

Local Anesthetic Systemic Toxicity

Background

Local anesthetics have many important uses in the perioperative setting. They can be used to perform peripheral nerve blocks, spinals, and epidurals, any of which can be used to reduce postoperative pain. IV lidocaine as an alternative to intraoperative opioids is shown to be associated with earlier return of bowel function, and subsequently earlier discharge¹. They may be used to topicalize the airway to allow for awake fiberoptic intubation (AFOI) in patients with difficult airways. Lidocaine may also be given intravenously as an induction adjunct to blunt the airway response to intubation or may be used as an antiarrhythmic drug. Local anesthetics are an important and helpful class of medications for surgeries and medical procedures; however, they have the potential to harm or even kill patients.

One danger from local anesthetics is their potential to cause local anesthetic systemic toxicity (LAST). This potentially fatal complication can occur through accidental rapid intravascular injection of local anesthetics exceeding the maximum recommended dose, rapid absorption of local anesthetics after injection into a highly vascular site, or an overdosing of local anesthetics. The resulting toxic levels of intravascular local anesthetics lead to excitatory symptoms in the central nervous system (CNS), including sensory and vision changes, muscle excitation, and seizure activity². These CNS manifestations are most often the first symptoms of LAST to appear. LAST may also cause cardiac toxicity with conduction disturbances, myocardial dysfunction, and lability of peripheral vascular tone, and ultimately, cardiac arrest². It is relatively uncommon for doses above the toxic dose to be administered, as it has an estimated incidence of approximately 0.03%³. Although rare, the neuro and cardiovascular toxicities are potentially fatal and can be difficult to identify in an operating room setting.

The Problem

The workflow in the perioperative space at Michigan Medicine is not optimized for LAST prevention. Multiple different teams carry out procedures requiring local anesthesia in the perioperative space. The anesthesia acute pain service (APS) performs regional blocks in the pre-operative area and epidurals in the preoperative area or operating room. The patient's OR anesthesia team (which is different from the anesthesia APS team) may do airway topicalization for AFOI, may spray local anesthetics on the glottis for intubation, or may give intravenous lidocaine as an anesthetic adjunct for induction in the operating room. The OR anesthesia team might also be responsible for placement of an epidural or spinal in the operating room. Surgeons may perform subcutaneous and intraarticular injection of local anesthetic in the operating room. Thus, there are multiple times and places at which local anesthesia may be administered to a single patient on the day of surgery, and different providers may be using different local anesthetics. The separation in space and time of different providers administering local anesthesia creates barriers to effective communication

between teams. There is a maximum dose of local anesthetic allowed for a given patient based on their weight. Thus, it is imperative that providers communicate about what procedures will be requiring some of the maximum dose of local anesthetic that a given patient can receive to avoid putting them at risk for LAST. Currently, there is no formal mechanism for tracking the local anesthetics given in the perioperative period by these different parties.

Although LAST is uncommon, poor communication regarding maximum dose of local anesthetic and procedures requiring it has led to near misses perioperatively. For example, a patient may require an AFOI, but the attending surgeon is not present for this procedure and the OR anesthesia team is unaware that the surgeon plans to do a subcutaneous injection during the procedure. If the maximum remaining allowable dose is not discussed during the pre-incision time out and the surgeon is unaware that some has already been given for the AFOI. There is a real and preventable risk of LAST.

The Problem : Michigan Medicine

A query of the Centricity database at Michigan Medicine showed no cases of reported local anesthetic systemic toxicity within the timeframe searched (1/1/2004-9/1/2019). However, a query of cases where local anesthetic was used and “seizure-like activity” was reported yielded 12 cases in the timeframe queried (1/1/2004-9/1/2019). Given that there are approximately 50,000 anesthetic cases performed annually at Michigan Medicine, this suggests that LAST occurs in approximately 0.0015% of cases. It is important to recognize that a number of cases of LAST present atypically, with cardiac toxicity in the absence of neurotoxicity, and these cases may not be accounted for within the query described above². Additionally, some of the cases included in the query described above may have had a seizure unrelated to the use of local anesthesia. There may also be cases of LAST that have occurred, but have not been reported in Centricity. As mentioned above, although the occurrence of LAST is low, it is potentially fatal, it can cause case cancellations, as well as near-misses. Near misses are especially likely when multiple teams are administering local anesthetic in multiple locations, and there is no standardized time at which this is discussed before the case.

What is Being Done : Nation-Wide

Prevention requires a multifactorial approach, as there is no single measure that will prevent the occurrence of LAST. There are some basic precautions that should always be taken in order to mitigate the risks of LAST, including ensuring there is access to a secure intravenous line and adequate resuscitation equipment during administration. When large doses of local anesthetic are being used, they should be given in divided doses rather than in one large bolus. The needle or catheter should be gently aspirated before each injection to prevent inadvertent intravascular injection. Vital signs should be monitored both during and after the procedure as there may be a delayed onset of LAST up to *** hours later⁴. Additionally, use of an intravascular marker, such as adrenaline, should be used when high doses are being utilized⁵. It has

also been found that the use of ultrasound for peripheral nerve blocks reduces the risk of local anesthetic systemic toxicity⁶.

What is Being Done : Michigan Medicine

In addition to the measures discussed above, the anesthesiology department at Michigan Medicine has developed a local anesthetic dosing calculator as a support tool for anesthesia providers. This allows easy calculation of the maximum allowable dose of each local anesthetic for a patient based on their weight. This tool is available as a link located on the internal anesthesia home page. In my observation, this website appears to be accessed most commonly in the operating room, just prior to or during the pre-incision time-out, when a discussion of maximum local anesthetic dose sometimes takes place. It is worth noting, however, that discussion of local anesthetic dosing is not a specifically required part of the pre-incision time-out, and thus, it is dependent on providers to include a discussion of local anesthetic dosing at that time. Furthermore, the pre-incision time-out is not an optimal time to discuss local anesthetic maximum dose, as the block team often places blocks in the pre-operative area, prior to the pre-incision time-out in the operating room. Therefore, some percentage of the total allowable dose may have already been administered by the acute pain service, without the knowledge of the rest of the team. It is easy to see how this could be problematic if you are dividing a finite amount of local anesthetic amongst multiple procedures without knowledge of what those other procedures are.

Future Directions : Areas for Improvement

While the above steps are helpful in reducing the risk of LAST, there is still more that can be done on an organizational level to ensure that the risk is minimized. While it is helpful to be aware of and discuss maximum local anesthetic dose during the pre-incision time-out, this conversation occurs after some local anesthetic has been administered and does not usually include the acute pain service, and thus is inadequate as the primary form of communication between teams regarding maximum local anesthetic dose. In order to facilitate better communication regarding local anesthetic use, cases should be formally booked including mention of planned procedures such as regional nerve blocks, neuraxial procedures, intra-articular injections, and possible AFOI. These additional procedures should be documented clearly. This way, all providers are privy to the fact that there are possibly multiple procedures occurring that will require local anesthetic, and that a conversation about maximum dose needs to occur. To optimize the timing of this conversation, ideally there would be some discussion about the procedures requiring local anesthesia, and the maximum dose that is to be divided among them, for a given case prior to the day of surgery. This way, the maximum allowable dose is not reached without knowledge of the other procedures included in the case that require local anesthetic. One possibility is for members of the acute pain service, OR anesthesia team, and surgical team to meet in the preoperative slot with the patient to discuss possible procedures requiring local anesthesia, as well as maximum dose, before any local anesthetic is administered. While this would be ideal for many reasons, including shared decision making with the

patient, it is also somewhat unrealistic. The OR anesthesia team and surgical team are often finishing prior cases and unable to go to the patient's pre-op slot before they would need their block administered, especially in a coordinated manner, which would thereby cause delays. An additional possibility is having some sort of electronic communication between providers, rather than in person. If cases were scheduled with all possible procedures requiring local anesthesia, there could be a system through which cases with multiple procedures requiring local anesthesia are flagged for potential LAST, with the maximum dose included in the flag. Although this is not ideal, it would give providers administering local anesthetic pre-operatively some warning that they should not administer the maximum allowable dose. The OR anesthesia team and the surgical team could then discuss the amount of local anesthesia administered preoperatively and the maximum allowable dose remaining during the pre-incision time-out.

Citations

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