Short-term and long-term impact of Intraosseous catheterization training on medical staff readiness to stabilize critically ill patients

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Introduction

Administration of fluids and drugs to pediatric patients during resuscitation necessitates frequent use of intravenous access. However, establishment of an intravenous access can be time consuming, challenging, and difficult in critically ill pediatric patients. Depending on the situation, techniques like umbilical catheter, venous cut-down, central venous catheterization are not an option. A rapid and effective alternative route for infusion of fluids and drugs in the emergency care of pediatric patients is the use of intraosseous (IO) line [2, 8, 9]. The bone marrow spaces inside the bone cavity are not collapsible unlike veins, making it readily available for use. Also, fluids, resuscitation drugs and blood products given through this route would go rapidly into the central circulation at about the same rate as an intravenous access [4,5,8,10].

The American Heart Association (AHA), the UK resuscitation council and the International Liaison Committee on Resuscitation (ILCOR) have widely accepted and approved the use of the intraosseous line as a first line method of resuscitation in cardiac arrest and first or second line in peri-arrest situation. It was discussed to transfuse fluids, blood products and a variety of drugs. [1,3,11]. Despite these indications, the use of intraosseous access is not a prominent feature in actual emergency cases and studies describing its use across diverse emergency department and hospital settings are blurry, particularly from low and lower-middle-income countries.

All emergency physicians are required to attend these vocational training programs with some frequency every 2 years or once every 3 years. Also international conferences or congresses held in emergency care include practical training courses in intraosseous injection. Because of this, a doctor or resident who is less proficient in this methodology is empowered to demonstrate practical skills in this methodology.

To our knowledge, the use of intraosseous access has not been established in Georgia and it's not readily used in the emergency department of both pediatric and adult cases.

Therefore, the groundwork should be laid in Georgia for the introduction of bone injection methodology as an alternative way when peripheral vein catheterization is not possible. As it is accepted in the West by conducting practical classes at conferences and congresses. Also at this stage, BLS, ACLS, ATLS and PALS courses are being established in Georgia, part of which is the training of intraosseous injection techniques.

The main purpose of study at this stage was to determine the need for repeated training for staff. A further aim was divide trained physicians into two conditional groups: the first group who use this methodology after training (Tab.1) and the second group who do not to use it in the practice. (Tab 2).

Methods and Study Design

To support the above theory a total of 16 doctors from Pediatric emergency department from two Children's clinics in Georgia were trained in theoretical and practical skills on intraosseous catheter implantation, contraindications, and catheterization techniques.

The aim of the training was physicians to gain the competence to successfully administer an IO infusion if IV access failed in an emergency.

In brief, the curriculum of this training contains the following:

(i) A short interactive lecture for the knowledge of IO access: guidelines, algorithm, indications (failed IV access or resuscitation), contraindications (e.g. nonintact bone), location for IO puncturing (e.g. proximal part of tibia).

(ii) Practice: skill stations with a plastic bone, an IO set per participant and one instructor per four participants. After demonstration every participant administers a full IO infusion including fixation technique.

The handling of the IO needle is crucial for success. Each participant received feedback after practical demonstration of the skill.

Staff testing was conducted before the start of the training. Relevant post-testing was also conducted after the trainings. As can be seen from the pre-test and post-test results (short-term), the training was successful. Physicians have mastered new theoretical and practical skills.

The average time for the procedure is about 2 minutes when performed by experienced medical personnel with a suitable device like EZ-IO [5,7,13]. This technique, in capable and skillful hands, can attain relatively quick resuscitation but it's not without life-threatening complications.

Most of the doctors in this study was female, one was male. Most are over the age of 40, with medical experience of 2 to 5 years working as a pediatric emergency physician. Five of these physicians actively, used the appropriate methodology in the management of severe patients when peripheral venous catheterization was impossible and complete indication was intraosseous catheterization.

We used paired sample t-test to compare pre- and post-test scores among groups, as well as independent sample t-test to compare scores among participants who performed the procedure between the post-test and the long-term post-test and those who didn't perform it.

Results and Discussion

Exam scores differed statistically significantly between the pre (mean:7.62, SD:4.5) and post-test (mean:9.65, SD:5.05) groups ($p<0.001$), as well as between the post-test and long-term control post-test groups (mean:13.88, SD:5.3) ($p<0.05$). Test scores, as could be expected, decreased on average over time.

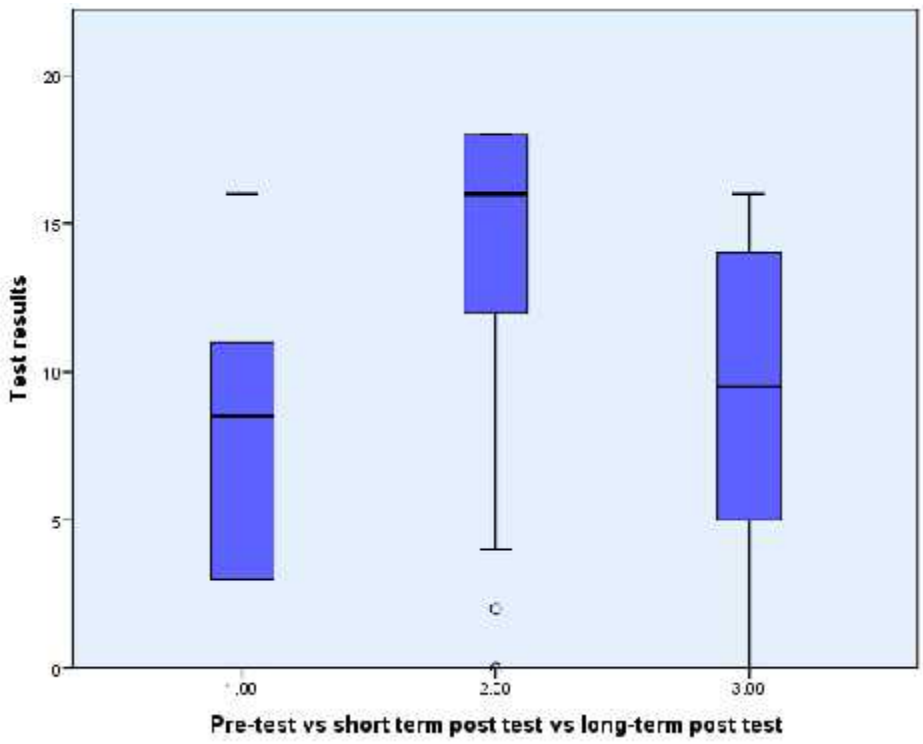
Tab. 1 Paired Samples Statistics Pre-test and the first Post-Test Comparison

	Mean	N	Std. Deviation	Std. Error Mean	Sig.
Pre-test	7.62	26	4.500	.882	.001
PostT	13.88	26	5.309	1.041	

Tab.2 Paired Samples Statistics Pre-test and Long-term Post-Test Comparison

	Mean	N	Std. Deviation	Std. Error Mean	Sig.
Pre-test	7.62	26	4.500	.882	.024
LT Post-Test	9.65	26	5.051	.991	

While the first post-test results didn't differ statistically significantly (p=0.521) the results of the second post-test (long-term) different statistically significantly between the groups of 5 physicians who had practically performed the procedure between the post-tests, and those who didn't perform the procedure (p<0.001).



We suggest that if the methodology is used by a physician, the need for active repetitive training in practice every two years will suffice.

If physicians do not apply this methodology in practice, this practical skill and theoretical knowledge will lead to repeated trainings every 6 months. An interesting link was also found between medical experience and the age of physicians using this methodology.

We observed that the younger the doctor and the less clinical experience he has, the more easily and often they use the intraosseous catheterization method. The IO route is reemerging in pediatric emergency care due to its effectiveness, also its ease and practical use. It is generally acknowledged as an adequate "plan B" in emergency situations where the use of peripheral IV access has failed usually after 3 attempts or about 90 seconds.

Conclusion

One of the major advantages of the intraosseous route is that its technique requires little or no experience to acquire expertise, it is readily accepted and frequently used by medical personnel trained in it [9]. The limiting factor of use of this route would be lack of training and low indication in the neonatal critical care life support guidelines, as in our case. In this case, there is high focus on the use of umbilical venous access alone [6,9,12). This study is to help pave way for further research work and consequent use of this method in emergency care of critically ill pediatric patients, which requires training and repeated training sessions.

Key words: Intraosseous Access, Intraosseous access training, intraosseous catheter, pediatric emergency care, intraosseous line, pediatric resuscitation, vascular access.

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Abstract

The introduction of intraosseous injection methodology is very important in critically ill patients With whom peripheral venous catheterization is impossible and there is not enough time to implant a central vein due to a life-threatening condition of the patient.

To carry out the relevant manipulation in Georgia, for the first time in 2016 and then in 2017, the USA Mayo Clinic Emergency Care Physicians held trainings in Intraosseous Catheterization, which included both theoretical (indications, contraindications, complications, etc.) and practical trainings (techniques for using a special tool on manikin bone).

A team of emergency physicians from two pediatric clinics of Georgia was later selected to undergo the above-mentioned training (theoretical and practical). Both teams were pre-tested before the training and post-tested after. The results were compared. For two years, a certain number of physicians underwent appropriate manipulation in patients on testimony.

The aim of our further study was to determine whether physicians possessed theoretical and practical skills two years after training. Doctors were divided into two groups: those who performed this manipulation during this period and the other who did not perform the manipulation. Physicians have been tested, which has shown us the need for periodic intraosseous catheterization training so that physicians who have not undergone this manipulation do not lose the relevant skills and perform this manipulation safely when needed.

Резюмэ

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Внедрение методики внутрикостных инъекций очень важно для пациентов с критически тяжелыми формами, у которых катетеризация периферических вен невозможна и у которых недостаточно времени для введения центральной вены из-за опасного для жизни состояния пациента.

Для проведения соответствующих манипуляций в Грузии впервые в 2016 году, а затем в 2017 году США Экстренные тренинги Mayo Clinic, которые включали в себя как теоретические (показания, противопоказания, осложнения и др.), Так и практические занятия (приемы использования специального инструмента по мульчированию костей голени).

Позднее была отобрана бригада врачей скорой помощи из двух педиатрических клиник для прохождения вышеуказанного обучения (теоретического и практического). Обе команды прошли предварительное и пост-тестирование после тренировки. Результаты сравнивали. В течение двух лет определенное количество врачей по показаниям подвергали пациентам соответствующие манипуляции.

Целью нашего дальнейшего исследования было определить, обладают ли врачи теоретическими и практическими навыками через два года после обучения. Врачи были

разделены на две группы: те, кто выполнял эту манипуляцию в этот период, и другие, кто ее не выполнял. Доктора прошли тестирование, которое показало нам необходимость периодического обучения внутрикостной катетеризации, чтобы врачи, которые не подвергались этой манипуляции, не теряли соответствующих навыков и при необходимости выполняли эту манипуляцию безопасно.

<u>რეზუმე</u>

ძვალშიდა ინექციის მეთოდოლოგიის დანერგვა ძალიან მნიშვნელოვანია კრიტიკულად მძიმე პაციენტებში, რომლებთანაც შეუძლებელია პერიფერიული ვენის კათეტერიზაცია, ხოლო ცენტრალური ვენის დასაყენებლად არ არის საკმარისი დრო პაციენტის სიცოცხლისათვის საშიში მდგომარეობიდან გამომდინარე.

შესაბამისი მანიპულაციის ჩასატარებლად საქართველოში პირველად 2016 წელს და შემდეგ 2017 წელს ჩატარდა ა.შ.შ. მეიოს კლინიკის გადაუდებელი დახმარების ს ტრეინინგები, რომლებიც მოიცავდა როგორც თეორიულ (ჩვენებები, უკუჩვენებები, გართულებები და ა.შ.) და პრაქტიკული ტრეინინგებს (სპეციალური ხელსაწყოს გამოყენების ტექნიკა (წვივის ძვლის მულიაჟზე).

მოგვიანებით შეირჩა ორი პედიატრიული კლინიკის გადაუდებელი დახმარების ექიმთა გუნდი, რომელთაც ჩაუტარდათ ზემოთ ხსენებული ტრეინინგი (თეორიული და პრაქტიკული). ტრეინინგის დაწყებამდე ორივე გუნდს ჩაუტარდა პრეტესტირება და ტრეინინგის შემდეგ პოსტტესტირება. მოხდა შედეგების შეედარება.

ორი წლის განმავლობაში ექიმთა გარკვეული ნაწილი ჩვენებით ახორციელებდა შესაბამის მანიპულაციას პაციენტებში.

ჩვენი შემდგომი კვლევის მიზანი იყო დაგვედგინა, რამდენად ფლობდნენ ექიმები თეორიულ და პრაქტიკულ უნარ-ჩვევებს ტრეინინგიდან ორი წლის შემდეგ. ექიმები

გაიყო ორ ჯგუფად: ვინც ჩაატარა ამ პერიოდში ეს მანიპულაცია და მეორე ვინც არ ჩაატარა მანიპულაცია. ექიმებს ჩაუტარდათ ტესტირება, რამაც დაგვანახა, რომ საჭიროა ძვალშიდა კათეტერიზაციის ტრეინინგების პერიოდულობით ჩატარება, რათა იმ ექიმებმა რომელტაც არ ჩაუტერებიათ ეს მანიპულაცია არ დაკარგონ შესაბამისი უნარ-ჩვევები და უსაფრთხოდ ჩაატარონ ეს მანიპულაცია საჭიროების დროს.

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