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Intraosseous access in opinion of medical faculty students

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Abstract

Background. The aim of this study was to collect students' opinions on the available intraosseous techniques (IO) and sites of application in victims who were suffering from life-threatening conditions. ***Material and methods.*** We surveyed 239 third-year medical students (152 women and 87 men) at Poznan University of Medical Sciences in 2012 and 2013. The students answered a questionnaire after completing a course on various methods of IO on mannequins. ***Results.*** Medical students preferred EZ-IO and a tibia approach for IO placement. *Anestezjologia i Ratownictwo 2014; 8: 140-143.*

Keywords: intraosseous access, intraosseous needle, intraosseous infusion, cardiopulmonary resuscitation, emergency treatment

Introduction

Quick intravenous access is an important procedure in the treatment of life-threatening conditions. The duration of venous catheterization is 2.5-16 minutes, which might be too long [1]. Rosetti demonstrated that during the resuscitation of 66 children, even experienced personnel encountered problems in establishing intravenous (IV) access in 24% of cases; IV access was unfeasible in 6% of cases [2]. According to the European Resuscitation Council (ERC) Guidelines 2010 for adults, if IV access cannot be effected in the first 2 minutes of cardiopulmonary resuscitation, intraosseous access should be considered [3].

All drugs and fluids can be administered via intraosseous (IO) access in similar doses and concentrations as through an IV catheter [4,5]. Warren reported that IO at various sites (femoral, humeral, tibia bones) provided the same therapeutic effects as IV route of drug administration [6]. There are several techniques of establishing IO access, such as FAST1 (Pyng Medical Corp., Vancouver, BC, Canada), BIG (WaisMed Ltd., Houston), EZ-IO (Vidacare Corp., San Antonio), COOK, and Jamshidi needles. FAST 1 was designed for IO placement in the sternum in adults only. BIG uses a spring that, when released, inserts a needle into the bone; the depth of insertion can be adjusted, depending on the patient's age. EZ-IO is a battery-powered drill with disposable needles in 3 sizes. COOK and Jamshidi are manual needles that are used for IO access in limbs.

The primary indications for IO are loss of consciousness, arrhythmia, burns, cardiac arrest, dehydration, head trauma, hypotension, seizures, shock and other critical conditions in the severely ill victims when rapid and timely intravenous access cannot be established.

The chief contraindications are fractures, orthopaedic interventions in the site of puncture, difficult localization due to obesity, site of burns, and injuries severe with coexisting bleeding at the site of IO access

[7]. The optimal time for maintaining IO is short (24 hours) and can be extended up to 72 hours [8].

As part of the medical curriculum, students are taught to perform IO access, and their individual attitude toward the equipment might influence the decision regarding IO methods in actual cases. We were interested in how the technical aspects or various devices influence this choice in inexperienced trainees. The aim of this study was to collect students' opinions on IO techniques and sites of application in victims who were suffering from life-threatening conditions.

Material and methods

We recruited 239 third-year medical students (152 women and 87 men) at Poznan University of Medical Sciences in 2012 and 2013. After a 2-hour presentation on IO, students practiced IO on mannequins for 2 hours. All students received the same theoretical preparation. During the presentation, the students were familiarized with the safety, pain and practical aspects of IO placement, including the list of possible complications and pain scores achieved by the real victims presented in the already published studies.

The practical classes were conducted per a strict, previously established program. Each participant practiced on all IO devices several times and agreed to fill out an anonymous questionnaire that comprised simple questions about the safety, pain and use of IO equipment. The students could refuse participation in the study with no consequences. None of the participants had previous experience in establishing IV or IO access. In order to assess the students' opinion we used open questions in the test, thus allowing for free answers. The created questionnaire covered the previously presented material.

Results

According to students' opinion, EZ-IO was the safest method of IO, and they would choose this method in emergent situations. Students considered BIG the least painful (Table I).

If IO was needed, students would choose the proximal tibia as the preferred site of application (Table II).

In this study, we chose a homogeneous group of students. The students considered EZ-IO the best solution compared with the other devices for IO access. The students highlighted the control that they had with the EZ-IO. BIG use is safe, as reported by the students in their evaluation. Nevertheless, despite previous theoretical training, students continued to have doubts over BIG. Students described certain dangerous situations that can occur during establishment of IO. They highlighted a spring in BIG that was difficult to load and caused unintended injuries to a rescuer and the danger of accidental trigger release with BIG. The students of the University of Medical Sciences in Poznan were also concerned over the risk of abrupt needle movements with BIG, which can break bones in fragile elderly patients. Further, the trigger elicited a sudden noise, and there were problems loading the device, discouraging students from using BIG. The students recognized the risk of injury to the sternum, pneumothorax, and cardiac tamponade with FAST1. The opinions on FAST1 varied with regard to use by inexperienced rescuers.

Generally, the students felt that with the COOK needle, there was no control of depth insertion or possibility for stabilization. Application of a COOK needle required a considerable forth, causing substantial pain in patients. Its insertion can be time-consuming, raising questions over its value in emergency medicine.

Table I. Students' evaluation of the IO devices

		EZ-IO	BIG	FAST 1	Cook	Jamshidi
Which system is the safest?	Number %	113 47.28%	95 39.75%	29 12.13%	2 0.84%	-
Which system is the least painful?	Number %	30 12.55%	67 28.03%	61 25.52%	62 25.94%	19 7.95%
Which system would you apply in emergent situations?	Number %	67 28.03%	11 4.60%	9 3.77%	-	-

Table II. The preferable quickest site of IO access

	Proximal tibia	Distal tibia	Humerus	Sternum	Calcaneus
Number %	110 46.02%	76 31.80%	35 14.64%	12 5.02%	6 2.51%

Discussion

During a sudden collapse of a victim, students chose the EZ-IO and BIG. After the classes, the students considered the EZ-IO as the fastest IO access. On cadavers, the EZ-IO takes approximately 6 seconds (range 3 to 25 seconds), as reported by Levitan [9]. Byars reported that the mean time to successful placement of FAST1 (insertion of the needle, with subsequent aspiration and fluid flow without infiltration) was 67seconds [10]. Reades compared tibial and humeral access for IO and concluded that tibia intraosseous access is associated with the highest first-attempt success for vascular access and the most rapid time to vascular access during out-of-hospital cardiac arrest compared with peripheral intravenous and humeral intraosseous access, confirming the students' choice after training [11]. Myers et al. performed a 93-patient study that compared manual and powered EZ-IO devices for paediatric use and noted a higher first-attempt success rate for the EZ-IO [12]. Gazin reported an overall success rate of 97% for the EZ-IO and a first-attempt success rate of 84%, with only one complication-transient local inflammation [13]. The students' first impressions regarding the superiority of the EZ-IO over the other techniques are supported by Sunde, who observed overall success rates of 50% with manual needles, 55% with BIG, and 96% with EZ-IO [14]. Miller measured a median time to needle deployment of 27.5 seconds and concluded that FAST1 should be applied only after extensive training [15]. Barratt tested the level of confidence for IV versus IO access (EZ-IO versus FAST1) in military clinicians who were deployed in Afghanistan and found that IV access has a similar level of confidence as FAST1 and significantly higher level than EZ-IO, although previous experience with EZ-IO increased the confidence in its application [16]. German studies of participants in emergency seminars have compared the effectiveness of manual and semiautomatic devices for IO access and noted the superiority of the EZ-IO over manual needles in first-time applications, accompanied by fewer technical complications. The objective time of procedure performance was not measured in our study, which can be a possible limitation of the study. The seminar participants gave higher subjective scores on user friendliness for the EZ-IO than for manual needles [17].

The BIG was considered as the least unpleasant device for the patient during application, likely due to the good control of the device and convenient handling. Pain during application of the EZ-IO was also reported in responsive military patients in Afghanistan, as described by Cooper [18].

Taking into consideration the results of many studies and our own ones, future doctors will likely choose the EZ-IO over other methods for IO access.

Notably, students avoided manual needles, even though they used them in manikins, and despite receiving satisfactory information before practical attempts and positive feedback from the teacher. According to the Consortium on Intraosseous Vascular Access in Healthcare Practice, steel manual needles are limited by the difficulty in accessing dense adult bone. The disadvantage of sternal access is the inaccurate location of the depth of insertion. In contrast, drilled powered devices facilitate efficient insertion and minimize trauma to the bone during insertion [19].

While answering the open questions, students suggested that the tibia was considered site of access that effected the fastest placement, which is a justified choice, because this site does not interfere with ongoing procedures, such as cardiopulmonary resuscitation, puncturing of pneumothorax, and endotracheal intubation, although IO cannot be performed in lower limb injuries.

Concluding, in our study the medical students preferred the EZ-IO and tibia approaches for IO placement. In our opinion, the most of students are able to evaluate a new medical equipment and even though they are people without previous experience, their opinions should be taken into consideration.

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Conflict of interest
None

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