

PBLD submission for SPA Spring 2014 Meeting

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Title: The “LAST” Surgery Prior to NICU Graduation with Unexpected Cardiac Arrest

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Educational Objectives: At the conclusion of this session the participant will be able to:

1. Identify the additional risks of anesthesia and surgery which a former premature infant may experience.
2. Compare and contrast the safety and efficacy of regional anesthesia techniques, including spinal, caudal, and TAP blocks, versus local infiltration performed by the surgeon.
3. Develop an evidence-based rationale for dosing local anesthetics in infants and neonates
4. Describe the clinical presentation of local anesthetic toxicity and current recommendations for treatment.

Case Description:

A 3 month old, former 27-week premature infant, is scheduled for bilateral inguinal hernia repair prior to his pending NICU discharge. He has a history of chronic lung disease and PDA which was closed surgically. At that time, he underwent an uneventful general anesthetic.

You explain to the parents that general anesthesia and a caudal for post-operative pain management is the best option to limit narcotics and avoid post-operative mechanical ventilation. Following an uneventful induction and intubation, a caudal is performed and 1 ml/kg of Bupivacaine 0.25% is injected following a negative test dose. Fifteen minutes later, you hear the EKG suddenly slow. The patient’s heart rate drops from his baseline of 170 to 65 to zero. Your heart rate doubles as you initiate CPR.

What caused this child's seemingly primary cardiac arrest? Was the dose of local anesthetic appropriate? Is this delayed local anesthetic toxicity (LAST) or intrathecal injection? Should resuscitation medications be altered if you suspect LAST? Is their evidence to support improved outcomes with regional techniques vs. local infiltration? The NICU team arrives 20 minutes into the resuscitation and suggest stopping CPR – how do you approach this situation?

Discussion Outline

A 4 kg, 3 month old, former 27 week premature infant, is scheduled for bilateral inguinal hernia repair prior to his pending discharge next week. He was “Twin A” of a gestation complicated by preterm labor and his twin died at 1 month of age from “respiratory complications”. He has a history of chronic lung disease and a patent ductus arteriosus that was closed surgically at one week of life. At that time, he underwent an uneventful general anesthetic.

1. A resident is assigned to this case with you. What can you teach her about the anesthetic risks for this premature infant versus a term infant having the same procedure? If there are increased risks, what are they? Are these anecdotal or supported by evidence?
2. If this patient was 6 months old (51 weeks PCA) and an outpatient, would you schedule them for day surgery? Would anything in the pre-operative assessment increase or decrease the risk for post-operative apnea? Does your hospital or anesthesia group have an absolute cut-off for PCA for when a former premature infant can have outpatient surgery? Term infants? Is the policy in writing or “understood” between providers?

You and the resident discuss and formulate an anesthetic plan. In the neonatal intensive care unit, you meet the parents and obtain informed consent for general anesthesia with a caudal for post-operative pain control. You note in the history that the patient’s twin died at one month of age from “respiratory complications” and the father is a pediatric pulmonologist at the institution.

1. Does performing a caudal with GA decrease the risk of post-operative apnea versus GA with local? Does a caudal provide superior analgesia vs. local infiltration in IHR? What about abdominal wall block vs. caudal vs. local infiltration? What if the surgery scheduled was a circumcision? Do the benefits of regional anesthesia outweigh the risks they add? What about the benefit of resident or fellow education when adding regional techniques?
2. The father asks if it’s possible to avoid general anesthesia as he’s concerned about neurotoxicity. Is a subarachnoid block a reasonable approach? In what circumstances? Does it decrease the risk for post-op apnea versus your

previous anesthetic plan? Did you include neurotoxicity as a risk of anesthesia in your informed consent? Is your discussion about anesthetics risks shaped at all by the death of the twin? By the fact the father is a physician?

The next day, the patient is transported to the OR for his surgery. He undergoes an uneventful combined induction with sevoflurane and propofol via a 24g PIV, is intubated, and placed on the ventilator with 30% FIO₂ and is maintained with 1.5% Sevoflurane. Your resident is about to place the caudal with the dosing you discussed the previous day.

1. What local anesthetic do you use – Bupivacaine or Ropivacaine? Do you routinely use a test dose – how much? What dose of Bupivacaine do you use for this patient? If you decrease the dose based on age, at what age is the dose normalized? What is the rationale for this strategy? Are there other things that may predispose to local anesthetic toxicity (LAST) besides age? What about dosage for an epidural infusion in neonates vs. older children?
2. What additives do you use? Which are “approved” or “safe”? How much does the addition of clonidine prolong post-operative analgesia? Does it increase the incidence of hypotension?

The caudal was placed without difficulty with negative aspiration. One minute after a negative test dose of 1 ml of bupivacaine 0.25% with epinephrine 1:200,000, 3 ml of 0.25% bupivacaine with epinephrine was injected. Twenty minutes later as the surgeon is about to make incision, you hear the EKG suddenly slow from a heart rate of 170 to 60 to zero. There is asystole.

1. What is your differential diagnosis? Does the timing of the event change what you're thinking?
2. You immediately begin CPR. What dose of epinephrine do you use? Does your dose change if you are suspecting LAST? Why? Do you begin intralipid? At what dose?
3. You continue resuscitation after calling for help. A central venous line is placed and you have administered multiple doses of epinephrine 5-10 mcg/kg and intralipid 1.5 ml/kg which was repeated 10 minutes later. There is still no spontaneous return of circulation and asystole continues. What is the best marker that your CPR is effective?

Twenty minutes into the resuscitation, the NICU team arrives and requests that the father (who has been informed of the situation by the surgeon) comes into the room to observe as part of their policy for parental presence during resuscitation.

1. What is your response? Is this part of the patient and family centered approach at your institution?

2. 30 minutes into the resuscitation, and asystole has progressed to PEA, the NICU Attending suggests that CPR is stopped. What do you do? Are there any other studies you'd like to perform before making that decision?

A transthoracic echo showed adequate volume status with normal sized ventricles and severe bradycardia. After 35 minutes of CPR, resulting in a consistent ETCO₂ tracing, intermittent epinephrine administration, and an intralipid infusion at 0.25 ml/kg/min, spontaneous return of circulation occurs with sinus tachycardia and a heart rate of 190. The patient is transported to the NICU intubated and in stable condition.

That night you are emergently called to the NICU to intubate the same patient. When you arrive, you learn the NICU team extubated the patient as he was "doing great" and he later had increasing apneic spells. They had been attempting to intubate him for the last hour and then called you.

1. Who is called for difficult pediatric intubations in your institution? Do you want any other airway equipment available in this situation?

The patient is eventually discharged home and doing well. 2 months later, he returns to the ER with an incarcerated inguinal hernia... What is your anesthetic plan????

Discussion

One of the most common regional blocks used in children is the single-shot caudal. Despite its widespread use and relative safety, complications may occur. In this report, we describe a 3-month-old infant who presented for inguinal hernia repair, received a caudal, and subsequently had cardiac arrest.

Neonates and former premature infants present unique challenges to anesthesiologists, even when presenting for minor surgeries. Although certain regional techniques, including caudals and abdominal wall blocks, are commonly used for post-operative pain control in this patient population, it is controversial whether or not these techniques are superior to local infiltration when general anesthesia is employed. The risk of neurotoxicity with general anesthesia in this population is an even greater controversy and has the potential to change the future of pediatric anesthesia dramatically.

The incidence of local anesthetic toxicity in children is rare. However, when toxicity does occur, its effects can be severe. It has been noted that children less than four months of age are at greater risk of local anesthetic systemic toxicity (LAST); compared to older children and adults, infants display decreased clearance of amide anesthetics. Also, neonates exhibit increased levels of unbound, active drug due to decreased plasma concentrations of alpha acid glycoprotein. Detecting an intravascular injection of local anesthetic in anesthetized infants and children can be difficult. Seizures may not be seen,

the test dose may be unreliable, and the first sign of toxicity may be dysrhythmias or even cardiac arrest. While most symptoms of toxicity will occur within 5 minutes of an injection, up to 25% of symptoms occur after 5 minutes. We concluded LAST was the most likely cause of cardiac arrest. We present this case to relate our experience with both a delayed presentation of LAST and a delayed response to rescue therapy.

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