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Case Report

The versatility of intraosseous vascular access in perioperative medicine: a case series

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Abstract Intraosseous vascular access is a time-tested procedure that is reemerging in popularity. This is primarily a result of the emphasis on intraosseous access in the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Advanced Cardiac Life Support. Modern intraosseous insertion devices are easy to learn and use, suggesting the possibility of use beyond the resuscitation setting. We present a case series of recent intraosseous insertions for a variety of indications by anesthesiologists at our institution to demonstrate the potential utility of this alternative access technique.

1. Introduction

Intraosseous vascular access is a time-tested procedure that is reemerging in popularity. This is primarily a result of the emphasis on intraosseous access in the 2010 American Heart Association (AHA) Guidelines for Cardiopulmonary Resuscitation and Advanced Cardiac Life Support (ACLS). The safety and efficacy of intraosseous access is well documented [1]. As a result, the 2010 AHA guidelines suggest providers to establish an intraosseous access if an intravenous line is not easily obtainable [2]. Similarly, the European Resuscitation Counsel, as well as the International Liaison Committee on Resuscitation, both endorse intraosseous over central venous or endotracheal drug administration if intravenous access cannot be obtained [3].

Newer intraosseous insertion devices, such as the EZ-IO (Vidacare Corporation, San Antonio, TX), can be placed quickly and require minimal training. In one study, a group of 99 health care providers with no intraosseous experience had a 96.9% first-attempt insertion success rate (on cadavers) with the EZ-IO device after watching a 5-minute video and 1 insertion demonstration by an instructor [4]. Another randomized trial demonstrated a similarly high first-attempt success rate (97.8%) as well as quick insertion time (32 ± 11 seconds) in cadavers [5]. Given the documented speed and accuracy of EZ-IO insertion, the role of intraosseous access outside the resuscitation setting should be explored. Specifically, anesthesiologists should consider intraosseous insertion when inadequate vascular access is encountered in the perioperative and critical care settings. We present a case series of recent intraosseous insertions for a variety of indications by anesthesiologists at our institution to demonstrate the potential utility of this alternative access technique.

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2. Case reports

2.1. Operating room

2.1.1. Case 1

A 34-year-old, 127-kg patient presented for elective robotic hysterectomy. She reported a history of "difficult intravenous access," and prior elective surgeries had been delayed or cancelled due to the inability to gain vascular access. The patient arrived in the operating room with no vascular access despite many attempts, and she refused central line placement. After careful discussion with the patient, the decision was made to place an intraosseous line rather than postponing the procedure for placement of a peripherally inserted central catheter. The patient was administered a 1:1 mixture of oxygen and nitrous oxide via facemask. Local anesthetic infiltration down to the periosteum was conducted at the proximal tibia insertion site. A 45-mm (15-gauge) needle was inserted in the right proximal tibia using an EZ-IO device. The patient reported just 2 of 10 insertion pain on a visual analog pain scale. Prior to initiating an infusion, the line was flushed with 5 mL of 2% lidocaine. The patient complained of 6 of 10 pain at the start of the injection, but was pain free by completion. An infusion of Lactated Ringer's solution was subsequently started without complaint of pain. A pressure bag was used to maximize flow. Induction of anesthesia with fentanyl, propofol, and rocuronium was completed without incident. Because the surgical procedure mandated the lithotomy position with the legs in stirrups, foam "donuts" were placed to pad and protect the needle insertion site. Interestingly, the lithotomy position with marked head-down tilt did not seem to affect flow through the intraosseous line. The surgery was completed without complication. After the procedure, the patient reported she was extremely satisfied with the intraosseous technique and she described the pain of insertion as "minimal." Importantly, she stated she would request intraosseous insertion again in the future as opposed to experiencing numerous unsuccessful intravenous attempts.

2.1.2. Case 2

A 21-year-old man with a history of cerebral palsy and muscle spasticity with extremity contractures was admitted the day of surgery for an intrathecal baclofen pump refill. He had a history of difficult peripheral intravenous access, and central venous access had been required for his most recent procedure. By the time the anesthesia team arrived, the patient had undergone multiple attempts at phlebotomy for blood tests. Physical examination was notable for contractures of all 4 extremities. His airway examination revealed a large head and short neck with limited extension and redundant neck and facial tissue. After chlorhexidine skin cleansing, 1 mL of 2% lidocaine was infiltrated subcutaneously and down to the periostium over the right proximal tibia. The EZ-IO device was used to successfully place a 25-mm (15-gauge) intraosseous needle (entire procedure took less than a minute). The patient indicated minimal pain on insertion. A bolus of 2 mL of 2% lidocaine was injected prior to using the line. Induction of anesthesia with propofol and rocuronium administered via the intraosseous line was uneventful.

After the procedure, the patient was transferred to an intermediate care unit. Although there is a hospital policy in place regarding management of intraosseous infusions, the nurses in these units have limited experience using them. The attending anesthesiologist provided a short tutorial to the surgical and nursing teams on the management of an intraosseous line. The patient's guardian indicated that she was satisfied with the use of intraosseous access and would request this for future short hospitalizations rather than repeated intravenous attempts or central venous access.

2.2. Critical care unit

2.2.1. Case 1

A 65-year-old, 70-kg female resident of an assisted living facility was admitted from the emergency department (ED) due to acute onset of altered mental status. She had a pertinent medical history of atrial fibrillation for which she was maintained on chronic warfarin therapy. A 20-guage peripheral intravenous line was established in the ED, and the patient was intubated for airway protection. Vital signs, diagnostic studies, and laboratory analysis led to the diagnosis of urosepsis, and she was transferred to the intensive care unit (ICU) for further management. Admission laboratory studies were notable for an elevated International Normalized Ratio (INR) (4.5).

On arrival to the ICU, the patient's condition deteriorated and she became hypotensive despite phenylephrine support. Multiple attempts to establish a second peripheral line were unsuccessful. Central line placement was considered based on the need for immediate volume resuscitation, blood component therapy, and vasoactive medication administration. In light of the elevated INR, however, a left tibia intraosseous line was placed instead. This allowed immediate resuscitation with fresh-frozen plasma (to reverse the high INR), fluid, and inotropic support. By ICU day 2, the patient's hemodynamic profile had improved considerably. The INR normalized allowing for placement of a central venous catheter. The intraosseous line, which served the dual purpose of both rapid resuscitation and a bridge to central line placement, was subsequently removed without complication.

2.2.2. Case 2

A 62-year-old, 95-kg woman presented to the ED in respiratory distress secondary to pneumonia. During direct laryngoscopy in the ED, she sustained a traumatic injury to the anterior trachea resulting in large amounts of peritracheal air demonstrated on radiographic imaging. The defect was surgically repaired 2 days later. The patient had a prolonged