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Local Anesthetic Systemic Toxicity Management: An Assessment of Simulation-Based Staff Education

Kevin L. Kanallakan
Southern Illinois University Edwardsville

Executive Summary

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Introduction of the Problem

Local anesthetic systemic toxicity (LAST) is a rare but life-threatening event that may occur with regional anesthesia. With the utilization of ultrasound guidance, the rate of accidental intravenous (IV) or arterial administration of local anesthetics is less (Collins, Neubrander, Vorst, & Sheffield, 2015). The estimated prevalence of LAST ranges from 7.5 to 20 per 10,000 peripheral nerve blocks and 4 per 10,000 epidurals placed in adults (Manavi, 2010). Providers must remain current on best practice management through evidenced-based research and education. Caregivers throughout the perioperative continuum must understand how to manage a LAST crisis. Many failures in care do not arise from lack of knowledge but from lack of experiences. Simulation-based LAST education has the potential to enhance perioperative staff preparedness to ensure better outcomes and increase patient safety.

This project was hosted by a tertiary care center in central Illinois. At the time of initiation the institution lacked staff education on LAST. A LAST had occurred within the previous year, which made LAST preparedness an important topic. LAST is a low incidence, high mortality event; therefore, staff need regular education and drills to safely care for patients.

Literature Review

There are many highly lipophilic local anesthetics that can create toxicity. Bupivacaine, a popular local anesthetic, was a common theme among reported LAST events in the literature reviewed. Toxic plasma concentrations of local anesthetics can occur due to accidental

intravenous injection or uptake of the drug into circulation through absorption (Ciechanowicz & Patil, 2012). Certain areas of the body, which are highly vascularized, are prone to rapid uptake through absorption. The rate of systemic absorption is related to the vascularity of the site of injection: intravenous or intra-arterial > tracheal > intercostal > paracervical > epidural > brachial plexus > sciatic > subcutaneous (Butterworth, Mackey, & Wasnick, 2013).

Intralipid emulsion was discovered as a treatment for LAST based on findings from Dr. Weinberg in 1998 (Weinberg, VadeBoncouer, Ramaraju, Garcia-Amaro, & Cwik, 1998). In 2006 the first successful case report on lipid emulsion therapy was produced by Dr. Rosenblatt (Rosenblatt, Abel, Fischer, Itzkovich, & Eisenkraft, 2006). LAST may not be replicated on human subjects due to the unethical nature. Information gathered to support the success rate of intralipid therapy has been through animal trials and case reports. The American Society of Regional Anesthesia supports the use of lipid emulsion for the treatment of LAST using the following regimen: 20% lipid emulsion bolus at 1.5 ml/kg followed by a continuous infusion at a rate of 0.25 ml/kg/min (Neil et al., 2012). The bolus of lipids may be repeated one or two more times if cardiovascular collapse continues and the rate of the infusion may be doubled to 0.5 ml/kg/min if blood pressure is inadequate. The lipid infusion should be continued for a minimum of 10 min after the patient stabilizes.

Incorporating lipid emulsion rescue therapy with simulation may improve the preparedness of the anesthesia provider and perioperative staff during a LAST event. Simulation has been utilized as a standard teaching and developmental learning tool in several other professions, such as aviation, aeronautics, military, and nuclear engineering (Lim & McIvor, 2015). Anesthesia has adopted simulation to aid in learning and further increase skills without practicing on patients (Castanelli, 2009). The purpose of using simulation as a learning tool is to

mimic clinical experiences as closely as possible (Rauen, 2004). The use of simulation may increase the healthcare provider's confidence, knowledge, and critical thinking skills. Simulation is also an important evaluation tool to measure a provider's competence (Scalese, Obeso, & Issenberg, 2008).

Project Methods

This project had a non-experimental study design. Simulations took place in the OR, PICU, and Adult ICU. The hospital staff included in the sample received a 20-minute educational presentation on local anesthetic systemic toxicity (LAST) followed by participating in a high-fidelity simulation. A total of 61 providers including nurse anesthetists, nurses, support staff, student nurses, and nurse anesthesia students participated in this project.

The Institutional Review Board at Southern Illinois University Edwardsville granted approval to proceed with this project on June 8th, 2017. Also on this date, the Institutional Review Board deemed the protocol exempt from further review. The Hospital's Research Review Committee also deemed the project acceptable.

Following the LAST education and simulation exercises a post-test questionnaire consisting of six questions was distributed. Providers participating in the survey had the ability to leave open-ended comments about their experiences during the education and simulation exercises. This project was evaluated through the use of the aforementioned survey.

Evaluation

This quality improvement project had several limitations. The first limitation was the lack of anesthesia providers in attendance for the simulation exercises. Anesthesia providers are often the first to recognize LAST and their presence at the drills would have made them more realistic. Nurses were the most abundant in attendance, followed by support staff. The second

limitation was related to survey completion. The majority of surveys were complete; however, some of the participants failed to answer every question on the survey. The third limitation was the difficulty in conducting the simulations in different areas of the hospital. The drills that took place in the OR were well attended by large groups who came to a room that had previously been set up. A valiant effort was made to transport the equipment and simulator mannequin to other units in the hospital to provide training to a wider population. This was by far the biggest flaw in the project. The heavy equipment was cumbersome and required at least two people to transport. Another important issue was coordinating the drill schedules with busy inpatient units. If the unit was experiencing high census, the drill was abandoned due to lack of staff available for the education.

After implementation of LAST education and the simulation exercises the majority of the participants provided positive feedback. Most of the sample group felt the simulation drill increased their knowledge on LAST management (N=59). The majority of participants also felt they were more prepared to manage or assist in the care of the patient experiencing LAST (N=55). An astonishing number of participants would recommend incorporating LAST simulation as an annual educational event (N=58). The group primarily had little experience with high-fidelity simulation (N=40). Surprisingly, the number of individuals that recorded they participated in the assigned LAST computer-based learning module on Heathstream was lower than expected (N=37).

Impact On Practice

With every local anesthetic administered, there is always the risk of LAST. This project immediately made a positive impact on practice at this institution. The data gathered from the questionnaire indicated that this project was successful in teaching the participants how to

diagnose and properly manage a LAST. Following the project this institution will adopt LAST education into their annual continuing education, positively impacting the staff long term on this topic.

This project can definitely be replicated due the fact that LAST education and treatment is standardized. LAST education should be taught in every medical facility that utilizes local anesthetics. The simulation portion of this project could be replicated as well. This project specifically used high-fidelity simulation. Seeing the limitations of using a high-fidelity simulator may prompt others to structure their project differently. As for those without a high-fidelity simulator, low-fidelity simulation is a great alternative

Conclusion

This project evaluated the effectiveness of high fidelity simulation-based education for the management of LAST. This project's findings suggested the use of simulation-based education increased overall knowledge for the participants involved, as well as made them more prepared to manage and assist in the care of the patient experiencing LAST. Ninety seven percent of the participants agreed that simulation education for the management of LAST should be recommended as an annual education event, this finding verified staff felt this project was warranted and meaningful.

Author Contact Information
Kevin Kanallakan
kekanal@siue.edu
klkanallakan@hotmail.com