MGH Cardiac Anesthesia Perioperative Electrophysiology-Device Management Training Program Exam (August 2020)

There are 75 questions. Questions 1-47 have 1 correct answer. Questions 48-55 have 1 or more correct answers. Questions 56-75 require short answers.

Select the 1 best answer for the following 47 questions:

1. When placing a magnet on an ICD, which two manufacturer types will emit a tone?
    a. Medtronic and St Jude/Abbott
    b. Biotronik and Boston Scientific
    c. Medtronic and Boston Scientific
    d. Biotronik and St Jude/Abbott

2. Which type of pacemaker will pace asynchronously at 85 when a magnet is placed on it (assume full battery)?
    a. Biotronik
    b. Boston Scientific
    c. Medtronic
    d. St Jude/Abbott

3. Your patient's pacemaker reportedly has a minute ventilation rate response mode active. Which manufacturer most likely makes the device?
    a. Biotronik
    b. Boston Scientific
    c. Medtronic
    d. St Jude/Abbott

4. If you place a magnet on a fully charged St Jude/Abbott pacemaker, what is the highest rate it will pace?
    a. 85
    b. 90
    c. 98
    d. 100

5. If you place a magnet on a fully charged Boston Scientific pacemaker, what rate will it pace?
    a. 85
    b. 90
    c. 98
    d. 100

6. The Medtronic 5392 temporary pacemaker's AVI is programmed at 170 msec. What is the sensed AVI in this situation?
    a. 170 msec
    b. 140 msec
    c. 200 msec
    d. 210 msec

7. Your patient has a Medtronic leadless pacemaker. How can you convert the pacer to VOO pacing?
    a. Use a standard Medtronic programmer
    b. Apply a magnet over the chest, moving it around until the asynchronous pacing occurs
    c. A and B
    d. None of the above

8. Your patient has a Biotronik pacemaker in the DDD-CLS mode. What type of rate response sensor is active?
    a. Minute ventilation
    b. Accelerometer
    c. Ventricular impedance
    d. Minute ventilation and accelerometer

9. Your patient is going to have a complicated hip surgery with significant blood loss. She has a pacer in the DDDR mode. You will use general anesthesia. Which rate response mode sensor should always be turned off in this situation?
    a. Accelerometer
    b. Minute Ventilation
    c. Ventricular impedance
    d. None of the above

10. The patient has an ICD with DDD pacing. She is not pacer dependent. She is scheduled for a left thoracotomy. Which is the best management strategy?
    a. Place the electrocautery return pad behind the left shoulder
    b. Leave the ICD anti-tachy therapy on
    c. Inhibit the ICD anti-tachy therapy with a magnet
    d. Inhibit the ICD anti-tachy therapy with a programmer

11. Your patient has a Biotronik pacer programmed DDD mode and LRL 60. The patient rhythm strip demonstrates AV pacing at 60. You place magnet on it and it asynchronously paces at 90 for 10 beats, before reverting to a rate of 60. Which magnet mode is the pacer programmed in?
    a. Async
    b. Auto
    c. Sync
    d. None of the above

12. Which of the following patients would be the best candidate for using a magnet to inhibit his or her ICD during surgery?
    a. A patient with a Boston Scientific ICD having upper abdominal surgery
    b. A patient with a Medtronic ICD having a right thoracotomy
    c. A patient with a Biiotronik ICD having thoracic disc surgery in the prone position
    d. A patient with a St Jude/Abbott ICD having thyroid surgery

13. Which manufacturer's pacemakers cannot be programmed to ignore a magnet?
    a. Biotronik
    b. Boston Scientific
    c. Medtronic
    d. St Jude/Abbott

14. Your patient has a pacemaker. You have noticed very long PR intervals and an occasional non-conducted p-wave. Which pacing mode is most likely associated with these findings?
    a. Auto mode switch
    b. Noise reversion mode
    c. MVP, VIP, and RhythmIQ
    d. Rate drop response

15. You finished interrogating a pacemaker 30 minutes ago. The anesthesia team notifies you that the pacer is now not responding to a magnet. Which company makes this pacemaker?
    a. Biotronik
    b. Boston Scientific
    c. Medtronic
    d. St Jude/Abbott

16. Which part of the ECG coincides with the relative refractory period of a typical ventricular myocyte?
    a. QRS complex
    b. ST Segment
    c. Ascending limb of the T-wave
    d. Descending limb of the T-wave

17. The patient has a Boston Scientific ICD in the DDDR mode. When placing the ICD in the Electrocautery Safe Mode, which of the following will occur?
    a. The pacer is DOO, the anti-tachy therapy remains on
    b. The pacer is DOOR; the anti-tachy therapy remains on
    c. The pacer is DDD; the anti-tachy therapy is suspended
    d. The pacer is DOO; the anti-tachy therapy is suspended

18. You assess a patient who is going to have a very complicated open vascular procedure. Blood loss will be significant. The patient has significant renal disease. Which of the following interventions would be most prudent?
    a. Increase the ventricular sensitivity setting
    b. Increase the sensed AV-interval
    c. Increase the ventricular pacing amplitude
    d. Increase the PVARP

19. What two timing cycles when added together comprise the Total Atrial Refractory Period (TARP)?
    a. AV interval + Ventricular Refractory Period (VRP)
    b. Ventricular Refractory Period (VRP) + Post Ventricular Atrial Refractory Period (PVARP)
    c. AV interval + Post ventricular atrial refractory period (PVARP)
    d. Atrial escape interval (AEI) + AV interval

20. Which of the following values of pacing amplitude and pulse wave duration is most likely to capture a given segment of myocardium?
    a. 1.5 V with 0.2 ms PWD
    b. 1.5 V with 2.0 ms PWD
    c. 1.75 V with 0.2 ms PWD
    d. 1.75 V with 2.0 ms PWD

21. If a retrograde P-wave initiates a pacemaker mediated tachycardia, what is the first timing cycle that is typically changed to prevent a recurrence?
    a. Ventricular blanking period
    b. Post atrial ventricular blanking period (PAVB)
    c. Post ventricular atrial refractory period (PVARP)
    d. Post atrial ventricular refractory period

22. What best determines the maximum tracking rate that can be set for a pacemaker?
    a. Post ventricular atrial refractory period (PVARP)
    b. Total atrial refractory period (TARP)
    c. Atrial refractory period (ARP)
    d. Ventricular refractory period (VRP)

23. You have a patient who is scheduled for ECT. She has a Medtronic ICD with backup VVI pacing at a rate of 45. The patient is in atrial fibrillation and has an underlying ventricular rhythm in the 70-80's. If you follow the ASA Practice Advisory 2020, what is the best management of the ICD during the ECT treatment
    a. Place magnet on the ICD to inhibit the anti-tachy therapy and convert the pacer to VOO
    b. Reprogram the ICD to convert the pacing mode to VOO
    c. Reprogram the ICD to suspend the anti-tachy therapy but leave the pacing mode in VVI
    d. Monitor the patient for dysrhythmias but leave the device unchanged.

24. Your patient has a Boston Scientific pacer set at DDD with LRL=60. You place a magnet and the pacing rate is 90. Which of the following statements is most likely?
    a. The battery is fully charged
    b. The battery is at end of life
    c. The battery is getting close to elective replacement time
    d. The battery life cannot be estimated with a magnet in Boston Scientific pacers

25. A high voltage asynchronous pacing stimulus is most likely to cause ventricular fibrillation when delivered during the:
    a. PR-segment
    b. QRS
    c. ST segment
    d. Descending limb of the T-wave

26. The lowest capture threshold with a very long pulse wave duration is called the:
    a. Chronaxie
    b. Rheobase
    c. Minimus
    d. None of the above

27. You are determining the ventricular capture threshold in the OR post AVR. You are reducing the amplitude by 0.5 mA increments. The pacer stops capturing at 1 mA. What is the reported capture threshold?
    a. 1.0 mA
    b. 2.0 mA
    c. 1.5 mA
    d. 1.25 mA

28. Your patient has a Biotronik pacer in the DDIR mode. Which of the following rates will not be relevant?
    a. Lower rate limit
    b. Upper tracking rate
    c. Upper sensor rate

29. Your patient has an Abbott/St Jude pacer in the DDDR mode. What is the best way to convert the pacer to DDD?
    a. Select the DDD mode in the pacing mode menu
    b. Turn the rate response mode sensor off
    c. Turn the rate response mode sensor to passive
    d. None of the above

30. Which of the following statements about pacemakers is TRUE:
    a. The post ventricular atrial blanking period prevents ventricular oversensing of atrial pacing impulses
    b. The atrial blanking period is triggered by native p-waves but not atrial pacing stimuli and is designed to prevent sensing of ventricular pacing impulses
    c. Ventricular safety pacing occurs when there is ventricular sensing during the crosstalk detection window
    d. Noise reversion mode detection occurs during blanking periods but not during refractory periods

31. You have a patient who presents from Logan airport—she is from Italy. Not knowing what type of CIED she has, you place a magnet over her device in the OR. The pacer starts to AV-pace at 96. What is the likely manufacturer of her device?
    a. Medtronic
    b. Boston Scientific
    c. Abbott St Jude
    d. Sorin/Liva Nova

32. According to the ASA Practice Advisory published in 2020, which of the following is the best answer?
    a. Pacer dependent patients with an ICD scheduled for ECT should have their ICD anti-tachy therapy turned off and their pacer converted to an asynchronous mode
    b. Patients with ICDs having MRIs need a pre and post procedure interrogation
    c. Pacer dependent patients with an ICD scheduled for surgery above the umbilicus should have their ICD anti-tachy therapy suspended and their pacer converted to an asynchronous mode.
    d. All the above

33. Which of the following statements is true regarding the Heart Rhythm Society Guidelines for Perioperative CEID Management?
    a. Most of the authors are anesthesiologists
    b. It was published in 2019
    c. It recommends turning off the anti-tachy therapy of an ICD for all surgery on the hips or knees
    d. None of the above

34. Magnets can be helpful in managing most pacemakers. Which of the following cannot be done with a magnet?
    a. Convert the pacer to asynchronous pacing
    b. Estimate the battery life
    c. Inhibit the rate response mode
    d. Determine the programmed pacing mode
    e. Stop a pacemaker mediated tachycardia

35. A patient with a Biotronik pacer in a DDDR mode (LRL=60, Upper tracking rate=120, Upper sensor rate=130) is having surgery. You notice p-waves followed by V-pacing at a rate of 105 on the monitor. This most likely represents:
    a. Pacemaker mediated tachycardia
    b. Noise reversion mode
    c. Auto mode switch
    d. Normal pacer function

36. When using the Medtronic Temporary 5392 Pacemaker, using the DDD mode with only the V-wires connected (and not the A-wires) can lead to:
    a. Premature battery depletion
    b. Inappropriate atrial pacing
    c. Ventricular fibrillation
    d. Pacemaker mediated tachycardia

37. Which of the following statements about ICDs is FALSE?
    a. Electrocautery frequently can be detected as VF in 2-5 seconds
    b. Capacitor charging typically takes 1-3 seconds depending on the ICD battery life
    c. Anti-tachy pacing may occur during capacitor charging
    d. Dysrhythmia reconfirmation typically occurs before delivering the first shock

38. Optimal care of the patient with a pacemaker or ICD includes all the following EXCEPT:
    a. Strategic placement of the cautery return pad to minimize current flow near the device and its leads
    b. Determining if the surgeon can safely use bipolar cautery
    c. Placing a magnet on a pacemaker in all patients who are pacer dependent
    d. Performing a post op interrogation in any patient having cardiac surgery

39. Which of the following statements is FALSE regarding the Medtronic 5392 Temporary Pacemaker?
    a. The pacer will continue functioning for at least 30 seconds after battery removal
    b. Turning on the pacer with standard on/off button puts the pacer into a DDD mode at a rate of 80 with atrial and ventricular output 10 mA
    c. Turning on the pacer by pressing the red DOO button puts the pacer into a DOO mode at a rate of 80 with atrial output 20 mA and ventricular output 25 mA
    d. The highest maximum sensor rate is 130 bpm.

40. Regarding the Boston Scientific standard ICDs and the Boston Scientific Sub-Q ICDs, which of the following are the same?
    a. Magnet induced audible tone patterns
    b. Pacing capabilities
    c. Shocking outputs
    d. Pacemaker response to a magnet

41. A patient with a Medtronic pacer in a DDDR mode (LRL=60, Upper tracking rate=120, Upper sensor rate=130) is having chest surgery. The pacing mode was not changed preoperatively. Intraoperatively, the anesthesiologist temporarily notices A-V pacing up to a rate of 105 on the monitor. This most likely represents:
    a. Pacemaker mediated tachycardia
    b. Noise reversion mode
    c. Auto mode switch
    d. Rate response mode pacing

42. You have been inhibiting your patient's ICD for a very long abdominal procedure. Eight hours after placing the magnet, you notice patient movement that appears consistent with an ICD shock. Which is the most likely ICD manufacturer?
    a. St Jude Abbott
    b. Medtronic
    c. Biotronik
    d. Boston Scientific

43. You perform an interrogation of a pacemaker and the ventricular lead impedance is >2500 ohms. What is the most likely explanation?
    a. Lead fracture
    b. Lead insulation disruption

44. You have a patient post CABG whose pacer is set to DDD pace at 86. The PR interval has been set to 300 msec. You notice a pacing spike inside the QRS waveforms. When you turn off the pacer, the QRS morphology is entirely unchanged. How would you describe these QRS waveforms?
    a. Fusion Beats
    b. Pseudofusion Beats

45. If a patient's ICD anti-tachy therapy has been suspended with a magnet and external defibrillation pads are applied and connected to an external defibrillator, what is the fastest way to defibrillate the patient if he develops VF during knee surgery?
    a. Remove the magnet and let the ICD shock the patient
    b. Defibrillate with the external defibrillator

46. A patient has a CRT-D. You interrogate his device and notice that he is Bi-V pacing 90% of the time. What should you do?
    a. Nothing—this is great
    b. Notify the patient's EP physician that the Bi-V pacing percentage is too low

47. The sensed AV-interval is typically set _____ than the paced AV-interval
    a. Shorter by 30-50 msec
    b. Longer by 30-50 msec

The following 8 questions will have 1 or more correct answers:

48. How can you inhibit the anti-tachy therapy of a Boston Scientific Sub-Q ICD? Select ALL correct answers:
    a. Apply a magnet
    b. Use a Boston Scientific Standard Programmer
    c. Use a Boston Scientific Sub-Q ICD specific Programmer

49. If you need to convert the pacing mode of a Boston Scientific ICD from DDD to DOO, what can you do? Select ALL correct answers:
    a. Reprogram the ICD's pacing mode to DOO
    b. Turn off the ICD's anti-tachy therapy first, then convert the pacing mode to DOO
    c. Place a magnet over the ICD
    d. Activate the electrocautery safe mode

50. Which of the mode(s) is/are non-tracking modes? Select ALL correct answers:
    a. DDD
    b. VAT
    c. DDIR
    d. VVI

51. You have a patient presenting for emergency upper abdominal surgery. He has a device in the left pectoral area, but you do not know anything about the device. The patient is in NSR in 70's and is monitored. You decide to place a magnet on the device. You do not hear any tone emitted and the pacing rate changes to 100. What type of device could this be? Select ALL correct answers:
    a. Abbott/St Jude ICD
    b. Boston Scientific ICD
    c. Abbott/St Jude pacer
    d. Boston Scientific pacer

52. Treatment options for pacemaker mediated tachycardia include which of the following: (Select ALL correct answers)
    a. A magnet
    b. Decreasing the PVARP
    c. Inducing PVCs
    d. None of the above

53. Your patient has an ICD with a DDDR pacing mode. Which of the following reprogramming options are possible? (Select ALL correct answers)
    a. Convert the pacer to DDD and leave the anti-tachy therapy on
    b. Convert the pacer to DOO and leave the anti-tachy therapy on
    c. Convert the pacer to VVI and turn the anti-tachy therapy off
    d. Convert the pacer to DDI and turn the anti-tachy therapy off

54. The patient has an ICD in the left infraclavicular position. He is scheduled for a cholecystectomy. According to the 2020 ASA practice parameter, what are acceptable options for managing the ICD? Select the TWO most likely options:
    a. Place the electrocautery return pad behind the left shoulder
    b. Leave the ICD anti-tachy therapy on
    c. Inhibit the ICD anti-tachy therapy with a magnet
    d. Inhibit the ICD anti-tachy therapy with a programmer

55. Pacer B is programmed with bipolar ventricular sensing at 2 mV. Pacer U is programmed with unipolar ventricular sensing at 1 mV. Select TWO correct answers:
    a. Pacer B is more susceptible to electrocautery noise
    b. Pacer U is more susceptible to electrocautery noise
    c. Pacer B's sensitivity is higher than Pacer U's
    d. Pacer U's sensitivity is higher than Pacer B's

The remaining are Short Answer Questions:

56. List four common negative effects of electrocautery on pacers and ICDs
    1. Asystole
    2. Inappropriate V-pacing tracking cautery sensed on atrial channel
    3. Noise reversion mode activation
    4. Inappropriate charging and or shocking by ICD

57. What should you always do before making a change to a patient's ICD or pacemaker?
    1. Print the baseline parameters

58. Prior to turning OFF the anti-tachy therapy of a patient's ICD, what two steps should you take?
    1. Connect patient to a monitor
    2. Apply backup defibrillation pads

59. Describe two ways to differentiate a pacemaker from an ICD on CXR.
    1. High voltage shocking coil(s)
    2. Capacitor in pulse generator

60. What happens to an ICD's pacing function when a magnet is applied to the ICD?
    1. Nothing except with a Sorin/Liva Nova pacer which paces at 96

61. Your patient has a Medtronic pacemaker in the DDD mode with a LRL=60. Intraoperatively he develops atrial fibrillation. What happens to her pacemaker mode and LRL?
    1. Mode switches to non-tracking mode DDIR
    2. LRL remains the same

62. Your patient has a St Jude/Abbott pacemaker. The mode is DDD and LRL=60. The patient develops atrial fibrillation. What two things are likely to happen to the pacemaker?
    1. Mode switches to non-tracking mode (DDI or DDIR)
    2. LRL typically increases

63. A patient's pacer has a LRL of 60. In the preop period he has a NSR at 70. After induction of anesthesia, the patient's intrinsic HR falls to 54. The anesthesiologist calls you confused why the pacemaker is not pacing at 60—he thinks the pacer is malfunctioning. What special function most likely explains this?
    1. Hysteresis

64. A pacemaker-dependent patient has a St Jude pacemaker programmed in DDDR with LRL=60. For upper abdominal surgery, you program the pacer to DOO at 70. During the surgery, the HR periodically drops to 50. What special function most likely explains this?
    1. Rest Mode

65. The surgeon is using extended bursts of electrocautery in a patient who was otherwise not pacing. As soon as the surgeon stops using the cautery you notice what appears to be AV pacing for several beats. What special pacemaker function most likely explains this?
    1. Noise reversion mode

66. A patient has a CRT-D device and is V-paced 99%. Does this mean that the patient is definitely pacer dependent and will need her pacer converted to DOO for breast surgery? What would you do to determine the best management plan?
    1. NO
    2. Check underlying rhythm with a programmer

67. A patient has an active ICD and was under general anesthesia with muscle relaxation for an emergency exploratory laparotomy. No shocks were noticed by the anesthesiologist during the case. The post op interrogation noted a significant decrease in battery life. Give two reasons how this might have happened.
    1. Shocks could have been delivered without any patient movement due to muscle relaxation
    2. Capacitor charging even in absence of shock delivery can deplete battery

68. Your patient has a pacemaker set in the DDD mode with LRL of 50. He is in NSR in the 50's. You place a magnet and the pacer starts to v-pace at a rate of 60. What is likely true about the pacer's battery?
    1. The battery is at end of life

69. What do most ICDs do after the capacitor is fully charged just prior to delivering a shock?
    1. Confirm that the dysrhythmia is still present

70. Prior to converting any ICD to an asynchronous pacing mode, what must be done to the ICD programming?
    1. Disable the anti-tachy therapy

71. A patient has an active ICD. You are about to insert a PA line. What should you do to the ICD before starting the PA line insertion?
    1. Disable the anti-tachy therapy

72. A patient presents for emergency surgery. You know he has a device, but the patient does not know what kind it is. He does not have a card with device information. What two things will you do to try to determine the device type (pacer vs ICD) and device manufacturer?
    1. CXT
    2. Apply a magnet once patient is monitored and intrinsic HR is < 85

73. A patient in the ICU post CABG has a Medtronic ICD with a VT zone cutoff rate of 170. The ICD anti-tachy therapy is ON. The patient has temporary atrial and ventricular pacing wires attached to a Medtronic 5392 temporary pacemaker. The nurse asks if it is OK to AV pace at 90 with maximal pacing output. What would you tell her? Why?
    1. NO. This is likely to activate the ICD which would then shock the patient
    2. The atrial pacing spike and the ventricular pacing spike are both likely to be detected on the ventricular channel and thus the presumed HR will be 180

74. A patient with an ICD has the VF zone set to activate when the HR exceeds 200 bpm. What is the R-R interval associated with this HR in msec?
    1. 300 msec

75. Whenever you turn off a patient's ICD, you have effectively become: The patient's ICD