Emergency Preparedness in the OR: Part II

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Sinus Bradycardia and Sinus Tachycardia

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In the first part of the series titled "Emergency Preparedness in the O.R.—Malignant Hyperthermia," the reader was introduced to the current guidelines and research regarding this potentially lethal condition. In Part II of the series, the reader will be introduced to 2 case studies occurring in either the operating room or postanesthetic care unit involving sinus rhythms. Sinus bradycardia and sinus tachycardia are cardiac rhythms commonly seen in surgical and postanesthetic care units. These rhythms may be a response to medications administered during anesthesia and may be resolved with minimal intervention (Watterson, Morris, Williamson, & Westhorpe, 2005). There are a wide variety of other differential causes for these rhythms including cardiac ischemia, ventilatory abnormalities, and hypovolemia. The concern with these usually innocuous rhythms is when the patient's condition deteriorates as a result of reduced cardiac output. Cardiac output is a product of heart rate and the three components of stroke volume: preload, afterload, and contractility (Urden, Stacy, & Lough, 2010). When a patient presents in an unstable state and is in sinus bradycardia or sinus tachycardia, prompt assessment of the patient and intervention are required to prevent further deterioration. This case study—based article will address basic cardiac conduction system, the causes of sinus bradycardia and sinus tachycardia, and the role of the nurse in utilizing a systematic approach for patient assessment and treatment according to the 2010 American Heart Association Advanced Cardiac Life Support guidelines (Neumar et al., 2010).

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BASIC CARDIAC CONDUCTION SYSTEM

The heart's natural pacemaker is the sinus node and the hallmark of a sinus rhythm is when there is a P wave followed by a narrow QRS complex (Boudreau, 2004). The P wave is indicative of sinus node activity. The P waves are much smaller in amplitude than the QRS complex because the atria, where the sinus node is located, are smaller chambers than the ventricles. Depolarization of the ventricles is responsible for producing the QRS complex. The sinus node normally functions at a rate between 60 and 100 beats/min. For a variety of reasons, the sinus node may function faster (sinus tachycardia) or slower (sinus bradycardia) than normal rate. In all cases of a sinus rhythm, there will be one P wave followed by one QRS complex (see Figure 1).

CASE STUDY 1

You are caring for a 56-year-old female postoperative laparoscopic cholecystecomy patient who is on the oxygen saturation monitor when the monitor suddenly alarms. Upon approaching your patient, you note that they have an oxygen saturation level of 90%, heart rate is 40 beats/min, and blood pressure is 80/52 mmHg. Her skin is cool and she is diaphoretic. You attach the patient to the cardiac monitor. See Figure 2. What is the rhythm?

Rhythm Analysis

You observe the patient's heart rate to be 40 beats/min. There is a P wave prior to each QRS complex and the PR interval appears to be the same duration across the rhythm strip. A normal PR interval is between 0.12

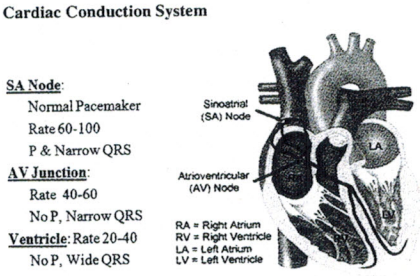

Figure 1. The electrical cardiac conduction system.

TABLE 1 A selected list of the top-five drugs or drug-related errors causing bradycardia

Drugs	Number out of 129 Subjects
Inhalational agents (i.e., enflurane, halothane, isoflurane)	34
Opioids (i.e., fentanyl, morphine)	20
IV anesthetic agents (i.e., thiopentone, propofol)	18
Suxamethonium (second dose)	12
Drug error (syringe swap)	9

and 0.20 s, or three to five small squares making this PR interval normal. This rhythm is originating in the sinus node because there is a P wave before each QRS complex. The heart rate is slower than the lower limit of 60 beats/min for a sinus rhythm; therefore, this is a sinus bradycardia.

Causes of Bradycardia in the O.R.

In an analysis of 265 reports of bradycardia during anesthesia, Watterson, Morris, Westhorpe, and Williamson (2005) identified that 28% of these cases were related to drugs used during surgery, followed by 16% being related to airway events. In the pediatric population, 75% of bradycardia during anesthesia was caused by airway and drug events. Probable drugs associated with inducing bradycardia are listed in Table 1. Of the airway-related events leading to bradycardia observed by Watterson et al., the four highest events were laryngospasm (10), hypoventilation (9), oxygen delivery/circuit/ETT (5), and airway obstruction (4). In an analysis of 677 cases of bradycardia, Lesser, Sanborn, Valskys, and Kuroda (2003) identified that a low-baseline heart rate of 60 beats/min or less is a strong, independent risk factor for severe and moderate bradycardia during anesthesia. Male gender was also identified as an independent risk for bradycardia in this analysis (Lesser et al.).

Patient Assessment

Having a systematic approach in assessing your patient is important to ensure that prompt and appropriate treatment has been initiated. What do you need to find out about your patient? The oxygen saturation alarm has sounded, which prompts you to check your patient. Is the patient responding to command? What is their blood pressure? Is their skin warm and dry or cool and clammy? Are they having chest pain or shortness of breath? See Table 2 for further assessment items to assess and actions to anticipate. Upon reassessing, your patient remains in a sinus bradycardia at a rate of 40 beats/min. The patient's skin is cool and clammy, blood pressure has now dropped to 76/40 mmHg, and oxygen saturation is at 86%.

Treatment

According to the 2010 Advanced Cardiac Life Support Guidelines (Neumar et al., 2010), patients may be treated one of three ways, depending on where the bradycardia is originating. Sinus bradycardia in the surgical setting usually responds well with 0.5 mg of atropine. One potential problem with atropine may occur in the setting of a patient who has an unstable sinus bradycardia and who is also having a myocardial infarction. In this situation, atropine may be given to increase the heart rate but may also inadvertently cause tachycardia resulting in increased oxygen demand and potential worsening cardiac ischemia (Neumar et al., 2010). To avoid undesirable tachycardia, the recommended dose of atropine is 0.5 mg every 5 min to a maximum of 3 mg (Neumar et al., 2010). Another potential problem in using atropine is in the setting of second-degree type II (also known as Mobitz II) and complete atrioventricular (AV) block (Neumar et al., 2010) (see Figures 3 and 4).

For patients who do not respond to atropine or should not receive atropine because of the type of bradycardia they are in, guidelines recommend either external pacing or an infusion of dopamine or epinephrine to increase the heart rate (Neumar et al., 2010). In this case study, the patient is not experiencing any symptoms associated with an acute coronary syndrome. Atropine 0.5 mg is given intravenously push with prompt improvement of heart rate, oxygen saturation, blood pressure, and relief of patient symptoms. Of interest, contrary to some practice patterns, the administration of saline in this case is not recommended as this patient is presenting in an unstable fashion primarily because of their bradycardia and not because of a hypovolemic issue. Administration of normal saline bolus to patients who are unstable because of a heart rate issue will

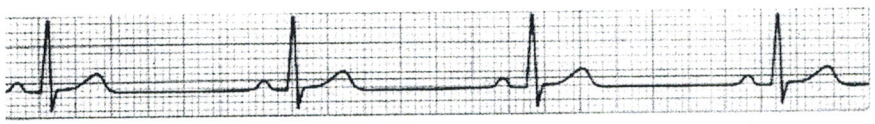

Figure 2. Sinus bradycardia; rate 40 beats/minute.

TABLE 2 Assessment of the patient with a low cardiac output

Assessment	Nursing Care
Circulation	*Circulation*
Does the patient have a pulse?	If no pulse, call for help and start hands-only CPR.
Are they warm and dry *or* cool and clammy?	When help arrives, defibrillate immediately if appropriate.
What is their blood pressure?	If patient has a pulse but is unstable and slow, anticipate methods to increase the heart rate.
Is their heart rate fast, slow, sinus tachycardia?	If patient has a pulse but is unstable and fast, anticipate methods to decrease the heart rate.
Is there any obvious bleeding?	If patient is unstable and in sinus tachycardia, anticipate fluid resuscitation.
Is the patient responding to verbal stimuli?	Anticipate other measures to improve the patient's circulation: medications, volume replacement
Airway	*Airway*
Is the airway patent and absent of obstruction?	Ensure airway remains patient.
Breathing	*Breathing*
Is the patient breathing?	If not breathing on their own, provide rescue breathing every 6–7 s with an oral airway in place and deliver oxygen via bag-valve mask device.
	If breathing on own, administer oxygen to achieve oxygen saturation above 94%.
	Differential diagnosis
	What are the possible causes:
	I—infarct, infection
	T—tension pneumothorax, thromboembolism
	C—cardiac tamponade
	H—hypovolemia, hypothermia, hypo/er-kalemia/natremia/magnesemia, hypoglycemia, hypoxia
	P—pulmonary embolism
	A—acidosis, aortic dissection, anaphylaxis
	D—drug

increase the volume but not improve the cause of the patient's instability, their rate.

CASE STUDY 2

You are caring for a 38-year-old man who is in recovery for gastric bypass surgery. His risk factors for surgery are increased lipids, sleep apnea, depression, and a body mass index of 41. The patient is on the cardiac monitor and you notice that his heart rate has slowly been increasing and is now at 130 beats/min. The blood pressure is 80/40 mmHg and oxygen saturation has decreased from 96% to 88%. The patient does respond to verbal command. You start the patient on oxygen and call for assistance. What do you anticipate appropriate treatment to be? Why do you think this patient is unstable? Let us take a look at the cardiac rhythm (Figure 5).

Rhythm Analysis

Upon assessing the rhythm, you note that the patient is in a sinus tachycardia. Sinus tachycardia is an autonomic nervous system response to a stressor, for example, pain, fever, anxiety, and hemorrhagic or cardiogenic shock. The body's response, when the autonomic nervous system is triggered, is an increase in heart rate and

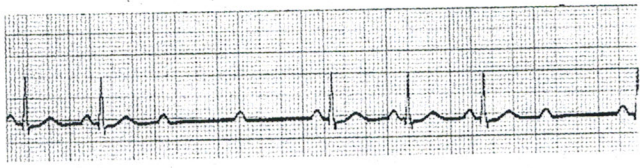

Figure 3. Second-degree AV block Type II (Mobitz II). Note the underlying sinus rhythm at a rate of 85 beats/min with PR intervals that do not change. In a 2-degree Type II, the AV node will suddenly block and prevent the sinus impulse from passing into the ventricle; therefore, the absence of a QRS complex is observed. This is a highly unpredictable AV block.

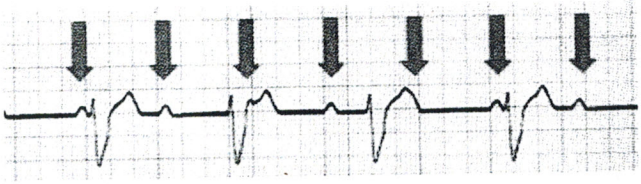

Figure 4. Third-degree AV block. Note the regular ventricular rate at 50 beats/min with a regular, faster atrial rate of 80 beats/min, as indicated by the arrows. In a third-degree AV block the PR intervals vary.

Figure 5. Sinus tachycardia, rate 130/min.

an increase in blood pressure (Neumar et al., 2010). The majority of patients immediately preoperatively or postoperatively may be in sinus tachycardia because of anxiety or pain; however, their blood pressure is often slightly elevated as part of the normal response when the autonomic nervous system is triggered. In this case study, though, the patient is in a sinus tachycardia with an inadequately low blood pressure. When a patient presents in sinus tachycardia and low blood pressure, this indicates that their attempt to compensate for the stressor has failed and that they are now in shock. The most common cause of sinus tachycardia and hypotension in the operative patient is hypovolemia (Watterson, Morris, Williamson, et al., 2005).

There are other causes of tachycardia that are nonsinus in origin with associated hypotension in the surgical setting. These nonsinus tachycardias include ventricular tachycardia, atrial fibrillation/flutter, and paroxysmal supraventricular tachycardia (Watterson, Morris, Williamson, et al., 2005). These tachycardias will be discussed in a future case study presentation.

Patient Assessment

See Table 2 for a detailed description of assessment priorities and actions. Despite placing the patient on oxygen, the oxygen saturation does not improve. The patient remains in sinus tachycardia, now at a rate of 146 beats/min and the blood pressure has dropped to 68/46 mmHg. The patient is now slow to respond to verbal command with a decreased level of consciousness. Their skin is cool and clammy. Upon performing a secondary assessment, you note the abdominal incision site to be intact. The abdomen appears distended and firm to light touch. The physician is notified immediately of this patient's deterioration.

Treatment

According to Neumar et al. (2010), patients who have decreased cardiac output resulting in hypotension and sinus tachycardia should have therapy directed toward identification and treatment of the underlying cause. Blood loss, dehydration, diuresis, and sepsis are noted causes of hypovolemia in the surgical setting (Watterson, Morris, Williamson, et al., 2005). Attempting to slow down the sinus tachycardia rate with drugs or cardioversion can be detrimental (Neumar et al., 2010). As the most common cause of tachycardia and hypotension in the surgical setting is related to hypovolemia, appropriate therapy includes intravenous fluid boluses to improve volume until the source of hypovolemia has been found and corrected.

In this case study, the patient had fasted in preparation for surgery and experienced considerable blood loss during surgery. After the administration of volume, the vital signs improved and the patient stabilized.

CONCLUSION

Common rhythm disturbances in the surgical setting include sinus bradycardia and tachycardia. The nurse needs to apply a systematic approach when assessing a patient who is experiencing a bradycardia or tachycardia. Is the patient responding to verbal stimuli or do they have a decreased level of consciousness? Do they have a palpable pulse? What is their blood pressure? Is their skin warm and dry or cool and clammy? According to the 2010 Advanced Cardiac Life Support guidelines, a patient who is hemodynamically unstable requires prompt intervention to prevent further compromise. Identifying the potential cause of the rhythm disturbance will provide the nurse with information on the anticipated treatment strategies. Sinus bradycardia in the surgical setting is often caused by medications used during anesthesia and normally reverses with atropine. Sinus tachycardia with hypotension in the surgical setting is usually caused by blood loss, dehydration, or diuresis. Appropriate treatments for this presentation are volume replacement along with identifying if a bleeding source exists.

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