IMPROVING KNOWLEDGE, RECOGNITION, AND MANAGEMENT OF LOCAL ANESTHETIC SYSTEMIC TOXICITY (LAST) IN LABOR AND DELIVERY NURSES

Sheena Brooke Hilton

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Approved by:

Terry C. Wicks, DNP, CRNA	Project Team Leader
Wanda Williams, PHD, MSN, WHNP-BC, CNE	DNP Program Director

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Dedication and Acknowledgements

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Abstract

Background: Local anesthetic systemic toxicity (LAST) is a high-impact, low-occurrence complication of administering local anesthesia, which can potentially be lethal to the patient if not recognized quickly. **Purpose:** This DNP project aims to provide education and increase awareness and proficiency in early recognition and management of a LAST event, specifically in labor and delivery nurses. **Methods:** A mixed-method design, including quantitative and qualitative methods. A quantitative method was used to evaluate recognition, knowledge, and confidence levels, and a qualitative method allows for an improved understanding of barriers to practice. Data were grouped into two categories. Group A comprised the entire sample of participants who completed the pre-intervention survey (n=22). Group B comprised the entire sample of participants who completed the post-intervention survey (n=22). Each group underwent statistical analysis using a two-sample T-test to determine statistical significance. **Results:** The average mean scores for knowledge and confidence increased across all categories. The education provided will be included in the annual competency training and orientation program for L&D nurses at this facility. **Recommendations and Conclusions:** It is recommended that LAST training be incorporated into the annual continuing education program. The results of this project have shown that knowledge and confidence improved for the L&D registered nurse.

"Key Words" Local Anesthetic Systemic Toxicity simulation, Local Anesthetic Systemic Toxicity in Labor and Delivery, Local Anesthetic Systemic Toxicity education.

Background and Significance

Local anesthetic systemic toxicity (LAST) is a high-impact, low-occurrence complication of administering local anesthesia. The complication results from increased local anesthetic plasma concentrations leading to seizures, loss of consciousness, or cardiac arrest (Butterworth, 2018). Based on numerous case studies, the overall LAST rate is approximately 1.8 per 1,000 nerve blocks (Macfarlane et al., 2021). LAST has been identified by the Centers for Disease Control and Prevention (CDC) as a contributor to maternal death due to the amount of local anesthetic used during labor and delivery or cesarean sections (Contino, 2020).

Pregnancy is associated with increased sensitivity to local anesthetics (LA) due to decreased maternal protein binding, which increases the fraction of free drug in the circulation and increases arrhythmia risk due to hormonal effects on cardiomyocytes (Contino, 2020). The engorgement of the epidural veins during pregnancy leads to an increased rate of systemic absorption or an unintentional intravascular injection of LA (Mock et al., 2021 & Willingham, D. B., 2022). Prompt identification of the signs and symptoms of LAST and the initiation of approximate treatment is vital due to the lethality of LAST when not managed appropriately.

Nursing staff education and awareness are essential when caring for patients undergoing regional anesthesia who are also at high risk for developing LAST. Fortunately, LAST is a rare adverse effect; however, the rarity of LAST can contribute to a lack of confidence, knowledge, and awareness in the nursing staff. Nursing staff knowledge is the basis for patients receiving prompt care when LAST occurs. Providing simulation training, didactic sessions, and a cognitive aid in the form of a checklist have been shown to correlate with improved performance in rare, high-mortality situations (McIntosh et al., 2018). Simulation exercises have increased nursing staff knowledge and retention while improving self-confidence, teamwork, and communication in

perioperative healthcare workers (McIntosh et al., 2018).

More knowledge and education regarding LAST among labor and delivery (L&D) nurses is needed (Ferry & Cook, 2020). These nurses are caring for a high-risk group for developing LAST, and the incidence of those patients receiving pain management via local anesthesia, with either epidural or spinal anesthesia, is exceptionally high. Education among L&D nurses is integral for recognizing the signs and symptoms of LAST as they are the clinicians at the bedside caring for these patients after epidural placement. LAST reactions can appear in the first 60 seconds; nevertheless, it is critical to assess for subtle signs for up to 30 minutes after administering local anesthetic (Schneider & Howard, 2021). Although the incidence of LAST is low, the early identification and treatment of symptoms could save two lives: the mother and the fetus. For this reason, this project intends to assess the labor and delivery nursing staff's current level of knowledge and confidence in recognizing and managing LAST and improve both through the presentation of didactic education, engagement in simulation exercises, and the provision of cognitive aids.

Purpose

The purpose of this DNP project is to assess the initial knowledge and confidence of registered nurses in Labor and Delivery (L&D) in managing a LAST event. The goals of this project are as follows:

- To measure the knowledge, confidence, and recognition of L&D registered nurses before and after an educational PowerPoint presentation and hands-on LAST event simulation.
- To develop a scenario for LAST event management in a local hospital setting.
- To measure the knowledge, confidence, and recognition of L&D registered nurses one month after the educational PowerPoint presentation and LAST event simulation.

The aim is to create a lasting educational tool that helps L&D staff recognize the signs and symptoms of a LAST event and adhere to evidence-based treatment plans. A PowerPoint presentation and an educational simulation will be provided to the staff. The PI anticipates this will lead to the integration of LAST simulation training and education for new registered nurses on the L&D unit during their initial orientation and integrated into annual competency practice.

Review of Current Evidence

The PI conducted an extensive review of the current literature to understand LAST history, pathophysiology, signs and systems, treatment, prevention, current guidelines, and staff education. Two thousand five hundred articles were found using the Cumulative Nursing and Allied Health Literature (CINAHL), PubMed, and ProQuest Central databases through the UNC Greensboro library webpage. Searches of the databases were conducted using terms such as "Local anesthetic," "systemic toxicity," "perioperative," "simulation," and "labor and delivery," which were used alone or in conjunction with "AND" as the Boolean operator. The PI eliminated articles by setting the search to the last five years, reducing the number of articles reviewed to 583. Another elimination strategy used was using the most relevant terms: "local anesthetic systemic toxicity AND labor and delivery resulted in 7 articles; “local anesthetic systemic toxicity AND perioperative resulted in 77 articles; “local anesthetic systemic toxicity AND simulation resulted in 24 articles, reducing the number of reviewed articles to 97 articles. Multiple searches were conducted using several advanced search inclusion criteria such as "Peer Review Articles, Meta-Analysis, Systematic Review," and custom publication dates ranging from 0 to 5 years.

Exclusion criteria included article type, year of publication, and article validity. The PI reviewed the articles, and half focused on improving patient outcomes by improving

perioperative healthcare workers' critical event management skills through educational simulation. In contrast, the others focused on LAST history, pathophysiology, treatment, and current guidelines.

History of Local Anesthetic Systemic Toxicity

Local anesthetics were first recognized in the late 1800s, initially with the application of cocaine. Bupivacaine was developed in 1957 and was the first long-acting local anesthetic with reported dose-dependent separation between sensory and motor function (Dillane & Finucane, 2010). Local anesthetics are known to prevent nociceptive sensation by blocking the transmission of pain pathways to the brain and providing pain relief in the postoperative period while producing minimal central nervous system effects.

Local anesthetics are typically injected peripherally and work by blocking sodium channels on the peripheral nerves as well as in the brain and heart. As the local anesthetic is metabolized, small amounts pass through the central nervous system (CNS). If local anesthetic plasma concentrations become too high, toxicity can occur, leading to CNS instability and cardiovascular collapse if not recognized and treated. Intralipid therapy became the gold standard for the treatment of LAST in 2008. Prior to 2008, supportive therapy was the standard treatment for LAST; unfortunately, resuscitation was not always successful (Schneider & Howard, 2021).

Clinical Manifestations and Risk Factors of LAST

Toxicity symptoms may appear within minutes of a regional anesthetic injection, with central nervous system signs presenting first (El-boghdadly & Chin, 2016). The most severe cases result in CNS and cardiac toxicity. However, it is possible to produce LAST without direct intravascular injection. Dillane and Finucane explain how CNS toxicity results from elevated plasma levels of local anesthetics in the CNS, causing an interruption of neurotransmission

between excitatory and inhibitory pathways (2010). Usually, local anesthetics block nerve conduction by inhibiting sodium, calcium, and potassium transduction through voltage-gated inotropic channels in the cell membrane (Neal et al., 2018). During a LAST event, suppression of the inhibitory pathways results in overstimulation of the excitatory pathways. Central nervous system manifestations of LAST include light-headedness, dizziness, tinnitus, blurred vision, involuntary muscle twitching, and eventually culminating in seizures. As plasma concentrations increase, excitatory pathways are blocked, leading to CNS depression, reduced levels of consciousness, and coma (Dillane & Finucane, 2010).

Recognizing the signs and symptoms of LAST is crucial in managing this potentially life-threatening event. Seizures, agitation, drowsiness, visual disturbances, metallic taste, loss of consciousness, coma, and respiratory arrest are signs of CNS toxicity and should alert the provider to the presence of LAST. Central nervous system signs are followed by cardiovascular changes such as tachycardia, hypertension, ventricular arrhythmias or bradycardia, hypotension, loss of peripheral vasomotor tone, and asystole (El-boghdadly & Chin, 2016).

Pregnancy increases sensitivity to local anesthetics, elevating the risk of LAST. The increased risk of LAST during pregnancy is associated with decreased protein binding of local anesthetics (increasing the free fraction of local anesthetics), and increased neuronal sensitivity to local anesthetics lowers the seizure threshold. Additionally, pregnancy hormones estradiol and progesterone influence cardiomyocytes, increasing the risk of arrhythmias (Bern & Weinberg, 2011). Furthermore, epidural vein engorgement during pregnancy can lead to an increased risk of accidental intravascular injection and systemic absorption risk (Dun-Chi Lin et al., 2017).

Prevention and Treatment of LAST

Prevention, early recognition, and treatment of LAST are essential for the safety of patients during regional anesthesia. The infrequency of LAST creates a gap in knowledge, recognition, and treatment. Local anesthesia safety has improved and significantly reduced LAST events by using ultrasound-guided regional anesthesia and implementing maximum local anesthesia dose guidelines. Ultrasound-guided regional anesthesia allows providers to visualize the correct location where they wish to inject a local anesthetic, reducing the chances of intravascular injection (Neal, 2016).

The American Society of Regional Anesthesia and Pain Medicine (ASRA) created practice advisories to provide guidelines on managing local anesthetic systemic toxicity (LAST). The first meeting was held in 2001, coinciding with lipid emulsion's emergence as an antidote to LAST and the release of new medications such as ropivacaine and 1-bupivacaine (Neal et al., 2010). The first practice advisory on LAST was issued by ASRA in 2010, and since then, they have updated the guidelines regularly to include the latest research findings. The most current ASRA guidelines were released in 2020 and are presented in an easy-to-follow checklist format, which can be found in Appendix C (Neal et al., 2021).

Lipid Emulsion Therapy (LET) has become the gold standard treatment for LAST since its introduction in the early 2000s (Neal, 2016). Lipid Emulsion reverses LAST by linking to cellular mechanisms affected by local anesthetics (Fettiplace & Weinberg, 2018). Lipid emulsion is administered as a large intravascular bolus followed by a continuous infusion. This creates a large lipid-soluble compartment in the blood for local anesthetics to transfer from drug-sensitive organs with high blood flow, such as the heart, brain, and kidney, to organs that can store and detoxify the drug (Fettiplace & Weinberg, 2018). Current LET guidelines suggest that intralipids

should be given as a bolus at the beginning of LAST symptoms, followed by an intralipid infusion.

Using Simulation for LAST Training

LAST is a rare event most Labor & Delivery nurses are only aware of if they have had sufficient training annually. Because of this rarity, a challenge is created in training labor and delivery staff to ensure rapid treatment of LAST (Bevil et al., 2020). Knowledge, communication, and teamwork are critical in managing emergencies, especially in rare events like LAST. Training and didactic education for crisis management have been evaluated for knowledge retention of nursing staff regarding LAST. Contemporary research suggests educational exercises and simulation training increase knowledge, self-efficacy, communication, and teamwork (Bevil et al., 2020). Mock drills and simulations have improved knowledge gaps and increased baseline knowledge (Ferry & Cook, 2020). Integrating simulations with didactic training during orientation and annual competency training will improve the knowledge and self-efficacy of labor and delivery staff in managing LAST events.

Conceptual Framework/Evidence-Based Practice

The PI selected the Johns Hopkins Nursing Evidence-Based Practice Model to guide this Doctoral project. This model describes a three-sequence process called PET, which stands for practice question, evidence, and translation (Dang & Dearholt, 2018). The model employs a 19-step, cyclical process of evaluating an area of improvement, drafting a PICO question, researching the current evidence, and translating the evidence into practice through education (Dang & Dearholt, 2018). After this step, evaluate the current status, which could lead back to the inquiry phase or lead to improved practice. The key is evaluating the process and improving practice.

The Johns Hopkins model was applied using the PET process, after acknowledging the lack of education about LAST in Labor and Delivery nurses who manage epidural infusions in laboring patients. The step-by-step process allows this project to be approached and structured systematically. The initial phase included developing a PICO question and identifying stakeholders at the project site. The second phase will be researching current evidence and synthesizing the evidence to lead to the final steps of developing an action plan for implementing education, simulations, and process change. After completing these steps, it will be essential to evaluate the action plan, disseminate the findings, and make recommendations based on these findings.

Permissions

The PI received verbal and written permission from the Director of Practice, Quality, & Research, the Chief Nursing Officer, and Vice President of Patient Care Services at the project site. The Director of Practice, Quality, & Research, and Labor & Delivery manager will serve as the point of contact and advisor for the implementation of this project. Per the research committee, this project will be exempt from institutional IRB approval and will agree with UNCG IRB approval. The PI submitted and obtained approval before beginning the implementation of the project.

Methods

Nursing staff education is essential when caring for patients undergoing regional anesthesia who are at high risk for developing LAST. Fortunately, LAST is a rare adverse event; however, the infrequency of LAST can contribute to a lack of confidence, knowledge, and awareness of LAST in the nursing staff. Healthcare workers' knowledge retention, teamwork, communication, and self-confidence improved by simulating low-volume catastrophic events

(Dang & Dearholt, 2018). This project will educate labor and delivery nurses to increase their awareness and knowledge in the early recognition and treatment of LAST.

Design

Following LAST education and simulation training, the PI used a mixed-method design, including quantitative and qualitative methods. A quantitative method was used to evaluate recognition, knowledge, and confidence levels, and a qualitative method allows for an improved understanding of barriers to practice. Data was collected by analyzing quantitative data and supplementing it with qualitative measures to enhance understanding of the project question.

The L&D LAST project consisted of three parts. First, a pre-intervention survey was administered to participants before the educational interventions. Second, a PowerPoint presentation and hands-on simulation drill occurred after completing the pre-intervention survey. Lastly, a post-intervention survey was administered approximately one month after the presentation. The pre-intervention and post-intervention surveys were identical and consisted of 13 questions focusing on LAST causes, signs and symptoms, treatment, and personnel to notify. The surveys allowed the PI to gauge the nurses' knowledge of LAST signs and symptoms, management if a LAST event occurs, and confidence level with managing a LAST event.

Translational Framework

Jerome Bruner's Discovery Learning Theory was used to frame the implementation of this DNP project. This constructivism theory builds on the works of Jean Piaget and Seymour Papert. Bruner's discovery learning theory involves using previous knowledge and experience to solve problems through manipulation, questioning, and experimentation (1961). Discovery learning theory suggests that learners are more likely to remember information through hands-on experiences than traditional classroom lectures and text-based learning.

Bruner's theory of discovery learning has given rise to different models, one of which is simulation-based learning. Since most L&D staff have not witnessed LAST, a simulation will introduce the staff to this critical event. According to Bruner's theory (1961), providers will better understand the clinical manifestations of LAST and the correct treatment needed to prevent catastrophic outcomes in this low-volume, high-acuity event. A combination of high-fidelity simulation and lectures can be used to assess learners' current skill levels and identify areas for improvement. (Park et al., 2010). This combination of learning also provides learners the repetition needed to acquire and retain the knowledge and skills to manage LAST in a safe environment.

Setting

The project occurred in the Women's Health Center at a southeastern urban hospital. The project site is a private, not-for-profit healthcare system containing 609 inpatient beds. Approximately 31,000 procedures are performed at this location annually, and services are provided for people of all ages. Operative services and procedures for patients include orthopedic, bariatric, obstetrics and gynecology, general, plastic, podiatry, ophthalmology, urology, heart & vascular, neurology, and ear, nose, and throat procedures. Specifically, the labor and delivery unit delivered 5,025 babies in 2022; of those, 4,281 had epidural or spinal anesthesia.

Sample

The target population was the L&D nursing staff at an area hospital. The PI used a convenience sampling of the L&D nurses to obtain participation and composed a recruitment email to the unit manager, who distributed it to the L&D staff. The inclusion criteria for this study were the clinicians working in the L&D unit and registered nurses not working in the L&D

unit were excluded from participating in this project. The sample size was determined by the individuals who participated and met inclusion criteria via convenience sampling.

Labor and Delivery nurses voluntarily attended an educational session. Offering the class three times ensured a sample size of over 20 and allowed attendance from both day and night shift nurses.

Implementation Plan

Current evidence supports the use of both didactic education combined with simulation to increase knowledge and confidence during crisis intervention (Park et al., 2010). Three educational sessions were conducted to obtain the largest sample size possible. These sessions included an educational LAST PowerPoint presentation and a hands-on simulated experience. Clear objectives were identified and met by the end of the presentation. Before the educational session, all participants took a pre-intervention survey. One month after completing the educational presentation and LAST simulation, a post-intervention survey was distributed and completed by class participants.

The LAST simulation provided an opportunity for L&D nurses to encounter a rare and critical event that they might have only previously encountered in literature or heard of in theoretical contexts. The simulation served as a valuable exercise in bridging the gap between theoretical knowledge and practical experience, thereby equipping the nurses with the necessary skills and confidence to handle such events if they arise in their clinical practice. According to Bruner's theory (1961), providers will have a greater understanding of the clinical manifestations of LAST and the correct sequence of events needed to prevent catastrophic outcomes in this low volume, high acuity event. When faced with a critical LAST event, it is crucial to promptly identify the situation and initiate appropriate management strategies to prevent further

complications. Timely recognition of the condition, coupled with increased confidence and proficiency in managing the situation, can significantly improve patient outcomes and reduce the chances of morbidity and mortality.

Data Collection

The PI provided a Qualtrics link to the participants, where a survey with combined participant information and pre-intervention evaluation instrument was found (Appendix A). This form instructs the participants to provide information describing their practice role and years of experience. The pre-evaluation instrument portion evaluated participant knowledge of LAST and the comfort of managing a LAST event. Participants answered questions on a five-point Likert scale with the following options: strongly disagree, disagree, undecided, agree, and strongly agree (Appendix A).

One month after the education and simulation, the LAST post-intervention survey (Appendix B) was emailed to the participants. The survey included the same questions as the pre-intervention survey.

Data collection was anonymous, and no identifying information was collected, exposing participants to minimal risks. The participants were provided a survey link and could fill out the survey anonymously before the educational session and one month after the educational session. The PI shared the results from this quality improvement project with the L&D clinical manager, Dr. Aucoin, and Lorie Rhine.

Budget, time, and Resources

Minimal finances are needed for the implementation of this project. The PI will provide funding for snacks during the educational sessions.

Data Analysis

Twenty-two Labor and Delivery RNs completed the pre-intervention survey (Appendix A) and the post-intervention survey (Appendix B). The PI developed the pre-and post-intervention survey tools (Appendix A & B); therefore, there is no reliability or validity score. Data from the completed twenty-two pre- and post-intervention surveys were entered into Microsoft Excel software version 16 and analyzed using descriptive statistics. Each Likert scale item was assigned a score from one to five, with one indicating "strongly disagree" and five indicating "strongly agree."

Data were grouped into two categories. Group A comprised the entire sample of participants who completed the pre-intervention survey (n=22). Group B comprised the entire sample of participants who completed the post-intervention survey (n=22). The responses of group A (pre-intervention survey) were separated by each of the ten questions about LAST, and the percentage of response rates for each Likert-scale category were tabulated. The average of these response rates was then calculated. The same was done for Group B, the participant responses to the post-intervention survey (n=22). Finally, the average response rates for both groups (pre- and post-intervention surveys) were compared.

Groups A and B were analyzed using a two-sample T-test, which compared the pre-intervention survey results to the post-intervention survey results. The primary goal of this analysis was to evaluate the effectiveness of an education intervention by comparing the mean results and p-values from two surveys. By comparing these metrics, we aimed to determine the statistical significance of the intervention and its impact on the surveyed population.

Demographic data was also obtained from each participant during the pre-test survey. The collected demographic information included race, gender, age range, and years of L&D

experience. Demographic data was entered into Microsoft Excel version 16, and data was tallied to understand the participants' demographics. There were four categories of years of experience as a L&D nurse that the participants were able to select: <2 years, 2-5 years, 6-10 years, and >10 years.

Results

The results of Group A (pre-intervention survey) showed an average Likert response of 1.82. In contrast, the results of Group B (post-intervention survey) showed an average Likert response of 4.3. Notably, the progression of the participant's confidence level in managing a patient with LAST, measured with the pre-intervention survey and compared to the post-intervention survey was statistically significant ($p<0.05$).

Figure 1

Comparison of Pre- and Post-Intervention Survey Total Average Likert Score

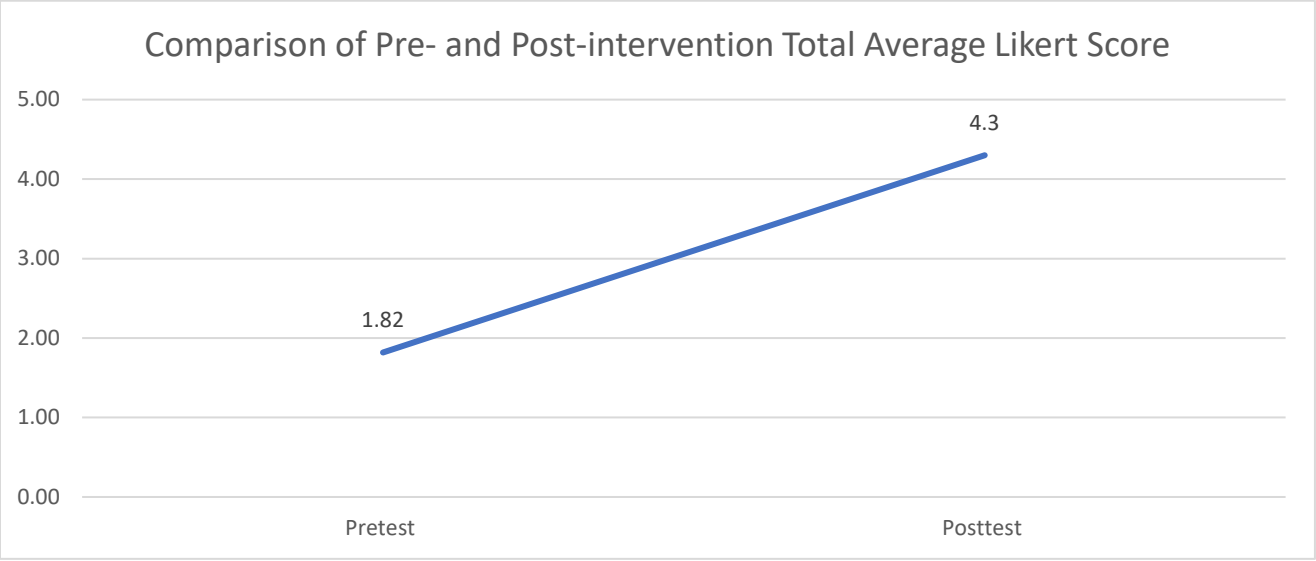
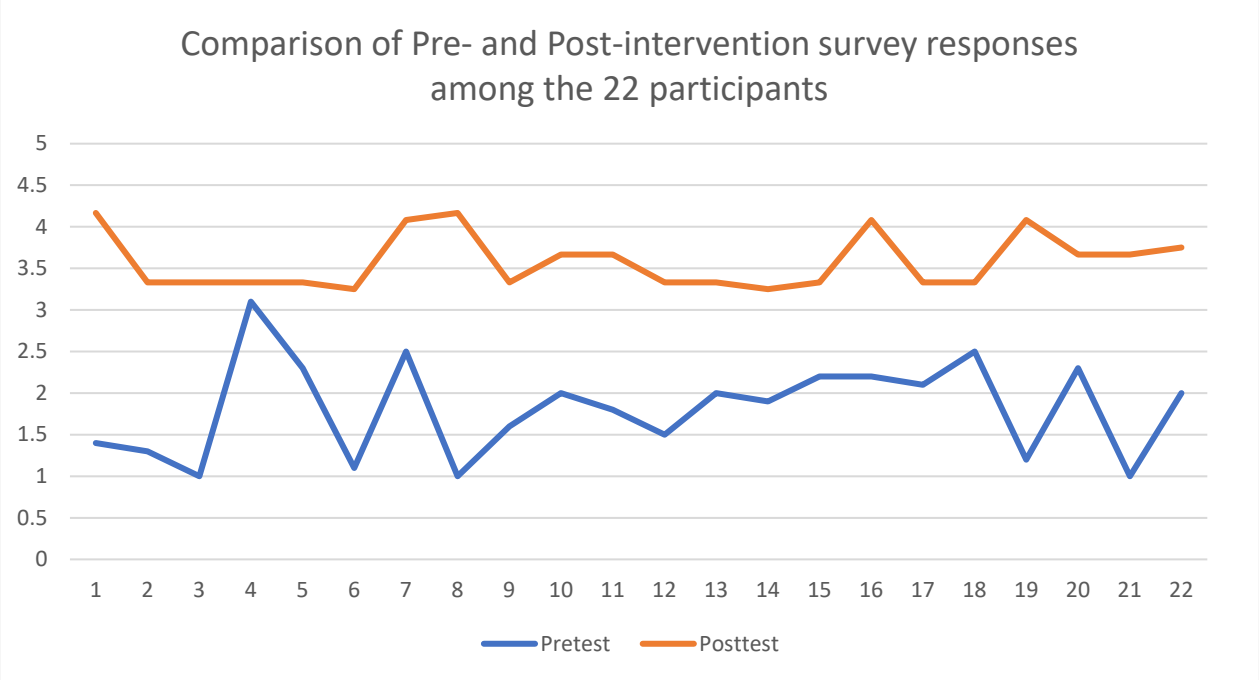


Figure 2

Comparison of Pre- and Post-intervention survey responses among the 22 participants



The surveys also included a demographic data section indicating the participant's self-reported race, gender, age range, and years of L&D experience. The results of the demographic information are as follows: 100% of the participants were female, 95% self-reported as Caucasian while 5% self-reported as other. Age ranges were the following: less than 25 (1), ages 25-35 (7), ages 35-45 (4), and older than 45 (10). Years of experience were reported as less than 2 years (2), 2-5 years (2), 6-10 years (5), and over 10 years (13).

As part of the pre-intervention survey, the participants were specifically inquired in question 11 about the effectiveness of a LAST educational briefing and demonstration in enhancing their ability to manage a LAST event. The purpose was to determine whether such an intervention would boost their confidence and competence levels. The results averaged 4.68 on the Likert scale, with 15 participants strongly agreeing and 7 agreeing, signifying all participants believe educational briefing and demonstration builds confidence and competence.

Discussion

It is essential to consider that the participants involved in this DNP project are experienced healthcare professionals rather than novice learners. Although the L&D nurses receive training on managing epidurals, they need to gain the required knowledge and training regarding LAST. Due to this gap, there is a significant difference between participants' mean responses before and after the evaluation.

While analyzing all the data categories, a notable and significant rise in positive responses was found. On comparing the average responses before and after the intervention, there was an increase of more than 50% in positive responses, which included Agree or Strongly Agree. These results indicate that the intervention at the project facility was effective. The increase in positive responses is directly proportional to the increase in knowledge and confidence related to LAST events. The results also suggest that the L&D registered nurses who were part of this project demonstrated increased knowledge and confidence. As a result, patients at this facility can be assured of having healthcare workers in L&D who are better prepared to intervene efficiently in case of a LAST event.

Limitations

It was found that staffing conflicts, unit scheduling conflicts, and a hectic clinical schedule were limiting factors for this project. Due to the rarity of LAST events, some staff felt the education was irrelevant to their jobs because this was the first time they had heard of LAST. However, they take care of patients with epidurals or status post cesarean sections with spinal anesthesia, which puts their patient population at greater risk of LAST occurring. Furthermore, the attitude and willingness of the staff posed as a limitation.

Recommendations for Future Study

This quality improvement project, which focused on improving the knowledge, preparedness, and confidence of L&D RNs, has yielded positive results. It's crucial to continuously strive for better preparation of healthcare providers for crisis situations, as there's always room for improvement.

The pre-survey results revealed that most L&D nurses were unprepared for a LAST event. However, data collected after the nurses participated in the educational presentation and training session scenario showed a statistically significant increase in their recognition, preparedness, and knowledge of LAST management. Based on these findings, the L&D unit has introduced annual LAST training. This will benefit patients and improve their response to a LAST event. It is important for all locations using local anesthetics, including L&D units, to incorporate scenario-based training and education in their LAST training. By conducting a well-organized annual training session, simulation drill, and an educational PowerPoint module, patient care and safety can be improved by better managing LAST.

It is recommended that more time be allocated to spread the presentation information across more sessions. This will allow for a larger sample size, resulting in more promising data and favorable statistical analysis.

It would be helpful to emphasize the significance of recognizing and managing a LAST event by including a testimony from a nurse who has experienced managing such an event. This recommendation can help overcome the limitations of nurses feeling that the education they receive is irrelevant to their job.

Additionally, LAST scenario simulations for L&D nurses should be implemented at other institutions where annual LAST training is not a priority. Post-survey scores provide evidence of

improved preparedness for LAST management among healthcare providers who practice rescue measures for high-acuity, low-frequency events.

Conclusion

Local Anesthetic Systemic Toxicity (LAST) is a rare but critical event that requires the knowledge and expertise of the L&D team to ensure patient safety. Early recognition of LAST's initial signs and symptoms, followed by prompt treatment, can make a significant difference in providing effective, life-saving care. However, since LAST is a rare event, L&D RNs may need more confidence in recognizing its onset, affecting their ability to manage it effectively.

To address this issue, this DNP project aimed to provide evidence-based education and LAST scenarios to L&D RNs to improve their knowledge, preparedness, and confidence in LAST management. The results of this project show a significant improvement in all areas of concern. It has become increasingly clear that healthcare providers staffing L&D units must have the necessary skills to manage LAST and save lives effectively. These findings may provide a sound basis for a practice change that will ensure that all healthcare providers, regardless of their level of expertise, are trained to handle LAST competently and confidently. Such a change would be a positive step towards reducing maternal mortality rates and improving the overall quality of care provided in L&D units.

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Appendix A: LAST Pre-Intervention Survey
SD: (strongly disagree); D: (disagree); UN: (undecided): A: (agree); SA: (strongly agree)

Questions	SD	D	UN	A	SA
1. I am confident in my ability to recognize initial LAST signs and symptoms.					
2. I know the initial interventions in LAST treatment.					
3. I know where the closest LAST kit/cart is located.					
4. I know to utilize the ASRA checklist during a LAST event					
5. I know where the ASRA checklist is located.					
6. I know how to dose lipid emulsion therapy.					
7. I know which drugs to avoid during a LAST event					
8. I understand to use modified ACLS as described in ASRA checklist.					
9. I feel confident in managing a LAST crisis event.					
10. I know my role and responsibilities during a LAST crisis event.					
11. A LAST educational briefing and demonstration is beneficial to increase confidence and competence in managing a LAST event?					
12. Simulation education is superior to a PowerPoint or online module alone in teaching the management of a LAST event.					

Demographic Information

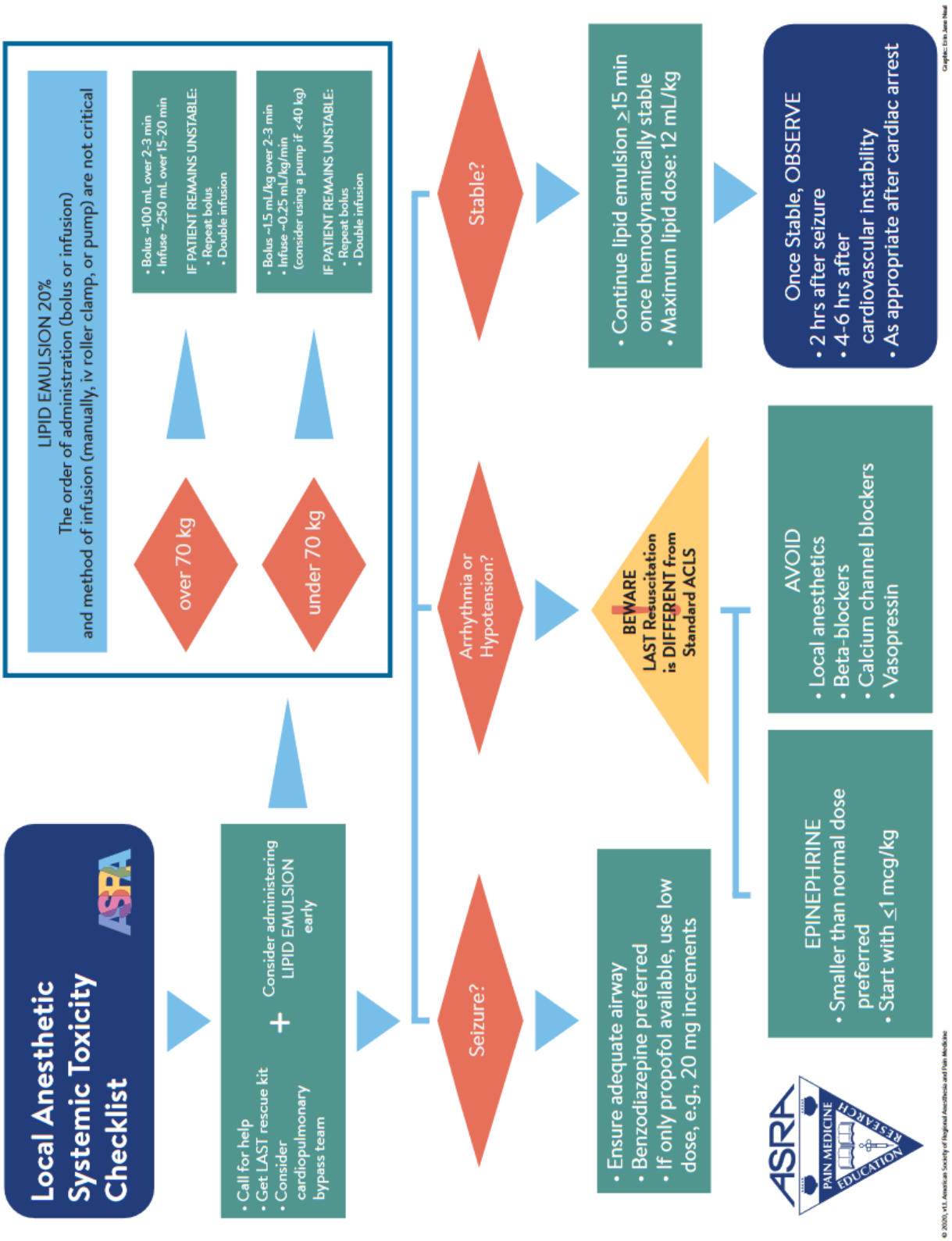
Age: <25 yrs 25-35 yrs 35-45 years >45 years
Gender: M F
Ethnicity: White Black Hispanic Asian American Pacific Islander Other
Years you have been practicing: < 2 yrs 2-5 yrs 6-10 yrs >10 yrs

Appendix B: LAST Post-Intervention Survey

SD: (strongly disagree); D: (disagree); UN: (undecided): A: (agree); SA: (strongly agree)

Questions	SD	D	UN	A	SA
1. I am confident in my ability to recognize initial LAST signs and symptoms.					
2. I know the initial interventions in LAST treatment.					
3. I know where the closest LAST kit/cart is located.					
4. I know to utilize the ASRA checklist during a LAST event					
5. I know where the ASRA checklist is located.					
6. I know how to dose lipid emulsion therapy.					
7. I know which drugs to avoid during a LAST event					
8. I understand to use modified ACLS as described in ASRA checklist.					
9. I feel confident in managing a LAST crisis event.					
10. I know my role and responsibilities during a LAST crisis event.					
11. A LAST educational briefing and demonstration is beneficial to increase confidence and competence in managing a LAST event?					
12. Simulation education is superior to a PowerPoint or online module alone in teaching the management of a LAST event.					

Appendix C: ASRA LAST Checklist



Appendix D: LAST Educational PowerPoint Presentation

Local Anesthetic Systemic Toxicity (LAST)

Sheena Hilton

What local anesthetic is typically used in labor epidurals at Rex Hospital?

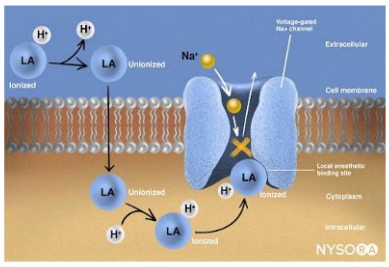
Bupivacaine

Does this drug fall into the category of a faster or slower metabolism?

Amide which is slower metabolism

Local Anesthetic: Mechanism of Action

- Bind to voltage-gated sodium channels, blocking sodium currents which leads to reduced neuronal, cardiac, and central nervous system excitability
- Produce conduction blockade (preventing transmission of nerve impulses) by inhibiting sodium ions from passing through the sodium channels in nerve membranes
- Slows the rate of depolarization making cells unable to reach threshold potential.
- When threshold potential is not reached, an action potential will not propagate.



How does blocking sodium channels block pain sensation?

- Local anesthetic agents suppress action potentials in excitable tissues by blocking voltage-gated Na^+ channels.
- In doing so, they inhibit action potentials in nociceptive (pain) fibers, which blocks the transmission of pain impulses.
- Another way to say it…local anesthetics prevent nociception by blocking the transmission of pain signals to the brain

Bupivacaine

What you need to know…

- Amide Local Anesthetic
- Onset
  - Epidural - 4-17 minutes
  - Spinal - <1 minute
- Peak
  - Epidural - 30-45 minutes
  - Spinal - 15 minutes
- Duration - 240-480 minutes
- Elimination ½ time - 3 hours 30 minutes
- Concentration
  - 0.25% = 2.5mg
  - 0.50% = 5mg
- Max dose 2.5mg/kg or 175mg
- Dosing
  - Epidural - 50-150mg bolus
  - Spinal - 7-15mg

Calculating dosage

- Bupivacaine 0.25%
- 0.25% = 2.5mg/ml
  - .25g/100ml = 250mg/100ml = 2.5mg/ml
- 5ml bolus = 5ml x 2.5mg = 12.5mg

Let's do some math

Your patient, a G1P0 39w5d is 8cm, weighs 80kg. She received an epidural 6 hours ago and after 3 self boluses she is still hurting. You call the Anesthesiologist, and they give you an order for a 10ml bolus of 0.25% Bupivacaine. How many mg are you giving and how do you know if it could be a toxic dose?

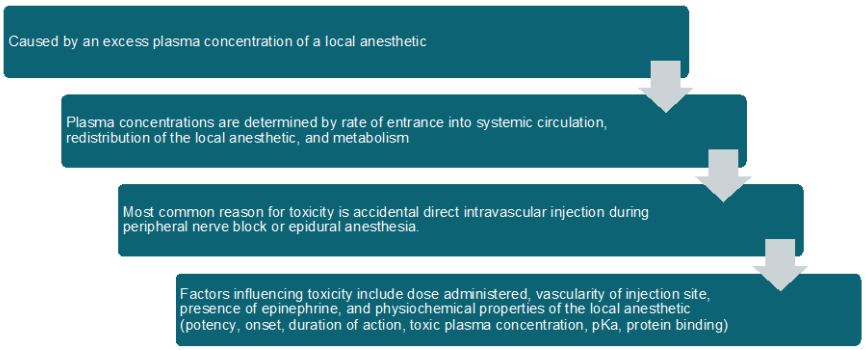
0.25% bupivacaine =

- 0.25% = 2.5mg/ml
  - .25g/100ml = 250mg/100ml = 2.5mg/ml
- Ordered dose: 10ml
  - 10ml x 2.5mg = 25mg

What is the maximum dose for this patient?

- Max dose: 2.5mg/kg or 175mg
  - 2.5mg x 80kg = 200mg
  - To be safe you wouldn't want to give over 175mg.
  - Your dose of 25mg is safe

Local Anesthetic Systemic Toxicity



Local Anesthetic Systemic Toxicity

Signs & Symptoms

CNS Toxicity

- Minor Signs & Symptoms
  - Tongue and perioral numbness
  - Paresthesias
  - Restlessness, anxiety
  - Tinnitus, blurred vision
  - Muscle fasciculations & tremors
- Major Signs & Symptoms
  - Tonic-clonic seizures
  - Global CNS depression
  - Hypotension
  - Decreased LOC
  - Apnea
- Initial excitatory manifestations reflect depression of inhibitory cortical neurons/inhibition of GABA release

CVS Toxicity

- Early Signs: Hypertension & tachycardia
- Late Signs
  - Peripheral vasodilation & profound hypotension
  - Sinus bradycardia, AV blocks
  - Conduction defects (Prolonged PR and/or QRS)
  - Ventricular dysrhythmias
  - Cardiac arrest

Name some minor or early signs and symptoms of toxicity?

CNS

- Tongue and perioral numbness
- Paresthesias
- Restlessness, anxiety
- Tinnitus, blurred vision
- Muscle fasciculations & tremors

CVS

- Early Signs: Hypertension & tachycardia

Name some major or late signs & symptoms of toxicity?

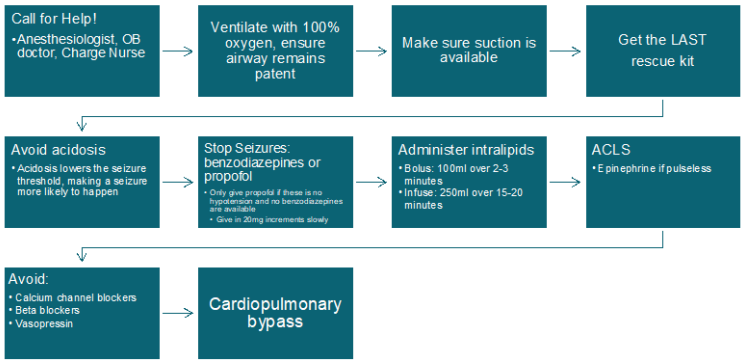
CNS

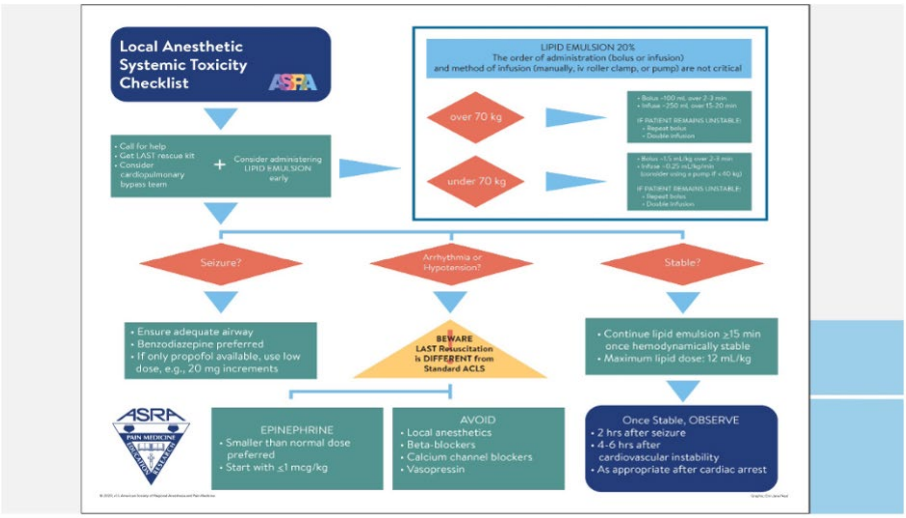
- Tonic-clonic seizures
- Global CNS depression
- Hypotension
- Decreased LOC
- Apnea

CVS

- Late Signs
  - Peripheral vasodilation & profound hypotension
  - Sinus bradycardia, AV blocks
  - Conduction defects (Prolonged PR and/or QRS)
  - Ventricular dysrhythmias
  - Cardiac arrest

What are the treatment steps?





Local Anesthetic Systemic Toxicity

What is my Role?

- After epidural placement - inform patient to notify you immediately if they experience any tingling around the mouth, changes in taste or vision, or feel like they are going to pass out.
- Inject local anesthetic in 5ml increments, aspirate before injection and between each 5ml increment to ensure no blood is aspirated.
- Monitor the patient for at least 15 minutes after they receive local anesthetic, including boluses.
  - VS every 5 minutes
  - FHR charted every 5 minutes
- Understand the signs & symptoms associated with toxicity
- Be familiar with treatment protocols
- Know the location of the LAST rescue kit and the ASRA checklist

LAST rescue kit

Located in Pyxis on POD D and in PACU. → Type in lipid, fat, or intra in the pyxis and the intralipids will come up. → Grab the ASRA algorithm for dosing and list of steps to take.

- List is available near the pyxis in all areas and above the charge computer.

Sharon is a 36 year old female, 38w6d, G2P1, 6cm requesting an epidural. Platelets are 159, baseline BP is 128/72, pulse 70, patient has no co-morbidities and no allergies. Anesthesia comes to place an epidural, placement is easy and anesthesia leaves after placement. You are at the bedside and you are almost finished with your every 5 minute VS and FHR checks. Your patient says she feels weird. What do you do next?

Ask Sharon to describe how she is feeling.

She responds and says she feels tingly in her hands, and her lips are starting to feel numb.

What's your next step?

Sit the head of her bed up → thinking maybe the epidural level is too high?
Cycle a BP to make sure her BP hasn't dropped →maybe she needs ephedrine?
Assess FHR →is baby responding negatively?

Her BP is 156/97, her pulse is 95. FHR is elevated from baseline. Sharon is now not responding to you and has tremors. You cycle another BP and she is now 96/50 and her pulse is 56.

What's next?

Call for help!!!

- Anesthesia, OB, charge nurse, and tech to be a runner.

Make sure you have Oxygen and Suction available and working.

Ask for the LAST rescue kit.

DO NOT LEAVE YOUR PATIENT ALONE

MAKE SURE YOUR PATIENT IS SAFE AND AIRWAY IS PATENT

Emily is a 19 year old female, 40w5d, G1P0, 9cm, baseline BP 116/68, pulse 82. She received an epidural 7 hours ago and is now hurting even after her three self boluses. You get an order from the anesthesiologist for a 5ml 0.25% bupivacaine bolus. You give the bolus but forgot to aspirate before injecting the bolus. Your patient begins to have a seizure. What do you do?

- Call for HELP!!!
- Don't touch your patient but make sure they are safe.
- Have someone bring in the LAST rescue kit and crash cart to the bedside
- Anticipate an order for a Benzodiazepine
- Anticipate an order for Intralipids
- Anticipate possible Code Green or delivery at bedside.