

**479.** You are doing CPR on a patient with an implanted ICD near the ICD generator. When the patient's ICD defibrillates, you would feel:

- a. Nothing
- b. Tingling
- c. A distinct shock
- d. A shock which could send you into cardiac arrest

ANSWER b. Tingling. Watson says: "During emergency situations, however, care of the patient should be based on BCLS and ACLS protocols. Standard treatment should not be delayed. Persons touching the patient during device discharge may feel a slight tingling sensation, but will not be harmed. The use of rubber gloves by persons touching the patient during device discharge will minimize the effect. "

See: Watson, Chapter on "Implantable Cardioverter Defibrillator"

**481.** Most current ICD sensing electrodes are:

- a. BP and motion sensors in the ICD can
- b. Unipolar transvenous RV electrodes
- c. Bipolar transvenous RV electrodes
- d. Epicardial active-fixation ventricular electrodes

ANSWER c. Bipolar transvenous RV electrodes. These electrodes are currently implanted transvenous, much like pacemaker leads. Bipolar leads are better, because they are less sensitive to muscle tremor and EMI noise, which can be mistaken by the ICD for VF. Some systems use the coils around the electrode both for sensing and shocking. These are termed "integrated" electrodes, because they serve a dual function - both sensing and shocking.

See: Watson, Chapter on "Implantable Cardioverter Defibrillator"

**484.** Current ICDs use high efficiency cardioversion and defibrillation. The most efficient shock waveforms are:

- a. Monophasic
- b. Biphasic
- c. Sinusoidal
- d. Square waves

ANSWER b. Biphasic waveforms convert patients with less energy than the traditional monophasic waveform. In the biphasic defibrillation current goes for cathode to anode then reverses and returns in a push-pull manner. Watson says: "Much investigation has gone into developing the optimal shock waveform. As a result, the shape of the defibrillation waveform has changed and become more efficient. The biphasic or bidirectional waveform has proven to be more efficient

than the unidirectional or monophasic waveform, thus providing lower defibrillation thresholds."

See: Watson, Chapter on "Implantable Cardioverter Defibrillator"

**488. Cardioversion from an ICD may be painful to the patient. One method to reduce this discomfort in ventricular tachycardia patients with ICDs is to:**

- a. Incorporate anti-tachy pacing (ATP)
- b. Incorporate brady-support pacing
- c. Reduce the defibrillation threshold (DFT)
- d. Reprogram from biphasic to monophasic shocks

ANSWER a. Incorporate anti-tachy pacing (ATP). Watson says: "Antitachycardia pacing (ATP) may be effective in terminating tachyarrhythmias. If successful, it may eliminate the need for painful cardioversion or defibrillation shock." Monophasic shocks are less efficient, would require more energy, and would be more painful.

See: Watson, Chapter on "Implantable Cardioverter Defibrillator"

**489. When cardioverting or defibrillating most modern ICDs utilize \_\_\_\_\_ as the positive electrode.**

- a. RA coil
- b. RV distal tip electrode and RV coil
- c. RV coil and RA coil electrodes
- d. RA coil and Left pectoral generator can

ANSWER d. RA coil and Left pectoral generator can. The RV coil is usually the negative electrode, similar to pacemakers. This sends current through the entire LV up to the generator metal can and RA. This is termed a hot can because it acts as one of the electrodes, similar to a unipolar pacemaker. Different types and positions of electrodes may be required. Once these electrodes are positioned, they can be tested and programmed for the patients optimal defibrillation pathway.

See: Watson, Chapter on "Implantable Cardioverter Defibrillator"

**490. With ICDs the lowest energy that achieves successful defibrillation is termed:**

- a. Minimum Defibrillation Level (MDL)
- b. Pre-Defibrillation Force (PDF)
- c. Cardioversion Threshold (C-T)
- d. Defibrillation Threshold (DFT)

ANSWER d. Defibrillation threshold testing (DFT) is performed to assure adequate detection of ventricular fibrillation and efficacy of device therapy. The defibrillation threshold can be defined as the lowest energy at which successful defibrillation occurs at least two times.

See: Watson, Chapter on "Implantable Cardioverter Defibrillator"

**491. When programming an patient's ICD, how high should you set the defibrillation output level?**

- a. **2 times threshold safety margin**
- b. **50% safety margin**
- c. **10 joules safety margin**
- d. **10 joules on 1st shock, then maximum thereafter**

ANSWER c. 10 joules safety margin is necessary - on two successive attempts. The defibrillation threshold (DFT) varies with different catecholamine levels. You always want a wide safety margin to be sure that the first shock will succeed when VF occurs. This margin is generally agreed to be 10 joules above the defibrillation threshold. Since measuring DFT consumes time and battery power, some physicians do not actually measure DFT. Instead they set the output level at 10 joules below maximum ICD output level. Watson says: "It is recommended that at least a 10 J safety margin be obtained, no matter which DFT protocol is used."

**See:** Watson, Chapter on "Implantable Cardioverter Defibrillator"

**492. During ICD testing after implant, how is VF induced?**

- a. **It is not. Only VT is induced and tested**
- b. **50 Hz pacing burst or shock on T wave**
- c. **2000 Hz pulse trains at different rates**
- d. **Low voltage pulse trains at different rates**

ANSWER b. 50 Hz burst pacing or pulses on T wave. Some ICDs use a 50 Hz fibrillation, much like those used in open heart surgery. Holding a button down generates 50 Hz sine wave electrical signal in the heart. This lethal frequency induces VF. Other companies protocols shock the patient on the T wave vulnerable period to induce VF or use rapid ventricular burst pacing.

**See:** Watson, Chapter on "Implantable Cardioverter Defibrillator"

**494. What does a magnet do when applied to a patient's ICD?**

- a. **It only inhibits the tachy (shocking) portion of the ICD**
- b. **It only inhibits the brady (pacemaker) portion of ICD**
- c. **It inhibits all output from ICD both pacer spikes and shocks**
- d. **It puts backup pacer into asynchronous mode, ICD cardioversion mode still functions**

ANSWER a. It only inhibits the tachy (shocking) portion of the ICD. This is a safety feature to shut down a malfunctioning ICD which gives inappropriate shocks. Watson says: "Patients should avoid large magnets that can, unknown to the patient, deactivate certain ICD models should the magnet be in too close proximity. Beep tones are emitted from some ICDs when a magnet is placed near the device. These tones can indicate normal functioning or warn of ICD malfunction or deactivation. Patients should be instructed as to which model they have and what to do should beep tones occur."

**See:** Watson, Chapter on "Implantable Cardioverter Defibrillator"

**495.** During ICD testing when VF is induced and the ICD fails to fire, all the following are true EXCEPT:

- a. Defibrillating over the ICD may damage the device
- b. Delay ACLS for up to 1 minute to allow the ICD to detect and treat the VF
- c. Epicardial ICD patches may insulate the heart against anterior-lateral shocks
- d. If your initial shocks fail try different paddle positions (E.g. AP)

ANSWER b. Delay ACLS for up to 1 minute to allow the ICD to detect and treat the VF is TOO LONG a delay. Remember in cardiac arrest you only have 4 minutes until brain death begins, less in sick patients. Watson says: "Should an arrhythmia occur, the device will usually detect and start therapy in less than 30 seconds. During emergency situations, however, care of the patient should be based on BCLS and ACLS protocols. Standard treatment should not be delayed. . . . If external defibrillation is required, avoid placing the paddles directly over the implanted device. Should the standard anterior-lateral paddle placement fail to convert the rhythm, consider changing the paddle placement to anterior-posterior. Epicardial patches may tend to insulate the heart from external shocks, thus reducing their effectiveness."

See: Watson, Chapter on "Implantable Cardioverter Defibrillator"

**498.** What medication helps electrical cardioversion of atrial fibrillation (to NSR)?

- a. Warfarin
- b. Isoproterenol
- c. Ibutilide
- d. Digitalis

ANSWER c. Ibutilide is a new class III IV medication used to terminate atrial fibrillation especially in conjunction with cardioversion. However, it is not useful to prevent it ahead of time. Braunwald says: Administration of ibutilide has been shown to facilitate electrical cardioversion of atrial fibrillation to sinus rhythm.

See: Braunwald chapter on "Electrotherapy for Cardiac Arrhythmias"

**500.** Radio-frequency ablation works to slow or terminate \_\_\_\_\_ tachyarrhythmias. The RF signal destroys myocardial tissue by \_\_\_\_\_.

- a. Automatic, heating it
- b. Automatic, ionizing radiation
- c. Reentry, "heating it"
- d. Reentry, "ionizing radiation"

ANSWER c. Reentry, "heating it" through radio-frequency electrical waves similar to electro-cautery or Bovie. This burns adjacent tissue with the intent of breaking up the reentry loop. Braunwald says: "Because energies in the RF portion of the

electromagnetic spectrum are not conducted by cardiac tissue, RF energy instead causes resistive heating in the cells in close proximity to the catheter tip (i.e., these cells transduce the electrical energy into thermal energy). Once tissue temperature exceeds 50° C, irreversible cellular damage and tissue death occur. An expanding front of conducted heat emanates from the region of resistive heating while RF delivery continues, resulting in production of a homogenous hemispheric lesion of coagulative necrosis 3 to 5 mm in radius. RF-induced heating of tissue that has inherent automaticity (His bundle, foci of automatic tachycardias) results in acceleration of a rhythm, whereas RF delivery during a reentrant arrhythmia typically causes slowing and termination of the arrhythmia."

See: Braunwald chapter on "Electrotherapy for Cardiac Arrhythmias"

**507. Invasive programmed stimulation often uses an incremental pacing train followed by Extrastimuli. Standard nomenclature for incremental pacing spikes is: S1 is the \_\_\_ and S2 is the \_\_\_\_.**

- |    |                      |                      |  |
|----|----------------------|----------------------|--|
|    | <u>S1</u>            | <u>S2</u>            |  |
| a. | First Extrastimuli,  | Second Extrastimuli  |  |
| b. | First Cardioversion, | Second Cardioversion |  |
| c. | Pulse train stimuli, | First Extrastimuli   |  |
| d. | First Extrastimuli,  | Pulse train stimuli  |  |

ANSWER c. Pulse train, First Extrastimuli. In incremental pacing the "Pulse train" stimuli are each labeled as S1, The premature Extrastimuli following the train are labeled S2, S3, etc. Eight regularly spaced pacing pulses (in a row like a train) first establish a fixed heart rate. Then a premature pacing spike (S2) follows the last (8th) stimuli in the train. A second (S3) or third (S4) premature stimuli may follow that.

If pulse trains are not used. These last extrastimuli are moved closer together in an attempt to initiate a tachy-arrhythmia. Extrastimuli may be coupled to sinus beats like PVCs. Then the first Extrastimuli is more clearly labeled as S1, the second S2, etc.

See: Kern, chapter on "Electrophysiology." Keywords: programmed stimulation S1, S2

**509. Which rhythm below originates from an automatic focus and will NOT usually respond to cardioversion?**

- a. Reciprocating WPW tachycardia
- b. Atrial Fibrillation/Atrial Flutter
- c. Ventricular Tachycardia
- d. Accelerated idioventricular rhythm

ANSWER d. Accelerated idioventricular rhythm is usually not over 100/min. But, it can accelerate to where it looks like slow VT. Because this is an automatic rhythm it will respond better to medications than to cardioversion, because there is no reentry loop to break up. Braunwald says: "Electrical cardioversion appears to most effectively terminate those tachycardias due to reentry, such as atrial flutter and atrial fibrillation... reciprocating tachycardias associated with the Wolff-Parkinson-White syndrome, most forms of VT, .... Tachycardia thought to be due to disorders of impulse formation (automaticity) include parasystole, some forms of atrial tachycardia and accelerated

idioventricular rhythms. An attempt to cardiovert these tachycardias electrically is not indicated in most instances, because they typically recur within seconds after the shock. **See:** Braunwald chapter on "Electrotherapy for Cardiac Arrhythmias"

**510. Synchronized cardioversion delivered during the QRS complex is used for all cardioversions EXCEPT:**

- a. Rapid ventricular tachycardias
- b. Slow ventricular tachycardias
- c. Rapid supra-ventricular tachycardias
- d. Slow supra-ventricular tachycardias

ANSWER a. Rapid ventricular tachycardias such as ventricular flutter or fibrillation should not be cardioverted, because there is no distinct QRS for the synchronizing circuit to trigger from. Fibrillation and flutter waves are typically broad low amplitude waves. Braunwald says: "A synchronized shock (i.e., one delivered during the QRS complex) is used for all cardioversions except for very rapid ventricular tachyarrhythmias, such as ventricular flutter or VF. "

**See:** Braunwald chapter on "Electrotherapy for Cardiac Arrhythmias"

**511. Elective cardioversion via R2 pads for atrial fibrillation should start at a minimum of:**

- a. 25 joules
- b. 50 joules
- c. 100 joules
- d. 200 joules

ANSWER c. 100 joules is the minimum to start with in AF. AF usually originates deep in the pulmonary veins where the reentry focus is difficult to reach with transthoracic shocks. Plus it is a complicated loop to interrupt with cardioversion energy. The wave fronts fragment and wander through the atrium. These give rise to new wavelets that collide and mix. Braunwald says: "The starting level to terminate atrial fibrillation should be no less than 100 joules. If this fails, up to 360 joules can be used safely. Anteroposterior pads may have a higher efficacy rate by placing more of the atrial mass in the shock vector than is the case for apical-anterior pads."

**See:** Braunwald chapter on "Electrotherapy for Cardiac Arrhythmias"

**512. In patients with debilitating atrial fibrillation that is unsatisfactorily treated with medications or anti-tachy pacing, the cardiologist may decide to "ablate and pace." This involves:**

- a. Ablating the AV node and placing a AAIR pacemaker
- b. Ablating the AV node and placing a VVIR pacemaker
- c. Ablating the SA node and placing a AAIR pacemaker
- d. Ablating the SA node and placing a VVIR pacemaker

ANSWER b. Ablating the AV node and placing a VVI pacemaker. Chronic unconvertible atrial fibrillation that is conducted down the AV node often causes a rapid irregular ventricular rhythm. If the AF cannot be controlled the AV node may be ablated via RF catheter energy, which blocks the AV node and leaves the patient with a slow idioventricular rhythm. A VVIR pacemaker can then be used to speed the ventricular rate. Motion sensors can make the ventricular rhythm responsive to exercise. Complete AV node ablation is often avoided by ablating small areas of the AV node, which may slow the conduction time adequately so a VVIR pacemaker implant may be avoided.

**See:** Braunwald, Chapter on "Electrical Therapy of Arrhythmias" and Fogoros, chapter on "Transcatheter Ablation"