Emergency Intraosseous Access:

A Useful, Lifesaving Device Used in Afghanistan

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ABSTRACT
Intraosseous access is becoming a lifesaving procedure under emergency conditions in Afghanistan's battlefield. The EZ-IO system (Vidacare, San Antonio, TX, USA) was successfully used in five patients in whom there was difficulty finding a peripheral venous access. The EZIO is an indispensable medical device to be used on the battlefield and during the evacuation of the wounded in a moving vehicle or helicopter.

Introduction
Wounds caused by explosions are often confronted in emergencies on the military battlefield, and it is not rare for patients to experience hypovolemic shock.1 On the battlefield, the dynamics of trauma with high kinetic energy can cause devastating wounds with massive hemorrhage and the collapse of blood vessels and burns. Combined with hostile environmental and tactical conditions, it is often difficult to obtain peripheral venous access to a limb in a Soldier, for example, with multiple wounds or at night inside a vehicle. In these situations, intraosseous (IO) access becomes indispensable and lifesaving. IO access has been used since World War II. Its use declined in the years thereafter due to the advent of venous catheters but has reemerged in the 1980s, especially in pediatrics. Its use on the military battlefield has developed during the past decade, with constant evolution in devices. It has particular importance in environments outside the hospital, both on the battlefield and during casualty evacuation, such as when performing the procedure in a helicopter in flight.

Case Report
From April 2008 to October 2008, five patients (four males and one girl) were treated with IO access in an American ROLE 2 Facility (advanced first aid with an operating room) in southwestern Afghanistan during the International Security Assistance Force (ISAF) mission. All five patients were of Caucasian origin (Americans and Afghans) and were between 5 and 26 years of age. All patients presented with traumatic wounds, and all were in hypovolemic shock. They were treated according to Advanced Trauma Life Support (ATLS) as soon as they reached the Aid Station. One patient presented with third-degree burns on the upper limbs and second-degree burns on the face (about 27% of skin surface). Another patient presented with third-degree burns on the upper limbs and second-degree burns on the lower limbs and on the face (about 63% of skin surface). The little girl had a penetrating head wound from a firearm (AK-47). Two of the patients were unconscious with a Glasgow Coma Scale (GCS) score of < 8. The final two patients (Afghans) presented with chest wounds from a firearm and a massive left hemothorax. None of the patients came to our attention with venous access. IO access was used in these five patients due to the difficulty of finding a suitable peripheral venous access (Figure 1). The EZ-IO system (Vidacare, San Antonio, TX, USA) was used to obtain IO access, and the point of insertion of the needle was obtained just under and medial to the tuberosity of the tibia. American military nurses and paramedics performed this procedure. IO access was used to introduce crystalloids in all patients as well as opioid analgesic and antibiotic medications in four patients. Insertion occurred quickly on the first attempt, within 5 seconds. One patient complained of strong pain (Numeric Pain Intensity Scale 8) after the insertion of the needle. The pain was subsequently controlled with an infusion of opioid analgesic (10mg of morphine).8 Once stabilized, all the patients were brought to the operating room, where a central venous line was placed. In addition, it was then possible to obtain peripheral venous access in the girl's foot with use of a 25-gauge venous catheter as a result of fluid resuscitation that resulted from the IO access (Figure 2). In all cases, IO infusion occurred under pressure using pressure bags (300mm Hg). The girl died 2 hours after the emergency treatment as a result of a high-energy head wound. In the short-term follow-up (<24 hours), no complications were indicated after IO access was obtained in the other four patients.

Discussion
EZ-IO is a small, battery-powered drill with a 15-gauge terminal needle with three different lengths (15mm, 25mm, and 45mm): two for adults and a shorter one for children (patients <40kg). The point of insertion is just under and medial to the tuberosity of the tibia. Insertion can also be obtained at the head of the humerus and at the radius. IO access is obtained in under 10 seconds.9–11 Its indications for use are in patients who have extensive burns (>30%), cardiac arrest, difficult peripheral venous access, hypovolemic shock, or epileptic seizures; in those who are comatose or polytraumatized; or in pediatric patients.A pressure bag is used to improve the reach of the infusion, which can increase flow by more than 100%. Absolute contraindications to the use of the EZ-IO are few. It may not be introduced into a fractured or semiamputated bone, into an area where an infection is evident at the point of insertion, or in any patient in whom it is not possible to identify the anatomical landmark.

Relative contraindications include osteoporosis, burns at the insertion point, imperfect osteogenesis, or a limb previously used for placing an IO catheter.14 The most frequent complications are pain, which can be controlled with the infusion of 20–50mL of lidocaine 2%, and the appearance of soft-tissue edema, especially due to improper insertion of the needle. Compartment syndrome is a rare event. Other possible complications are osteomyelitis, cellulitis, and skin infections (<1% of cases) caused by prolonged use (>24 hours). Bone fracture at the point of insertion has also been reported, and rare cases of embolism have been reported in animal studies.15–19 The IO pathway to obtain vascular access has also been considered in ATLS and Advanced Pediatric Life Support. IO access may represent the only access pathway for the infusion of liquids in an emergency situation.

Conclusion

Based on this experience, EZ-IO appears to be an indispensable medical device on the battlefield to be used both outside the hospital environment and during the evacuation of the wounded in moving vehicles or in helicopters, as well as at an advanced medical site for stabilization of the patient. It allows for the administration of fluids and medications by rapidly obtaining safe IO access.23,24 We believe that this medical procedure may be performed by paramedical and nursing staff who are properly trained. The wide diffusion of this procedure in domestic environments outside the hospital could bring numerous advantages in the stabilization of critical patients, with a clear decrease in time for obtaining an infusion pathway.

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