



Nightmare of Tachycardia with Hypercarbia

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Abstract

Tachycardia is common in the pediatric age group, and is defined as the presence of a heart rate value greater than expected for age. It is affected by numerous factors and varies in part with age. The heart rate is usually between 110 and 150 beats per minute in infants, with a gradual slowing over the next six years. The case is here presented of a newborn with intraoperative sinus tachycardia and hypercarbia while undergoing bilateral inguinal herniectomy.

Introduction

Sinus tachycardia is a rhythm in which the rate of impulses arising from the sinoatrial (SA) node is elevated. It is one of the most commonly encountered, and often overlooked, rhythm disturbances that may portend an adverse prognosis, particularly in patients with cardiovascular disease [1-3]. Although values have been published for specific age groups, clinicians may use the basic guideline of >160 BPM for infants (<2 years), >140 BPM for children (2 to 12 years), and >100 BPM for adolescents and adults to define tachycardia. During sedation or anesthesia, sinus tachycardia most commonly occurs due to adrenergic stimulation resulting from inadequate anesthesia or analgesia, or as a reflex response to hypovolemia or anemia (typically due to blood loss). Other possible causes include hypoxemia, hypercarbia, sepsis, fever, myocardial ischemia, pulmonary embolism, hyperthyroidism, and malignant hyperthermia [4].

Malignant Hyperthermia (MH) is a very rare hypermetabolic muscle disease with a frequency of 1:15,000 in children and 1:40,000 in adults and is usually caused by exposure to succinylcholine or inhalation anesthesia [5] (Morgan&Michaels clinical anesthesiology, Lange, 5th edition.p = 1185-1186). MH presents with multiple, non-specific signs and laboratory findings such as tachycardia, tachypnea, hypercarbia, respiratory and metabolic acidosis, and masseter muscle rigidity, hyperkalemia, and hemodynamic instability. The case presented here is of a newborn undergoing a scheduled bilateral inguinal herniectomy, who developed sinus tachycardia and severe hypercarbia.

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Case Presentation

A 19-day male infant, weighing 5 kg, was scheduled for bilateral inguinal hernia operation. The physical examination, and preoperative laboratory finding results were normal. On the operating day, standard anesthesia monitoring was applied. Baseline vital values were; blood pressure = 70/50 mmHg, heart rate = 130 beat/minute, saturation = 98%. Anesthesia induction was applied with sevoflurane inhalation, intravenous cannulation was applied and propofol 10 mg, fentanyl 10 mcg, rocuronium 5 mg was administered intravenously. Intubation was applied using a no. 3.5 uncuffed endotracheal tube without any problem. Ventilation was provided using pressure support of 15, and respiratory rate of 40/min. Sevoflurane 2% with a mixture of 50% oxygen, 50% air was applied for maintenance of anesthesia. Infusion of 40 ml/h Izolen-P was started. Surgery was started and after 20 minutes, the heart rate began to rise to 140-150 bpm. The fluid rate was increased considering hypovolemia and fentanyl 5 mcg was given in consideration of pain. After a further ten minutes, 5mcg fentanyl was added. Blood pressure was 80/40 mmHg, heart rate, 150-155 bpm, saturation, 97%, and end-tidal CO₂, 55-60. The respiratory rate was increased. Thinking of possible tube obstruction, the endobronchial tube was aspirated and very few clear secretions emerged. The lungs were ventilated bilaterally and lung sounds were rough on auscultation. Heart rate and end-tidal CO₂ values increased to 160 bpm -165 bpm and 55-60, respectively. The surgeon was warned to be quick and finish the procedure as soon as possible. Arterial blood gas values were analyzed as pH = 7.075, pO₂=186, pCO₂=85,6, and simultaneous end-tidal CO₂ of 75-77. Malignant hyperthermia was considered and heat monitoring was applied. The patient had no fever perioperatively. Sevoflurane was stopped, propofol infusion was started and ventilation was applied manually via external oxygen. Surgery was completed in 45 minutes. A urinary catheter was inserted and the urine was clean. Aspiration was applied again and very few secretions came from the tube.

The patient was turned sideways and taputman was applied gently. The end-tidal CO₂ values suddenly decreased and heartrate decreased to 140 bpm. Extubation was applied without any problem. As the problem was considered to be that a secretion plug was creating tachycardia and hipercarbia and the hemodynamics returned to normal after taputman, the diagnosis of malignant hyperthermia was no longer considered. Postoperatively, the patient was admitted to the newborn Intensive Care Unit (ICU) for follow-up and treatment. Hemodynamics were stable in ICU with blood gas values of pH=7.43, pO₂=181 mmHg, and pCO₂=33.8 mmHg. The follow-up chest X-ray and laboratory findings were normal. The patient stayed in ICU for 24 hours, then was admitted to the Paediatric Surgery Service and was later discharged without any problem.

Discussion and Conclusion

Due to the presence of sinus tachycardia and severe hypercapnia in this case, a differential diagnosis of hypovolaemia, inadequate anesthesia and analgesia, airway obstruction, malignant hyperthermia and pulmonary embolism was considered. When hypercapnia associated with tachycardia was seen, the first consideration in this case was that there may be a blockage in the airways, or a twisting in the tubes. However, the open tube aspiration, the equalization of bilateral lung sounds on auscultation, and the presence of high saturations during the course ruled out the possibility of plug or atelectasis-embolism. Karlin et al. [6] presented a 2-year old patient with hypercapnia and tachycardia. Their differential diagnosis included malignant hyperthermia, light anesthesia, hypoventilation, increased dead space, and a malfunctioning CO₂ absorber. However, the prompt response of the patient after removal of the Heat and Moisture Exchanger (HME) indicated that the hypercapnia was secondary to increased respiratory dead space after addition of the HME. In the current patient HME was not used, but after gentle taputman, the heartrate and end-tidal CO₂ levels decreased surprisingly.

Intraoperative arrhythmias are common; nearly 11% of patients experience an abnormal heart rhythm during general anesthesia. While most intraoperative arrhythmias are transient and clinically insignificant, they may indicate an underlying pathology (eg, myocardial ischemia, electrolyte abnormalities). Occasionally, an arrhythmia causes intraoperative hemodynamic instability and postoperative morbidity. For most patients with mild sinus tachycardia (eg HR 100 to 120 bpm), prompt treatment of the underlying causes (eg, deepening anesthesia or volume resuscitation) is adequate. In the current case, the addition of fentanyl and increasing the volume intake did not correct the tachycardia. In addition, there was no electrolyte imbalance in the blood gas analysis. Esenther et al. [7] reported a tachyarrhythmia after sevoflurane induction in a 4-year old child undergoing bronchoscopy and a presumptive diagnosis of Wolf-Parkinson White was detected by a pediatric cardiologist via smartphone recordings.

It was concluded that any evidence of sustained arrhythmia, including those that have no hemodynamic significance, should prompt further investigation because it may be an underlying cardiac conduction disturbance [7]. Malignant hyperthermia is a catastrophic situation for all anesthetists. It is a hypermetabolic disorder of skeletal muscles linked to anesthesia with early symptoms of succinylcholine-associated masseter spasm, tachycardia, and hypercapnia. Hyperthermia is a late symptom. Mathur et al. [8] presented a case report of MH in a 6-month old infant who was scheduled for emergency laparotomy for intussusception, and succinylcholine and halothane were used. No succinylcholine was used in the current case, and no masseter spasms were seen. Tachycardia and hypercapnia, associated with respiratory acidosis in the blood gas was considered to be malignant hyperthermia. However, the normal urine color and absence of fever ruled out MH. All probabilities should be followed in detail with a protocol of treatment for a patient with tachycardia. Simple techniques such as taputman should be kept in mind when tachycardia and hypercarbia occur as in the current case.

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