PACEMAKERS

COURSE DESCRIPTION

Pacemakers are small electronic devices placed in the chest (and sometimes in the abdomen) that help control abnormal heart rhythms. Abnormal heart rhythms include bradycardia, tachycardia, and dysrhythmias. Pacemakers use electrical signals that move from a small generator to leads placed in the heart to prompt the heart to beat in a normal rhythm. This CE course provides an overview of pacemakers including basic information, paced rhythms, pacemaker malfunctions, and management of pacemakers in perioperative settings.

Note: An internet connection is required to complete this course.

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OBJECTIVES

Upon completion of this continuing education course, the professional should be able to:

1. Identify indications for pacemaker implantation.
2. Describe the components of a pacemaker.
3. Describe types of pacemakers.
4. Identify sources of electromagnetic interference that may or may not interfere with pacemaker function.
5. Identify pacemaker classifications including the meaning of the letters A, V, D, and I, naming the most common classifications.
6. Identify the repercussions of pacemaker oversensing and failure to capture.
7. Discuss pacemaker malfunction with sensing and pacing.
8. Describe dysrhythmias associated with pacemaker malfunction.
9. Identify perioperative requirements for surgical patients that are pacemaker dependent.
10. List sources of electromagnetic interference found in perioperative settings, naming the source most likely to result in pacemaker malfunction.
11. Identify historical and current use of magnets on pacemakers.
12. Describe perioperative management of patients with pacemakers undergoing urgent and non-urgent surgical procedures.

Disclaimer

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## GLOSSARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Arrhythmia</td>
<td>A disturbance or abnormality of a normal cardiac rhythm; same as dysrhythmia</td>
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<tr>
<td>Asynchronous pacing</td>
<td>Fixed rate generation of electrical impulses by the pacemaker independent of any underlying cardiac activity by the patient</td>
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<tr>
<td>Asystole</td>
<td>A state of no cardiac activity</td>
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<tr>
<td>Bradycardia</td>
<td>An abnormally slow heart rate, usually defined as 60 beats per minute or less</td>
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<tr>
<td>Demand pacing</td>
<td>Generation of electrical impulses by the pacemaker occurring when the patient's own heart rate is too slow or misses a beat</td>
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<tr>
<td>Dysrhythmia</td>
<td>A disturbance or abnormality of a normal cardiac rhythm; same as arrhythmia</td>
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<tr>
<td>Interrogation</td>
<td>Process by which the pacemaker functions are evaluated; performed by placing a computer sensor over the pacemaker and downloading information into a computer for evaluation; may be performed over the telephone; results of interrogation can identify problems that can be resolved by reprogramming</td>
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<tr>
<td>Intrinsic rhythm</td>
<td>The patient's own rhythm coming from the SA or AV nodes, the natural pacemakers; may be called native rhythm</td>
</tr>
<tr>
<td>Rate-responsive pacing</td>
<td>Pacemaker electrical impulses speed up or slow down based on the patient’s activity level</td>
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<tr>
<td>Sensing</td>
<td>The pacemaker senses (identifies) the patient’s own rhythm</td>
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<tr>
<td>Spike</td>
<td>Vertical lines seen on the ECG strip that represent the electrical activity of the pacemaker</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>An abnormally fast heart rate, generally defined as 100 beats per minute or higher</td>
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## INTRODUCTION

Pacemakers are small electronic devices placed in the chest (and sometimes in the abdomen) that help control abnormal heart rhythms. Abnormal heart rhythms include bradycardia, tachycardia, and dysrhythmias. Pacemakers use electrical signals that move from a small generator to leads placed in the heart to prompt the heart to beat in a normal rhythm. This CE course provides an overview of pacemakers including basic information, paced rhythms, pacemaker malfunctions, and management of pacemakers in perioperative settings.

Why are we sending you to the internet to read course material? The articles selected for this course are copyrighted. Therefore, we cannot provide them in printed or electronic form for you to read. We can, however, send you to the websites to read/print a copy for your individual use. The educators at NCCT also consider the ability to use the internet to learn and/or review information as critically important.

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ARTICLE 1: Patient Information: Pacemakers (Beyond the Basics)

While the information in this article is designed for patients, it provides a good review of the need for a pacemaker, the types of pacemakers, and the precautions patients must take after implantation of a pacemaker.

- Copy and paste the following link into your internet browser.
  http://www.uptodate.com/contents/pacemakers-beyond-the-basics
- Print and/or read the article.
- CE test questions 1 - 9 are over information in this article.

Important note: This article has been updated since the CE test was written. In section TEMPORARY AND PERMANENT PACEMAKERS subsection How They Work, please insert the following between the 2nd and 3rd bullet.

One or more electrodes at the tips of the leads transmit electrical impulses to the heart muscle when needed and also sense the heart's own electrical activity.

ARTICLE 2: Electrocardiography Paced Rhythms

- Copy and paste the following link into your internet browser.
  https://www.siumed.edu/oec/students/Cardiology/Curriculum/paced_rhythms.html
- Print and/or read the article.
- CE test questions 10 - 17 are over information in this article.

ARTICLE 3: Pacemaker Malfunction

- Copy and paste the following link into your internet browser.
  http://lifeinthefastlane.com/ecg-library/pacemaker-malfunction/
- Print and/or read the article.
- CE test questions 18 – 22 are over information in this article.

ARTICLE 4: Managing Cardiovascular Implantable Electronic Devices (CIEDS) During Perioperative Care

- Copy and paste the following link into your internet browser.
  http://www.apsf.org/newsletters/html/2013/fall/01_cieds.htm
- Print and/or read the article.
- CE test questions 23 – 29 are over information in this article.
CONCLUSION

About 200,000 people in the United States have pacemakers to normalize their heartbeats. Most of these are dual chamber pacemakers. Pacemakers are most often implanted for bradycardia or heart blocks but they can also be used to treat atrial fibrillation, dysrhythmias, certain types of congenital heart disease, and more. Pacemakers ease the symptoms of individuals' heart beat abnormalities, thus improving their quality of life and allowing them to be more physically active.

QUESTIONS
Pacemakers #1220715

Directions:
- Before taking this test, read the instructions on how to complete the answer sheets correctly. If taking the test online, log in to your User Account on the NCCT website www.ncctinc.com.
- Select the response that best completes each sentence or answers each question from the information presented in the module.
- If you are having difficulty answering a question, go to www.ncctinc.com and select Forms/Documents. Then select CE Updates and Revisions to see if course content and/or a test questions have been revised. If you do not have access to the internet, call Customer Service at 800-875-4404.

Questions 1 – 9: Patient Information: Pacemakers (Beyond the Basics)

1. Bradyarrhythmias are heart rhythm abnormalities that result in a/an __________.
   a. abnormally fast heartbeat
   b. abnormally slow heartbeat
   c. slightly irregular heartbeat
   d. very irregular heartbeat

2. Which of the following is considered the most serious kind of heart block?
   a. Left bundle branch block
   b. Right bundle branch block
   c. First-degree AV block
   d. Third-degree AV block

3. Which one of the following is a type of tachyarrhythmia?
   a. Atrial fibrillation
   b. First-degree AV block
   c. Left bundle branch block
   d. Right bundle branch block
4. While there are many situations in which a pacemaker is used, most commonly it is used for a __________.
   
   a. bradyarrhythmia  
   b. heart valve disease  
   c. myocardial infarction  
   d. tachyarrhythmia  

5. Which part of a pacemaker transmits electrical impulses to the heart muscle?
   
   a. Electrodes at the tips of the leads  
   b. Flexible insulated wires or leads  
   c. Generator  
   d. Rigid insulated wires or leads  

6. Which type of pacemaker discharges impulses at a single, steady rate, regardless of the heart’s own electrical activity?
   
   a. Demand  
   b. Fixed-rate  
   c. Rate-responsive  
   d. Selective-rate  

7. The lithium batteries in pacemakers last an average of __________ years.
   
   a. 1-3  
   b. 3-5  
   c. 5-8  
   d. 8-10  

8. Which one of the following may be identified when a pacemaker is interrogated?
   
   a. Battery life  
   b. Pacemaker lead function  
   c. Type of heart rhythm  
   d. All may be identified.  

9. Which of the following electromagnetic energy sources is most likely to interfere with pacemaker function?
   
   a. Airport metal detectors  
   b. Anti-theft systems  
   c. Cellular phones  
   d. Therapeutic radiation for cancer
Questions 10 – 17: Electrocardiography Paced Rhythms

10. The first letter used in the classification of pacemakers identifies the ________.
   a. ability of the pacemaker to be rate responsive  
   b. activity in the specific chambers that inhibit the pacemaker  
   c. chamber that is paced  
   d. chamber that is sensed

11. The second letter used in the classification of pacemakers identifies the ________.
   a. ability of the pacemaker to be rate responsive  
   b. activity in the specific chambers that inhibit the pacemaker  
   c. chamber that is paced  
   d. chamber that is sensed

12. The third letter used in the classification of pacemakers identifies the ________.
   a. ability of the pacemaker to be rate responsive  
   b. activity in the specific chambers that inhibit the pacemaker  
   c. chamber that is paced  
   d. chamber that is sensed

13. The fourth letter used in the classification of pacemakers identifies the ________.
   a. ability of the pacemaker to be rate responsive  
   b. activity in the specific chambers that inhibit the pacemaker  
   c. chamber that is paced  
   d. chamber that is sensed

14. Which of the following is the classification for a pacemaker with atrial demand pacing, inhibited by sensed atrial activity?
   a. AAI  
   b. VVI  
   c. DDD  
   d. DDI

15. The VVI and ________ pacemakers are the two most common types of pacemakers implanted.
   a. AAI  
   b. VVI  
   c. DDD  
   d. DDI
16. Which of the following is a FALSE statement about interpreting paced rhythms?
   a. Most pacemakers are set to pace between 40-80 beats per minute.
   b. Pacemakers produce low voltage spikes on the ECG that can easily go unnoticed.
   c. The biggest obstacle is identifying the paced beats.
   d. There is no single lead that consistently demonstrates pacemaker spikes.

17. In a DDD pacemaker, the AV delay is designed to decrease battery usage and _________.
   a. force the atrium to contract
   b. force the ventricle to contract
   c. allow for natural conduction from the atrium to the ventricle
   d. allow for natural conduction from the ventricle to the atrium

Questions 18 – 22: Pacemaker Malfunction

18. Which of the following results when the pacemaker fails to sense native cardiac activity?
   a. Absent pacemaker function
   b. Asynchronous pacing
   c. Large P or T waves
   d. Paroxysms of pacing spikes

19. Which of the following can result in pacemaker output failure?
   a. Electrolyte disturbance
   b. Lead displacement
   c. Overstimulated muscles
   d. Pacemaker programming problems

20. Sensor-induced tachycardia may occur as a result of a/an _________.
   a. AV block
   b. lead dislodgement
   c. hyperventilation
   d. low battery voltage

21. Which of the following is a FALSE statement regarding a runaway pacemaker?
   a. Definitive treatment requires application of a magnet.
   b. It is seen in older-generation pacemakers.
   c. It is potentially life-threatening.
   d. The cause is related to low battery voltage.
22. Accidental or deliberate patient manipulation of the pulse generator resulting in dislodgement of the pacing leads results in __________.
   a. Lead displacement dysrhythmia
   b. Pacemaker-mediated tachycardia
   c. Pacemaker syndrome
   d. Twiddler’s syndrome

Questions 23 – 29: Managing Cardiovascular Implantable Electronic Devices (CIEDS) During Perioperative Care

23. If a pacemaker dependent patient is to undergo surgery, which of the following should occur perioperatively?
   a. The surgery should be cancelled as pacemakers are a contraindication for surgery.
   b. A secondary method for pacing the patient should be present in the operating room suite.
   c. The pacemaker should be turned off prior to surgery and an alternative pacing method used during the surgery.
   d. The surgeon should call the pacemaker manufacturer for further instructions.

24. The most common cause of pacemaker malfunction due to surgical electromagnetic interference is due to __________.
   a. bipolar electrocautery
   b. electroconvulsive therapy
   c. monopolar electrocautery
   d. TENS units

25. In what way does surgical electromagnetic interference (EMI) affect a pacemaker?
   a. EMI increases battery usage and quickly uses up the energy supply, causing the pacemaker to stop functioning.
   b. The pacemaker interprets EMI as intrinsic cardiac activity, and it will not trigger a paced rhythm even when needed.
   c. The pacemaker senses the EMI and quickly triggers a change in pacemaker rhythm.
   d. EMI reprograms the pacemaker, disabling the pacemaker’s defibrillating capability.

26. Historically, magnets were used on pacemakers to __________.
   a. charge the battery
   b. check the functioning of the leads
   c. determine the battery life
   d. reprogram the pacemaker
27. Currently, magnets are used on pacemakers most often to ___________.
   a. encourage demand pacing
   b. freeze the pacemaker software
   c. prevent inappropriate oversensing
   d. reprogram the pacemaker to an intrinsic rhythm

28. In general, surgical procedures below the __________ do not require pacemaker reprogramming.
   a. carotid artery
   b. heart
   c. stomach
   d. umbilicus

29. If a patient requires immediate surgery and the anesthesiologist is unable to obtain pacemaker information from the medical records, which of the following procedures can provide useful information?
   a. chest ultrasound
   b. chest x-ray
   c. chest MRI
   d. chest CT scan

*End of Test*