

Epidural medications given intravenously may result in death

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Abstract

Anesthetics, such as bupivacaine, intended for epidural analgesia can cause severe cardio- and neurotoxicity when inadvertently administered via the intravenous route. This article highlights a case report and the dangers associated with the inadvertent administration of an epidural solution intravenously. Multiple system-based strategies for prevention are provided.

Practitioners in critical care units routinely care for post-operative patients receiving continuous epidural infusions for pain management. Critically ill patients commonly have multiple lines and tubes in place for the administration of medications (e.g., central, peripheral, gastric), as well as for monitoring their status (e.g., arterial line, central line). Previous reports of mix-ups between intravenous (IV) and epidural medications have often focused on the risk for harm if an IV product is inadvertently given epidurally (or intrathecally) (Hew, Cyna, & Simmons, 2003; ISMP, 1998, September; ISMP, 2000; ISMP, 2006, April; JCAHO, 2005; Landow, 1985; Salvolini, Bonetti, & Ciritella, 1996; Sigg & Leiken, 1999). The following case report highlights the dangers associated with a reverse mix-up (i.e., epidural premixed solution inadvertently administered IV) and the numerous system safeguards that should be considered to prevent such an occurrence.

Case report

An event in the United States (U.S.) demonstrates the high risk of harm if medications intended for epidural administration are inadvertently administered intravenously (ISMP, 2006, August; Wahlberg, 2007):

A healthy 16-year-old girl died during labour after an epidural analgesic (presumably containing bupivacaine) was inadvertently infused intravenously. The nurse had intended to administer a minibag containing penicillin. Five minutes after the start of the infusion the patient was noted to experience “seizures, clenched jaw and gasping respirations” (WISCTV, 2006). Efforts to resuscitate the patient were unsuccessful.

System safeguards are required

Anesthetics intended for epidural (or spinal) analgesia can lead to severe adverse events when administered intravenously in error. For example, the inadvertent IV rather than epidural administration of bupivacaine can lead to cardiotoxicity (bradycardia, hypotension, heart block, ventricular arrhythmias including ventricular fibrillation) and neurotoxicity (e.g., excitation, restlessness, paresthesia, dizziness, blurred vision, tremors, shivering preceding the

onset of generalized convulsions) (MicroMedex, 2007). Cases of cardiotoxicity and neurotoxicity resulting in serious harm have also been reported with the injection of regional anesthetics (Bacsik, Swift, & Hargreaves, 1995; Hew et al., 2003; Litz, Popp, Stehr, & Koch, 2006; MicroMedex Healthcare Series, 2007; Rosenblatt, Abel, Fischer, Itzkovich, & Eisenkraft, 2006).

System safeguards to consider

The case identifies and emphasizes the need to ensure there is adequate segregation and differentiation between IV and epidural products, as well as the need to ensure distinctive processes in the medication use system for handling and administration of these products. A summary of previously shared recommendations from ISMP in the U.S. and ISMP Canada, related to *prevention of substitution errors* between intravenous and epidural medications, is noted here.

- Keep premixed epidural solutions separate from intravenous solutions during all phases of the medication use process, including drug preparation, delivery, retrieval and administration (ISMP, 2003; ISMP Canada, 2006). While the increased availability of premixed solutions is promoted (Cohen, 2007; ISMP Canada, 2005), there also need to be system safeguards in place that reduce the potential risk for substitution errors with look-alike premixed solutions (ISMP Canada, 2006).
- Ensure that all medication labels prominently identify the route of administration (ISMP Canada, 2003; ISMP Canada, 2006).
- Require distinctive labelling that readily distinguishes epidural solutions from intravenous solutions. Use brightly coloured auxiliary labels to differentiate epidural solutions (e.g., for EPIDURAL USE ONLY) (ISMP Canada, 2005).
- Store epidural solutions in a separate storage area, away from other premixes. Keep them sequestered until needed for administration (ISMP Canada 2005; ISMP Canada, 2006).
- Retrieve and administer epidural medications at a separate time from the administration of intravenous solutions (ISMP Canada, 2006).
- Restrict stocking of epidural solutions to patient care areas that require them, based on patient population and drug use evaluation (ISMP Canada, 2005; ISMP Canada, 2006). Whenever possible, epidural solutions should be dispensed from pharmacy on a patient-specific basis so the label includes the patient's name and patient care area.

Additional general recommendations designed to *ensure distinctive processes for administration* of epidural medications include:

- Use distinctly coloured epidural tubing to differentiate it from other tubing (ISMP, 1998, June; ISMP Canada 2005; ISMP Canada, 2006).
- Use tubing without injection ports for epidural administration to prevent the inadvertent administration (direct injection or piggyback) of other medications via the epidural line (ISMP Canada, 2003; ISMP Canada 2005; ISMP Canada, 2006).

- Use brightly coloured labels to identify epidural solution and epidural infusion lines. Labelling lines at the distal connection site has been recommended (ISMP, 1998, June; ISMP, 1998, June; ISMP Canada, 2003; ISMP Canada, 2005; ISMP Canada, 2006).
- Use single-channel pumps for epidural infusions (ISMP Canada, 2003; ISMP Canada, 2005; ISMP Canada, 2006).
- Consider using dedicated infusion pumps for epidural use and have biomedical engineering pre-program the maximum infusion rate to a predetermined level (e.g., 20 mL/hour). Add a large visible label marked “Epidural Pump” on the pump being used to administer an epidural infusion (ISMP Canada, 2005; ISMP Canada, 2006).
- Physically separate epidural pumps from other pumps. Some hospitals encourage placing the epidural pump and IV pump on opposite sides of the bed, when patients are not ambulating, to better distinguish the two infusions (ISMP Canada, 2005; ISMP Canada, 2006).
- Consider an independent double-check policy and associated documentation for epidural infusions to verify patient identification, correct medication and its concentration, and route of administration upon initial programming and changes in programming of the infusion pump (ISMP Canada, 2003; ISMP Canada, 2005; ISMP Canada, 2006).
- Ensure training and competency assessment of all staff *before* they are required to work with patients with epidurals, including those receiving epidural infusions (ISMP Canada, 2005; ISMP Canada, 2006).
- Widely share this information with staff/peers to heighten awareness of the risk for mix-ups between epidural and IV medications (ISMP Canada, 2003).

Bar-coding technology is designed to help prevent substitution errors. According to the media reports at the time, a contributing factor to this incident was failure to use bar-coding technology that had been implemented and was “policy but not practice” in the hospital (WISCTV, 2006). This incident serves to remind us all of the need to (i) identify the barriers for successful implementation, and (ii) provide ongoing training, monitoring and evaluation when there has been investment in new technologies designed for enhanced patient safety.


In addition to all the steps health care providers and health care organizations can take to prevent misidentification of infusion products, an ideal safeguard is a “lock and key” redesign of bags, tubing and catheters so that medications intended for epidural use cannot be connected to intravenous lines or vice versa. This is similar to the changes made to products for use with gastric tubes – distinct pumps, lines and oral syringes that cannot interconnect to equipment intended for IV use.

Additional information

It has been reported that even with supportive measures, including administration of IV fluids, vasopressors and cardiopulmonary resuscitation, resistance to aggressive measures usually occurs after cardiovascular collapse associated with toxicity from anesthetics such as bupivacaine (Bacsik et al., 1995). Of special interest, two

case reports describe the use of intravenous 20% lipid emulsion (administered intravenously) for successful resuscitation following a cardiac arrest likely caused by systemic toxicity of local anesthetic products (bupivacaine and ropivacaine) (Rosenblatt et al., 2006; Litz et al., 2006). Although these reports are anecdotal in nature, lipid emulsion has been shown to increase the cardiotoxic threshold of bupivacaine in animal studies (Weinberg, VandeBoncouer, Ramaraju, Garcia-Amario, & Cwik, 1998; Weinberg, Ripper, Feinstein, & Hoffman, 2003). A recent editorial suggested having 20% lipid emulsion available where regional anesthesia is performed. The author of the editorial noted that use of 20% lipid emulsion should be considered only after standard resuscitative measures have proven ineffective for cardiac arrest induced by a local anesthetic agent (Weinberg, 2006). In addition, Weinberg (2006) emphasizes that propofol, with its 10% lipid emulsion base, is NOT to be used as a substitute as it can also increase cardiotoxicity in the higher doses that would be required under these circumstances. (For further information, including suggested IV dosing of 20% lipid emulsion, we would encourage readers to consult the cited references and other documents in the medical literature.)

Conclusion

Consider how epidural solutions are managed in your critical care area. Review and consider where failure points in the process may exist. All practitioners handling and administering these medications can often identify potential failure points and may even have knowledge of near misses that would assist in identifying strategies to improve safety. Implementing multiple system safeguards to prevent the inadvertent intravenous administration of epidural solutions containing anesthetics is paramount. Safety can be enhanced by focusing on how to make the system or process of administering epidural medications less error prone (i.e., to prevent errors or to facilitate practitioners to catch errors and take corrective action). Collectively and in collaboration with other health care providers, critical care practitioners can influence changes within their organization that can prevent the inadvertent IV administration of epidural solutions. 

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ISMP Canada gratefully acknowledges the valuable lessons learned and information reported by professionals in the Canadian health care community that can then be shared to enhance medication system safety.

ISMP Canada is a national voluntary medication incident and ‘near miss’ reporting program founded for the purpose of sharing the learning experiences from medication errors. Implementation of preventative strategies and system safeguards to decrease the risk for error-induced injury and thereby promote medication safety in healthcare is our collaborative goal.

Medication Incidents (including near misses) can be reported to ISMP Canada:

- (i) through the website http://www.ismp-canada.org/err_report.htm or
- (ii) by phone: 416-733-3131 or toll free: 1-866-544-7672.

ISMP Canada guarantees confidentiality and security of information received, and respects the wishes of the reporter as to the level of detail to be included in publications.

ISMP Canada is a key partner in the Canadian Medication Incident Reporting and Prevention System. ISMP Canada can be contacted by email: cmirps@ismp-canada.org. All ISMP Canada Safety bulletins are available from <http://www.ismp-canada.org/ISMPCSafetyBulletins.htm>.

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