

Topic Overview: Intraosseous insertion

Module P3

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Topic overview (Handout)

Intraosseous (IO) access refers to the insertion of a cannula into a long bone for the purpose of drug and fluid administration.

“The bone marrow has a rich blood supply and forms part of the peripheral circulation. The intraosseous route is an acceptable alternative to intravenous injection 1 (Class A). Injected drugs are distributed as fast and attain the same plasma concentrations as those injected intravenously. Although most commonly used for young children, it can be used for patients of any age including premature newborns and adults. Establishment of the intraosseous route is quicker to achieve than the intravenous route in severely dehydrated children and fluids administered by this route stabilize vital signs as quickly as fluids given intravenously. Any intravenous fluid or drug may be administered with the aid of gravity, infused under pressure or injected from a syringe. Although many sites may be used, the antero-medial surface of the proximal or distal tibia are the most suitable puncture sites during resuscitation of infants and children.” (ARC 2010)

“Correct positioning of the needle, confirmed by aspiration of bone marrow or injection of 0.9% sodium chloride without extravasation, is necessary to avoid compartment syndrome. Bone marrow may be used reliably for venous biochemical and haematological analysis but not for venous blood gas tensions.

Indications

Intraosseous insertion (preferentially performed using a device such as the EZ-IO™) is used to access the intravascular system for administration of fluids or medications to patients of all weights in a time critical manner. In an arrest situation, if peripheral IV access has not been obtained within 90 seconds then an IO needle should be inserted.(ARC 2010). Intraosseous needle insertion also has a role for less urgent cases where vascular access cannot be obtained through other means. The IO cannula should stay in place for no longer than 24 hours.

Contraindications

- Fracture (targeted bone)
- Bone disease eg osteogenesis imperfecta
- Previous IO attempts on the same bone within past 24 hours (targeted bone)
- Prosthetic limb or joint
- Infection at the insertion site
- Inability to locate landmarks or excessive tissue
- Vascular injuries that may prevent reliable venous flow

Paediatric Considerations

Permanent injury may result from the placement of an IO catheter into the growth plate therefore it is always important to maintain a reasonable distance from the growth plate to avoid its inadvertent penetration.

Preparing for IO Cannulation

IO insertion is an invasive procedure requiring consent where possible. In paediatrics consent is usually obtained from the parent or carer. In many situations IO cannulation is carried out in the unconscious patient and this can be then performed under duty of care. Informed consent necessitates an explanation of the procedure, and reason for insertion, to the patient/parents. Risks associated with the procedure also need to be explained.

Equipment:

- Personal protective equipment - gloves and goggles
- Skin preparation - lignocaine for anaesthesia of the skin and periosteum in conscious patients may be considered.
- IO cannula (appropriate size) and prime an extension set.
- IV blood pump giving set, burette & Normal Saline 500 or 1000 ml bag
- 5 ml normal saline flush
- 5 ml syringe
- 50mL Luer-Lock Syringes
- 3-way Tap
- EZ-IO™ Drill
- IO Cannula

Cannula Selection

EZ-IO™ cannula (**Pink**) 15 mm in length - Use if the patient “fits” on the Broselow™ Tape or is known to be less than 40 kg in weight.

EZ-IO cannula (**Blue**) 25 mm in length – Use if patient \geq 40kg in weight. (May be used in smaller patients if needle retention is an issue due to thickness of soft tissues).

EZ-IO cannula (**Yellow**) 45mm in length – Use if patients \geq 40kg with excessive tissue and for humeral insertion where the 25mm needle is not long enough

Pink 15mm 15 gauge



Blue 25mm 15 gauge



Yellow 45mm 15 gauge



While any of the above needles can be used in any child, using a larger needle will result in the hub not sitting near the skin, increasing the risk of dislodgement. Conversely, using a needle that is too small risks not accessing the medullary space.

The EZ-IO™ cannula is a uniquely designed needle tip that cuts into the bone allowing for a relatively painless insertion. This technology creates a hole in the cortex that is the same size as the needle thus minimizing the risk of extravasation and dislodgement. Since the EZ-IO™ cannula is inserted gently with minimal pressure, the risk of micro-fractures is also greatly reduced.

Anatomy of bone

Intraosseous needles are placed in the epiphysis of long bones such as the tibia and humerus due to the thinner compact bone and abundance of cancellous (spongy) bone found at these sites. Within the medullary space lies a vast system of canals that provide access to the central circulation.

Insertion Sites

There are 4 main sites for inserting an IO cannula:

Proximal Tibia – This is the preferred site in paediatrics. The insertion site is a flat piece of bone without muscle over it and it is relatively close to the heart and major veins. It allows patients to be rolled and does not interfere with other activities going on at the head of the patient. This site is easy to ascertain the position of the growth plate in children allowing it to be missed.

Insertion site is 1 finger width (1-3cm) below the tibial tuberosity on the medial side. The IO needle should be inserted perpendicular to the flat centre aspect of the bone. In small children if you are unable to locate the tibial tuberosity then the insertion site is 2 finger widths below the patella on the medial side.

Distal Tibia – Is another site because of a flat piece of bone without muscle over it. The insertion site is a flat piece of bone without muscle over it and allows patients to be rolled. It does not interfere with other activities going on at the head of the patient. This site also makes it easy to ascertain the position of the growth plate in children allowing it to be missed however, it is further away from the heart and major veins.

The insertion site is located approximately 1-2 finger widths proximal to the most prominent aspect of the medial malleolus. Place one finger directly over the medial malleolus; move approximately 1-2 finger widths proximal and palpate the anterior and posterior borders of the tibia to assure that your insertion site is on the flat center aspect of the bone.

Distal Femur – Insertion site is 1-2 finger widths above the patella and slightly laterally in children

Proximal Humerus – Insertion site is located directly on the most prominent aspect of the greater tubercle. *Ensure that the patient's hand is resting on the abdomen and that the elbow is adducted (close to the body).* Slide thumb up the anterior shaft of the humerus until you feel the greater tubercle, this is the surgical neck. Approximately 1 cm (depending on patient anatomy) above the surgical neck is the insertion site. For patients >40 kg the 45 mm needle should be used. In small children, the proximal humerus may be difficult to locate. Therefore, the placement may be a proximal humeral shaft placement.

IO Cannulation Technique Guidelines

Insertion

- Wash hands and don personal protective equipment (PPE)
- Use aseptic technique
- Choose and locate insertion site mindful of contraindications
- Clean the insertion site with appropriate skin cleaning solution. Cannulation always poses a risk of infection, necessitating careful skin preparation.
- Prime the extension set tubing with 0.9% NaCl (Normal Saline)
- Ensure the needle is securely seated on the drill
- Remove and discard the needle safety cap from the IO Cannula
- Stabilise the extremity and guard against unexpected patient movement.

Note: DO NOT put your hand behind the insertion site in infants as the cannula may go right through the bone and into your hand.

- Position the IO needle at a 90° angle to the bone surface. Push the needle through the skin onto the bone. At this point you need to verify that you can see one of the black lines on the needle above the surface of the skin prior to powering the drill on. This assures that your needle is long enough to penetrate completely through the compact bone and into the medullary space.
- Depress the trigger on the drill to drill the needle into the medullary space. Do not push very hard, let the drill do the work. RELEASE the trigger when you feel a “pop” and allow the drill to stop. DO NOT drill the needle in as far as the hub as it should sit just above the skin surface to prevent a pressure area.
- Detach the driver from the needle taking care to stabilize the needle set. Failure to stabilize the needle may cause inadvertent dislodgment
- Unscrew the trocar and dispose of in sharps bin
- Take some blood/marrow for testing and to help confirm placement.
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- Attach the extension set to the standard Luer lock and syringe flush the needle with 5-10ml of Normal Saline. **“NO FLUSH = NO FLOW” Failure to “syringe flush” may result in limited no flow into the IO**

Confirming placement:

- Needle is firmly seated and does not move.
- Blood is observed on the trocar tip (noted by wiping tip on gauze) prior to placing stylet in the sharps container.
- Blood is noted at the needle hub.
- Blood or marrow can be aspirated from the catheter.
- Drugs or fluids can be infused without difficulty – there are no signs of extravasation. Administered drugs have the desired effect.
- X-Ray confirmation.

There is no need to secure the needle in any site but the proximal humerus. In all other sites secure the extension tubing to the patients skin.

Ongoing care

- Routinely reconfirm that the needle is secure and in position.
- Do not cover the insertion site with any dressings.
- Maintain appropriate protection at the insertion site guarding against accidental bumping or dislodgement, especially at the proximal humerus site.
- Frequently monitor the needle, the fluid and the extremity (circulation checks of distal limb).
- Remove the needle within 24 hours, document the insertion time and site.

Infusing Fluids and Medications

Any fluid or medication which can be delivered intravenously can be delivered via the IO route. IO infusions require pressure. IV Pumps will NOT work because they will alarm high pressure. In a person with a BP of 120/80, IO Pressure is 35/25. This means 7 times the pressure is needed to run fluid through an IO needle than through a peripheral IV cannula.

Pain

Some patients will experience bone pain during the infusing of fluids into the intraosseous space. This pain should be distinguished from the pain of extravasated fluids or medications. If pain from intraosseous infusion of fluids or medications is a significant problem, some clinicians infiltrate lignocaine into the marrow via the IO. There is little evidence in the literature to support this practice however, if the decision is made, use a tourniquet on the limb above the IO site to reduce systemic effect, infiltrate 1mg/kg of 1% lignocaine as a flush via the IO, then wait 30 seconds before releasing the tourniquet and infusing fluids or other medications.

Complications and Troubleshooting

IO cannulation is not without risk. Complications may occur during and after insertion. The following table identifies common problems encountered

Problem	Cause	Corrective Action
Gone right through the bone	Pushing too hard on the drill	Try again with a new cannula in another suitable site. If a cannula has failed you cannot resite a IO cannula in that bone for 24 hours as fluid will extravasate
Needle not in the medullary space	IO Cannula too short	Try again with a longer needle. When inserting the IO cannula push it through the soft tissue onto bone before you start to drill. Ensure you can see a black line on the IO cannula before commencing to drill the IO cannula into place
Limb is getting larger	Extravasation	Stop infusing fluids and drugs. Resite the IO cannula in another suitable site without contraindications.
Medications don't seem to be working	Either the IO cannula is not in the medullary space or it has extravasated	See comments above

References & further reading

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Vidacare EZ-IO educational resources CD.

Vidacare Defining in field in intraosseous medicine located at <http://www.vidacare.com/EZ-IO/Index.aspx> (accessed Jan 2012)

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