Anesthesia Quality Institute®
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Anesthesia Incident Reporting System (AIRS)

Case 2023-02: When Is Too Much Enough?

Patient was an infant (1-3 years), approx 10 kg. Pt presented to the operating room for bilateral syndactyly repair. After the induction of general anesthesia, the plastic surgery resident infiltrated the right hand, left hand, and left groin with lidocaine 1% for a total of 16 mL (160 mg). Fifteen minutes later, the attending plastic surgeon infiltrated the left hand with lidocaine 1% with epinephrine for a total of 7 mL (70 mg). In both circumstances, the surgical technician confirmed with the surgeon the request for lidocaine 1%. The anesthetic and surgical courses were uneventful and no signs of local anesthetic toxicity were detected.

The maximum recommended dose of lidocaine for local infiltration without or with epinephrine is 4.5-5 mg/kg (the actual dose differed depending on the source) and 7 mg/kg, respectively. In this patient who weighs 10 kg that would be 45 mg (4.5 mL)-50 mg (5.0 mL) without epinephrine and 70 mg (7.0 mL) with epinephrine. The initial infiltrative amount of 16 mL was a significant (~3.5 times the maximum recommended dose) overdose of local anesthetic. The second dose of 7 mL is an appropriate dose, but it was given only 15 minutes after the initial overdose. At no time was the maximum recommended dose discussed with the anesthesia team.

This incident report highlights a true near miss. The patient's total dose of lidocaine far exceeded published recommended maximum dose guidelines, and it was fortunate that the patient did not manifest any signs of local anesthetic systemic toxicity (LAST). LAST is a life-threatening complication that has been recognized for many years, dating back to 1891, with the use of cocaine. In 1928, the AMA reported 40 deaths presumably attributable to local anesthetics (LA). The seminal moment in recognizing the seriousness of LAST came in 1979 when Albright highlighted the relationship between LA lipophilicity and cardiac arrest, especially when accidentally injected intravascularly.

Since then, much has been studied and published on LAST, but unfortunately these events continue to occur. The exact incidence of LAST events ranges anywhere from approximately 0.87 to 2.6 events per 1,000 blocks. Early reports involved primarily epidural and brachial plexus blocks, but as surgical and anesthesia techniques have progressed, so have the opportunities for LAST. The Pediatric Regional Anesthesia Network (PRAN) database indicates that the incidence of LAST is much higher in central neuraxial (caudal and epidural) blocks than in peripheral blocks, with most incidents occurring in infants. Other literature seems to show an increase in the incidence of LAST in penile blocks and with local infiltration, as described in this incident report. There are more incidents of LAST being reported with the use of continuous indwelling catheters in a number of blocks. Finally, newer reports show an increasing number of reports with oral, mucosal, and submucosal application of local anesthetics or with local anesthetics in gel form.

This entry was written by Dr. Tetsu Uejima on behalf of the AIRS Committee.

Preventative Measures:

1. Determine what local anesthetic will be used and in what concentration. Agree upon a maximum volume.
2. All local anesthetics being introduced onto the surgical field should be double-checked, and all teams (nursing, surgery, and anesthesia) should verify the dose.
3. Use the lowest effective dose (concentration x volume).
4. Use ultrasound guidance when possible.
5. Use a marker of intravascular injection, especially in blocks in which ultrasound is not used.
6. Administer local anesthetic doses in smaller aliquots.
7. Aspirate before each aliquot.
8. Always know where the intralipid is located and pre-calculate the dose to save time should an emergency occur.

Traditionally, LAST most often occurred during or immediately after the performance of a block. The use of continuous nerve catheters can delay the time of onset of LAST. Since many patients may be discharged with a continuous nerve catheter, patients and families should be educated on the early signs and symptoms of LAST. Approximately 80% of LAST incidents occur in hospitals, with the remainder occurring in offices, emergency rooms, and at home. Anesthesia personnel are involved with about 60% of cases; the rest of the cases are spread across many providers in emergency medicine, pediatrics, cardiology, dentistry, and dermatology.

Hypoxia and metabolic acidosis have long been recognized as risk factors for LAST. Other risk factors have now been identified and include extremes of age, small patient size, reduced plasma protein levels, presence of heart disease, mitochondria dysfunction, liver or kidney disease, and concomitant use of certain drugs (beta-blockers, digoxin, calcium channel blockers, cytochrome P450 inhibitors). On the other hand, increasing use of ultrasound-guided regional anesthesia has decreased the likelihood of an inadvertent intravascular injection of LA. Furthermore, studies have demonstrated that less local anesthetic may be used with more precise ultrasound-guided precision.

This report states there was communication between the surgical tech and the surgeon; however, it is not known whether the anesthesia team was aware of the total amount of lidocaine injected by the surgical team. Most of the recommendations in the anesthesia literature focus upon how anesthesiologists might prevent LAST. In this case, however, the local anesthetic was administered by the surgical team.

Prevention of intraoperative LAST should be considered a team effort, with nursing, surgical, and anesthetic teams all playing a role, especially when the LA is to be injected by the surgeon. While we might not expect OR nursing personnel to be aware of maximum dose guidelines for all the local anesthetics, it would be reasonable for the entire team to be aware of which local anesthetic the surgeon was planning to use and to agree upon a maximum volume that can be administered. This could be performed during a preoperative huddle or the surgical time out. For anesthesia teams performing blocks, one might consider a parallel process with verification occurring during the block time out.

In situations in which the surgeon is injecting the local anesthetic, the circulating nurse should clearly identify the local anesthetic and the concentration of the local anesthetic being handed to the scrub tech. The scrub tech should, in turn, verbally communicate to the surgeon and the anesthesia team the local anesthetic as well as its concentration. All team members should concur that the volume to be injected is below the maximum recommended dose before it is administered.

There may also be a misconception among our surgical colleagues that higher concentrations of local anesthetics result in "better" and longer postoperative analgesia. For example, there is little evidence to support using 0.5% bupivacaine over 0.25% bupivacaine when locally infiltrated for postoperative analgesia. In many of these situations, especially in small patients or in children, lower concentrations allow for higher volumes that may improve efficacy.

What about liposomal bupivacaine (LP)? LB was first approved by the FDA in 2011 initially for direct injection into a surgical site, but its usage has expanded since that time. Very little of the drug is present as free drug, and the analgesic effects may persist for days. As such, patients may be at risk for LAST during that period. Injection of any non-bupivacaine local anesthetic with 20 minutes of the administration LB may result in a sudden release of LB with the potential for LAST. This may occur, for example, if a surgeon injects lidocaine along with the LB in order to improve the speed of onset of analgesia.

Everyone in the OR should know where the intralipid is stored. While it may not be practical to have it in the OR for every block, one could consider doing so during nights and weekends when support staff may be limited. Simulations of LAST events should always be conducted on a regular basis. ■

Bibliography:

1. Mattison JB. Cocaine poisoning. *Med Surg Rep* 189: 115:645-650.
2. Albright GA. Cardiac arrest following regional anesthesia with etidocaine or bupivacaine. *Anesthesiology* 1979, 51:285-287.
3. Weinberg G, Rupnik B, Aggarwal N et al. Local anesthetic toxicity (LAST) revisited: a paradigm in evolution. APSF Newsletter February 2020.
4. Neal JM, Bdernards CM, Butterworth JF et al. ASRA Practice advisory on local anesthetic systemic toxicity. *Reg Anesth Pain Med.* 2012:37(1):16-18.
5. Dickerson DM and Apfelbaum JL. Local anesthetic systemic toxicity. *Aesthetic Surg J* 2014, 34(7):1111-1119.
6. Walker BJ, Long JB, Sathyamoorthy M et al. Complications in pediatric regional anesthesia: An analysis of more than 100,000 blocks from the pediatric regional anesthesia network. *Anesthesiology* 2018, 129:721-732.

Each month, the AQI-AIRS Steering Committee abstracts a patient history submitted to AIRS and authors a discussion of the safety and human factors challenges involved. Absence of commentary should not be construed as agreement with the clinical decisions described. Reader feedback can be sent to **airs@asahq.org**. Report incidents or download the AIRS mobile app at **www.aqiairs.org.**