Chapter 19
Local Anesthetic Systemic Toxicity (Pediatric)

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Case Outline

Learning Objectives

1. Discuss indications for suspicion of local anesthetic systemic toxicity (LAST).
2. Review management of LAST.

Simulator Environment

1. Location: post-anesthesia care unit (PACU) of a children's hospital.
2. Manikin setup:
   (a) Age: infant.
   (b) Lines: 1 x 24 Gauge (G) peripheral intravenous (PIV) catheter
   (c) Monitors: non-invasive blood pressure (NIBP) cuff, 3-lead electrocardiogram (EKG), pulse oximeter
3. Medications available: normal saline, propofol, etomidate, succinylcholine, rocuronium, epinephrine, albuterol, fentanyl, midazolam, intralipid.

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4. Equipment available:
   (a) Airway equipment: ventilator, face mask, laryngoscope and cuffed and uncuffed endotracheal tubes (ETTs) of various sizes, stylets, oral airway, nasal trumpet, laryngeal mask airway (LMA), suction.
   (b) Monitors: pulse oximeter, blood pressure cuff, 3-lead EKG.
   (c) Crash cart with defibrillator

Actors

1. PACU nurse
   (a) The PACU nurse is helpful and very concerned about the patient's cyanosis.
2. Anesthesiologist who did the case
   (a) The anesthesiologist who took care of the child in the operating room and who performed the caudal block is busy in the operating room taking care of another child now. They give a quick sign-out but are unable to come to help.

Case Narrative

1. Scenario background given to participants:
   (a) The patient is a healthy, ex-38-weeker, 6-month-old boy, 7 kg who just underwent a circumcision and arrived in PACU 30 minutes ago. The nurse paged the anesthesiologist on-call because the patient seems to be shivering a lot and looks a little cyanotic.
2. Scenario development
   (a) Phase 1: evaluation for shivering
      (i) The learner should go to evaluate the baby at bedside. The patient covered up in blankets and will be shivering and have perioral cyanosis. Vital signs show tachycardia heart rate (HR) 130 s, blood pressure (BP) 70s/40s, oxygen saturation (SpO_2) 80s%, high respiratory rate (RR).
      (ii) The learner should check a temperature to rule out hypothermia and should uncover the baby to perform a thorough physical exam.
      (iii) The learner should gather more information from the nurse, including administration of recent medications. On physical exam, the learner/nurse should notice that there is a Band-Aid over the patient's back and start to think of a caudal block that was not reported in sign-out.
      (iv) The learner should try to call the anesthesiologist who did the case, and they will learn that the anesthetic went fine except that they did a caudal block at the beginning of the case and it didn't seem to work well. The patient ended up receiving fentanyl 2 mcg/kg, acetaminophen 15 mg/kg IV, and the surgeon performed a penile block.

(v) While performing this history and physical exam, the learner should provide supportive care including administering supplemental oxygen (simple face mask, bag mask ventilation). For suspicion of seizure, the learner may consider administering midazolam 0.1 mg/kg.

(b) Phase 2: treatment of LAST

(i) The learner should treat with intralipid: bolus 1.5 cc/kg and infusion 0.25 cc/kg/min.

(ii) The learner may consider intubating the patient.

Scoring Rubric

Table 19.1 Scoring rubric for case scenario on Pediatric Local Anesthetic Systemic Toxicity (LAST)

Topic: Pediatric Local Anesthetic Systemic Toxicity		
Participant Name:		
Evaluator Name:		
Score:		
	Completed	Not Completed
Shivering		
Go to evaluate patient at bedside		
Obtain recent set of vital signs		
Check rectal temperature for highest accuracy		
Uncover baby for physical exam		
Obtain history: Recent medication administration in post-anesthesia care unit (PACU), intraoperative course and any complications		
Provide supportive care: Supplemental oxygen		
For suspected seizure, administer midazolam 0.1 mg/kg		
Identify local anesthetic systemic toxicity from intraoperative caudal block as etiology of "shivering"		
May administer meperidine 0.25 mg/kg for "shivering" while performing assessment		
Local anesthetic systemic toxicity		
Call for help		
Provide supplemental oxygen (nasal cannula, simple face mask, bag-valve mask, re-intubation)		
Identify respiratory distress due to local anesthetic systemic toxicity (LAST) and seizure		
Re-intubate in a timely fashion		
Call pharmacy for Intralipid		
Administer Intralipid 1.5 cc/kg bolus over 10–15 minutes and Intralipid 0.25 cc/kg/min as infusion		
Provide hemodynamic support (ephedrine, caution with epinephrine dosing, dopamine)		

Summary of Clinical Teaching Points

How does local anesthetic toxicity (LAST) occur? [1, 2]

- Etiology:
  - Unintended intravascular injection

    Symptoms typically present within the first 5 minutes
  - Absorption from peripheral tissue or epidural injection
- Extent of absorption depends on route and site of injection
  - Blood/intravenous > tracheal > intercostal > caudal > epidural > brachial plexus > sciatic > subcutaneous
  - BICEPS
- Risk factors
  - Extremes of age
  - Cardiac disease
  - Hepatic dysfunction
  - Hypoxemia
  - Acidosis
- Generally central nervous system toxicity will occur before cardiac toxicity

What are the central nervous system (CNS) features of LAST? [1, 2]

- Initial excitatory phase: perioral numbness and tingling, shivering, muscle tremors, tonic-clonic seizures
- Eventual depressant phase: coma, hypoventilation, respiratory arrest

What are the cardiac features of LAST? [1, 2]

- Initial excitatory phase: tachycardia, hypertension
- Direct cardiac toxicity: arrhythmias, decreased contractility, electrical conduction delay
  - Inhibition of sodium, potassium, and calcium channels
  - Prolonged PR and QRS intervals
  - Depression of SA and AV nodes
  - Prolonged QT
  - Ventricular tachycardia, ventricular fibrillation, Torsades
- Bupivacaine is the most arrhythmogenic. It binds tightly to myocyte sodium channels. Of the local anesthetics, it is most refractory or resuscitation. Severe LAST due to bupivacaine may require cardiopulmonary bypass.

What are special considerations for performing Advanced Cardiac Life Support (ACLS) in LAST? [1, 2]

- Treat seizures as soon as possible with benzodiazepines
- Prioritize oxygenation and ventilation to avoid acidosis
- Administer Intralipid early
- Use lower dose epinephrine 1 mcg/kg (versus the full code dose of 10 mcg/kg)
- Avoid vasopressin, beta blockers, calcium channel blockers, or additional local anesthetics
- Consider mobilizing resources for extra-corporeal membrane oxygenation (ECMO) / cardiopulmonary bypass if necessary

References

1. Wolfe JW, Butterworth JF. Local anesthetic systemic toxicity: update on mechanisms and treatment. Curr Opin Anaesthesiol. 2011;24(5):561–6.
2. Lonnqvist P. Toxicity of local anesthetic drugs: a pediatric perspective. Pediatr Anesth. 2011;22(1):39–43.