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CLINICAL PRACTICE UPDATE

Infant venous access: 'Counting fingers' and 'playing baseball'

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Summary Gaining vascular access remains one of the first priorities after managing the airway and breathing in sick babies. However, there are many questions and myths attached to gaining intravenous access in small babies. What site, what size cannula, and what fluid are some of the many questions facing emergency personnel. This article will attempt to answer some of these questions and help simplify the process for emergency teams facing the stressors associated with infant vascular access.

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"The difference between men and women is that, if given the choice between saving the life of an infant or catching a fly ball, a woman will automatically choose to save the infant, without even considering if there's a man on base." Dave Barry

Any hints about putting IV's in babies?

Just as you handle infants gently, so should you handle their veins. They are delicate, small (not much bigger than the diameter of embroidery thread!), and prone to 'blow.' When inserting the cannula, go slowly and aim more superficially (about a 15–20° angle). Remember, most newborns do not have a lot of subcutaneous fat and veins are not usually very deep. Do not expect a big flashback, but keep your eyes open for some sign of a blood return. Once you see it, push the cannula in just slightly more, then remove the stylet, attach a flush and continue advancing the cannula while flushing with a 3 or 5 mL syringe. The cannulas used for newborns are small, but they should flush easily. Do not try or expect to be able to aspirate blood back once the cannula is in place. Again, the keyword is 'small' and the vein will collapse easily

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if aspiration is attempted. As long as the intravascular (IV) cannula flushes easily and there is no localised swelling, you can be confident you have achieved IV access!¹

What size should be used?

The first law of paediatric IV therapy—‘Any size IV is a good size IV.’ Emergency personnel have an ongoing vision ... that every patient needs an 18 g (gauge) IV. Why? No one knows for sure, but seemingly, everyone has to have one. So, can you put an 18 g peripheral IV in a premature baby? Sure ... when they are 18 years old (and it is not going to happen until then). Therefore, can you put a 24 g in? Sure. What fluids/medications can you give through a 24 g? Anything. Is not blood going to haemolyse if you give it through a 24 g? No. Any size IV is a good size IV—use it!²

Where do you put the IV?

The second law of paediatric IV therapy—‘Any vein is a good vein.’ Anywhere you see a little blue line that is not pulsating, stick it. It certainly is harder to stick kids; therefore, we are willing to try places usually avoided in ‘big people.’ Heads (scalp veins directed toward the heart), hands, feet ... all bets are off. In general, if you see something in a distal site, try it first, before moving to a proximal site like an antecubital vein. Also, remember veins dilate when they are warmed so briefly applying a warm pack may increase your success of finding a vein for IV insertion. Newborns have veins in the same location as other patients and it may be possible to palpate a vein, even if you cannot see it.¹

Can you put an intraosseous line (IO) in a newborn’s tibia?

Yes, and the indications/placement are the same as utilised with paediatric patients. In the prehospital or emergency department (ED) settings, especially, in a baby who is over a few days old (the umbilical cord has already fallen off) presenting in distress, intraosseous (IO) access with traditional Cook (Cook Medical, Bloomington, IN) (Fig. 1) or Jamshidi needles (Cardinal Health, Dublin, OH) (Fig. 2), or newer devices such as the EZ-IO PD (Vidacare, San Antonio, TX,



Figure 1 Cook intraosseous needle. (Photo courtesy of Cook Medical, www.cookmedical.com).



Figure 2 Jamshidi intraosseous needle. (Photo courtesy of Cardinal Health, www.cardinalhealth.com).

USA) (Fig. 3) or the Bone Injection Gun (BIG) (Waismed, Hertzeliya, Israel) (Fig. 4) can be a life saving technique. If peripheral IV access cannot be established within 60 s of a shocked child presenting, IO access should be obtained. In summary, essentially any medication that can be administered IV, can be administered via the IO route with great success.¹

Infant IO technique

The site is cleansed with antiseptic and the needle is inserted perpendicular to the bone using a rotary action to transverse the bone cortex. Sudden loss of resistance is felt when the bone marrow compartment is entered and the nee-



Figure 3 EZ-IO PD Intraosseous Device. (Photo courtesy of Vidacare, www.vidacare.com).



Figure 4 Bone Injection Gun (BIG) Intraosseous Device. (Photo courtesy of WaisMed, www.waismed.com).

70 dle should stand solid in the bone when the stylet is removed
71 (Fig. 5). Medications and fluids are pushed in using a syring-
72 ing technique as the high resistance often prevents using
73 pumps as they read the high pressure as an occlusion.^{3,4}

74 Infant IO sites

75 Many sites may be used for IO insertion, however, the antero-
76 medial surface of the upper tibia (a few centimeters below
77 the anterior tuberosity) or lower tibia (a few centimeters
78 above the medial malleolus) are most commonly used.^{3,5}

79 Securing the IO needle in place

80 The less tape the better! The needle will stay in the bone
81 without strapping, however, securing the IV tubing prevents

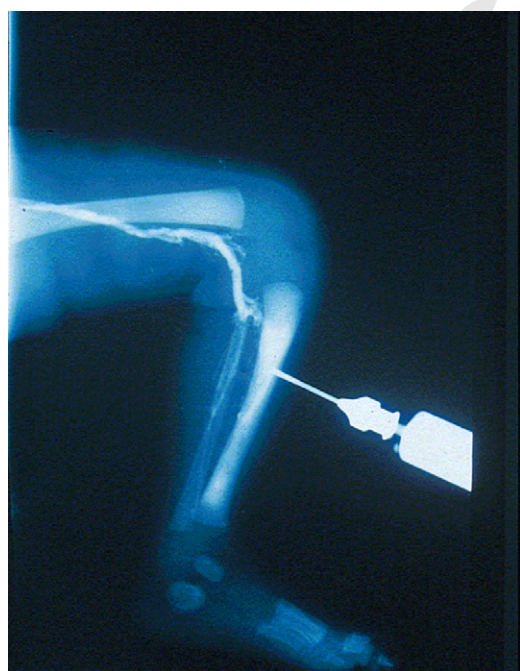


Figure 5 Demonstration of intraosseous fluid and medication delivery. (Photo courtesy of WaisMed, www.waismed.com).



Figure 6 Securing the IO needle. (Photo courtesy of Debbie Andrews).

accidental dislodgement (Fig. 6). Do not cover the needle
site with gauze or any other dressing as this prevents visual
inspection of the site and extravasation can lead to major
tissue injury.⁵

What about umbilical lines?

In the Neonatal Intensive Care Unit (NICU), IO's are very
rarely placed in babies. They have nurses that are nothing
short of amazing in their abilities to put IV's in the smallest
of babies, as well as having staff to place umbilical cannulas,
and perform cut-downs, etc. With newborns, the umbilical
vein is usually easily accessible and should be the access site
of choice in a sick newborn.^{6,7}

Babies have two arteries and one vein in their umbilical
cord (Fig. 7). The arteries are smaller, typically spasming
shut, and are located at '4 and 8 O'clock.' The vein is easily
identifiable as the gaping hole located at '12 O'clock', which
is screaming 'put an IV in me!' Formally placed umbilical
arterial (UA) or umbilical venous (UV) lines can be inserted
in the NICU setting.^{6,7}

In the context of prehospital or ED resuscitation, an easy
technique for umbilical venous access is available. First,
loop umbilical tape (looks like a shoestring) around the base
of the umbilical cord. Then, use a scalpel to cut under the
clamp closest to the baby, and gently tighten the 'shoe
string' to minimise bleeding. Finally, take a 20 g 2 in. (5 cm)
IV cannula (with the needle removed), flush it with 0.9%
saline, and gently thread it into the umbilical vein. As this is
threaded into place, blood should be able to aspirated into
a 3 mL syringe, and the IV can then be used until a formal
UA/UV line can be placed. Once the line is placed and place-
ment confirmed via the ability to easily flush/draw blood,
securing the line can be done with a 'goal post' or Neo-

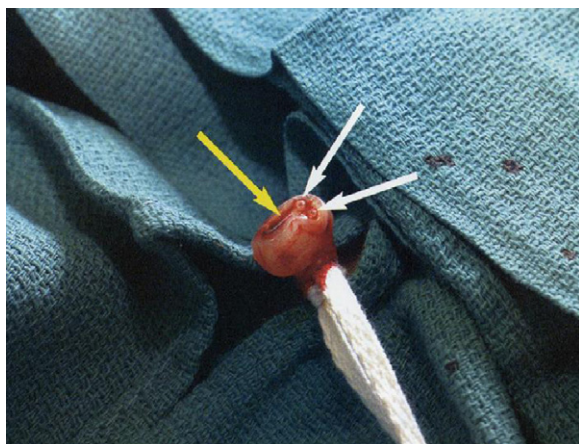


Figure 7 Umbilical vessels. (Photo courtesy of Angela Golden, RN, MSN, FNP).

Bridge (Neotech Products, Valencia, CA, USA) type dressing. Also, remember once the umbilical clamp is removed from the cord, and if the umbilical tie is not secure, there is a risk of bleeding from the cord (Figs. 8–10). Therefore, the cord must always be visibly accessible.^{6,7}

What kind of IV fluids should I hang?

Emergency departments have only three types of IV fluids to worry about: maintenance, bolus, and blood products.

Maintenance fluids

These are most commonly a dextrose/saline solution given via an IV pump, as they need a continuous infusion of sugar to keep them sweet. Ideally, the child's blood sugar level (BSL) and electrolytes need to be assessed and taken into consideration before commencement of maintenance fluids. In the emergency department, for infants less than 3 months of age, fluids are usually administered at 120–150 mL/kg/day. Newborns have lower BSLs (2.6–? mmol/L) than their 'big people' counterparts, their continuous glucose source, the

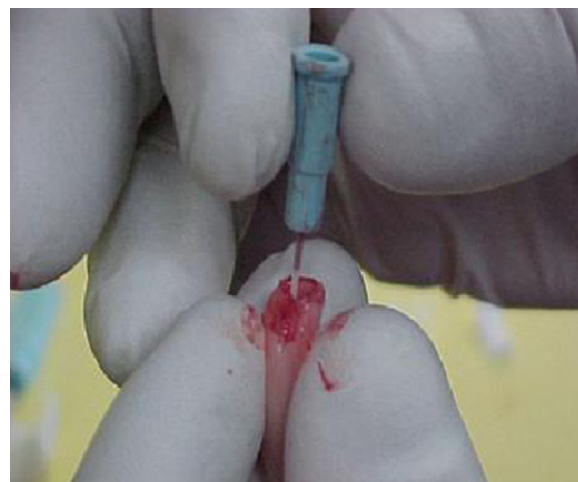


Figure 9 Emergency UV placement (2). (Photo courtesy of Angela Golden RN, MSN, FNP).

placenta, is no longer available, and hypoglycemia can easily develop, especially, when stressed or ill. Initiating a glucose infusion promptly once an IV is established is extremely important in protecting their still developing brains.⁸

For the older child, refer to the following:

- >3 months of age:
- 100 mL/kg/day for the 1st 10 kg (4 mL/kg/h) plus
- 50 mL/kg/day for the 2nd 10 kg (2 mL/kg/h) plus
- 20 mL/kg/day for each subsequent kg (1 mL/kg/h)⁴

Bolus fluids

Restoration of intravascular volume should be with an isotonic crystalloid solution (normal saline or Hartmann's solution) or a colloidal solution such as 4% albumin. Think about adults who are shocked. How much fluid do we give them? A litre. If they do not look better, how much fluid do we give them? Another litre. Unfortunately, this does not

Umbilical Venous Access using a 20g IV cannula

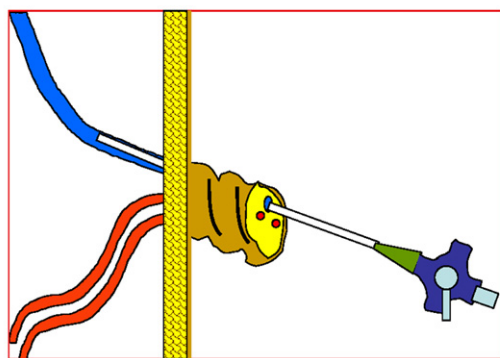


Figure 8 Emergency UV placement (1). (Photo courtesy of S. Lakshminrusimha, MD).

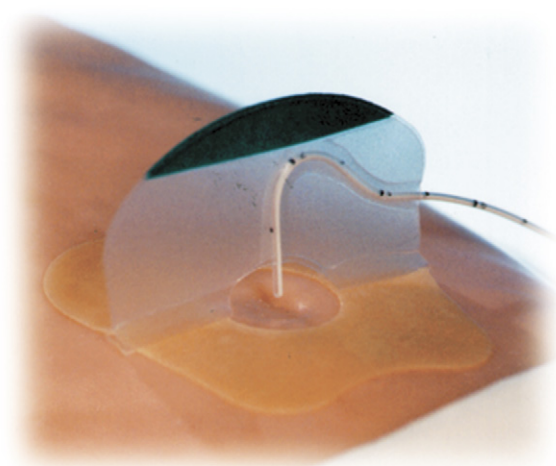


Figure 10 NeoBridge umbilical vessel dressing. (Photo courtesy of Neotech Products, www.neotechproducts.com).

work for babies, because 'if the IV bag weights more than the baby does, you are probably doing something wrong!' Babies come in all shapes and sizes; therefore, everything in babies is always 'something per kilo.' An easy way to remember the appropriate fluid bolus for babies is simply to 'count their fingers or their toes.' In a really crook baby, i.e. one that you are starting an IV on, you will be looking at every finger and every toe and hoping you can find an IV somewhere between those fingers or toes. If you count all the fingers or the toes, how many hopefully should there be? Ten. Therefore, a 0.9% saline or Hartmann's solution fluid bolus should be 10 mL/kg.^{7,9,10}

However, in most paediatric emergency/critical care training courses, attendees are taught a 20 mL/kg bolus for paediatric patients. Can you give a 20 mL/kg bolus to a baby? Sure, but be very careful as infants are easily fluid overloaded and the risk of pulmonary and/or neurologic damage from over-zealous fluid resuscitation is very real. As with any intervention, you should regularly re-evaluate the responses to your interventions, and adjust your treatment plan accordingly.¹¹

Playing baseball

You should also remember to 'play baseball' when administering fluid boluses to babies. Playing baseball means, 'three strikes and you're out! Next batter up!' Therefore, give 10 mL/kg of 0.9% saline to the baby and then see if they still look shocked and if their lungs are still clear. If the baby is still crook and the lungs are still clear, slowly and cautiously give another 10 mL/kg and so on until three boluses have been given. After three strikes, 'you're out.' Three strikes should be enough to 'fill up their tank.' The 'tank' is the blood volume entering the heart and fluid boluses are given to 'fill it up.' Babies only have 80–85 mL/kg of blood; therefore, giving three boluses of 10 mL/kg should be enough to help fill their tank quite well. If they still look shocked after three strikes, again, 'you're out' and you need to be doing something else.⁹

So, if 'I'm out' and shouldn't give any more fluids, what else can be done?

It depends on why the baby is still shocked. This again is just like treating 'big people' who are 'crook as Rookwood.' Fluids are tried first. Why? They are cheap, easy, and sitting on the shelf. So, why do not you give 20 L of fluids to an adult trauma patient? You certainly could, but how does their blood look after 20 L of saline? Like cordial. How many red blood cells are swimming through the saline? Two. How well does saline carry oxygen? It does not. However, the numbers look 'smashing' as you have an oxygen saturation of 100% (how hard is it to saturate two red blood cells?), while the kid is crashing. Therefore, after three strikes of fluid, you have to try something else. If the patient needs blood, give them blood. If they are presumed to be septic and the 'tank' is way too big (i.e. a sewer pipe instead of a garden hose), then think about dopamine or another vasopressor to make the tank smaller. Remember, IO cannulas are considered as central access and are suitable for administration of inotropes.¹¹

So, if blood is needed, how much should be given?

Again, with adults, blood product administration in a shocked patient is easy. You give them 'a unit.' If they do not look better, then you give them another 'unit.' However, this does not work with babies. In infants, just remember to count the fingers or the toes. Fluid boluses are 10 mL/kg and blood products are 10 mL/kg as well. Whether you want to give red blood cells, fresh frozen plasma, or normal saline, 'Count their fingers or their toes' ... give fluids first and if 'you're out,' do something else.⁷

How fast should bolus fluids or blood products be pushed?

It depends on how sick the baby looks. If the baby is 'crashing and burning,' give the fluid as fast as the IV will allow. However, if at all possible, boluses should be administered over at least 5–10 min. The fear is of inducing an intra-ventricular haemorrhage (IVH) or 'brain bleed.' Rapid fluid boluses or administration of hyperosmolar medications, such as sodium bicarbonate, can precipitate an IVH, especially, in premature infants. Therefore, if the baby needs the fluid immediately, certainly give it, however, if the infant's condition permits, slower administration is preferred.¹²

So if the baby is still shocked despite fluids, what about vasopressors?

Our recommendation is simply to try fluids first. The majority of babies respond very well to carefully monitored fluid resuscitation. If the child remains in shock despite three fluid boluses, dopamine or dobutamine can be considered, however, we highly recommend consulting a Paediatrician or the Retrieval Service before starting vasopressors.^{5,7,11}

In summary, remember that the vast majority of newborns and infants do not require IV access, and certainly not vasopressors. They are cute, healthy, and just happen to be born in the emergency department. However, if the infant is crook, venous access in 'any blue line,' the umbilical vein, or intraosseous, and then 'count the fingers or toes' and 'playing baseball' are the keys to successful pre-transport resuscitation.

'Resuscitate'—to revive from an apparent state of unconsciousness—not to be confused with 'Resurrect'—to raise from the dead.

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