Intraosseous device insertion

Summary: Intraosseous devices inserted in a timely manner, aid in the resuscitation process for patients with difficult intravenous access, who require urgent resuscitation.

Approved by: ICU Medical Director A/Prof Parr
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Replaces Existing Guideline: None
Previous Review Dates: N/A
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Background Information:
Current Australian resuscitation guidelines recommend that during resuscitation, the intraosseous space is the preferred route of access if intravenous access is not available. It has been proven to be safe and effective for fluid resuscitation, drug delivery, and laboratory evaluation, and is attainable in all age groups. If intravenous access cannot be established, intraosseous delivery of resuscitation drugs will achieve adequate plasma concentrations (1). Clinical studies found that intraosseous catheter placement was significantly faster than peripheral intravenous or central venous catheter placement with increased minor complications and perceived pain. It was therefore concluded that intraosseous access is absolutely life-saving when peripheral intravenous or central venous catheters are difficult or impossible to insert. (2)

1. The risk addressed by this policy:

Patient Safety

The Aims / Expected Outcome of this policy:

For the patient requiring urgent resuscitation, an intraosseous device will be inserted in a safe and timely manner, when intravenous access is difficult or impossible.

2. Policy Statement:
All care provided within Liverpool Hospital will be in accordance with infection prevention/control, manual handling and minimisation and management of aggression guidelines. Insertion of an intraosseous device must be authorized by a medical officer. Accreditation using the EZIO competency tool must be achieved prior to being authorized to insert an intraosseous device.
Intraosseous devices are only to be inserted in the recommended anatomical landmarks. Intraosseous devices are to be removed within 72 hours of insertion.

3. **Principles / Guidelines**

**Equipment**

One (1) EZ-IO Power Driver

![The EZ-IO Lithium Driver](image)

- G3 Designed for up to 750 human insertions
- G2 Designed for up to 750 human insertions
- Sealed cap
- Battery Life Indicator
- Both Battery Life @ 10 years
- Both Have Magnetic Tip

Appropriate size intraosseous Needle Set based on patient size and weight:
- EZ-IO 15mm 3-39 kg
- EZ-IO 25mm 40 kg and greater
- EZ-IO 45mm excessive tissue and proximal humerus

![EZ-IO – AD & PD / LD needle sets](image)

Length and color are the only differences between AD & PD/LD needles:
- 15 mm/15 Ga. 3-40 kg
- 25 mm/15 Ga. +40 kg
- 45 mm/15 Ga. Adult Humerus
One (1) EZ-Connect

Three (3) 10 ml syringes
Sterile 0.9% sodium chloride solution for flush. Note: Consider 2% lignocaine without adrenaline for conscious patients (assessed based on their pain response).
Two (2) pairs of non-sterile latex gloves
One (1) alcohol / chlorhexidine swab
One (1) semi-permeable transparent dressing (optional)
One (1) sterile 2x2 or 4x4 gauze pad
One (1) (appropriate volume and type) intravenous solution
One (1) fluid administration set
One (1) fluid administration pump or pressure bag

EZ-Stabilizer
Indications for Use

Adults
For intraosseous access anytime in which vascular access is difficult to obtain in emergent, urgent or medically necessary cases.

Sites

<table>
<thead>
<tr>
<th>Proximal humerus</th>
<th><img src="image1.png" alt="Proximal humerus" /></th>
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<tbody>
<tr>
<td>Proximal tibia</td>
<td><img src="image2.png" alt="Proximal tibia" /></td>
</tr>
<tr>
<td>Distal tibia</td>
<td><img src="image3.png" alt="Distal tibia" /></td>
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</tbody>
</table>

Paediatrics
For intraosseous access with emergent patients where vascular access is difficult

Sites
- Proximal tibia
- Distal tibia
- Proximal humerus can be used in patients when the landmarks can clearly be identified

Contraindications
- Fracture of the targeted bone
- Previous orthopaedic procedures near insertion site (prosthetic limb or joint)
- Intraosseous device inserted within the past 24 hours in the targeted bone
- Infection at the insertion site
- Inability to locate landmarks or excessive tissue over the insertion site
Clinical issues

- Ensure the administration of a rapid syringe bolus (flush) prior to infusion. **NO FLUSH = NO FLOW**
- Rapid syringe bolus (flush) the catheter with 10 ml of 0.9% sodium chloride saline
- Repeat syringe bolus (flush) as needed
- Pain: The physician-prescribed dosage of 2% lignocaine without adrenaline must be infused slowly to prevent it from being sent directly into the central circulation. Medications intended to remain in the medullary space, such as a local anaesthetic, must be administered very slowly until the desired anaesthetic effect is achieved.
- Ensure you have chosen the correct needle size prior to insertion. A needle that is too short will not enter the intraosseous space therefore increasing the risk of extravasation. This may eventually lead to compartments syndrome. (When the needle pierces the skin and touches the bone, ensure you can still visualise the 5mm black line on the base of the needle, above the skin.)
- Care should be taken during insertion to prevent fracture of the targeted bone.
- Aseptic techniques is essential during insertion to prevent osteomyelitis.
- Blood samples taken from the intraosseous space are only to be analysed by the i-STAT® machine. Blood samples can be sent to pathology only for the purpose of crossmatch.

Procedure

- Explain procedure to patient/family
- Obtain assistance as needed
- Wash hands
- Draw up syringe with sterile 0.9% sodium chloride solution (10 ml)
- Connect 10 ml syringe to EZ-Connect, primed with sterile 0.9% sodium chloride or 2% Lignocaine without adrenaline for conscious patients receptive to pain
- Leave syringe attached to EZ-Connect
- Palpate site to locate appropriate anatomical landmarks for Needle Set placement
- Locate the appropriate insertion kit and site (please refer to APPENDIX 1 for details).
- Apply non-sterile latex free gloves
- Drop the following onto non-sterile field:
  - Chlorhexidine/ alcohol solution
  - Semi-permeable transparent dressing (optional)
  - 2x2 gauze or 4x4 gauze
  - Needle Set and EZ-Connect (with attached syringe)
- Cleanse site using chlorhexidine/alcohol solution
- Allow to air dry thoroughly
- Connect appropriate Needle Set to driver
- Stabilize site
- Remove needle cap
- Insert EZ-IO needle into the selected site. **IMPORTANT: Keep hand and fingers away from Needle Set**
- Position the driver at the insertion site with the needle set at a 90-degree angle to the bone surface. Gently pierce the skin with the Needle Set until the needle set tip touches the bone.
- Check to ensure that at least one black line is visible. If no black line is visible, patient may have excessive soft tissue over selected insertion site and needle set may not reach the medullary space. Consider an alternative site for insertion or a longer needle set.
- Penetrate the bone cortex by squeezing driver’s trigger and applying gentle, consistent, steady, downward pressure (allow the driver to do the work). Release the driver’s trigger and stop the insertion process when:
  - A sudden “give or pop” is felt upon entry into the medullary space, when desired depth is obtained
- Remove EZ-IO Power Driver from Needle Set while stabilizing the catheter hub
Remove stylet from catheter by turning counter-clockwise and immediately dispose of stylet in appropriate biohazard sharps container

*NEVER return used stylet or cartridge to the EZ-IO kit or resuscitation trolley*

- Confirm placement by aspirating blood from intraosseous device
- Collect blood sample as required
- Secure site with EZ Stabilizer
- Connect primed EZ-Connect to exposed Luer-lock hub
- Syringe bolus: flush the catheter with 10 ml of 0.9% sodium chloride. If the patient is conscious and responsive to pain the clinician may consider use of 2% Lignocaine without adrenaline for anaesthetic effect prior to the 10ml 0.9% sodium chloride flush. It may be necessary to administer additional Lignocaine following the 0.9% normal saline flush (please refer to Appendix for Lignocaine administration guidelines).
- Assess for potential IO complications
- Disconnect 10 ml syringe from EZ-Connect extension set
- Connect primed EZ-Connect extension set to primed IV tubing
- Begin infusion utilizing an intravenous infusion pump
- Secure tubing
- Continue to monitor extremity for complications
- Place EZ-IO armband on patient, document time and date in patient’s notes.

CATHETER REMOVAL

- Remove the extension set from the needle hub
- Attach a 5-10 ml sterile syringe to act as a handle and to cap the open intraosseous port
- Grasp syringe and continuously rotate clockwise while gently pulling the catheter out (maintain a 90-degree angle to the bone). DO NOT ROCK OR BEND DURING REMOVAL.
- Dispose of catheter into a sharps container
- Apply pressure to site as needed; apply adhesive dressing as indicated

4. Performance Measures
All incidents are documented using the hospital electronic reporting system: IIMS and managed appropriately by the NUM and staff as directed.

References / Links


**Author:** Ryan Walker (Liverpool hospital MET co coordinator and RTO)

**Reviewers:** Director-ICU, ICU – Staff Specialists, ICU CNC,NUM, CNE’s, CNS’s, Pharmacists.

**Endorsed by:** A Prof M. Parr, Director- ICU.
APPENDIX 1: Intraosseous Device Insertion Kits & Sites.

EZ-IO 25mm: (commonly for 40 kg and over)
- **Proximal Tibia** – Insertion site is approximately 2 cm below the patella and approximately 2 cm (depending on patient anatomy) medial to the tibial tuberosity.
- **Distal Tibia** - Insertion site is located approximately 3 cm proximal to the most prominent aspect of the medial malleolus. Place one finger directly over the medial malleolus; move approximately 2 cm (depending on patient anatomy) proximal and palpate the anterior and posterior borders of the tibia to assure that your insertion site is on the flat centre aspect of the bone.
- **Proximal Humerus** – Insertion site is located directly on the most prominent aspect of the greater tubercle. 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. Ensure that the patient’s hand is resting on the abdomen and that the elbow is adducted (close to the body).

EZ-IO 45mm: (recommended for the proximal humerus application, patients with excessive tissue over the insertion site or when a black line is not visible after penetration into the tissue)
- **Proximal Tibia** – Insertion site is approximately 2 cm below the patella and approximately 2 cm (depending on patient anatomy) medial to the tibial tuberosity.
- **Distal Tibia** - Insertion site is located approximately 3 cm proximal to the most prominent aspect of the medial malleolus. Place one finger directly over the medial malleolus; move approximately 2 cm (depending on patient anatomy) proximal and palpate the anterior and posterior borders of the tibia to assure that your insertion site is on the flat centre aspect of the bone.
- **Proximal Humerus** – Insertion site is located directly on the most prominent aspect of the greater tubercle. 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. Ensure that the patient’s hand is resting on the abdomen and that the elbow is adducted (close to the body).

EZ-IO 15mm: (commonly for 3-39 kg, consider tissue density over the landmark desired)
- **Proximal Tibia** - If NO tuberosity is present, the insertion is located approximately 4 cm below the patella and then medial along the flat aspect of the tibia. If the tuberosity is present, the insertion site is located approximately 2cm medial to the tibial tuberosity along the flat aspect of the tibia. Carefully feel for the “give” or “pop” indicating penetration into the medullary space.
- **Distal Tibia** - Place one finger directly over the medial malleolus; move approximately 2 cm (depending on patient anatomy) 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.
- **Proximal Humerus** - The insertion is located directly on the most prominent aspect of the greater tubercle. 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. Ensure that the patient’s hand is resting on the abdomen and that the elbow is adducted and positioned at the level of the spine. The proximal humerus may be difficult or impossible to palpate in children less than 5 years of age as the greater tubercle has not yet developed. In these cases the insertion will most likely be a shaft insertion.
**Intraosseous Guide**

**Consider:**
1. Site
2. Needle
3. Analgesia
4. Flush
5. Pressure-flush Flow
6. Monitor Site

**Suggested IO Sites**

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**IO Analgesia: a suggested protocol**

Intraosseous administration of preservative-free lidocaine. Read this guideline fully before use - if in doubt seek senior medical advice.

- **Patient with intravenous (IV) needle in situ:**
  - Assure marrow for laboratory analysis, cross-match and culture if required.
  - Responsive to pain?
    - **Yes:**
    - Exclude contra-indications to lidocaine
    - Consider caution to lidocaine
    - Monitor patient closely. Consider additional monitoring as indicated.
    - Administer initial (highest) dose of IO lidocaine over 1 to 2 minutes.
    - Flush the IO needle with up to 10 ml sodium chloride 0.9% over 5 seconds.
    - Administer subsequent (lower) dose of IO lidocaine over 30 seconds.
    - Inject to infuse fluids and medication under pressure as required.
    - If discomfort re-occurs, consider repeating the subsequent (lower) dose of IO lidocaine at a maximum frequency of once every 30 minutes.

- **No:**
  - Flush the IO needle with up to 10 ml sodium chloride 0.9% over 5 seconds.

**Volume of preservative-free lidocaine - titrate IO to analgesic effect**

<table>
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<th>Volume of 1% lidocaine</th>
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**Comments:**
1. Observation of temperature, hypotension and other side effects with every IO lidocaine injection: dizziness, paresis, vasovagal, rash, diarrhoea, confusion, tachycardia, bradycardia, hypotension, methemoglobinemia.
2. If arrhythmia occurs, stop the IO injection and administer 100 mg 10% calcium gluconate immediately.
3. The internal volume of the IO needle and administration set must be considered when calculating administration speed. Ensure the IO needle and other dead-space has been totally cleared of lidocaine before infusing medication or fluids are commenced.

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Disclaimer: While every care has been taken to ensure that doses and volumes are correct, the responsibility for final checking must rest with the prescriber. © Liverpool Hospital 2014. All rights reserved.