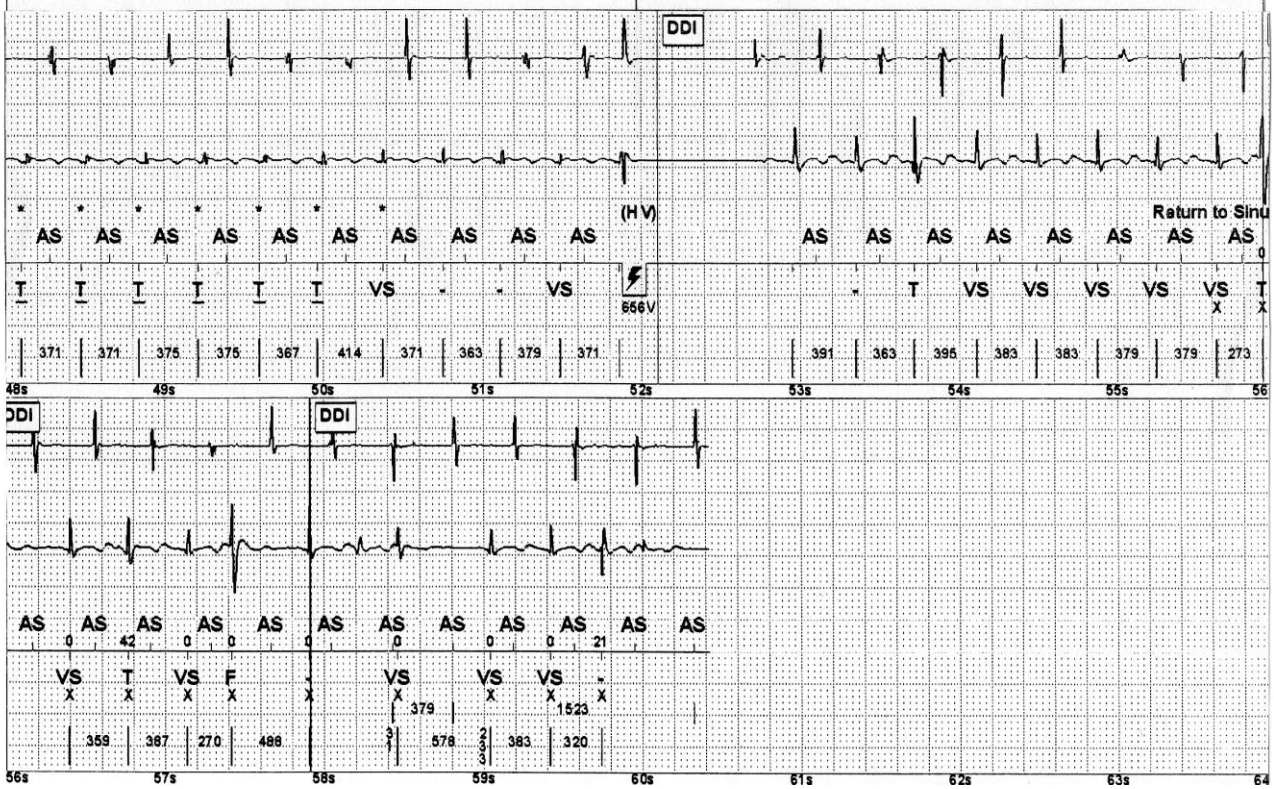
Bigeminal rhythm detected, VT diagnosis aborted.

High Voltage Therapy Details

Last Charge Time: 4.4 s
Last Lead Impedance: 35 Ω
Delivered PW: +4.4 ms, -4.4 ms

ATP Therapy Details: VT

Burst 1: 296, 296, 296, 296, 296, 296, 296 ms
Burst 4: 276, 276, 276, 276, 276, 276, 276 ms

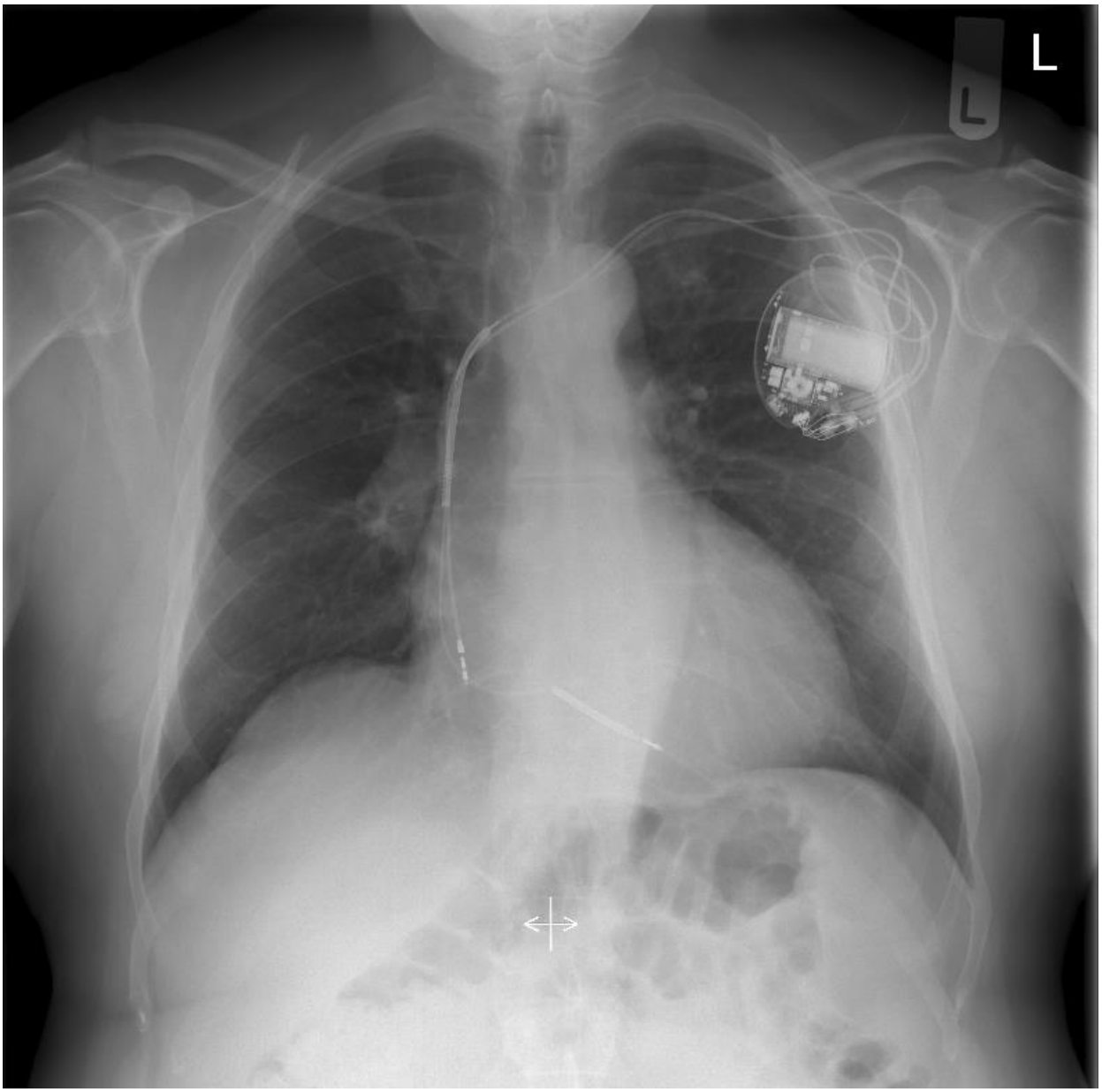


40. A 27-year-old patient with a dual chamber ICD presents to clinic following a series of shocks from his ICD. The patient was dancing at his Christmas party when he received the shocks. The above printout was obtained. Which detection enhancement would you re-program?

A. Morphology
B. Sudden onset
C. Morphology and sudden onset
D. Stability
E. V > A response

41. Which of the following constitutes a Class I indication for pacemaker implantation?

A. 1st degree AV block
B. 2nd degree AV block – Mobitz type I
C. Nocturnal bradycardia
D. Complete heart block in the context of acute myocardial infarction
E. Symptomatic complete heart block



42. What device complication is demonstrated in the above chest X-ray?

A. A dual chamber pacemaker with a lead fracture
B. A single chamber pacemaker with RV lead displacement
C. A dual chamber ICD with RV lead displacement
D. A dual chamber ICD with atrial lead displacement
E. A dual chamber pacemaker with RV lead displacement

43. An 82 year-old man with known ischaemic heart disease has a dual chamber pacemaker implanted for sinus arrest. He initially presented to casualty following a fall where he sustained significant bruising to his face and left hip. Two weeks post-discharge he presents to the pacemaker clinic complaining of marked breathlessness and significantly reduced activity. On interrogation, the pacemaker is functioning normally, with all measurements within normal limits. Paced rhythm shows consistent atrial tracking of sinus rhythm (A_SV_P) with occasional ventricular fusion. Programming is as follows:

DDD
60-130ppm
PAV 150
SAV 120
PVARP 320

Intrinsic rhythm is sinus rhythm, HR 45bpm. Which of the following programming changes are most likely to improve the symptoms described?

A. Increase AV delay or decrease lower rate
B. Increase AV delay or programme to DDI mode
C. Increase lower rate or increase ventricular output
D. Increase ventricular output or increase AV delay
E. Increase lower rate or programme to rate responsive mode

44. A normal HV interval is

A. 20 – 40 ms
B. 35 – 55 ms
C. 30 – 120 ms
D. 50 – 120 ms
E. 80 – 120 ms

45. A patient with an ICD:

A. May drive a Group 2 vehicle if no shocks have been delivered for more than 2 years
B. May drive after 6 months if only anti-tachycardia therapy has been delivered and the arrhythmia did not cause incapacity
C. May resume driving 1 week after a routine generator replacement
D. May not drive for a period of 1 year following therapy that has resulted in incapacity
E. May drive after 3 months if the ICD was implanted for prophylactic reasons in an asymptomatic individual

46. What is demonstrated in the above trace?

A. Anterograde curve with normal AH decrement
B. Burst atrial pacing
C. Ramp atrial pacing
D. Anterograde curve with AVNERP
E. Anterograde curve with AERP

47. Which statement is correct with regards to the COMPANION trial?

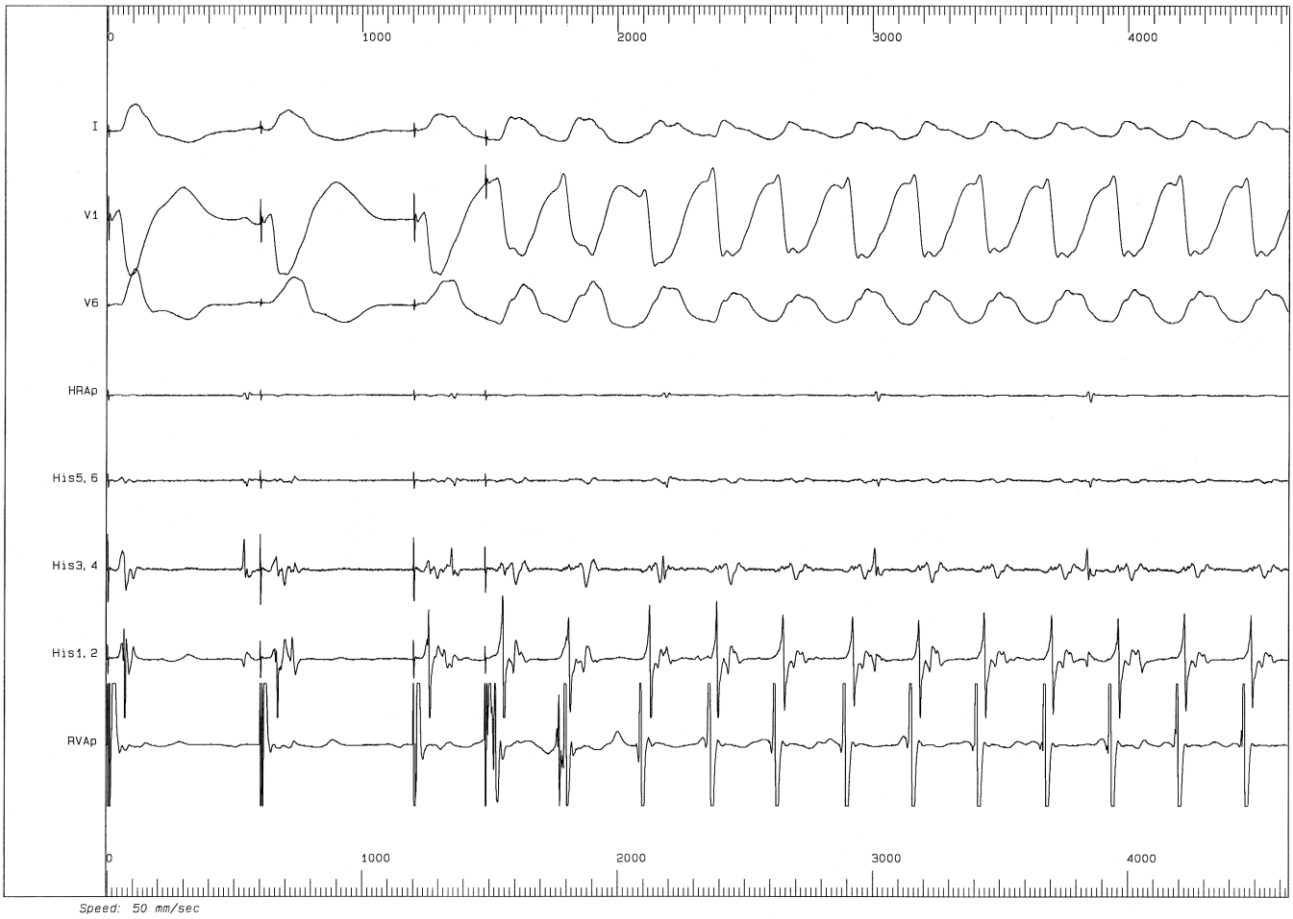
A. Patients were included if they had NYHA class II – IV heart failure
B. Patients were randomised equally to optimal medical therapy alone, optimal medical therapy plus CRT-P or optimal medical therapy plus CRT-D therapy
C. The primary end-point was all cause mortality
D. Optimal medical therapy plus CRT-P or CRT-D resulted in a significant reduction in all cause mortality
E. Optimal medical therapy plus CRT-D resulted in a significant reduction in all cause mortality

48. What is demonstrated in the above trace?

A. Anterograde curve with normal AH decrement
B. Burst atrial pacing
C. Ramp atrial pacing
D. Anterograde curve with AVN ERP
E. Anterograde curve with A ERP

49. When dealing with erosion of an implantable cardiac device (pacemaker, ICD etc)

A. Primary closure of the wound is usually effective
B. The device can be re-sterilised by ethylene oxide and re-utilised in the same patient
C. Removal of the device and leads is usually required
D. Abandoned leads can be safely capped and buried
E. The device will not be infected if the skin is not broken



50. What is shown in the above trace?

A. Initiation of monomorphic VT with burst ventricular pacing
B. Initiation of VF with burst ventricular pacing
C. Initiation of monomorphic VT with retrograde curve (S_1, S_2)
D. Initiation of VF with retrograde curve (S_1, S_2)
E. None of the above

51. Which of the following has no significant interaction with warfarin?

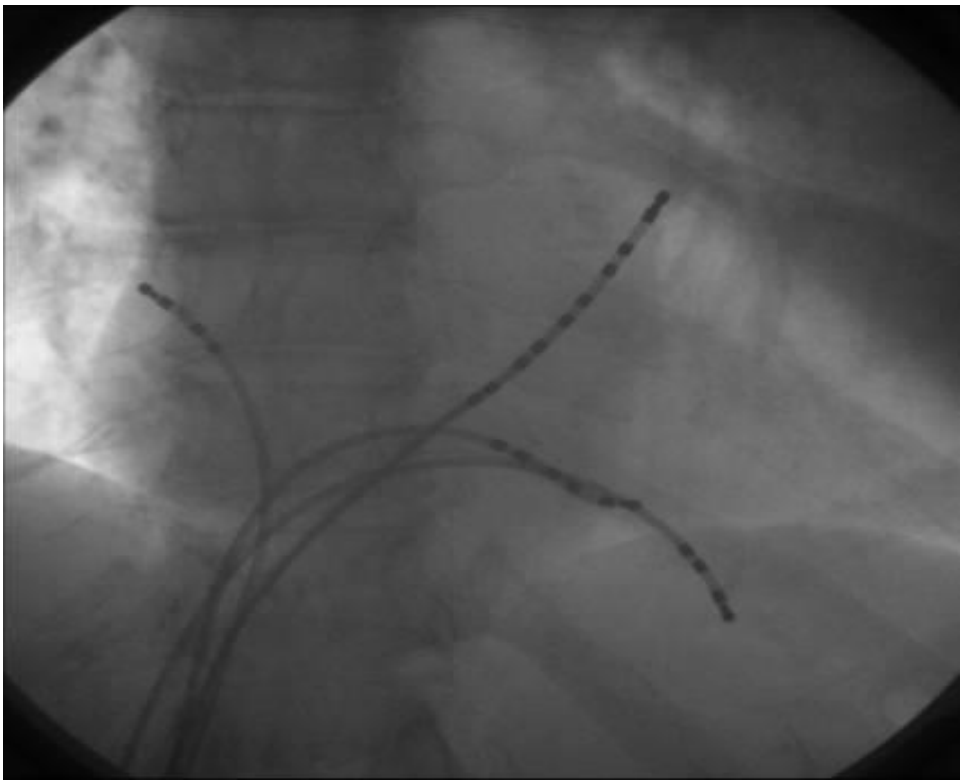
A. Cranberry juice
B. Amiodarone
C. Digoxin
D. Flecainide
E. Simvastatin

52. The role of the Medicines and Healthcare products Regulatory Agency (MHRA) includes:

A. Preventing the occurrence of adverse incidents
B. Assigning blame for adverse incidents
C. Assessing liability for adverse incidents
D. Recycling removed pacemakers
E. Registration of ICD implants

53. Which of the following studies did not show a significant reduction in mortality in the ICD arm of the study as compared to the other arm(s)?

A. The Sudden Cardiac Death in Heart Failure Trial (SCD-HeFT)
B. The Multicenter Automatic Defibrillator Implantation Trial II (MADIT II)
C. The Canadian Implantable Defibrillator Study (CIDS)
D. The Multicenter Unsustained Tachycardia Trial (MUSTT)
E. The Antiarrhythmics Versus Implantable Defibrillators (AVID) trial



54. What type of EP catheter is shown in the high right atrial position in the above X-ray below?

A. Bipolar catheter
B. Quadrapolar catheter
C. Hexapolar catheter
D. Ablation catheter
E. Decapolar catheter

55. What is the primary effect of amiodarone on the myocardial action potential?

A. Shortens phase III
B. Shortens phase II
C. Prolongs phase II
D. Prolongs phase III
E. Prolongs phase 0

56. A patient with complete heart block:

A. May only drive if he/she has a pacemaker
B. May not drive a Group 1 vehicle for 4 weeks after pacemaker implant
C. May drive a Group 2 vehicle after 3 months
D. Is required to inform the DVLA of his/her pacemaker
E. May drive with acquired complete heart block if asymptomatic

57. NICE guidelines for Cardiac Resynchronisation Therapy (CRT) state:

A. CRT-P is recommended for patients with sinus rhythm and QRS ≥150 ms
B. CRT-P is recommended for patients with an ejection fraction <40%
C. CRT-D is recommended for patients considered at risk of ventricular arrhythmias
D. CRT-P is recommended for patients with heart failure in NYHA class II-IV
E. Patients with atrial fibrillation should undergo AV junctional ablation before CRT

58. Which of the following is not a recognised side effect of amiodarone?

A. Pulmonary fibrosis
B. Peripheral neuropathy
C. Hepatic dysfunction
D. Xanthelasmata
E. Vivid dreams

59. Which of the following statements is correct? According to the DVLA Guidance for Medical Practitioners, patients with sinus node disease:

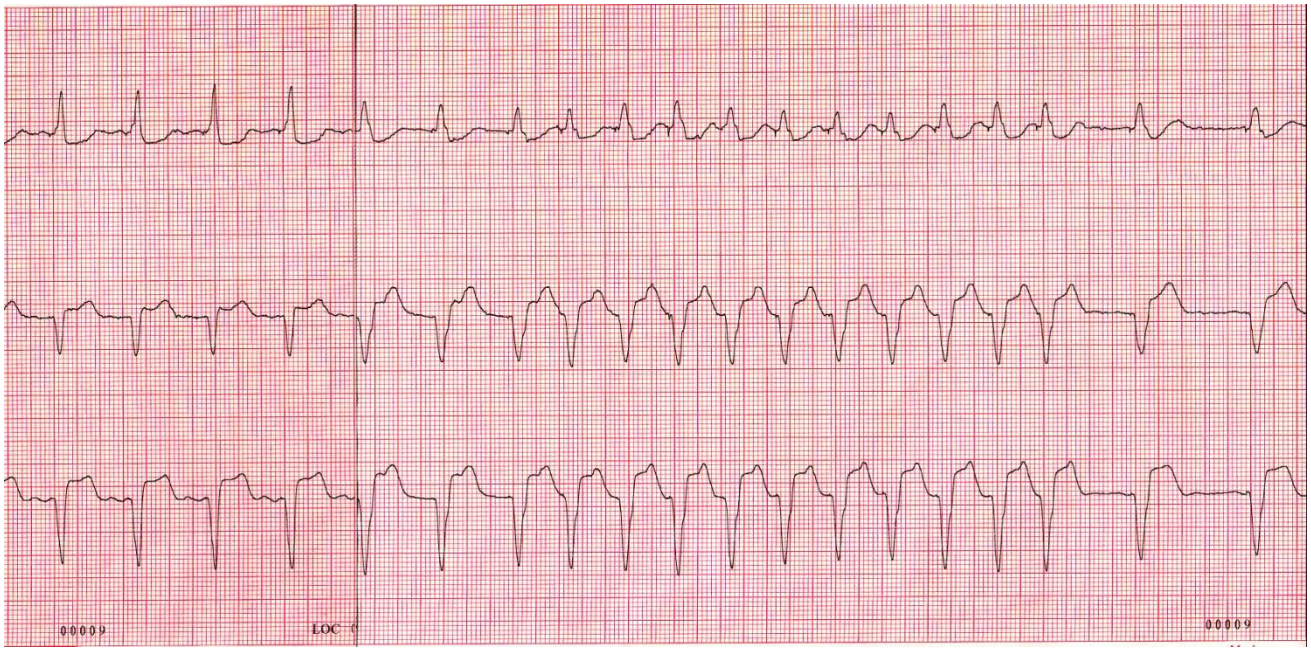
A. May drive a Group 1 vehicle as long as the patient has a pacemaker
B. May drive a Group 2 vehicle if they have an ejection fraction of 45% and no symptoms for > 3 months
C. Must notify the DVLA if they have any symptoms associated with their arrhythmia
D. May drive a Group 1 vehicle once their symptoms have been controlled for > 2 weeks
E. Will need annual review to continue to drive a Group 1 vehicle

60. Which of the following statements are false? Conscious sedation should be used with caution in patients with:

A. Sleep apnoea
B. Excess alcohol consumption
C. BMI greater than 30
D. Chronic obstructive pulmonary disease
E. Brugada Syndrome

SECTION 2 – DEVICES

ONLY ANSWER THIS SECTION OR SECTION 3 IN ADDITION TO SECTION 1.
DO NOT ANSWER BOTH SECTION 2 AND SECTION 3



61. The above rhythm strip, leads I, II, III was recorded during a dual chamber pacemaker check. What does it show?

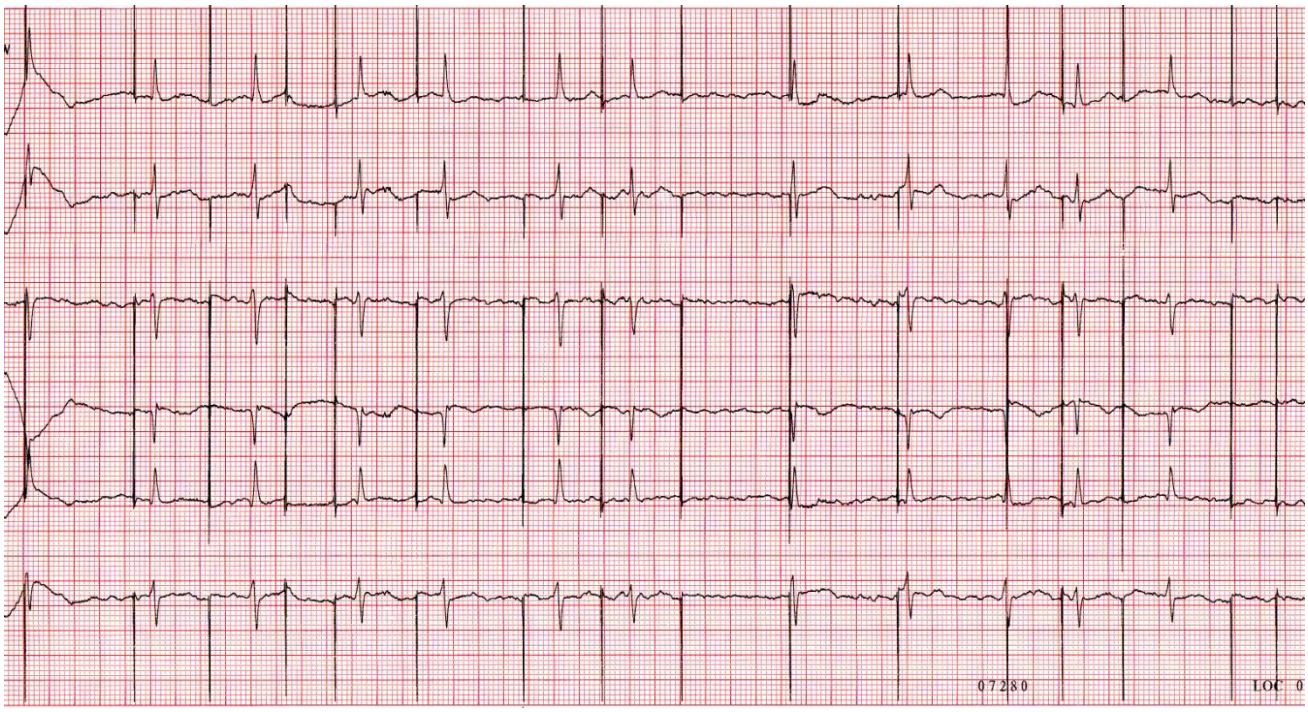
    A. Ventricular pacing tracking atrial fibrillation
    B. Normal pacemaker function
    C. Ventricular pacing tracking sinus arrhythmia
    D. Pacemaker mediated tachycardia on loss of capture during atrial threshold testing
    E. Atrial sensing followed by ventricular pacing

62. At a routine box change procedure of a single chamber ventricular pacemaker the following measurements were obtained. Threshold 0.9V at 0.5 ms and a measured current of 26 mA; sensing 12 mV. What is the lead impedance?

    A. 280 Ω
    B. 428 Ω
    C. 346 Ω
    D. 600 Ω
    E. 1200 Ω

63. With respect to the data in the previous question (question 62), which of the following statements is correct?

A. Implant a new lead as there is a possible conductor fracture.
B. Implant a new lead as there is a possible insulation break
C. Implant a new generator and reprogram the output to unipolar
D. Repair the lead
E. Do nothing



64. This above rhythm strip, leads I, II, III, aVR, aVL, aVF was recorded at a pacemaker check. What does it show?

A. Normal sinus rhythm with ventricular under-sensing and loss of capture
B. Atrial fibrillation with ventricular under-sensing and loss of capture
C. AAI pacing with atrial under-sensing during atrial fibrillation
D. AAIR pacing with atrial under-sensing during atrial fibrillation
E. AAT pacing with atrial under-sensing during atrial fibrillation

65. A patient who had an ICD implanted for primary prevention presented at follow-up having had a near-syncopal episode terminated by a shock. Interrogation of the ICD showed a fast VT in the VF zone and appropriate shock therapy delivered. With reference to current DVLA guidelines, which of the following is correct?

A. He must not drive for 1 month and need not notify the DVLA
B. He must not drive for 6 months and must notify the DVLA
C. He must not drive for 6 months and must re-notify the DVLA
D. He must not drive for 1 month and must notify the DVLA
E. He may continue to drive

66. An ICD patient has 2 different VTs documented at 145bpm and 188 bpm. Which would be the most appropriate settings for 2 VT zones for ATP therapy?

A. VT_1 500 ms VT 300 ms
B. VT_1 450 ms VT 340 ms
C. VT_1 425 ms VT 350 ms
D. VT_1 400 ms VT 300 ms
E. VT_1 380 ms VT 280 ms

67. Tapping on a pulse generator with which kind of sensor will increase pacing rate?

A. Accelerometer
B. Minute ventilation
C. Temperature
D. Ventricular impedence
E. Piezoelectric

68. A band pass filter modifies incoming signals according to which of the following units of measure:

A. Millivolt (mV)
B. Hertz (Hz)
C. Coulomb (C)
D. Microjoule (µj)
E. Ohm (Ω)

69. Over time, the battery cell impedance of a lithium iodide powered pacemaker:

A. Decreases
B. Remains constant
C. Increases
D. Changes only at EOS
E. Changes at ERI and EOL only

70. A patient with rheumatic heart disease has two prosthetic valves (mitral and tricuspid). Which of the following leads should be implanted?

A. Retractable, screw in
B. Steroid, tined
C. Steroid, active fixation
D. Epicardial
E. Fixed, screw in

71. The most common therapy for a patient demonstrating vasodepressor syncope with a positive tilt test is:

A. Drugs that stimulate cardiac C fibres
B. Patient education and appropriate hydration
C. DDD pacemaker with a rate drop algorithm
D. Beta-blockers in combination with disopyramide and theophylline
E. VVIR pacemaker

72. A DDD pacemaker patient complaining of palpitations is evaluated in the pacemaker clinic. Telemetry of event counters reveals a five-fold increase in the number of PVCs. Holter monitoring reveals no PVCs. The most likely reason for this apparent discrepancy is:

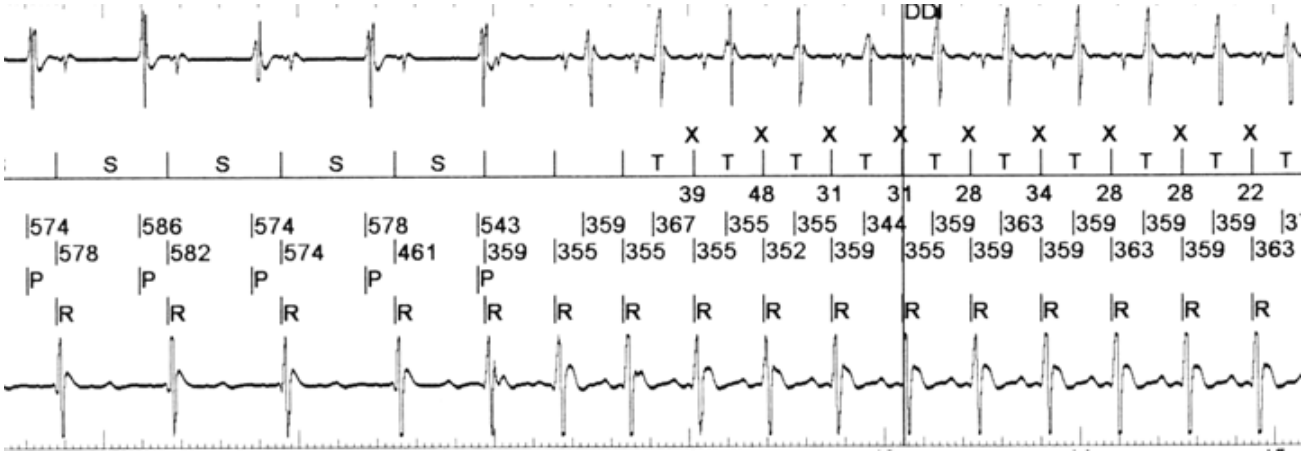
A. Ventricular undersensing
B. Rate hysteresis
C. Atrial oversensing
D. Atrial undersensing
E. AV hysteresis

73. Which of the following programmable features would minimise rate acceleration above the upper tracking rate in a sensor driven pacemaker utilising ventricular based timing:

A. Refractory extension
B. Tachycardia termination algorithm
C. Rate adaptive AV delay
D. DVI on PVC
E. PMT termination

74. Pacing thresholds are not influenced by:

A. Electrode material
B. Electrode surface area
C. Insulation material
D. Maturation process
E. Steroid elution



75. Which of the following is shown in the above EGM from a dual chamber ICD? (atrial channel is the top EGM, ventricular channel is the lower EGM)

A. AVNRT
B. VT
C. Atrial flutter
D. Sinus tachycardia
E. Atrial tachycardia & VT simultaneously

76. The most common cause of pacemaker failure to output is:

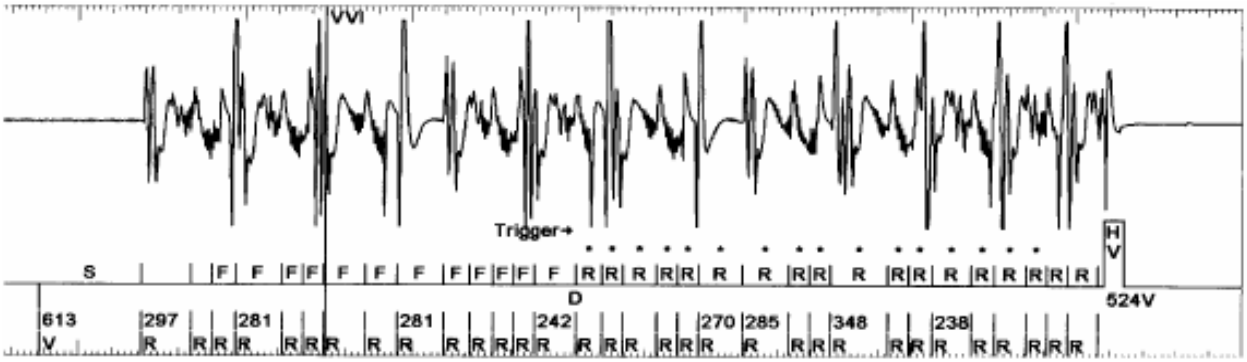
A. Oversensing
B. Lead fracture
C. Component failure
D. Exit block
E. Undersensing

77. RV pacing axis could be generated from an LV lead in which of the following scenarios?

A. Bipolar LV pacing from the lateral coronary sinus vein
B. Bipolar LV pacing with loss of capture and underlying RBBB
C. Unipolar LV pacing at 5.0V with loss of capture on the LV lead and anodal RV ring capture
D. Unipolar LV pacing at 5.0V with loss of capture on the LV lead and an RV coil as anode
E. None of the above

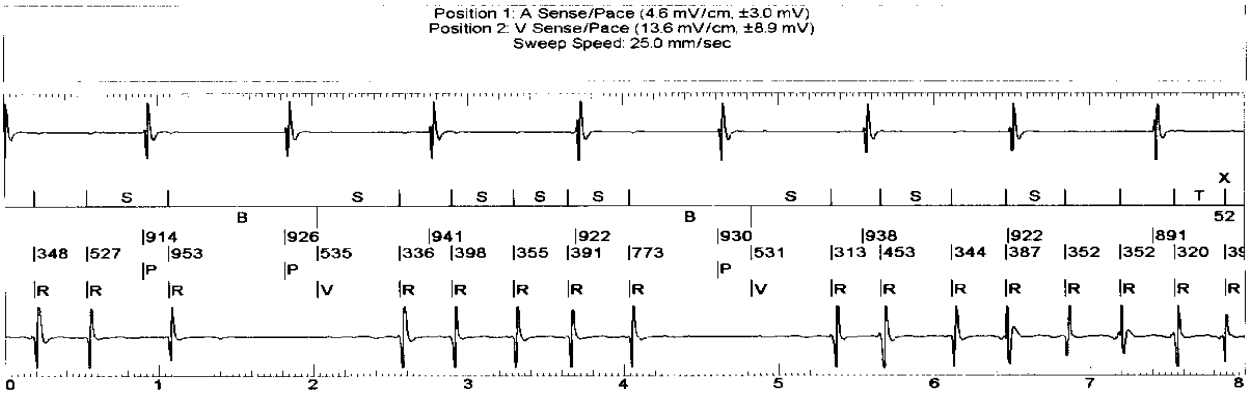
78. The most appropriate action to take with the above patient who has a dual chamber ICD would be? (atrial channel is the top EGM, ventricular channel is the lower EGM)

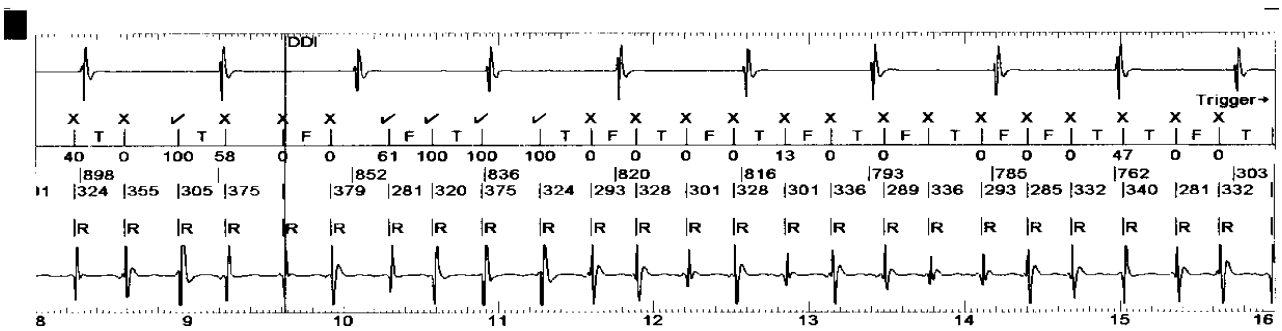
A. Program sudden onset discriminator on
B. Program the AV association algorithm on
C. Review the patient's medication
D. Increase the rate of the VT detection zone
E. Perform manual ventricular ATP



79. The above EGM recorded from a true bipolar ICD lead attached to a single chamber ICD most likely shows?

A. EMI
B. Brady induced ventricular fibrillation
C. Rapidly conducted atrial fibrillation
D. Fractured lead EGM
E. Mypotential oversensing





80. Which of the following is the most appropriate programming action with the above dual chamber ICD – patient was mildly symptomatic at time of arrhythmia

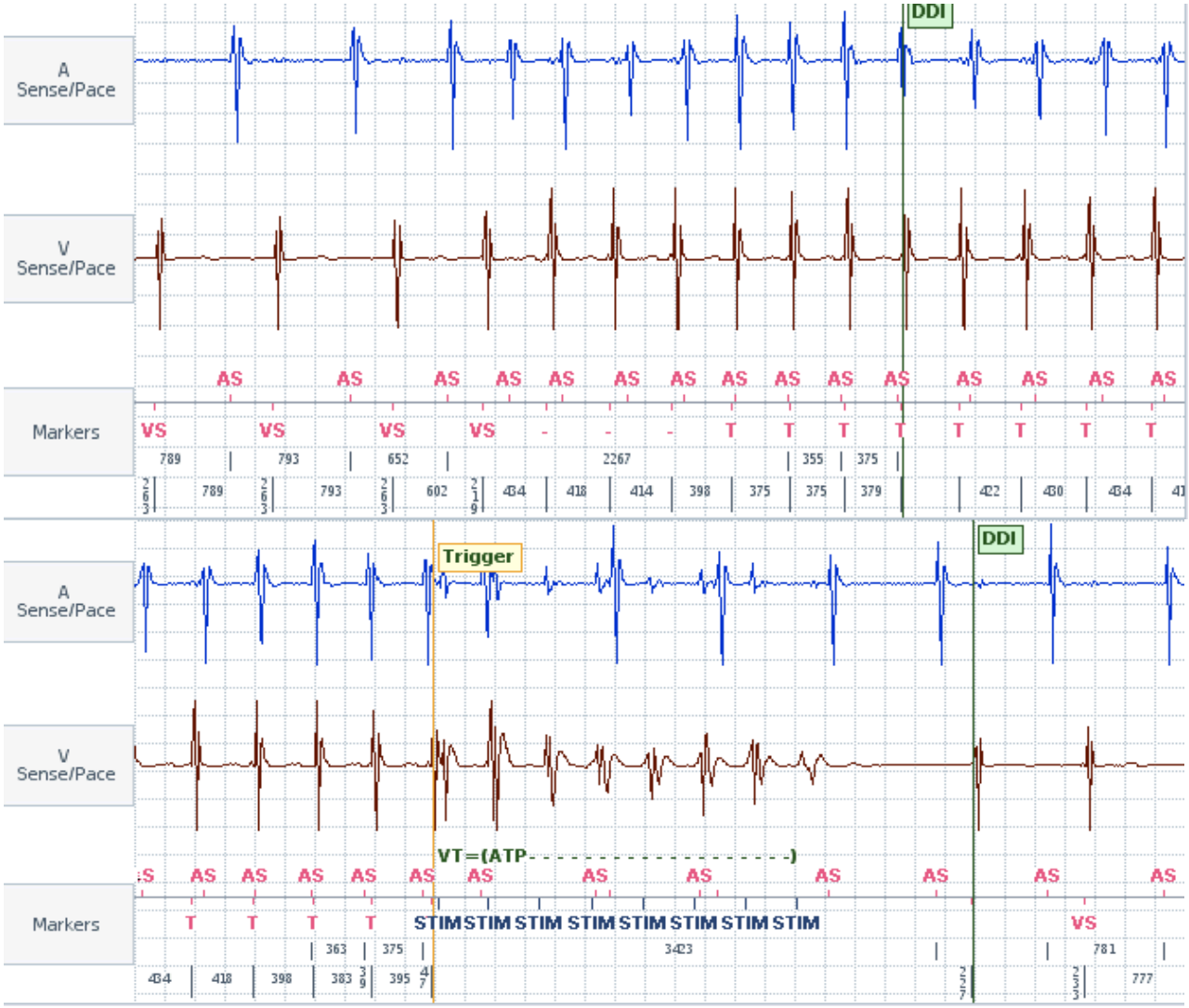
A. Increase the rate of the VT zone
B. Decrease the rate of the VT zone
C. Increase the rate of the VT zone, increase the rate of the VF zone
D. Decrease the rate of the VT zone and increase the rate of the VF zone
E. Decrease the rate of the VF zone

81. A single coil impedance would most likely be within the following range:

A. Less than 20 Ω
B. 20 – 30 Ω
C. 50 – 80 Ω
D. 100 – 150 Ω
E. Above 400 Ω

82. A potential complication of single lead VDD pacing is:

A. Atrial lead dislodgement
B. Pacemaker syndrome
C. Crosstalk
D. Atrial exit block
E. Ventricular exit block

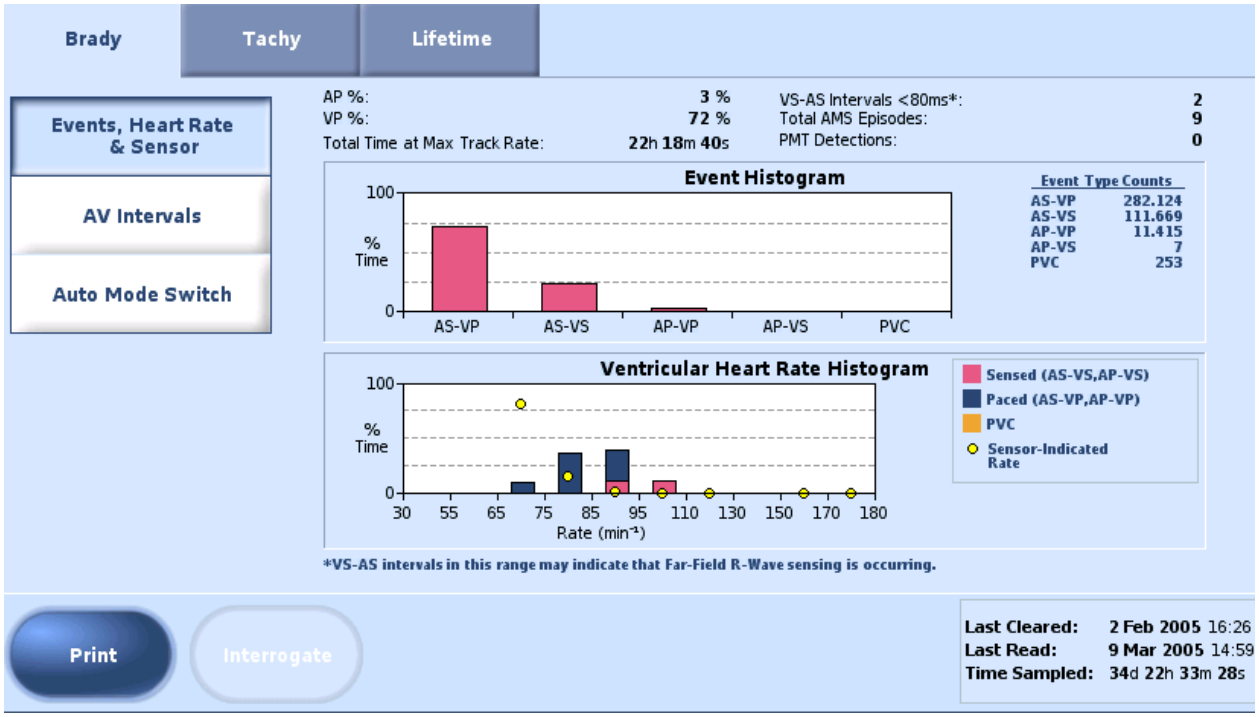


83. The above EGM demonstrates which of the following?

A. Atrial tachycardia
B. VT with 1:1 VA conduction
C. Double tachycardia
D. Scanning ATP
E. Atrial fibrillation

84. Which of the following does not feature on the strength-duration curve?

A. Chronaxie
B. Charge
C. Amplitude
D. Rheobase
E. Pulse width



85. The CRT device in the above trace needs which of the following programmed?

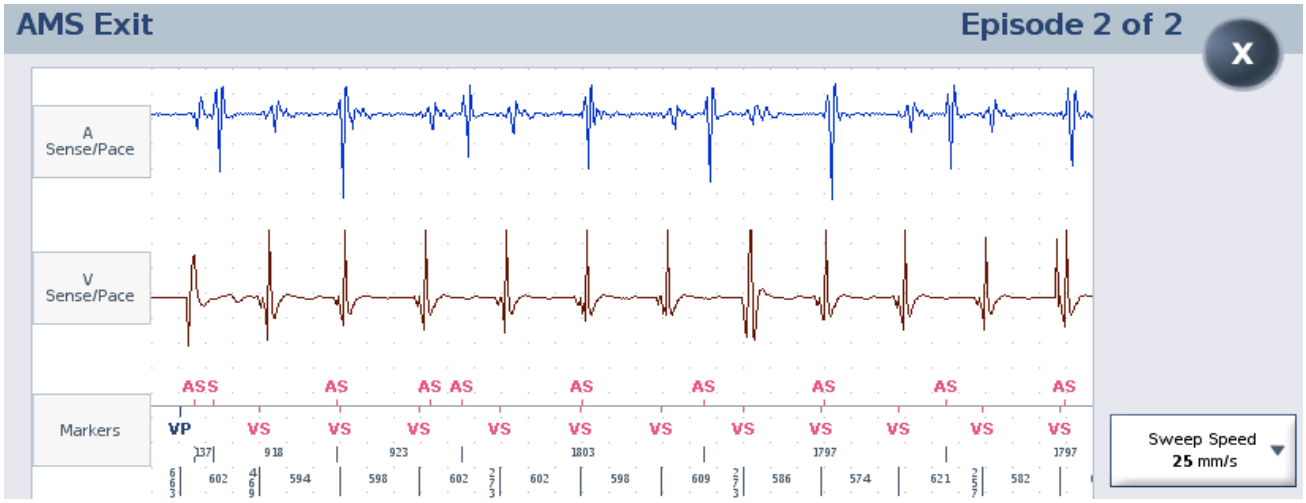
A. Trigger mode pacing programmed on
B. An increase in the maximum tracking rate
C. AV delays need shortening
D. Rate response needs programming on
E. AV and VV delay optimisation

86. Which of the following rate response sensors incorporates a true closed-loop circuit?

A. Accelerometer
B. Minute ventilation
C. QT sensor
D. Magnetic ball
E. None of the above

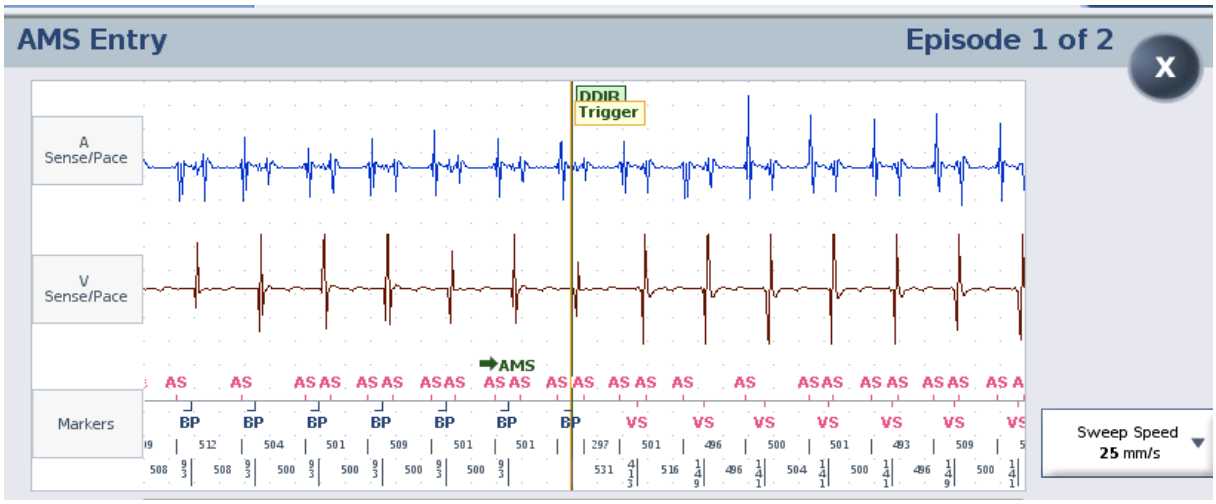
87. During an ICD implant, the implanted system fails to cardiovert ventricular fibrillation at maximum output despite adequate detection. Which of the following would you first suggest to rectify this?

A. Reverse shock vector polarity
B. Reposition the shock lead
C. Unplug / deactivate the SVC coil
D. Switch to a high output device
E. Remove the can from the shock vector



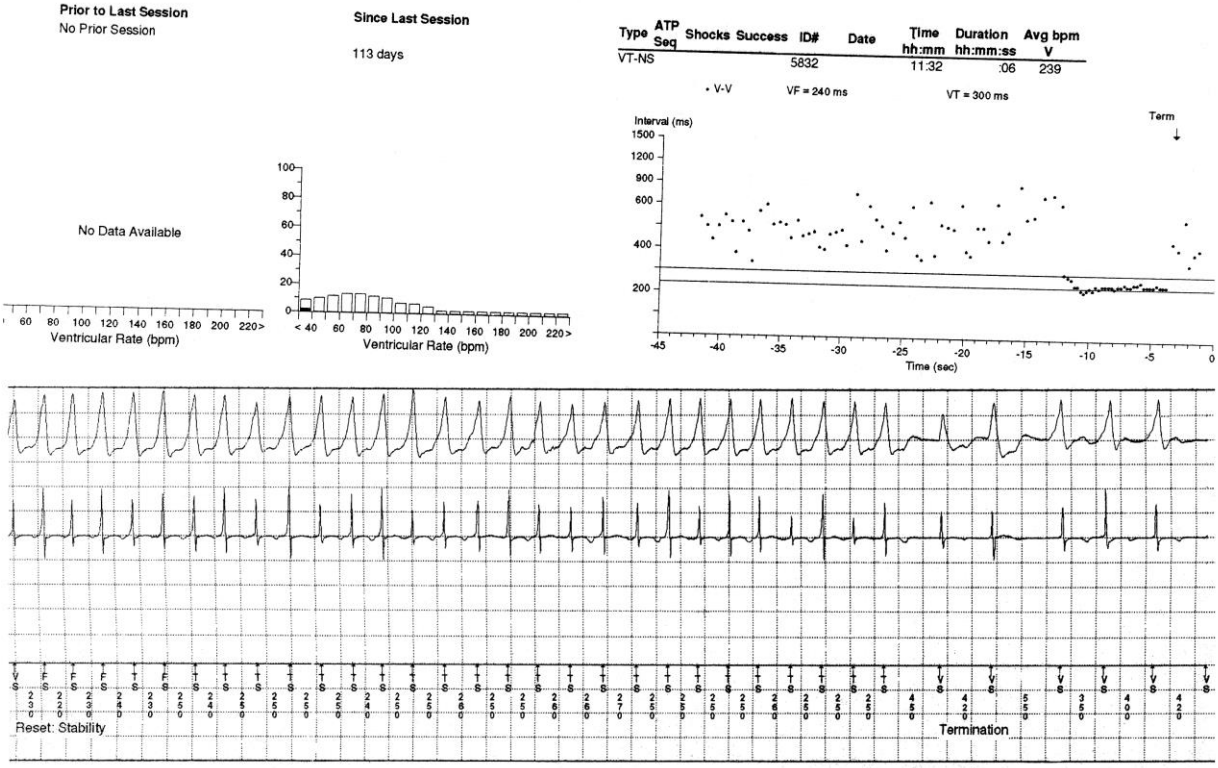
88. What does the above EGM show?

A. VT
B. AF
C. Oversensing in the V channel
D. Sinus tachycardia with Far R wave sensing
E. Atrial tachycardia



89. What needs programming from the information presented in the following EGM?

A. Increased PVAB
B. Decreased atrial sensitivity
C. Atrial lead reposition
D. VT zone rate reduction
E. Ventricular blanking programmed on

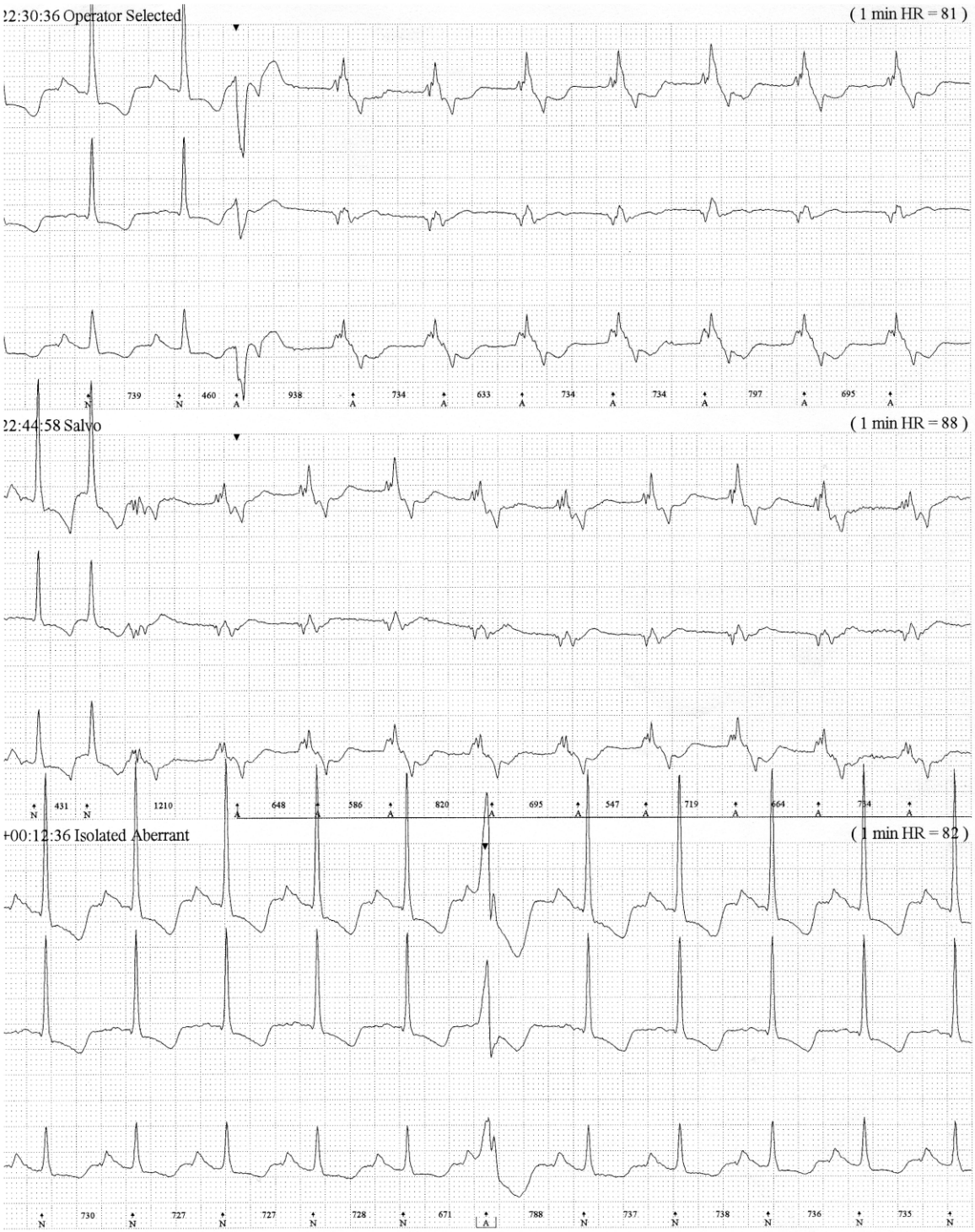


90. The above ECG and rate histogram were recorded from a patient with a single chamber ICD who had presented with a near syncopal episode but no shocks. From the tracings provided what should the next action be?

A. Reprogram the VF detection interval to 220ms
B. Reprogram the SVT discrimination algorithm
C. Reprogram the VT detection interval to 280ms
D. Start the patient on Warfarin
E. Change the patient's anti-arrhythmic medication

91. Which of the following does not influence the function of an implanted defibrillation system?

A. Shock vector
B. Biphasic waveform
C. Synchronisation
D. Waveform tilt
E. Defibrillation threshold

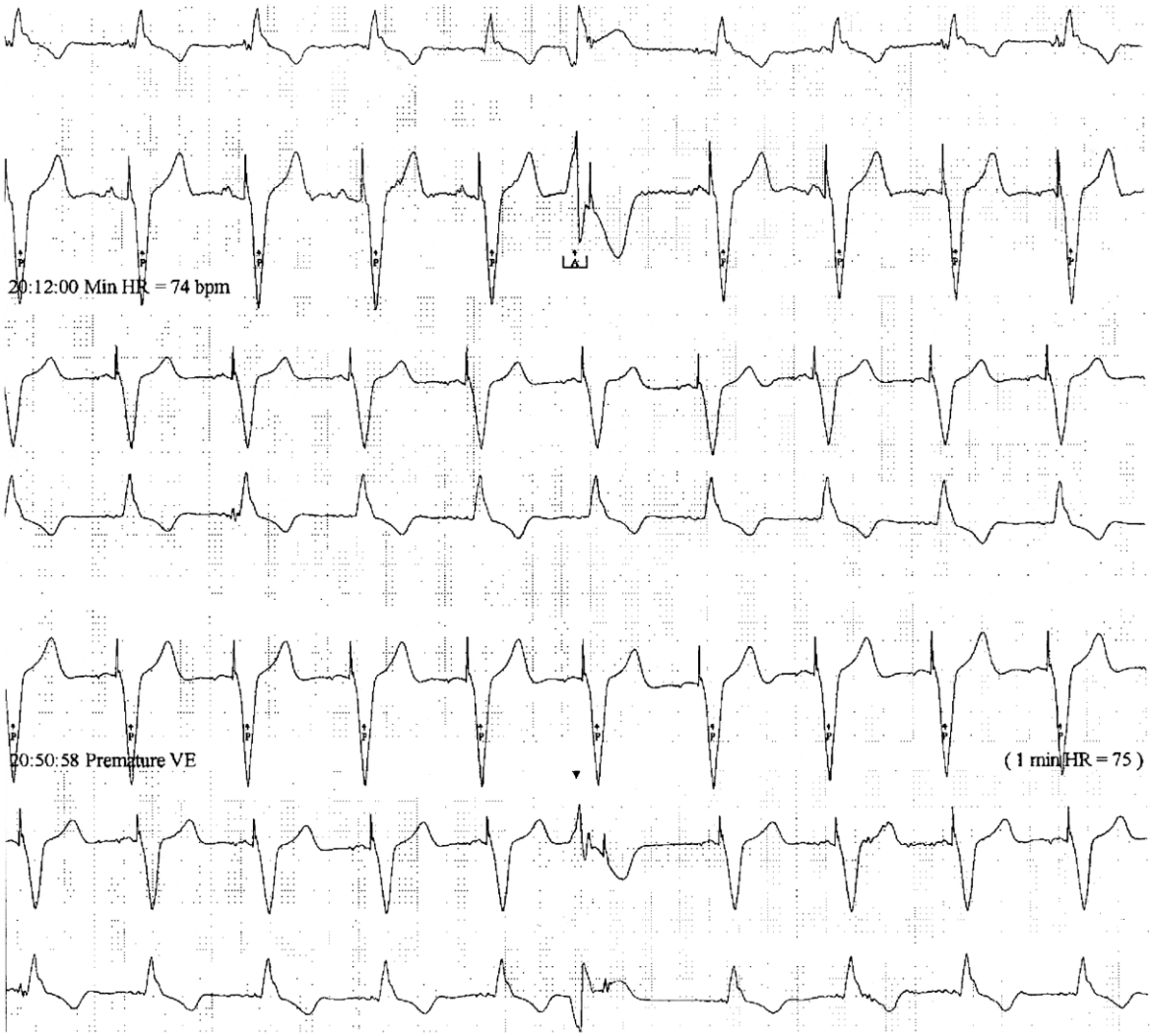


92. The above patient who has a dual chamber pacemaker implanted complained of heavy palpitations. No abnormality was found at follow-up. A Holter recording (above) showed the following. What mode is programmed?

A. VVI
B. DDI
C. AAI
D. VDD
E. DDD

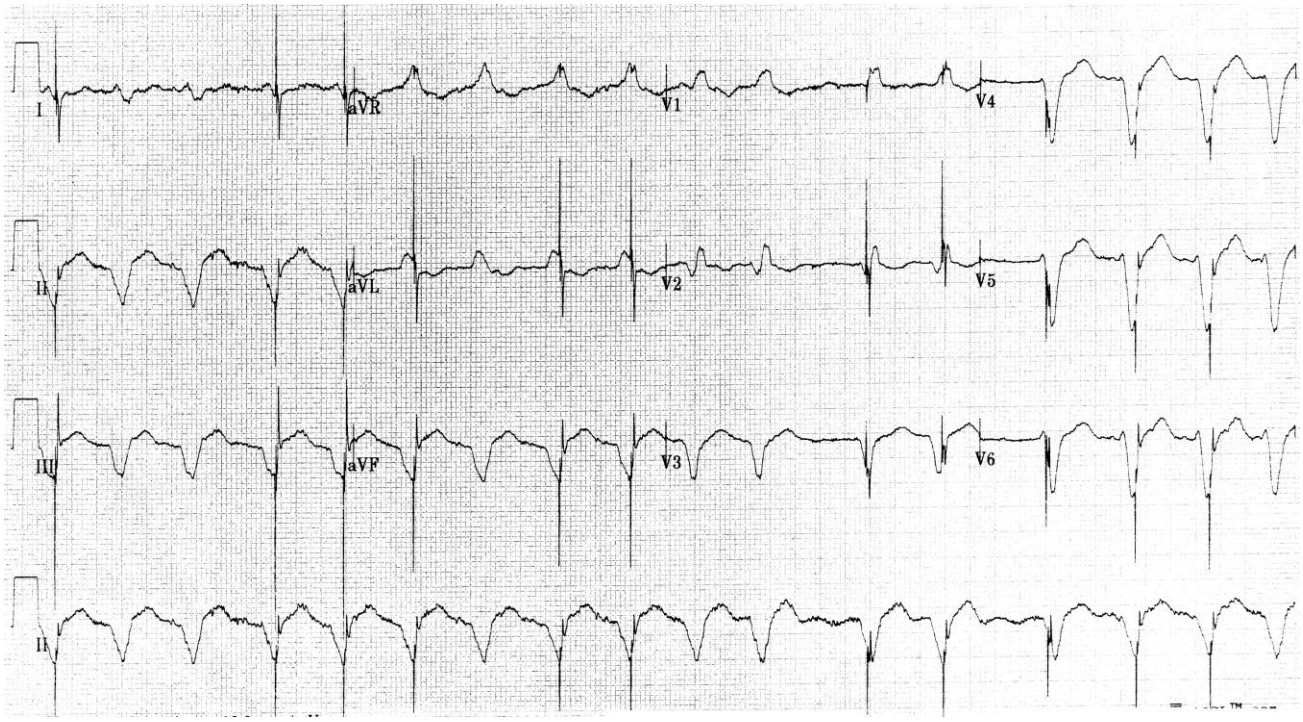
93. With regards to the patient in the previous question (question 91), which parameter should be re- programmed?

A. AV delay
B. Pacing mode
C. Lower rate
D. PVARP
E. A blanking



94. The above tracing was recorded from a patient who had a Holter monitor because of symptoms of heavy palpitations. She had a DDD pacemaker implanted which was functioning normally at her last check. What action should be taken?

A. Reprogram the ventricular blanking period
B. Reprogram the ventricular sensitivity
C. Reprogram the atrial sensitivity
D. Do nothing as it is normal function
E. Reprogram the atrial blanking period



95. The above ECG was recorded at a heart failure clinic. The patient was told that their pacemaker was not working properly. What is the most likely solution?

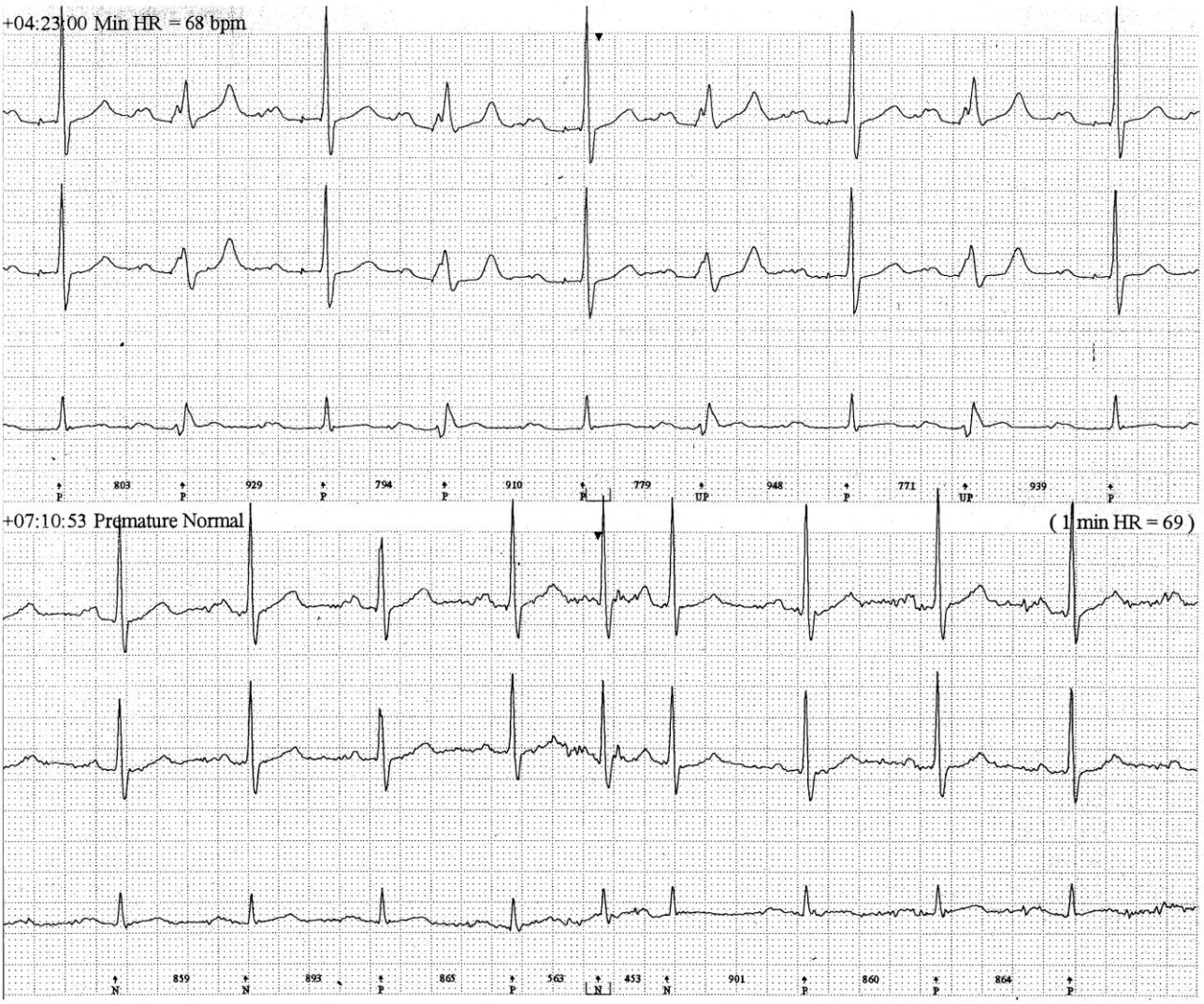
A. Reprogram the ventricular sensitivity
B. Reprogram the pacemaker to VVIR
C. Reposition the LV lead
D. Reprogram the lower rate
E. Do nothing and treat the patient medically

96. What is the best pacing mode for a young patient presenting with cardio-inhibitory vasovagal syncope?

A. AAI
B. DDD
C. DDI with rate drop response
D. DDD with rate drop response
E. DDDR

97. Which of the following ICD detection enhancements may be affected by changes in the electrode / myocardial interface immediately post implant if an active fixation ventricular lead is used?

A. Morphology
B. Stability
C. Sudden onset
D. V > A
E. All of the above



98. The above patient who has a dual chamber pacemaker implanted presented at the pacing clinic. His check was satisfactory with normal sensing and pacing function. His event counts showed extremely frequent ventricular ectopic beats and a 24 hour monitor was fitted (shown above). The pacemaker is programmed to DDI at 70 bpm with an AV delay of 240ms. What problem is shown?

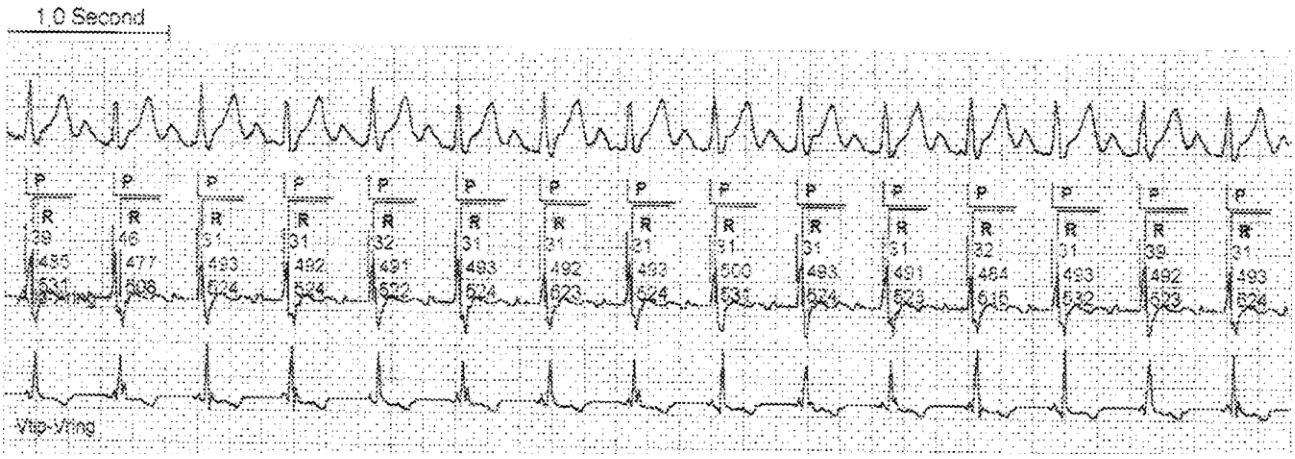
A. Intermittent loss of ventricular sensing
B. Intermittent loss of atrial capture
C. Normal sinus rhythm
D. Intermittent loss of ventricular capture
E. Loss of atrial sensing

ECG Controls

Surface ECG	On	
Position	1	
Gain	0.5	mV/cm
Filter	On	
Markers	On	
Position	2	
A. EGM / V. EGM	On / On	
Position	3 / 4	
Gain	5 / 10	mV/cm
Configuration	Atip-Aring / Vtip-Vring	
Sweep Speed	25	mm/s
EGM Filter	On	

Programmed Parameters

Mode	DDD	
Base Rate	60	min⁻¹
AV Delay	170	ms
PV Delay	160	ms
Magnet Response	Battery Test	
AutoIntrinsic Conduction Search	Off	ms
Negative AV/PV Hysteresis / Search	Off	ms
Hysteresis Rate	Off	min⁻¹



99. The above printout was recorded post-implantation of a dual chamber pacemaker. What action should be taken?

A. Reprogram the atrial output
B. Reprogram the ventricular sensitivity
C. Reposition the atrial lead
D. Reposition the ventricular lead
E. Give the patient a 1 month appointment

100. What pacemaker function is tested in the strip below?

A. Ventricular pacing threshold with loss of capture throughout
B. Ventricular pacing threshold with loss of capture at 0.2V
C. Atrial pacing threshold with stimulus-to-capture latency
D. Atrial pacing threshold with loss of capture at 0.2V
E. Atrial pacing threshold with loss of capture throughout

SECTION 3 – ELECTROPHYSIOLOGY

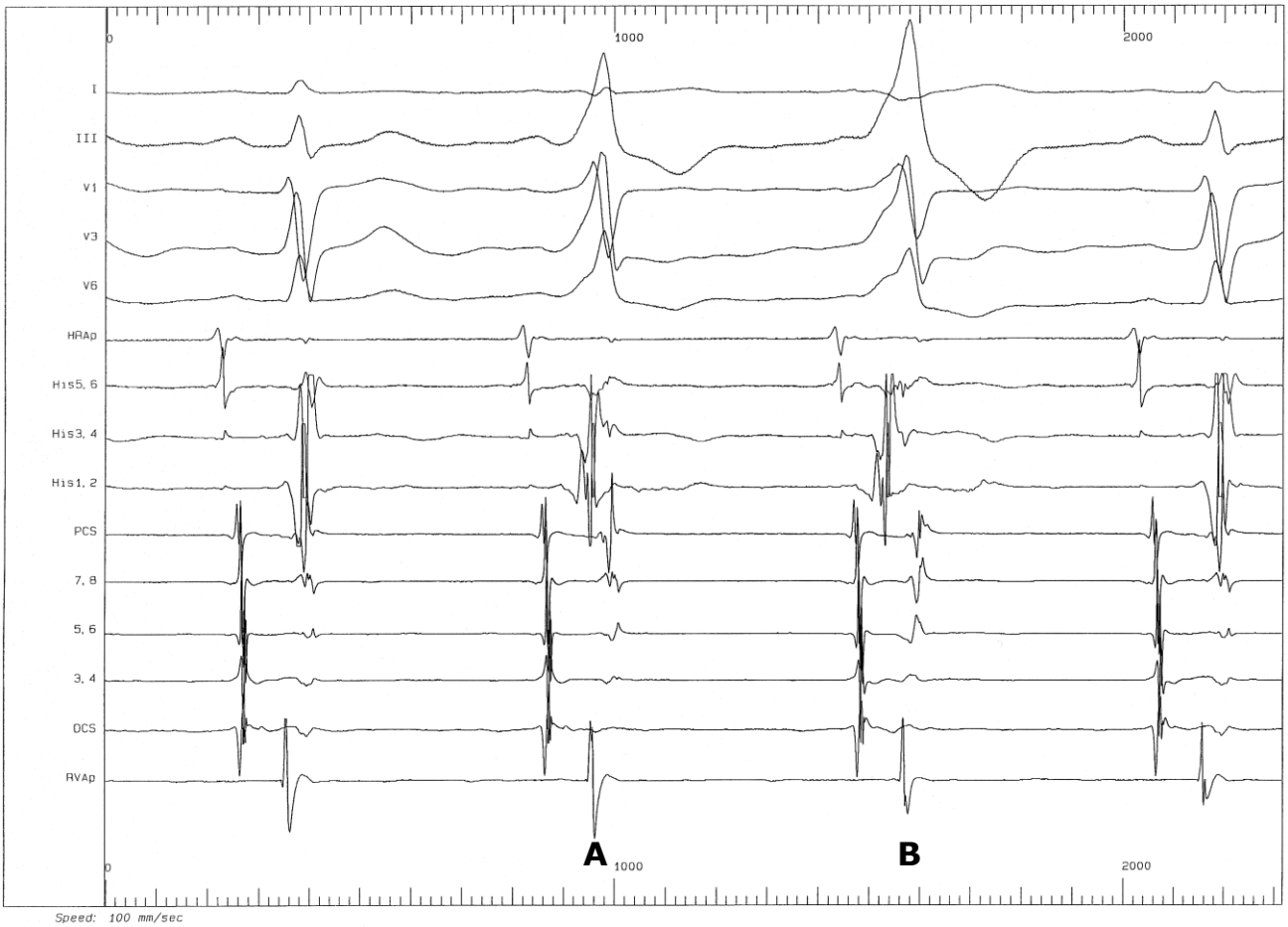
ONLY ANSWER THIS SECTION OR SECTION 2 IN ADDITION TO SECTION 1.
DO NOT ANSWER BOTH SECTION 2 AND SECTION 3

101. What happens to S_2 and S_3 in the above trace?

    A. S_2 conducts from atria to ventricles; S_3 fails to capture the atrium
    B. S_2 conducts from atria to ventricles; S_3 conducts from atria to ventricles
    C. S_2 fails to capture the atrium; S_3 conducts from atria to ventricles
    D. S_2 fails to capture the atrium; S_3 fails to capture the atrium
    E. S_2 and S_3 capture the atrium but do not conduct to the ventricles

102. Which of the following is not a re-entrant arrhythmia?

    A. Clockwise atrial flutter
    B. Post myocardial infarction, scar related monomorphic VT
    C. Right ventricular outflow tract ventricular tachycardia
    D. Counter-clockwise atrial flutter
    E. Non-isthmus dependant atrial flutter



103. What is the difference between beats A and B in the above trace?

A. Beat A is conducted via the AV node; Beat B is conducted via an accessory pathway
B. Beat A is conducted via an accessory pathway; Beat B is a junctional ectopic
C. Beat B is more pre-excited than Beat A
D. Beat A is conducted via an accessory pathway; Beat B is conducted via the AV node
E. Beat A is conducted via an accessory pathway; Beat B is conducted via a different accessory pathway

104. Which of the following manoeuvres can be used to aid mapping of target ablation site for a manifest accessory pathway with a short ERP?

A. Intermittent sensed PACs during sinus rhythm
B. Administration of verapamil
C. Administration of isoprenaline
D. A and B
E. B and C

105. What type of ablation is demonstrated in the above trace?

A. AV node ablation
B. Slow pathway ablation
C. Ablation of concealed bypass tract
D. Ablation of manifest accessory pathway
E. Ablation of focal atrial tachycardia

106. Which of the following manoeuvres can aid in the diagnosis of a broad complex tachycardia?

A. Entrainment
B. Sensed PACs during tachycardia
C. QRS morphology
D. Atrial activation sequence
E. All of the above

107. What pacing manoeuvre is demonstrated above?

A. Sensed PVC in sinus rhythm
B. Sensed PVC in tachycardia
C. His synchronous PVC during tachycardia
D. Para-Hisian pacing
E. Sensed PAC with aberrant conduction

108. What is the reversal agent for midazolam?

A. Alfentanil
B. Naloxone
C. Flumazanil
D. Fluticasone
E. Fentanyl

109. What pacing manoeuvre is demonstrated above?

A. Sensed PVC in sinus rhythm
B. Sensed PVC in tachycardia
C. His synchronous PVC during tachycardia
D. Para-Hisian pacing
E. Sensed PAC with aberrant conduction

110. During a pulmonary vein isolation for paroxysmal AF, the patient begins to cough with RF energy application. What should the operator do?

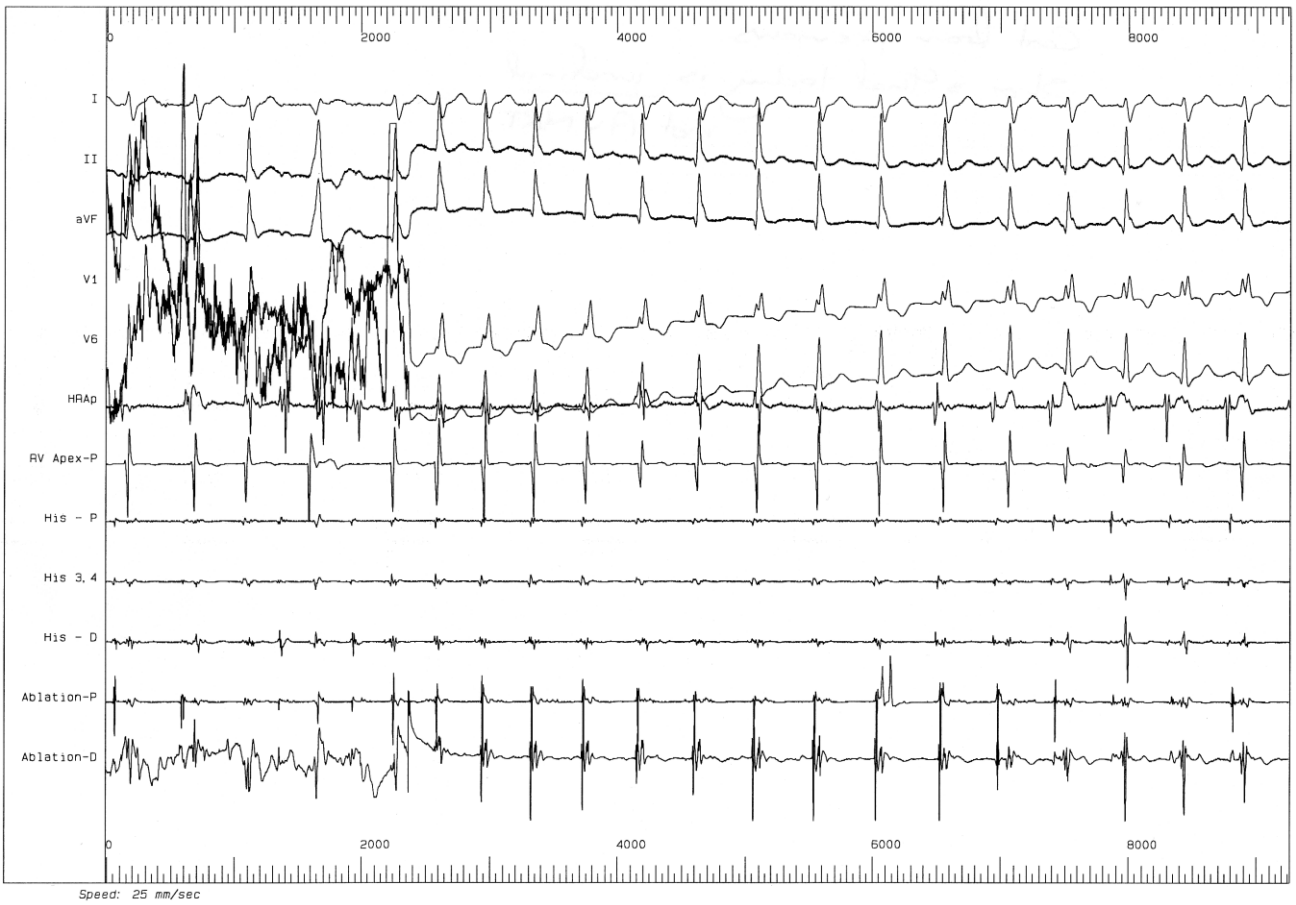
A. Give the patient some more sedation as the ablation is clearly uncomfortable
B. Ask the patient to stop coughing as it may cause movement of the RF catheter
C. Stop ablating and check the position of the RF catheter and the ablation settings on the generator
D. Continue ablation, coughing is often a side effect of left atrial ablation and can be ignored
E. Reverse the sedation

111. What pacing manoeuvre is shown in the above trace?

A. Entrainment of atrial tachycardia
B. Overdrive pacing of supraventricular tachycardia demonstrating V-A-A-V response
C. Overdrive pacing of supraventricular tachycardia demonstrating V-A-V response
D. Burst pacing to initiate supraventricular tachycardia
E. Burst pacing to terminate supraventricular tachycardia

112. What drug is often used to bring out the ECG abnormalities in a patient with suspected Brugada syndrome?

A. Isoprenaline
B. Amiodarone
C. Adrenaline
D. Ajmaline
E. Lignocaine

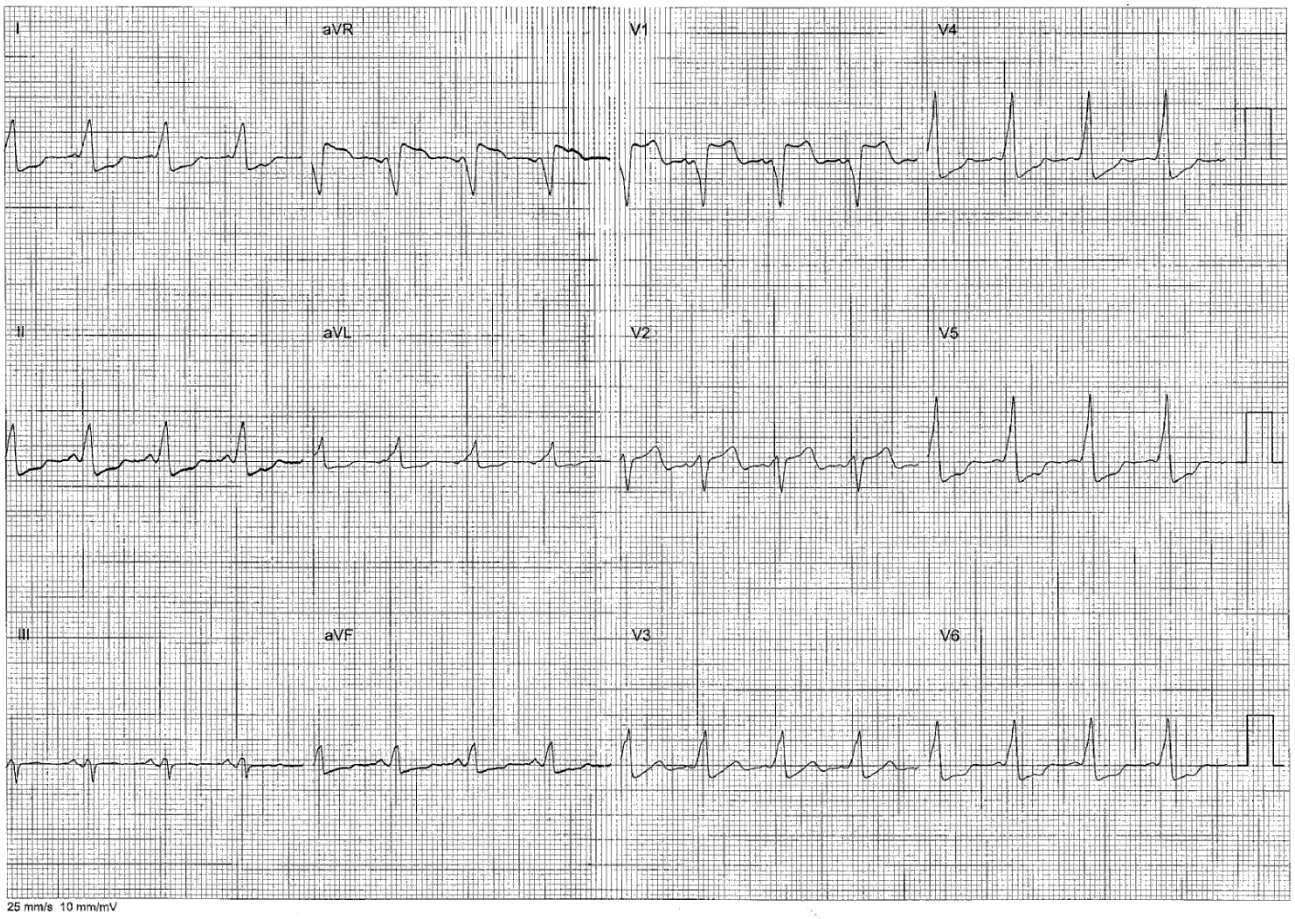


113. Which statement best describes the above trace?

A. Junctional tachycardia during AV node ablation
B. AVNRT during slow pathway modification
C. SVT with RBBB morphology
D. Transient junctional tachycardia during slow pathway modification
E. Junctional tachycardia with VA dissociation

114. Bachmann's bundle:

A. Contains the compact AV node
B. Lies at the apex of the triangle of Koch
C. Consists of fibres which conduct electrical impulses between the atria
D. Is often damaged during atrial flutter ablation
E. Runs between the IVC and the crista terminalis

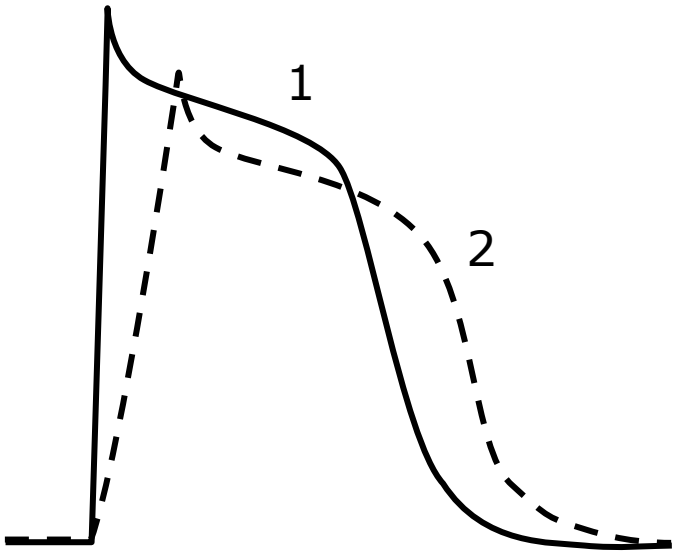


115. The above ECG is consistent with:

A. A left antero-septal accessory pathway with overt pre-excitation
B. A concealed left sided accessory pathway
C. A Mahaim pathway
D. A right antero-septal pathway
E. Brugada syndrome

116. In relation to refractory periods, which of the following statements is true?

A. The effective refractory period (ERP) of the AV node may be lower than the ERP of the atrium
B. The AV nodal functional refractory period will be affected by isoprenaline infusion
C. In Wolff-Parkinson-White syndrome, the anterograde refractory period of the accessory pathway is one of the factors used to determine the risk of dangerous arrhythmias
D. All of the above
E. None of the above



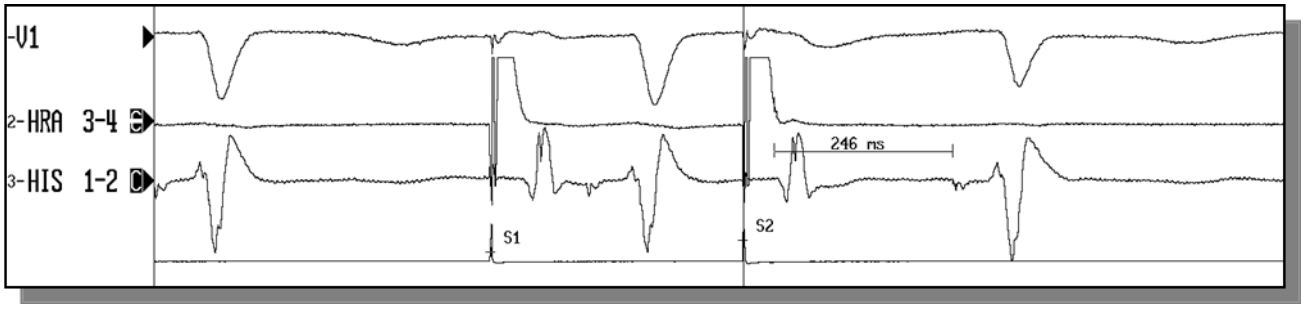
117. Which class of anti-arrhythmic drug produces the above change in the ventricular myocyte action potential from 1 to 2?

A. Class IA
B. Class IB
C. Class IC
D. Class III
E. Class IV

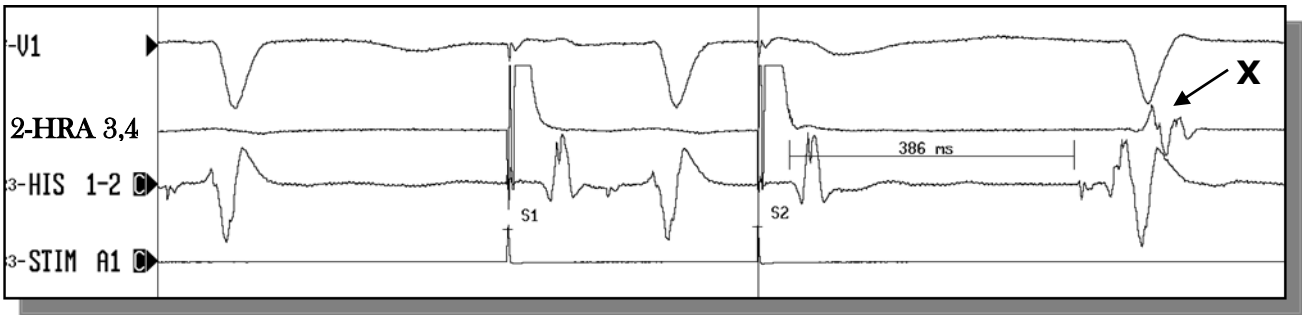
118. With regard to left atrial anatomy which of the following statements is true?

A. The left atrial appendage lies anterior to the left sided pulmonary veins
B. The lower pulmonary veins are usually larger than the upper pulmonary veins
C. The oesophagus always lies directly behind the junction of the right upper pulmonary vein and the left atrium
D. The mitral valve annulus is a posterior structure
E. The coronary sinus ostium lies superior to the left inferior pulmonary vein

(a)



(b)

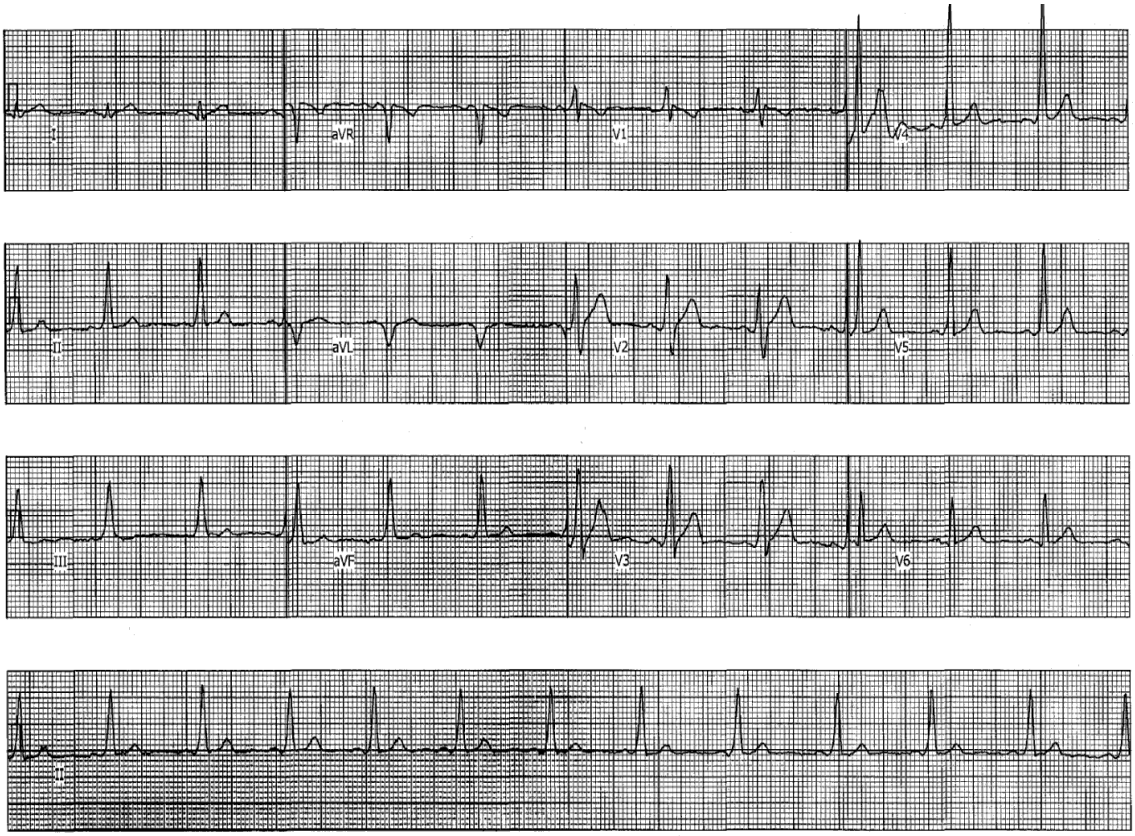


119. The first trace above (labelled (a)) shows the last beat of a drive train and extra stimulus with a coupling interval of 310ms. In the second trace (labelled (b)) the coupling interval is 300ms. What is indicated by the calliper measurements?

A. Normal decremental conduction in the AH interval
B. Normal decremental conduction in the HV interval
C. A "jump" of 140ms from the fast to the slow pathway in a patient with dual AV nodal physiology
D. A "jump" of 140ms from the slow to the fast pathway in a patient with dual AV nodal physiology
E. The effective refractory period of the slow pathway is 310ms

120. With respect to the traces in the above question (question 119), what is indicated by the "X"?

A. A sinus beat in the high right atrial channel
B. A paced atrial beat
C. An atrial ectopic
D. An "echo" beat
E. None of the above

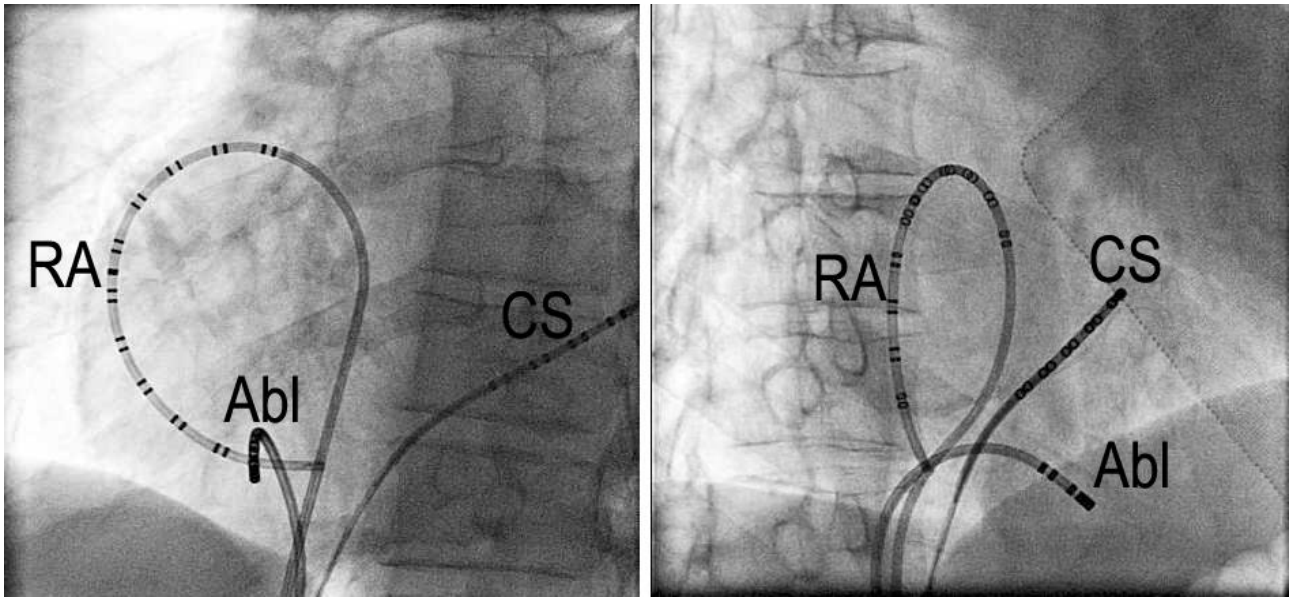


121. The ECG above shows:

A. A left anterior lateral pathway
B. Wolff-Parkinson-White syndrome
C. A mid-septal pathway
D. A concealed accessory pathway originating from the left free wall
E. Brugada syndrome

122. The differential diagnosis of a "long R-P" tachycardia includes:

A. Orthodromic tachycardia involving a concealed accessory pathway with decremental conduction
B. A left atrial tachycardia
C. Atypical AV nodal re-entry tachycardia
D. All of the above
E. None of the above



123. What procedure is the above patient most likely to undergo?

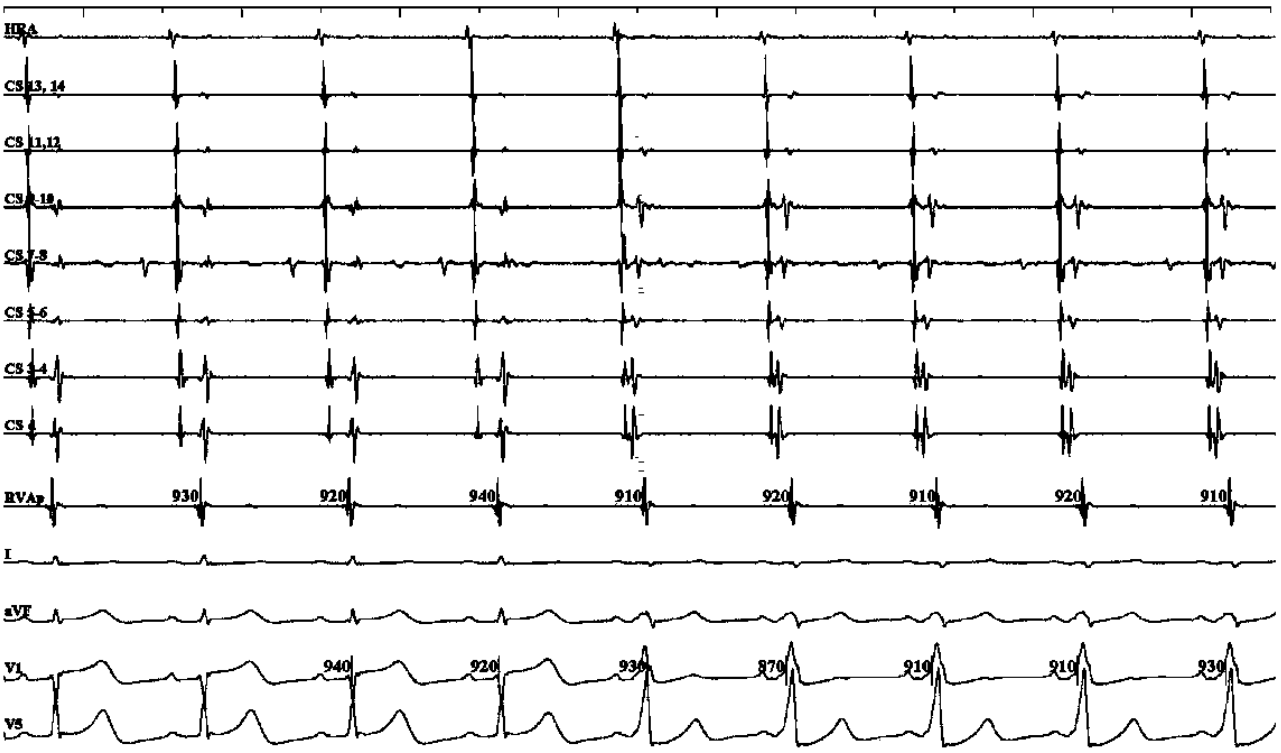
A. A pulmonary vein isolation for AF
B. A slow pathway ablation for AVNRT
C. A right-sided pathway ablation
D. An ablation for sinus node re-entry tachycardia
E. A typical atrial flutter ablation

124. Which of the following is not a Class I indication for radiofrequency ablation?

A. Symptomatic SVT due to AVNRT
B. Isthmus-dependant flutter
C. Ischaemic VT
D. Focal atrial tachycardia
E. Symptomatic VT

125. Para-Hisian pacing can aid in the differential diagnosis of :

A. AVNRT and antidromic AVRT
B. AVNRT and Koch's triangle tachycardia
C. AVRT via antero-septal accessory pathway and AVNRT
D. AVRT via right postero-septal accessory pathway and AVNRT
E. AVRT and atrial tachycardia



126. What is demonstrated in the above EGM sequence?

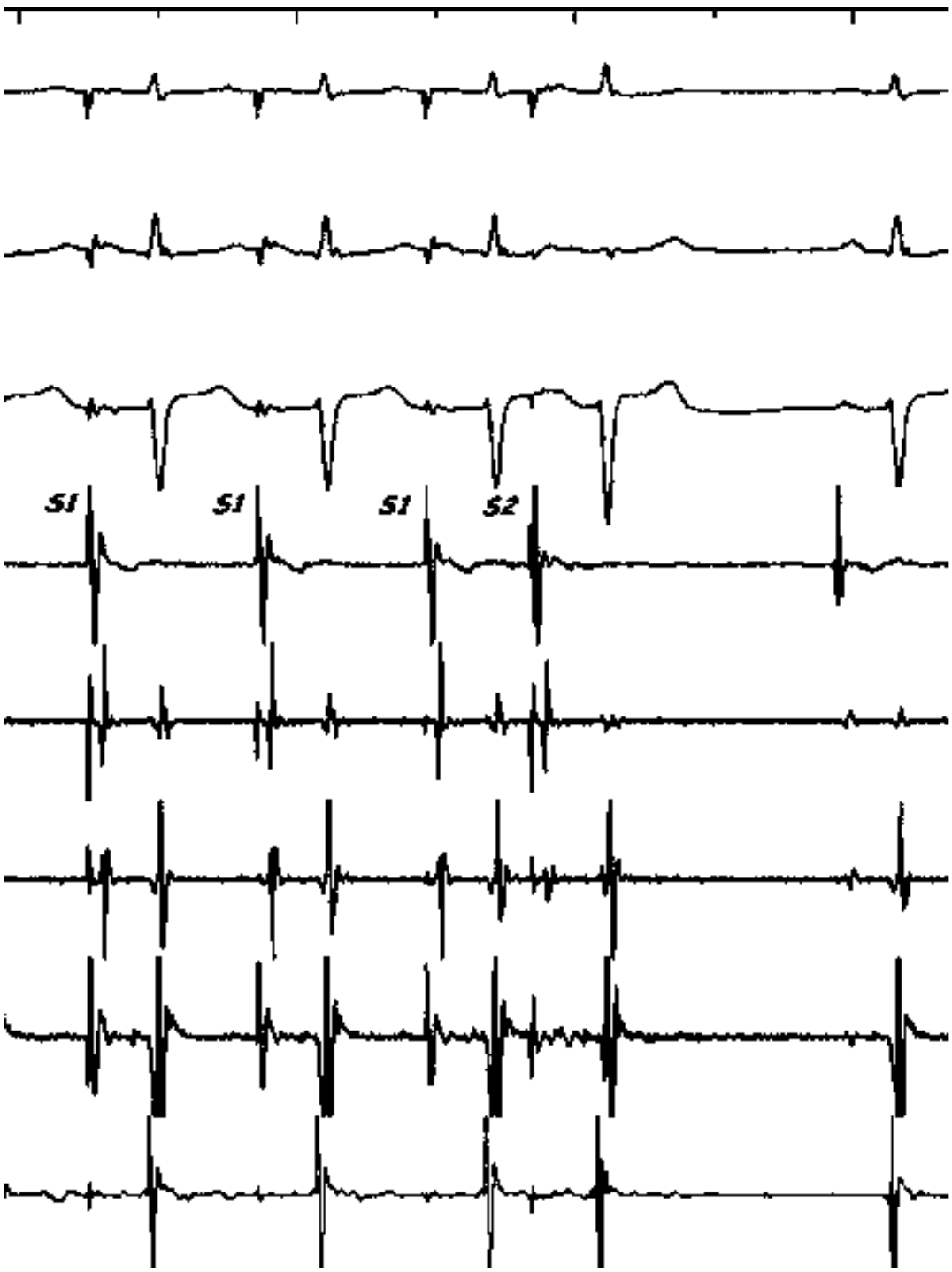
A. Normal sinus rhythm
B. Return of concealed left lateral accessory pathway
C. Return of postero-septal accessory pathway
D. Return of left lateral accessory pathway
E. Return of concealed postero-septal accessory pathway

127. Which of the following ablation catheters is commonly used to reduce the risk of thrombo-embolic events in the left atrium?

A. Cryocatheter
B. 8mm tip RF catheter
C. Irrigated tip catheter
D. 4mm tip thermocouple
E. 4mm tip thermistor

128. Pacing down a mapping catheter situated on the cavo-tricuspid isthmus at 280ms into a typical atrial flutter with a cycle length of 300ms will result in which post pacing interval if concealed entrainment is demonstrated?

A. 580ms
B. 300ms
C. 380ms
D. 370ms
E. 390ms

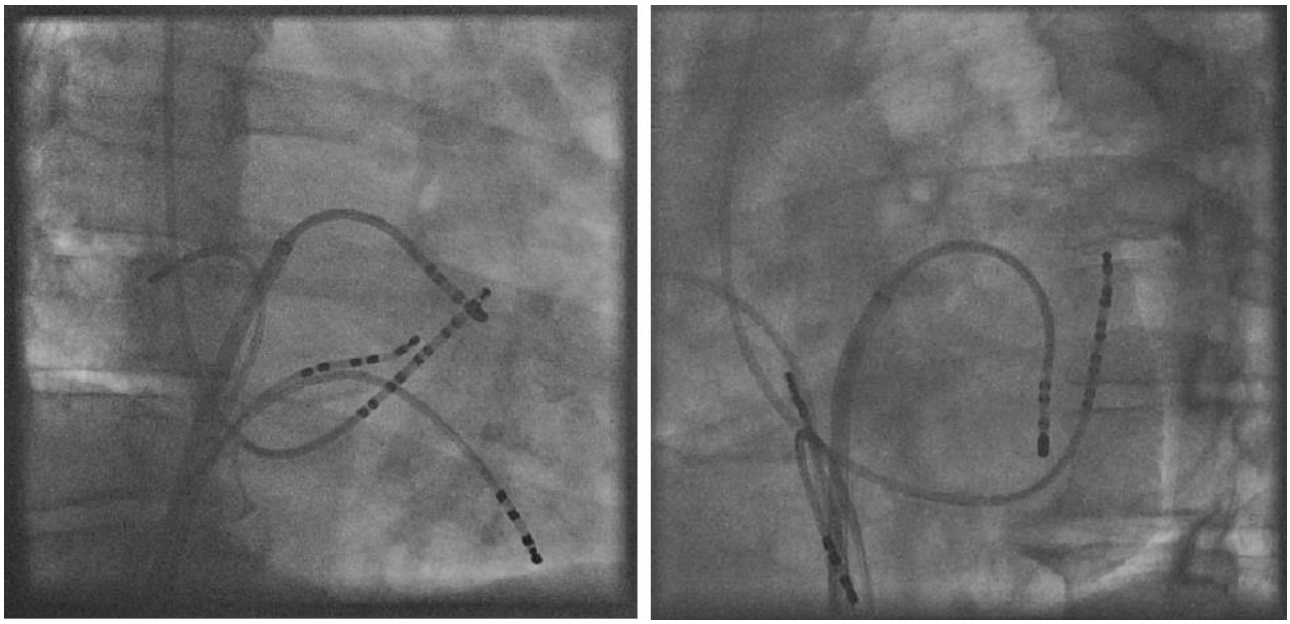


129. What is demonstrated in the above EGM sequence?

A. AH jump
B. AV decrement
C. AH prolongation
D. AV decrement with QRS aberrancy
E. None of the above

130. Typical electrogram filter setting on the EP recording system are:

A. Unipolar 30 – 50Hz, Bipolar 0.05 – 500Hz
B. Unipolar 1 – 50Hz, Bipolar 0.05 – 1000Hz
C. Unipolar 0.05 – 400Hz, Bipolar 0.05 – 500Hz
D. Unipolar 30 – 500Hz, Bipolar 30 – 500Hz
E. Unipolar 0.05 - 500Hz, Bipolar 30 - 500Hz



131. What type of ablation is being performed below?

A. Cavo-tricuspid isthmus line
B. Left posterolateral accessory pathway
C. LLPV – MV isthmus line
D. Slow pathway modification
E. Left lateral accessory pathway

132. Which of the following is an advantage of non-contact mapping?

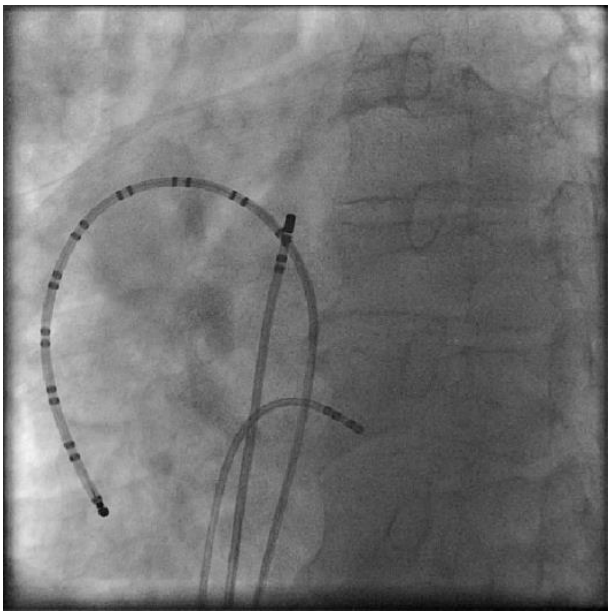
A. No other diagnostic catheters are needed
B. Allows quantification of areas of electrical scar
C. No arterial puncture is needed
D. "Virtual" EGMs can be appreciated retrospectively in any area of the specified chamber
E. The arrhythmia circuit can be visualised in colour

133. Which of the following are recognised complications of radiofrequency ablation for atrial fibrillation?

A. Transient ischaemic event
B. Haematoma
C. Cardiac tamponade
D. A and B
E. A, B and C

134. For which of the following procedures would you inform the patient of a small risk (approx 1%) of possible AV node damage?

A. AVNRT
B. Typical isthmus-dependant atrial flutter
C. AVRT via an anteroseptal accessory pathway
D. A and B
E. A, B and C



135. What type of arrhythmia is being ablated in the above X-ray?

A. Focal tachycardia arising from high inter-atrial septum
B. Atypical atrial flutter
C. Focal tachycardia arising from crista terminalis
D. Counter-clockwise isthmus-dependant right atrial flutter
E. Insufficient information to confirm based on this image

136. During premature stimulation, the "latency" phenomenon is seen due to/when:

A. Delayed phase I with pacing in the effective refractory period
B. Stimulation occurs in phase II of the action potential
C. Delayed phase 0 with pacing in the relative refractory period
D. Stimulation occurs in phase IV of the action potential
E. Stimulation occurs at an excitable gap junction

137. Entrainment of a 1:1 atrial tachycardia with a burst of ventricular pacing 40ms less than the tachycardia cycle length will typically result in a:

A. VAV response
B. VV response
C. VAA response
D. AAV response
E. VAAV response

138. Which term is influenced by both conduction velocity and refractoriness?

A. Membrane polarisation
B. Gap phenomenon
C. Functional refractory period
D. Anisotropic conduction
E. Effective refractory period

139. Typically, sinus node recovery time (SNRT) testing gives which of the following sensitivities and specificities for the diagnosis of sinoatrial disease:

A. 90% sensitivity and 90% specificity
B. 90% sensitivity and 50% specificity
C. 70% sensitivity and 70% specificity
D. 50% sensitivity and 90% specificity
E. 70% sensitivity and 50% specificity

140. If a right bundle branch block develops during an orthodromic atrio-ventricular re-entrant tachycardia using a left free wall pathway:

A. The tachycardia cycle length will not change
B. The tachycardia will terminate
C. The QRS will remain unchanged
D. The tachycardia mechanism will be forced into an antidromic direction
E. Ipsilateral bundle branch block is demonstrated