

# Local Anesthetic Systemic Toxicity (LAST)

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A nine-year-old, 35 kg boy presents for an open reduction and internal fixation of a right lateral condyle fracture. The patient has a past medical history of headaches presenting with nausea and vomiting. The main provoking factor is anxiety. The alleviating factors for the headaches are bed rest and caffeine. The parents provide consent for general anesthesia with regional anesthesia for pain management. He complains of a headache that seems to improve after intravenous midazolam is given. He is positioned for an ultrasound-guided supraclavicular block. Following negative aspiration, 10 mL of 0.5% ropivacaine is injected. He is resting comfortably in the holding area. After 30 minutes, the patient complains that his headache has returned and he begins to feel nauseous. He begins stuttering and cannot formulate sentences and begins to seize prior to entering the operating room.

intravascular injection of local anesthetic. However, even the correct placement of anesthetic can cause systemic toxicity. Factors that affect LAST include: concurrent medications, patient risk factors, location and technique of the block, total anesthetic dose, timeliness of detection, and adequacy of treatment.

## What Is the Incidence of LAST?

The location of the block is a significant risk factor for patients developing LAST. Supraclavicular and interscalene blocks have shown an incidence of 79 of 10,000 patients developing LAST symptoms in one institution. LAST is more likely to occur in infants compared to adults because of the infant's low protein binding and low intrinsic clearance of local anesthetics. As most infants and children have blocks performed under general anesthesia, the central nervous system manifestations of LAST, such as seizures, are not seen as commonly.

## What Is the Differential Diagnosis?

It is important to differentiate this patient's migraine from local anesthetic toxicity. The patient began having headaches that seemed to reflect his past medical history of having terrible migraines. Although the needle aspiration was negative upon placement of the supraclavicular block and a significant amount of time had passed prior to the onset of symptoms, local anesthetic toxicity cannot be ruled out. The patient has a past medical history that confounds the diagnosis even under direct ultrasound guidance and visualization.

## What Is Local Anesthetic Systemic Toxicity (LAST) and When Does It Occur?

LAST can occur in any patient at any location of local anesthetic placement. Pregnant patients, young patients, and patients with preexisting hypoxia and/or respiratory acidosis are at highest risk for developing LAST. LAST most commonly occurs during an

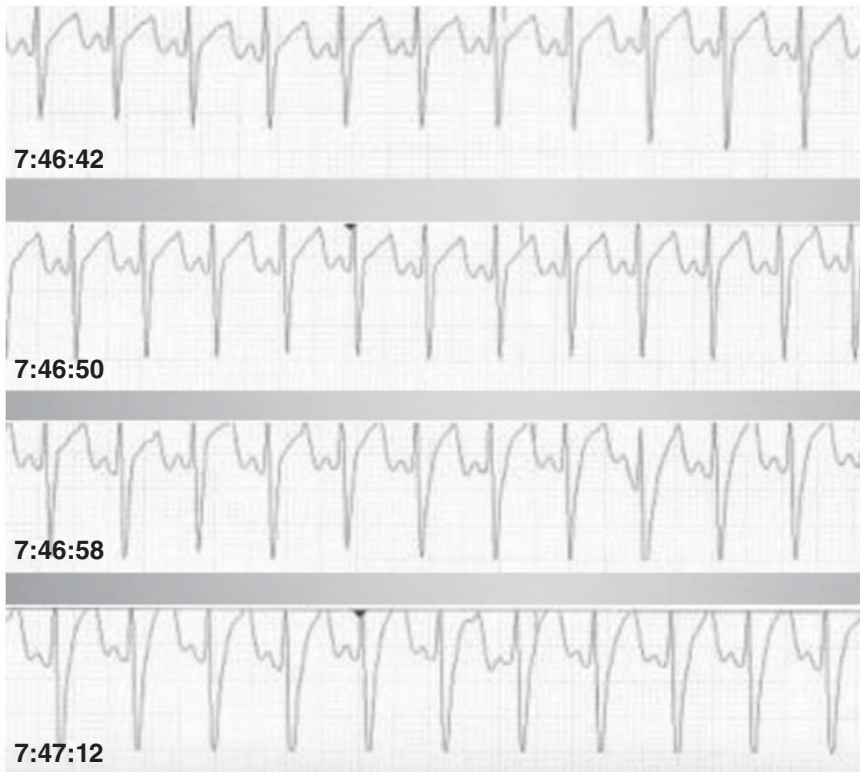
## What Are the Signs/Symptoms of LAST?

LAST has a classical presentation of central nervous system (CNS) disturbance. Auditory changes, circumoral numbness, metallic taste, agitation, and seizures are common presentations. This can progress to abrupt onset of psychiatric symptoms, drowsiness, respiratory arrest, and coma. Cardiac manifestations do not commonly occur prior to CNS manifestations. Typical cardiac manifestations are: hypertension, tachycardia, and ventricular arrhythmias. This can progress to bradycardia, conduction block, asystole, and cardiac arrest. Intravascular injections will cause a quicker onset of symptoms. However, onset of symptoms can occur from five minutes post injection to hours post injection. The danger of LAST occurring hours post anesthetic injection is that typically the patient is in a non-monitored area or perhaps even home. Forty percent of LAST symptoms have atypical presentation, such as delayed onset or cardiac issues prior to CNS manifestations.

Baseline ECG:



Immediately after block:



**Figure 54.1** Electrocardiography changes associated with intravascular injection of local anesthetic. Images courtesy of Kathleen Chen, MD

However, under anesthesia (e.g., caudal blocks) cardiac manifestations are often the first indication of LAST, and it is important to observe and document ECG changes after local anesthetic administration.

### **Immediately after Performing a Caudal Block on an Anesthetized Child, the ECG Appearance Changes as Follows. What Are the ECG Manifestations of LAST?**

A “peaked T wave” or T wave amplitude increase as well as widening of the QRS complex is seen in this ECG (Figure 54.1). This should raise suspicion for LAST,

especially in the anesthetized patient. Peaked T waves has been described after a test dose of local anesthetic with epinephrine but local anesthetic alone in toxic doses has also been reported to cause the same ECG changes. A study of bupivacaine infusion in pigs has shown that slower injection of bupivacaine can identify T wave elevation sooner compared to a fast injection of toxic doses. This supports the idea of incremental injection of local anesthetic during administration.

### **How Do You Prevent LAST?**

- Use the lowest effective dose for local anesthetic delivery

- Inject small amounts incrementally and aspirate frequently
- Use epinephrine (0.5 mcg/kg) in local anesthetic injection. T wave elevations or a systolic blood pressure greater than or equal to 15 mmHg in systolic blood pressure is an indicator of possible vascular involvement with potential for toxicity.
- Although ultrasound guidance would seemingly help decrease LAST, its use hasn't appreciably lowered the incidence of this complication
- Patients under four months of age, >70 years of age, and those with cardiac ischemic disease should receive lower doses

## How Do You Treat LAST?

Control of the airway is of utmost priority and has been shown to prevent hypoxia and acidosis, and halt seizures and cardiac manifestations.

To treat for seizures, administer a benzodiazepine. It is prudent to avoid propofol, if possible, in patients with LAST, especially if the patient displays cardiac manifestations. Alert the nearest facility to have cardio-pulmonary bypass available. Begin advanced cardiac life support/basic life support (ACLS/BLS) with avoidance of local anesthetics, vasopressin, calcium channel blockers, and beta-blockers. Reduce epinephrine dosage to less than 1 mcg/kg because larger doses of epinephrine can impair resuscitation in patients with LAST. Administer lipid emulsion therapy with 1.5 mg/kg IV over one minute, followed by a lipid emulsion infusion of 0.25 mg/kg/min. Repeat the bolus once or twice for persistent cardiopulmonary failure and double the infusion rate to 0.5 mg/kg/min. After cardiac stability has been achieved, continue the infusion for another 10 minutes. Continue to monitor the patient for a prolonged amount of time for further cardiopulmonary depression and recurrence.

## Suggested Reading

Neal JM, Bernards CM, Butterworth JF 4th, et al. ASRA practice advisory on local anesthetic systemic toxicity.

*Reg Anesth Pain Med.* 2010;35 (2):152–61. PMID: 20216033.

Weinberg GL. Lipid emulsion infusion: resuscitation for local anesthetic and other drug overdose. *Anesthesiology.* 2012;117:180–7. PMID: 22627464.

Weinberg GL. Treatment of local anesthetic systemic toxicity (LAST). *Reg Anesth Pain Med.* 2010;35:188–93. PMID: 20216036.