

## Bradycardia – Questions

1. You are cross-covering a previously healthy 15 year old boy admitted for new-onset polyarthritis. His nurse calls to notify you that his heart rate has been in the high-40s and low-50s overnight. List 5 potential causes of his bradycardia:

A. \_\_\_\_\_

B. \_\_\_\_\_

C. \_\_\_\_\_

D. \_\_\_\_\_

E. \_\_\_\_\_

2. As you are walking through the oncology unit, you are approached by a nurse who asks you to quickly evaluate her patient with bradycardia. Upon entering the room, you find the 4 year old girl in bed, nonresponsive, poorly perfused but with intact pulses, with a heart rate of 35 on her cardiac monitor. Think through how you would approach this patient, and list 8 (or more) interventions you would consider. Try to list them in order of priority/time course – what would your first step be? Are there some interventions that you would perform concurrently? Are there any interventions that can wait until the patient is stabilized?

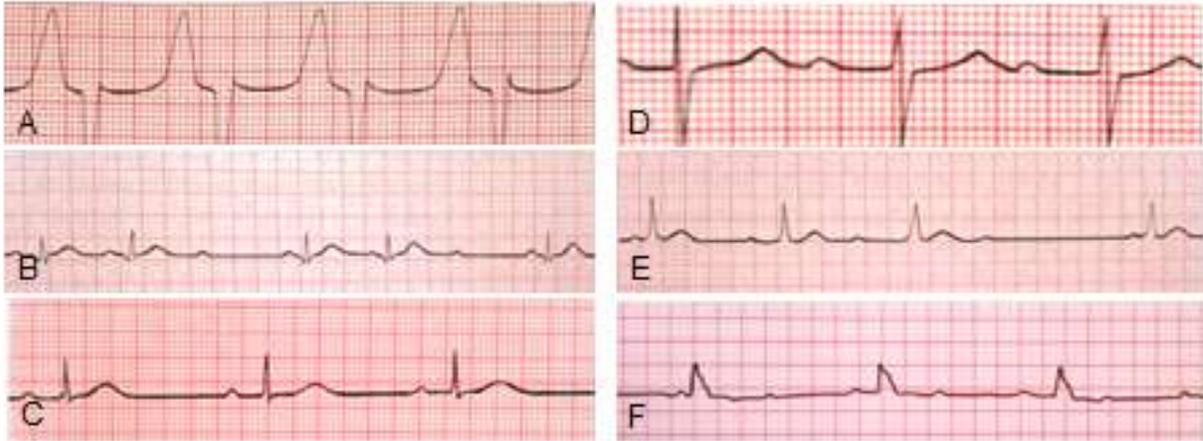
3. Which of the following statements regarding bradyarrhythmias in children is correct?

- A. Sinus bradycardia is a physiologic consequence of decreased metabolic demand and, if the patient is well-perfused, does not require further investigation
- B. Atrial escape, junctional escape, and idioventricular escape rhythms are caused by aberrant conduction through the AV node
- C. Mobitz I and Mobitz II AV blocks have similar clinical significance
- D. 3<sup>rd</sup> degree AV block is the most symptomatic form of heart block, and often requires placement of a pacemaker

## Bradycardia – Questions Continued

4. Identify the following arrhythmias:

Ralston et al 2006; Thaler 2003



A. \_\_\_\_\_

D. \_\_\_\_\_

B. \_\_\_\_\_

E. \_\_\_\_\_

C. \_\_\_\_\_

F. \_\_\_\_\_

5. As you are obtaining a history from the mother of a 5 year old girl with known Mobitz Type II 2<sup>nd</sup> degree heart block who is being admitted for syncopal episodes, the monitor alarms and you notice the heart rate is 32. You glance at the patient and see that she is no longer watching her movie. She does not arouse when her mom calls her name. Her extremities are cool, and her pulses are palpable but faint. Her breathing is unlabored, and her oxygen saturation is 89% on room air. You press the code blue button as the bedside nurse walks in. You and the nurse give oxygen via non-rebreather and begin chest compressions. What is the most appropriate next step?

- Epinephrine 0.01 mg/kg IV
- Atropine 0.02 mg/kg IV
- Check chemistry panel
- Obtain 12 lead EKG
- Defibrillate

6. Which of the following is true to AV block?

- Drugs such as calcium channel blockers, beta blockers, and digoxin can cause 1<sup>st</sup> and 2<sup>nd</sup> degree heart block
- Electrolyte abnormalities such as hyperkalemia can cause acquired 3<sup>rd</sup> degree heart block
- 3<sup>rd</sup> degree heart block is usually asymptomatic, and of little clinical significance if followed closely
- 1<sup>st</sup> degree heart block is a common cause of syncope in adolescents
- 2<sup>nd</sup> degree heart block (Mobitz type I) frequently progresses to 3<sup>rd</sup> degree heart block, and therefore usually necessitates a pacemaker

## Bradycardia – Answers

### 1. Answer: Sleep, athletic conditioning, medications, primary heart block, acquired heart block.

The definitive identification of the cause of this patient's bradycardia requires an evaluation of his rhythm on a cardiac monitor or 12 lead EKG. In general, the two most common categories of bradycardia in his age group would be sinus bradycardia and AV block. Given that he is an otherwise healthy teenager, he may have physiologic sinus bradycardia from decreased metabolic demand while he is sleeping, or he may have a slower heart rate at baseline because of increased stroke volume related to athletic conditioning. Sinus bradycardia can be pathologic as well, and over-administration of narcotic analgesics, for example, may lead to sinus bradycardia. He may have an underlying primary heart block that has gone unrecognized up until this point (1<sup>st</sup> degree and 2<sup>nd</sup> degree Mobitz Type II heart blocks tend to be asymptomatic). It is important to consider the context of the bradycardia – does this patient have an acquired prolongation of his PR interval (1<sup>st</sup> degree AV block) from acute rheumatic fever, which is causing his arthritis as well?

### 2. Answer:

This patient has significant cardiorespiratory compromise from her bradycardia, leading to poor perfusion and altered level of consciousness. The first step in management is to assess her ABCs: airway, breathing, and circulation. Ideally, this is done as you are seeking help (pressing Code Blue button, summoning nurse, etc.). If the patient remains hemodynamically unstable despite appropriate oxygenation and ventilation, the next step according to the PALS Pediatric Bradycardia Algorithm is to start chest compressions. Compressions should be administered hard and fast, with a goal rate of 100/min. If the patient remains symptomatically bradycardic despite these interventions, then pharmacologic agents are indicated (ie: atropine if known heart block or increased vagal tone; epinephrine in all other instances - 0.01 mg/kg via IV/IO [1:10000; 0.1 mL /kg], 0.1 mg/kg via ET [1:1000; 0.1 mL/kg], repeated every 3-5 minutes). In addition to chest compressions and pharmacologic interventions, it is important to check electrode position and contact, attach defibrillator, establish vascular access, monitor pulses and blood pressure, give oxygen, obtain a 12 lead EKG, draw appropriate labs, and seek to identify and treat reversible causes.

### 3. Answer: D. 3<sup>rd</sup> degree AV block is the most symptomatic form of heart block, and often requires placement of a pacemaker

Sinus bradycardia can indeed be a physiologic consequence of decreased metabolic demand (ie: while sleeping) or increased stroke volume (ie: athletes), but it can also be a pathologic finding. Pathologic causes of sinus bradycardia include electrolyte disturbances, infection, drug effects, hypoglycemia, hypothyroidism, and increased intracranial pressure. While AV blocks are due to disturbed conduction through the AV node, sinus blocks are due to absent pacemaker activity in the sinus node. Subsidiary pacemakers then take over, with pacemakers in the atrium, AV junction, and ventricles leading to atrial, junctional, and idioventricular escape rhythms, respectively. AV blocks are divided into 1<sup>st</sup> degree, 2<sup>nd</sup> degree (Mobitz types I and II), and 3<sup>rd</sup> degree. 1<sup>st</sup> degree blocks (characterized by prolonged PR intervals) are usually asymptomatic, and 2<sup>nd</sup> degree Mobitz type I blocks (characterized by progressive prolongation of the PR interval) are usually minimally symptomatic, transient, and benign. 2<sup>nd</sup> degree Mobitz type II blocks, on the other hand, frequently cause symptoms of palpitations, presyncope, and syncope, and can progress to 3<sup>rd</sup> degree heart block. 3<sup>rd</sup> degree heart block is the most symptomatic, and often requires a pacemaker.

## Bradycardia – Answers Continued

### 4. Answer:

- A. Idioventricular escape rhythm (sinus node block)
- B. Mobitz type II 2<sup>nd</sup> degree AV block
- C. 1<sup>st</sup> degree AV block
- D. Sinus bradycardia
- E. Mobitz type I 2<sup>nd</sup> degree AV block (Wenckebach)
- F. 3<sup>rd</sup> degree heart block

### 5. Answer: B. Atropine 0.02 mg/kg

This patient has significant cardiorespiratory compromise from her bradycardia, leading to poor perfusion, respiratory difficulty, and altered level of consciousness. If she remains symptomatically bradycardic despite appropriate initial interventions (airway maintenance, support of breathing, chest compressions), then pharmacologic agents are indicated. Because this patient has known heart block, the initial drug of choice is atropine, 0.02 mg/kg (min dose 0.1 mg). This can be repeated in 5 minutes, with a maximum total dose of 1 mg in children and 2 mg in adolescents. Atropine is also the drug of choice when a patient's bradycardia is due to increased vagal tone. In all other cases of bradycardia, epinephrine is the initial drug of choice (0.01 mg/kg via IV/IO (1:10000; 0.1 mL /kg), 0.1 mg/kg via ET (1:1000; 0.1 mL/kg), repeat every 3-5 minutes). In addition to chest compressions and pharmacologic interventions, it is important to check electrode position and contact, attach defibrillator, establish vascular access, monitor pulses and blood pressure, draw appropriate labs, and seek to identify and treat reversible causes. An EKG would be helpful, but should not delay treatment. Should she go into pulseless arrest, the PALS Pediatric Cardiac Arrest Algorithm guides the use of defibrillation.

### 6. Answer: A. Drugs such as calcium channel blockers, beta blockers, and digoxin can cause 1<sup>st</sup> and 2<sup>nd</sup> degree heart block

AV blocks are disturbances of electrical conduction through the AV node. 1<sup>st</sup> degree blocks are usually asymptomatic, and can be caused by AV nodal disease, increased vagal tone, myocarditis, electrolyte disturbances, myocardial infarction, acute rheumatic fever, and drugs (ie: calcium channel blockers, beta blockers, and digoxin). Mobitz Type I 2<sup>nd</sup> degree blocks can also be caused by these drugs, and are slightly more symptomatic (additional causes of Mobitz Type I 2<sup>nd</sup> degree blocks include increased parasympathetic tone, and myocardial infarction). Mobitz Type II 2<sup>nd</sup> degree blocks are even more symptomatic, and can progress to 3<sup>rd</sup> degree heart block. For this reason, individuals with Mobitz Type II 2<sup>nd</sup> degree block often require a pacemaker. Mobitz Type II 2<sup>nd</sup> degree block can be caused by a defect in the conduction pathway or acute coronary syndrome. 3<sup>rd</sup> degree heart block is the most symptomatic form of AV block, and is caused by conduction system disease or injury, myocardial infarction, or congenital block; it usually requires a pacemaker.