Complications and Circumstances Pertaining to Intraosseous Lines

Pennsylvania Patient Safety Authority analysts received an inquiry asking about the type of events that occurred with the use of intraosseous (IO) vascular access catheters and whether events might be related to patient age. IO line access is a method of delivering fluids when a peripheral intravenous (IV) line or central line cannot be obtained in a timely manner, and patient morbidity or mortality is possible.1-6 IO line access was first used in animals in 1922.7 Patient use in a clinical setting was noted in the early 1940s.8 IO access is obtained by inserting a needle through the bone (e.g., proximal tibia, humerus; see Figure 1)9,10 and are generally removed within 24 hours.11,12 The bone provides a non-collapsible cavity to instill fluids and medications, which are absorbed at a similar rate to absorption via peripheral IV lines.7,8

A variety of guidelines generally based on age identify the appropriate circumstances for implementing this type of line access.2-5,13 For example, the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science recommend the use of IO access in children and adults if venous access is not readily available during an emergency.5,12 Contraindications for an IO insertion include ipsilateral (i.e., same side) fractures, previous attempts at ipsilateral IO access, local vascular injuries, cellulitis, infection or injury to the skin around the site, and burns.14,15 Intraosseous insertion should also be avoided in patients with a high risk for fractures (e.g., severe or advanced osteoporosis, osteogenesis imperfecta).13,14

Authority analysts queried the Pennsylvania Patient Safety Reporting System (PA-PSRS) to identify events related to IO lines during the most recent 10-year time period, January 1, 2006, through December 31, 2015, by using the keywords “IO,” “i.o.,” “i-o,” “intraos,” and “interos.” The query identified 175 event reports; 85 were excluded because they were irrelevant to the scope of the query (e.g., IO as an abbreviation for intraocular) or addressed a non-IO line event (e.g., fall) during which the patient had an IO line present. The remaining 51.4% (n = 90 of 175) event reports addressed IO clinical (e.g., insertion site complications) or system matters (e.g., equipment availability or breakage).

Figure 1. Intraosseous Needle in Tibia

The first part of the analysis examined the occurrence of harm and patient age. Five of the 90 event reports (5.6%) resulted in harm reaching the patient.* Slightly more than one third 34.4% (n = 31 of 90) event reports occurred in children younger than 10 years of age. Figure 2 provides the distribution of event reports by patient age (i.e., newborn to 23 months old and newborn through 99 years old) by harm score.

All of the IO events were reported by hospitals, and analysts grouped them according to the type of care area. The list below shows the hospital location where the events were reported:

- Intensive care units (40.0%, n = 36 of 90)
- Emergency departments (36.7%, n = 33)
- Medical, surgical, or pediatric units (13.3%, n = 12)
- Intermediate medical, surgical, or pediatric units (5.6%, n = 5)
- Unit location not identified (2.2%, n = 2)
- Imaging (2.2%, n = 2)

An analysis of the event narratives identified 15 clinical conditions or system matters involving an IO line. Of the 90 event reports, 41.1% (n = 37) described two or more circumstances in the event narrative. For example, in four events, the plastic hub disconnected from the metal IO needle during removal and in each instance, a hemostat or plier was used to remove the needle from the patient’s bone. See Figure 3 for the clinical conditions and system matters and their numbers of events.

The following selected PA-PSRS event narratives provide clarity about the circumstances associated with the IO events reports:

### Extravasation and Pain

Registered nurse noticed that patient’s IO [site] was cold and appeared to be infiltrated. Patient complained of severe pain where IO was placed. Swelling around IO site. Warm compress applied, pain meds given.

### Extremity and Extravasation

Patient’s lower extremity noted to be swollen and cool. IV assessment prior to infiltration noted site ok... Infusions stopped, IO removed, extremity elevated, warmed packs applied.
Equipment

The patient coded and there was no IV access. There was no IO needle in the code cart so nurses had to go to another floor to obtain one.

Removal, Needle, and Equipment

Peripheral access had been obtained. Attempted removal of intraosseous (IO) line, unable to remove. During attempts to unscrew IO device, plastic attachment device came off leaving only the needle in the patient’s leg. After multiple attempts the needle was removed and found to be slightly bent.

In Pennsylvania, IO needles can be inserted by physicians, advanced emergency medical technicians, and paramedics.16 Regarding nurses, the Pennsylvania nurses’ scope of practice does not prohibit the insertion of an IO line;17 nevertheless, it is advisable for nurses to follow facility policies for inserting and accessing these lines.

The literature shows that use of IO lines is limited by lack of equipment and training.18 Training in proper insertion techniques is available through Advanced Trauma Life Support and Pediatric Advanced Life Support courses.19 The type of device used and training have been shown to increase insertion success rates.20,21 The American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care identified multiple case studies showing that providers with different levels of training could rapidly establish IO access with minimal complications for children in cardiac arrest.32

---

* 41.1% (37 of 90) of the event reports had two or more circumstances identified in the event narrative.
Although the overall number of events reported is small, the proportion involving young children is worth noting. It is unclear whether the larger number of IO event reports involving children reflects a greater risk of complications for each IO insertion or whether there may be a larger number of IO insertions in very young, ill children, in whom starting an IV may be particularly difficult. The risk of IO insertion is to be balanced against the risks of IV insertion and the risks of untimely vascular access. Training, education, and resource availability can help with successful insertion of IO lines.

NOTES


The Pennsylvania Patient Safety Authority is an independent state agency created by Act 13 of 2002, the Medical Care Availability and Reduction of Error (Mcare) Act. Consistent with Act 13, ECRI Institute, as contractor for the Authority, is issuing this publication to advise medical facilities of immediate changes that can be instituted to reduce Serious Events and Incidents. For more information about the Pennsylvania Patient Safety Authority, see the Authority’s website at http://www.patientsafetyauthority.org.

ECRI Institute, a nonprofit organization, dedicates itself to bringing the discipline of applied scientific research in healthcare to uncover the best approaches to improving patient care. As pioneers in this science for nearly 50 years, ECRI Institute marries experience and independence with the objectivity of evidence-based research. More than 5,000 healthcare organizations worldwide rely on ECRI Institute’s expertise in patient safety improvement, risk and quality management, and healthcare processes, devices, procedures and drug technology.

The Institute for Safe Medication Practices (ISMP) is an independent, nonprofit organization dedicated solely to medication error prevention and safe medication use. ISMP provides recommendations for the safe use of medications to the healthcare community including healthcare professionals, government agencies, accrediting organizations, and consumers. ISMP’s efforts are built on a nonpunitive approach and systems-based solutions.

Scan this code with your mobile device’s QR reader to subscribe to receive the Advisory for free.