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Syringe Swap During Regional Block: A Case of Medication Error and Recovery

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The Case

A 21-year-old male with a fractured radius was scheduled for open reduction and internal fixation under an ultrasound-guided supraclavicular brachial plexus nerve block. Following appropriate counseling and consent procedures, the initial attempt at local skin anesthesia using 2% lidocaine at the needle insertion site proved inadequate, necessitating a second cutaneous lidocaine injection. The procedural block was then executed using 20 ml of 0.375% plain bupivacaine.

Several minutes later, the patient manifested progressive dyspnea and diminishing oxygen saturation, prompting emergent intubation and initiation of mechanical ventilation. The patient remained hemodynamically stable throughout the episode, culminating in adequate reversal of anesthesia and successful extubation after surgery.

Upon thorough review, the respiratory distress was traced back to an inadvertent injection of vecuronium, a neuromuscular blocking agent, instead of the intended local anesthetic. This unfortunate error in drug administration arose from a preparatory oversight, specifically incorrect placement of a vecuronium-containing syringe on the anesthesia drug tray by a previously assigned anesthesia nurse, who then signed out to another nurse at shift change, and the anesthesiologist's failure to read the label and identify the medication immediately before injection. While the brachial plexus nerve block eventually met efficacy standards for intraoperative anesthesia, the delayed onset of vecuronium contributed to a gradual and progressive compromise in ventilatory function, necessitating definitive airway intervention.

The Commentary

By Kimberly Beres, DNAP, MHS, CRNA, and Maria Cristina Gutierrez, MD

In this case, a series of events unfolded during a planned brachial plexus block for a 21-year-old patient with a fractured radius, ultimately resulting in profound consequences to the patient. The intended local anesthetic, lidocaine, was mistakenly replaced with vecuronium, a neuromuscular blocking agent primarily used in general anesthesia, which induced respiratory muscle paralysis. The heightened level of care required, which included intraoperative mechanical ventilation and extended postoperative monitoring, not only impacted the patient's recovery but also strained healthcare resources. The patient's frightening and distressing experience of being chemically paralyzed without sedation necessitated clear and honest post-procedural communication with the patient and their family, emotional support during the recovery period, and a commitment to learning from the incident to prevent future errors.

The genesis of this medication error was likely rooted in a combination of unsafe conditions and poor practice habits. Medications were apparently stored inappropriately, contributing to confusion between vastly different drugs with distinct actions. The lack of a reliable approach for checking medications, insufficient differentiation of packaging, and communication gaps among team members may have played a role in the error. Inadequate training and reliance on assumptions probably complicated the situation, highlighting the need for a more rigorous and standardized approach to medication management in the operating room, supported by ongoing education and training. Creating a culture of safety that values transparency, continuous learning, and a systematic approach to medication management is crucial for improving overall patient care and preventing such incidents in the future.[1]

Background

Medication errors in the perioperative period are common[2] and occur in all phases of patient care from home to the operating room to discharge. Clinical anesthesia involves intravenous injection of potent drugs, often under stressful and fast-paced conditions, which may increase the risk of errors. The intraoperative phase is particularly high-risk as the anesthesia care provider may be the only person involved in selecting, preparing, and administering a drug as well as monitoring its effects.[2] Errors may occur at any of these stages, depending on the workflow and the scope of provider responsibility in an institution.[3] Further contributing to the potential for error and harm is the fact that anesthesia medications are high-risk drugs with narrow therapeutic indexes.[3] Given complex pharmacokinetics and the necessity for precision, anesthesia care is particularly vulnerable to the consequences of inaccuracies in medication delivery.

The anesthetic landscape is further complicated by similarities in drug packaging and labeling. In a review from 2017, Wahr and colleagues reported that medication errors in the operating room are relatively common with similar error or near miss rates across the world,[2] making this a global concern in anesthesia practice. The absence of standardized procedures for drug administration introduces variability and amplifies the likelihood of errors. A uniform approach, on the other hand, creates a reliable framework that minimizes the risk of mistakes.[4]

Preventing medication errors in anesthesia demands a concerted effort that may include implementing double-check procedures when feasible, enhancing drug labeling and clear packaging, integrating technology solutions like barcode scanning, and adopting standardized protocols. However, these approaches have often had disappointing results when implemented in isolation.[5,6] Continuous training and education, along with effective communication practices and reporting and learning systems, are key

components of a comprehensive approach.[7] The Anesthesia Patient Safety Foundation (APSF) convened a consensus conference in 2010 to develop new strategies for improving medication safety in the operating room. One hundred stakeholders from different backgrounds proposed a “new paradigm” to reduce medication errors that cause patient harm based on four avenues of approach: Standardization, Technology, Pharmacy (prefilled/premixed medications), and Culture (STPC).[8] These recommendations went far beyond the traditional emphasis on the “five rights” of proper drug administration (right patient, right drug based on correct labeling, right dose, right route, and right timing).[9]

In the operating room, the anesthesia care provider must attend to complicating factors such as infusion pump programming, drug concentrations, and patient allergies. When assessing medication errors, reviewers must also be aware of and properly assess human and environmental factors such as fatigue and production pressure, availability and usability of technology, and adherence to practice guidelines regarding medication preparation and handoffs at shift changes. In this case, several of these factors apparently contributed to the patient safety event.

For technology to be effective, technology workflows must be improved and designed around ease of use, speed of use and functionality, standardization, technical support to include tutoring and maintenance, and regular evaluation to ensure relevancy and compliance. Pharmacy, information technology, and anesthesia care providers must interact regularly to ensure drug libraries are updated, the electronic health record (EHR) is interfacing correctly, and equipment failure is immediately addressed. When introducing new technology into the clinical environment, there will be unexpected consequences[10] that will require attention and resolution. Staff acceptance can vary and will depend on many of the factors previously mentioned, including perceived threats and benefits, perceived barriers to use, and creative incentives to cue early adoption.

Approaches to Improving Patient Safety

Adopt and maintain a safety culture

Medication safety involves both the individual and the organization. Ensuring a safety culture starts from the time a provider joins the department and should include education on policy, practice, and assessment with clear expectations. A perception of poor safety culture has been linked to increased error rates.[10] Broadening awareness and helping providers to understand contributing factors are the first steps in preventing harm.[11] Proper handoff and report practices at all provider changes directly contribute to a culture of safety, are measurable, and ensure accountability and adherence to established standard operating procedures.

In a strong safety culture, error prevention and recovery programs are well developed, updated regularly, and include evaluations of progress and compliance. Program assessment and error investigation should consider a “just culture” approach that includes non-punitive discussions to promote understanding of the root causes of errors[12] and to encourage self-reporting and compliance. Strategic synchronization of medication preparation with the pharmacokinetic profile of each drug and the requirements of the impending procedure is not only a safety imperative, but also a fundamental driver of procedural efficiency.[13]

Utilize available technology and integrate automated alerts

Anesthesia care providers should be equipped with medication delivery technology that complies with regulatory requirements, is easy to use, and has readily available technical support. By standardizing concentrations of high alert medications, hospital pharmacies can provide ready-to-use bolus and infusion doses for adult and pediatric populations, avoiding the need for intraoperative preparation. Intravenous infusions are often delivered using a smart device with standardized drug libraries and labeling systems, often integrated with the EHR.

Recent research underscores the significance of labeling, color-coding, and standardization as pivotal components of a robust safety culture in the operating room. A 2014 study found syringe labeling compliance to be complete when anesthesia providers used a proprietary safe labeling system as opposed to preintervention practices,[14] although technical issues with the system could cause providers to return to hand labeling. While it may be difficult to conclude that technology directly prevents medication administration errors, the potential for reduction has been demonstrated with consistent use.[14,15] A systematic review concluded that multimodal interventions and improved medication labeling lead to fewer medication errors.[1] Each correctly labeled medication becomes a distinct entity, minimizing the potential for confusion and aligning practices with evidence-based principles that stand as bulwarks against errors.[16]

Multimodal interventions to increase medication safety include separate drug trays for common procedures, improved labeling systems, color-coded syringes, prefilled syringes for commonly used drugs, barcode readers with auditory and visual verification of selected drugs, checklists, medication infusion “smart” pumps, and workspace accommodations. One study found that a multimodal system that included the first five of these features with automated on-screen and audible alerts, and an integrated EHR, was associated with a 21% reduction in the rate of medication and documentation errors.[17] If any of these multimodal interventions had been employed in this case, there would have been one or more additional prompts for both the provider who prepared the medications and the provider who administered them.

Reinforce professional provider responsibilities

Medication checks. Even with the availability of any of the described interventions, the anesthesia care provider is professionally responsible to ensure that the correct and intended medication is injected. While it is common for the primary anesthesia provider to draw up all medications themselves, another provider often prepares one or more medications, so it is imperative to double check any medication that may have been prepared by another provider. In this case, the nurse who prepared the medications handed off to another nurse before the block administration began and the anesthesia care provider did not check the medication prior to administration.

Proper handoff between providers. The handoff at a provider change is a safety prompt that encourages medication reconciliation and individual responsibility, while providing “fresh eyes” and needed breaks to providers. In this case, a nurse prepared and labeled the medications correctly, but apparently placed all medications in the same tray. At shift change and perhaps without a proper handoff, a different nurse took the tray with the prepared local anesthetics along with vecuronium, which should have had a red colored label. A proper handoff report not only provides pertinent data about the patient, their condition, and case progress, but also serves to review medications prepared, given, and available. Adherence to evidence-

based handoff practices ensures a seamless transfer of patient care, upholding safety and promoting continuity in the patient's healthcare journey.

Checklists. In this case, proper pre-block checklists were not followed, medication labels were not checked by either the nurse or the physician, and the first local anesthetic was not drawn up at the time of administration. The second nurse swapped the local anesthetic syringe with vecuronium and handed it to the administering anesthesia care provider, who did not check the syringe. Conducting a pre-block checklist would have given the team an opportunity to review everything and interrupted the impending error. Commitment to evidence-based checklists and huddles is not merely procedural; it reflects a collaborative dedication to error reduction.

Include simulation training in clinical education

Simulation is an interactive educational tool that re-creates or imitates clinical scenarios in a safe learning environment for the purposes of training and evaluation. Workplace simulation is becoming the norm to improve high-quality, safe patient care, integrating human factor methodologies in its design.[17] Organizations should consider offering simulation as part of a comprehensive medication safety program, which can benefit all providers who are involved in conscious sedation, chronic pain management, and medical procedures.

Anesthesiology as a specialty has been instrumental in developing human simulation for education, especially for critical but infrequent clinical scenarios as well as frequently used technical skills.[18] An effectively designed simulation program specifically focused on nontechnical skills such as decision-making, communication, and procedure implementation can contribute positively to support an education program that reduces medication errors.[19]

Include outcome assessment, reporting reviews, and risk mitigation into safety programs

A robust safety culture requires active participation by key stakeholders, continual assessment, non-punitive mitigation efforts, and periodic reviews with program updates based on outcomes. Safety programs should integrate pharmacy, perioperative nursing units, and all anesthesia providers and support staff. A “top down” support system provides funding for maintenance contracts, dedicated training, and integration time for trainers and trainees. Automated reporting prompts can be continuously updated and assessed for user acceptance within the EHR. Self-reporting is one of the most common ways by which intraoperative medication errors are discovered and must be encouraged and positively reinforced as an element of the care provider’s professional responsibilities.

Be inquisitive after a discovered medication error

In this case, the anesthesia care providers may have first considered the possibility of local anesthetic systemic toxicity (LAST), which can occur when a local anesthetic is inadvertently injected into a blood vessel. LAST may result in central nervous system toxicity (e.g., seizures, tinnitus) and hemodynamic compromise with circulatory collapse.[20] However, isolated respiratory compromise and desaturation are not consistent with LAST. In this patient’s case, the medication error was recognized by reviewing the medication process intraoperatively after treating the patient’s ventilatory compromise and finding no signs

of LAST. The providers involved in this incident should be credited for their vigilance in rapidly identifying the etiology of the neuromuscular incident, self-reporting and critically reviewing it, and intervening immediately to rescue the patient.

Conclusion

This patient received a neuromuscular blocking medication instead of a local anesthetic for the skin wheal prior to regional blockade. The ensuing ventilatory compromise from absorption of vecuronium necessitated intubation and an unplanned hospitalization. Due to the anesthesia care provider's prompt intervention, the patient did not suffer any long-term sequelae, but the patient was distressed by the experience and the error was avoidable. Prudence would dictate that vecuronium should not have been included in the regional block preparation, a proper handoff should have occurred, and pre-injection medication checks should have been completed. While medication errors are not entirely preventable in the intraoperative period, nursing and anesthesia care providers must check all medications, follow established checklists and protocols, and utilize all technology available to minimize the risk of a poor outcome. Human and environmental factors, such as communication issues, fatigue, distractions, workflow inefficiencies, equipment malfunctions, cognitive biases, and team dynamics, must also be recognized and mitigated through standardized protocols, checklists, education, team training, technological support, incident reporting systems, and continuous quality improvement.

Take-Home Points

- Medication errors in the perioperative period are common[2] and can cause appreciable patient harm.
- Current recommendations for medication safety in anesthesia go beyond attending to the "five rights" of drug administration (right patient, right drug, right dose, right route, and right timing) and the traditional emphasis on proper drug labeling.
- Adopting a safety culture that includes available technology and training improves error rates and adherence to best practices. Use of the most advanced technology for medication verification and administration may significantly reduce the rate of medication errors, especially as part of multimodal interventions.
- Provider responsibilities and human factors contribute to the success or failure of a medication safety program and can directly contribute to poor patient outcomes from an inadvertent medication error.
- A comprehensive medication safety program should encompass various healthcare disciplines responsible for administering medications to patients. Additionally, it should incorporate a strategy for regular evaluation, including outcomes assessment, review reporting, and risk mitigation measures.

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