

USE AND INDICATIONS OF THE INTRASOSEOUS WAY IN EXTRAHOSPITAL EMERGENCIES

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Abstract: The use of the intraosseous route as an immediate alternative to the peripheral venous route has been known for many years, in fact its use is increasingly common, especially in emergencies that occur in the extra-hospital setting. This article will review the types of intraosseous channeling devices, their indications, contraindications, method of insertion, and certain considerations to take into account regarding their use. It is important to highlight and publicize the applications and form of cannulation of the intraosseous route, since it is a technique that all health professionals must know (mainly nurses, who are the ones who perform vascular cannulation techniques) and that has proven to be very useful in critical patient care, both adult and pediatric, especially in out-of-hospital emergencies.

Keywords: Intraosseous route, intraosseous perfusion, alternative vascular access, emergencies.

INTRODUCTION:

In an emergency, it is essential to channel a vascular access quickly to be able to administer medication or fluids, as well as to be able to take samples for blood analysis. Many times, in out-of-hospital emergencies we find ourselves in situations in which channeling a peripheral venous line becomes a real challenge, which can even become impossible to carry out. Environmental factors must be taken into account, such as low temperatures, which cause hypothermia and collapse of peripheral veins, lack of lighting, rain, etc. On other occasions, it is the pathology of the patient himself that prevents us from channeling a venous line, such as hypovolemia, serious burns, severe dehydration, some polytraumatized patients, shock, morbid obesity, or simply in the case of very young children.

According to Advanced Trauma Life Support (1), there are numerous studies that

support the use of the intraosseous route as an alternative to the peripheral route. In fact, both the European Resuscitation Council (ERC)(2) and the American Heart Association (AHA) (3) in their 2015 recommendations indicate the intraosseous route if it is impossible to channel a peripheral venous line or if it takes too long. Several years ago, the tendency was to channel a central venous access in the absence of a peripheral one, but currently this access is in disuse due to the complexity and high degree of expertise required to channel the central line, which implies a greater loss of time and the use of more material.

Today there are very effective devices for channeling via IO, making the technique even easier and faster.

ADVANTAGES OF THE INTRAOSSEOUS WAY (IO):

Intraosseous access is very useful because the interior of the long bones is provided with an extensive network of venous vessels, forming part of the bone marrow and draining that blood flow into the central venous circulation. The characteristic that makes these vessels interesting is precisely that they do not collapse, which makes the IO route a safe access in any type of pathology (even in cardiorespiratory arrest).

Another advantage is that all kinds of drugs can be infused through the IO route (except for cytostatics and parenteral nutrition, although these are irrelevant in the context of out-of-hospital emergencies, since they are not used). We can also perfuse fluids and blood products, and all of them with a flow equivalent to a peripheral access, which, depending on the size of the bone, the use of a perfusion pump or a pressure cuff or the type of needle used for the IO route can become similar to a large-bore (16G) peripheral catheter.

In addition, the effect of the drug or fluid administered via IO is very fast, essential in an

emergency situation. This cannot always occur with other types of administration such as the oral route (almost zero use in emergencies), subjugal, subcutaneous, intramuscular, endotracheal, etc., since these routes have limitations in terms of bioavailability, form and presentation of the drugs, amount they accept and some of them with erratic absorptions.

INDICATIONS:

- Indicated in all ages, both adults and children, including neonates in the absence of an umbilical route (first option in these cases).
- Decompensated shock, especially in septic and hypovolemic, but also in anaphylactic.
- Cardiorespiratory arrest.
- Trapped patients.
- Major burns.
- Epileptic status.
- Unstable polytraumatized patients.
- In general, as long as it is not possible to channel a venous line in a reasonable time (the AHA does not speak of a certain number of attempts, it simply refers to the fact that intravenous access is unsuccessful or not feasible. On the other hand, according to the Manual of Procedures of SAMUR-Civil Protection of Madrid (4) refers to a maximum time of between 60-90 seconds in the absence of a venous access).

CONTRAINDICATIONS:(5)

- **Absolute:**
 - * Broken bone or severe trauma.
 - * Prosthesis in the member of the puncture.
 - * Previous intraosseous puncture in the same site.
 - * Disruption of the vascular network of the extremity.
 - * Children under 3 kg

- Relative:

- * Absence of anatomical references.
- * Puncture in lower limbs in the presence of severe abdominal trauma.
- * Bone infection.
- * Osteoporosis, osteopetrosis.
- * Bone tumors.
- * Humeral puncture homolateral to a mastectomy.

COMPLICATIONS:

Possible complications of the IO route include infections (local and systemic), bruising, pain, extravasation, compartment syndrome, growth plate injury in children if punctured inappropriately, sepsis (if adequate asepsis is not performed when performing the technique or more time is used than due), fat embolism or gas embolism among others.

DEVICES FOR INTRAOSSEOUS ACCESS:

1. Cook's needle: manual device. It has a beveled or pyramidal trocar and a round handle to apply pressure, since the application of this device is done by exerting pressure and rotating until the bone is perforated. More suitable for the pediatric population as less force is required to perforate the cortex. Colloquially it is called "mushroom" because of its appearance. (7)

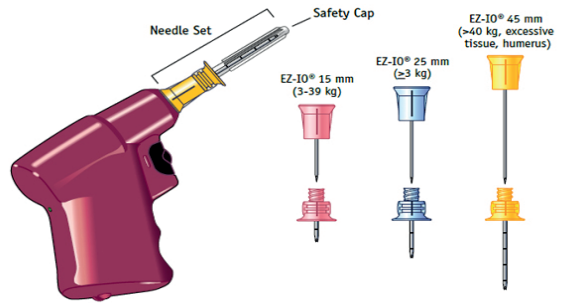


2. BIG intraosseous injection gun (Bone Injection Gun): two types: one for adults in blue and one for children in red. The depth of the shot can be adjusted (adults maximum 25mm and children maximum 15mm). The BIG mechanism is based on a spring that is activated by a trigger. It has two sizes: 15G (adult) and 18G (pediatric) and its use is mainly applied to the proximal tibia. (7)(8)



3. EZ-IO Drill: It is the most widely used device in out-of-hospital emergencies, including the SAMUR-City of Madrid Civil Protection Service. It consists of a drill with a non-rechargeable battery to which needles are attached as drill bits. The batteries have an average life of about 500 shots or ten years. There are three sizes of needles depending on their length (all of them have a thickness of 15G): Pediatric (pink, 15mm. For children from 3 to 39 kg), adult (blue, 25mm. From 40 kg) and for large, obese adults and in general for humeral access (yellow color, 45mm).

The puncture is made and when the drill is activated it perforates the bone. (5)

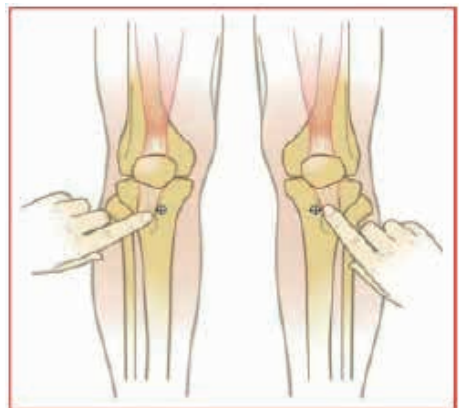


PLACES OR INSERTION POINTS:(6)

One of the first intraosseous accesses was described by Trocandins in 1940, where the sternum was used as the bone of choice for IO puncture. This location is located specifically on the handlebars and is fundamentally interesting in a tactical and military environment, which is why it is not widely used in out-of-hospital “civilian” emergencies. Other of the puncture points were originally to the iliac crest and the femur.

Currently, the trend is to use the tibia (proximal and distal), the distal femur and the humerus (humeral head).

- Proximal tibia: in adults, the insertion point is located about 3 cm below the patella (or 2 cm below the tibial tuberosity) and 2 cm medially. In children it is located approximately 1 cm below the patella and 1 cm medial to the tibia.



- Distal Tibia: In adults, 3 cm above (proximal) the crest of the medial malleolus of the tibia or 1-2 cm proximal to the base of the medial malleolus. In children it is located 1-2 cm above (proximal) the prominence of the medial malleolus of the tibia.



- Distal Femur: For pediatric patients (including neonates) only. The patella must be located and the needle inserted immediately above (maximum 1-2 cm proximal) and 1-2 cm medially.

- Proximal humerus: especially for adults (>40 kg) and highly indicated for conscious patients since it has been proven that this location is less painful. As a disadvantage, or rather a precaution, it must be mentioned that the shoulder must not move excessively and must not exceed an abduction greater than 45° because there is a risk of the needle displacing. On the other hand, the advantages are important: an average infusion of 5 liters/h of flow can be achieved and the drugs/fluids take only 3 seconds to reach the right atrium.

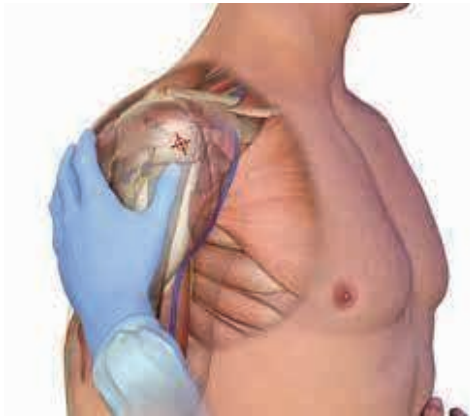
Regarding its placement, we will use the EZ-IO drill with the 45 mm needle and we will follow the following instructions:

- * Place the patient's arm in internal rotation and adduction (being able to put his hand on the absomen to maintain that position).
- * Put the palm of our hand on the front

face of the shoulder. Note a "ball" that will be the humeral head. The patient's armpit can be taken as a reference.

* Put the other hand on the midline of the patient's arm and join our thumbs on the shoulder, so that we will locate the surgical neck of the humerus (a small ridge is palpable). The puncture point is 1-2 cm above the surgical neck.





INSERTION TECHNIQUE:

- If the patient is conscious, we must inform him about the technique that we are going to perform and what he can feel.
- Locate the insertion point (either tibial, femoral or humeral).
- Cleaning the skin with antiseptic solution.
- In conscious patients, local anesthesia (Mepivacaine) can be applied before puncturing, although it is not clear that the discomfort caused by the local anesthetic puncture is much less than that of intraosseous.
- Assemble the device (in this article we will focus on the EZ-IO drill as it is the most frequent in the out-of-hospital environment). Place the needle on the hole, prepare the fixation dressing, purge the extension system with physiological saline and syringes for blood sample extraction.
- Place the needle on the chosen point, at

a 45° angle for humeral location and a 90° angle for tibial and femoral location.

- Introduce the needle until we notice a stop (bone). It must be taken into account that the 5 mm mark on the needle must be visible, otherwise it means that the selected needle is too small.
- Activate the drill and perforate approximately 2 cm, until a decrease in resistance is noted (through the cortex) or until the base of the needle touches the skin.
- Withdraw the drill carefully and hold the base of the needle. If the needle is firmly fixed to the bone, it is a sign of correct placement.
- Holding the base of the needle, unscrew the sear in an anti-clockwise direction and remove it. The sear can be disposed of in a dedicated magnet device that comes with the EZ-IO set.
- Connect the properly drained extension tube and aspirate to check that blood/bone marrow comes out.
- Put the dressing to fix the needle.
- A flush (bolus of serum) must be given to free the remains of trabecula and bone marrow from the needle. The flush is essential to ensure that the IO pathway is permeable. The manufacturer(6) itself emphasizes this matter with a phrase: “No flush = No flow”. This bolus is very painful, therefore, if the patient is conscious, we will first administer a bolus of local anesthetic. At this point, 2% lidocaine is chosen as the anesthetic as it is a suitable anesthetic for the central circulation. It must be taken into account that the lidocaine bolus will be administered in 2 minutes, at a dose of 40 mg for adults and 0.5 mg/kg for children. After waiting 1 minute, the physiological saline bolus is administered (5-10 ml for adults and 3-5 ml for children). It is very important to use lidocaine and not

mepivacaine, since the latter is a local anesthetic that is not suitable to penetrate the systemic circulation.

- Connect the extension to the serum system with the fluid or medication to be administered.

SOME CONSIDERATIONS REGARDING IO:

- The IO route allows the administration of large volumes of fluids in a short time, but is conditional on the use of a pressurizer or an infusion pump. According to the manufacturer(6), “an intravenous pressure bag capable of generating 300 mmHg of pressure or an infusion pump” is required.

- Indicate in the care report or on the patient’s own arm/leg, the date and time of placement of the IO device.

- The IO line can remain in place for a maximum of 24 hours (for the United States) or 72 hours (for countries of the European Union). (6)

- To remove the needle we need a syringe with a luer-lock connection. It connects to the base of the needle and is turned clockwise.

- Estimated battery life: if a green light appears when the drill is activated, the battery is good; If a red light appears, there is less than 10% battery left and it is recommended to replace the device as soon as possible (remember that batteries are not rechargeable).

- In the event that the drill stops working when it is being punctured, and the needle remains halfway, it can be finished manually, making a rotation and pressure movement as if it were a manual Cook needle-type device.

CONCLUSIONS:

Obtaining vascular access in emergencies is essential, and it must also be done quickly,

but it is not always possible for various reasons (luminosity, temperature, patient condition and its own characteristics). Intraosseous access is an emergency vascular access and is considered the second choice in case of difficulty or failure when cannulating a peripheral venous line (according to the AHA or the ERC, these refer to three attempts or 90 seconds without being able to channel a peripheral line).

The most frequent locations are in the proximal tibia and in the humerus.

The choice of the type of needle is made based on weight and the insertion site, rather than age, since there are adult-sized children and very low-weight adults.

The cannulation of the intraosseous route is normally performed by the nursing staff, being a technique that is easy to learn and apply. It is interesting that training programs are implemented so that the technique is known and mastered, since it has proven to have great advantages and, on the other hand, there is still a significant number of professionals who know of its existence but have never used it.

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