Neuro Quiz XLI - Cardiac Implantable Electronic Devices (CIED) & Neurosurgery

This quiz is being published on behalf of the Education Committee of the SNACC

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START
1. The chest radiograph of a 65y M with traumatic parietal epidural hematoma, who needs an emergent craniotomy. Which of the following statement is INCORRECT?

A. **A magnet should be placed over this device, during the surgery**
B. **(MRI)Magnetic Resonance Imaging of the cranium is contraindicated**
C. **It is an Implanted Cardioverter Defibrillator**
D. **It is a dual chamber Permanent Pacemaker**
1. A. A magnet should be placed over this device, during the surgery

- The chest X-ray shows an Implantable Cardioverter Defibrillator
- During surgery if an electrocautery is used, the device would over-sense and fire
- A magnet placed over the ICD will deactivate the anti-tachycardia function
- Therefore, this statement is CORRECT
1. B. (MRI) Magnetic Resonance Imaging of the cranium is contraindicated

- Patients who have pacemakers or defibrillators are not permitted to have MRI because of safety concerns, unless the devices meet certain criteria specified by the FDA (termed “MRI-conditional” devices)
- Although, there have been articles saying that MRI can be done safely even with ‘legacy’ devices, most facilities would deny MRI in such patients
- *N Engl J Med 2017;377:2555-64. DOI: 10.1056/NEJMoa1604267*
1.C. It is a cardioverter defibrillator

The thicker wires indicate that these are ‘shocking coils’ and so this device is an Implantable Cardioverter Defibrillator (ICD)

This statement is CORRECT
1.D. It is a dual chamber Permanent Pacemaker

This is **NOT** a dual chamber pacemaker.

There is only one cable with two segments of ‘shocking coils’

So this device is an Implantable Cardioverter Defibrillator (ICD)
2. This is the ECG of a 65y old male, with a Permanent Pacemaker – ICD, scheduled for excision of a right frontal meningioma. Which of the following statement is INCORRECT?

A. The pacemaker is sensing the atrial activity
B. During surgery, the pacemaker component should be disabled using a magnet
C. During surgery, the Cardioverter-Defibrillator component should be disabled
D. Intraoperative monitoring should include a plethysmograph or an intra-arterial pressure monitor
2.A. The pacemaker is sensing the atrial activity

- A pacemaker spike is seen after every ‘P’ wave and before each QRS complex.
- This indicates
  - The pacemaker is sensing the P wave.
  - Every ventricular beat is paced.
- This patient is pacemaker dependent.
2.B. During surgery, the pacemaker component should be disabled using a magnet

- This patient is pacemaker dependent and so it should not be disabled
- Importantly, when a magnet is placed over a Pacemaker – ICD, it suspends the anti-tachyarrhythmia detection and therapy, while the pacemaker activity is maintained
- When a magnet is placed over a Pacemaker, it converts it into an asynchronous mode
2.C. During surgery, the Cardioverter-Defibrillator component should be disabled

- This is correct, because during surgery, the use of electrocautery will lead to electromagnetic interference (EMI) which may be interpreted as a tachyarrhythmia and the ICD may deliver a shocking current.
- Therefore, the anti-tachycardia therapy should be suspended and this can be done by reprogramming or using a magnet over the device.
2.D. Intraoperative monitoring should include a plethysmograph or an intra-arterial pressure monitor.

Monitoring any patient with a CIED, during anesthesia, should include:

- ECG with pacer detection ‘on’ to identify the ‘pacing spikes’
- Ability to monitor mechanical capture of the myocardium, by one or more of the following:
  - Plethysmograph waveform of a pulse-oximeter
  - Intra-arterial waveform
  - TEE for visual confirmation of myocardial contraction is recommended for patients with Cardiac Resynchronization Therapy
3. A 70y M scheduled for anterior cervical discectomy has an implanted ‘device’ as shown. Which of the following is INCORRECT?

A. A magnet placed over this device will change the pacing to asynchronous mode

B. A bipolar electro-cautery interferes LESS with the functioning of this device than a monopolar cautery

C. The lead marked by the arrow stimulates the Left ventricle

D. If after a few years, this patient were to develop refractory tremors, implanting a Deep Brain Stimulator (DBS) would be an option
3.A. A magnet placed over this device will change the pacing to asynchronous mode

- The thick cables (RED arrows) indicate that this is an ICD, and placing a magnet over it will suspend the anti-tachycardia therapy but does NOT affect the pacemaker activity.
- Therefore, this statement is INCORRECT.
3.B. A bipolar electro-cautery interferes LESS with the functioning of this device than a monopolar cautery

- This statement is CORRECT, because in a bipolar electro-cautery the current flows between the tips of the forceps while in a unipolar one it passes between the hand-held piece and the grounding plate.
- The high-frequency current may be detected by the ICD as a tachyarrhythmia and deliver a shock.
3.C. The lead marked by the arrow stimulates the Left ventricle

- This device is a cardiac resynchronization therapy with a defibrillator (CRT-D)
- The lead marked with an arrow is passed through the coronary sinus to reach the left ventricle
- The purpose is to stimulate both the ventricles simultaneously to make the cardiac contraction more efficient.
3.D. If after few years, this patient were to develop refractory tremors, implanting a Deep Brain Stimulator (DBS) would be an option.

- DBS therapy is complicated in patients with pacemakers for two reasons:
  - Possible electrical interaction between the devices
  - Inability to use MRI guidance for implantation

- However, there are several case reports of successful DBS implantation in pts with pacemaker, and so would be an option.
4. Which of the following is labelled INCORRECTLY?

A. Subcutaneous Defibrillator

B. Cardiac Resynchronization Therapy

C. Leadless Pacemaker System

D. Implantable Loop Recorder
4. A. Subcutaneous Defibrillator

This is correct
The ‘shocking coil’ (RED arrow) is placed subcutaneously in the anterior thorax and is connected to a generator (BLUE arrow) which is usually implanted below the left axilla.
This is used in patients with difficult venous access.
4. B. Cardiac Resynchronization Therapy

This is CORRECT

- The three leads
  - 1. R atrium
  - 2. R ventricle
  - 3. L ventricle

- Since the thick shocking coils are not seen this is a CRT without anti-tachycardia mode
4. C. Leadless Pacemaker System

- The capsule-like gadget (RED arrow) is introduced into the Right Ventricle and attached to the endocardium with hooks.
- Medical gadgets are getting smaller!
4. D. Implantable Loop Recorder

This device is a Vagal stimulator and NOT an implantable loop recorder.

Indications of a vagal stimulator:
- Intractable seizures
- Depression
- Congestive cardiac failure

The (RED) arrow points to the coils within the carotid sheath encircling the Vagus nerve.

For Implantable Loop Recorder
Click Here
Implantable Loop Recorder

Implantable Loop Recorder is a subcutaneously implanted cardiac monitoring and recording device (RED arrow)

Indications

- Recurrent unexplained syncope or palpitations
- Atrial fibrillation
- Post MI
5. A 70y M with a Pacemaker is scheduled for a Cervical laminectomy for spinal canal stenosis. Which of the following statements is INCORRECT about the intraoperative management of this patient?

A. The rate modulation function, if present, should be turned off
B. The pacemaker should be reprogrammed to asynchronous mode
C. Monopolar diathermy, if needed, should be used in short bursts of 1-2s
D. Median nerve SSEP monitoring is not recommended as it may interfere with the functioning of the pacemaker
5. A. The rate modulation function, if present, should be turned off

- The rate modulation or responsive pacing is a feature whereby the PPM can alter the paced heart rate in response to motion or sensed physiological conditions.

- An accelerometer can detect muscle activity, or a sensing mechanism can monitor minute ventilation.

- Since anesthesia and surgery can alter the physiological parameters, and trigger this function, it should be turned off.
5. B. The pacemaker should be reprogrammed to asynchronous mode

- When electromagnetic interference is anticipated, especially if the surgery is above the umbilicus or within 15cm of the pacemaker, then the pacemaker should be programmed to asynchronous mode.

- The reprogramming can be done by handheld module or applying a magnet (if it is a pacemaker without anti-tachycardia functions).
5. C. Monopolar diathermy, if needed, should be used in short bursts of 1-2s

- This is CORRECT
- Electro-surgical unit (ESU) is the most common electromagnetic interference during surgery
- A bipolar cautery is preferred as the current passes between the tips of the forceps and does not affect the pacemaker
- If a monopolar cautery has to be used
  - The ground plate of the ESU should be placed such that the current path from the active cautery to the pad does not cross the pacemaker
  - The lowest possible current should be used
  - Short bursts of 1-2 seconds
  - Cutting current is better than coagulation
5. D. Median nerve SSEP monitoring is not recommended as it may interfere with the functioning of the pacemaker

- Although there is a theoretical concern that electrical impulses of nerve stimulation can be erroneously sensed by the pacemaker and be inhibited, no such incidence has been reported.
- The American Association of Neuromuscular and Electrodiagnostic Medicine, in a position paper, advocate that evoked potentials can be safely performed in patients with cardiac pacemaker.
- They advice caution while stimulating the brachial plexus ipsilateral to a pacemaker.
- [http://www.aanem.org/getmedia/653e87b3-f930-4951-9bd8-dde95c291ce2/risksinEDX.pdf](http://www.aanem.org/getmedia/653e87b3-f930-4951-9bd8-dde95c291ce2/risksinEDX.pdf)
Further Reading:
Anesthesiology, 114: 247- 261(2011)
Radiographics, 31:1669–1682 (2011)

Back to Question 1, 2, 3, 4, 5

Thank you!