

This podcast can be accessed at www.pedscases.com, Apple Podcasts, Spotify, or your favourite podcasting app.

Approach to PIV Insertion in a Pediatric Patient: Procedural Skills - Peripheral Intravenous Access

Hello everyone, my name is Nathan Gollner and I'm a medical student at the University of Alberta in Edmonton, Alberta Canada. This podcast was developed in conjunction with Dr. Karen Forbes, a pediatrician and medical educator at the University of Alberta.

This podcast and accompanying instructional video is the second of a 2 part series intended to introduce you to peripheral Intravenous (IV) insertion in the pediatric patient. Part 1 emphasized a pre-procedural approach, and in today's session we'll outline how to establish a peripheral IV in a child.

Objectives

By the end of this podcast and instructional video, the listener will be able to:

- (1) List common indications, contraindications, and complications of PIV placement
- (2) List the materials necessary for peripheral IV insertion
- (3) List the procedural steps of peripheral IV establishment

Let's start with a clinical case: *You are working as a medical student in the ED on New Year's eve. This is a busy night and the staff is swamped. You have been asked to place a peripheral IV in a 6yo patient named Danny who presented clinically dehydrated with a two day history of anorexia and vomiting. Reading his chart, you learn he has been in the ED for about 45 minutes and had EMLA cream applied by the triage nurse. You walk into Danny's room to introduce yourself to him and his parents. Danny is laying on the stretcher looking tired, with deep respirations, dry mucous membranes and the monitors show some tachycardia.*

Does this patient need to have a PIV established? Let's start by looking at the indications, contraindications and complications of PIV placement.

Indications¹:

Intravenous (IV) access is typically obtained in situations that require rapid provision of therapy or in those where therapy cannot be administered as effectively via other routes.

Examples include:

- hydrating a dehydrated patient with severe vomiting, who is unable to tolerate PO intake.
- providing IV medications. These may include resuscitation medications in patients who are acutely ill, antibiotics, pain medications, and others.
- providing blood products.
- Preoperatively to allow for administration of anesthetic agents.
- A PIV may also be established as a precautionary measure in a patient whose health is at risk of deteriorating

Contraindications:

Next, let's talk about Contraindications: In general terms, if therapy can be given via less invasive measures such as enteral administration, they should be. Relative contraindications to PIV insertion are site specific and include infection, phlebitis, sclerosed veins, previous IV infiltration, arteriovenous fistulae, and burns/traumatic injury proximal to the intended insertion site¹.

Complications:

Finally, what are the potential Complications of peripheral IV placement: placement of PIV is generally a safe procedure with little risk. Complications include phlebitis, extravasation of IV fluids, bruising, hematoma formation, pulmonary thromboembolism, and cellulitis^{2, 3, 4, 5}. While generally safe, there is always potential for more severe complications. For example, extravasation of certain medications can be severe and cause significant tissue damage requiring debridement or surgical intervention. Fortunately these are rare and careful monitoring of a PIV site can help avoid these complications.

Case Continuation

It is clear to us now that peripheral IV placement is indicated in Danny's case. You explain to Danny and his parents the process of what you will be doing, using the

skills described in part 1 of this podcast series. You then leave the room to collect your supplies.

Materials:¹

Now that we have covered some indications, contraindications and complications of peripheral IV placement, Lets' take inventory of what materials we'll need for this procedure and how to set them up.

- 1st, consider using a topical anesthetic. Common topical anesthetics may include EMLA cream which takes full effect in 30-45 minutes or Maxeline which is a faster onset option, taking full effect in about 20-30 minutes. If time permits and the situation is not urgent, plan ahead and apply a topical anesthetic to the intended IV site. This has been clinically proven to reduce the pain felt by the child.⁶
- 2nd: ensure you have proper personal protective equipment which includes a pair of Clean gloves and Eye protection for yourself.
- 3rd: if a helper is available to assist you, this can make the process easier, especially when first learning to place IVs. It is always better to have help; even those experienced at PIV insertion benefit from an extra set of hands.
- 4th a tourniquet
- 5th skin cleansing agents: Common options are chlorhexidine or alcohol swabs.
- 6th you will need a peripheral venous catheter of appropriate size: typically you will use an over-the-needle catheter with the gauge ranging from 24 in newborns to 18 in older children. Remember the larger the gauge number, the smaller the diameter of the needle and catheter.
- 7th: a saline flush and extension tubing: to prepare this, take a 10cc syringe filled with isotonic saline (sometimes prepackaged as a "flush") and extension tubing. Attach the extension tubing to the 10cc syringe and prime the line by pressing fluid through to the end of the extension tubing to ensure there is no air that can inadvertently be injected into the patient. Unless you have a helper, it is important to do this step now while you have both hands free. For sterility purposes, ensure that you keep the cap on the end until just before you are ready to connect your IV.
- 8th: you will need tape or commercial adhesives such as a Tegaderm® to secure the catheter in place. It is helpful to have these ready ahead of time so there is no delay in securing the IV once it is in place.

- 9th: Dressings/Covers – arm-boards to stabilize limbs are particularly helpful in infants/young children, as are plastic covers to help prevent the IV from becoming dislodged.

IV Placement:^{1, 7}

We have collected our materials and are ready to place the IV. We will assume you have applied the various teaching points from part 1 of this podcast series and have sufficiently prepared the patient and their caregiver for this procedure.

- Step 1 – Identify your site: One of the most commonly reported challenges is having difficulty finding a vein. This is in part due to the fact that children have smaller and underdeveloped superficial vasculature than adults and often have a relatively higher proportion of adipose tissue on their extremities^{8,9}. A few techniques exist to support target vein identification. Consider wrapping the extremities in warm blankets for a short period of time to help the veins expand. Allow gravity to assist you by having the patient hold their hand or foot below the level of their heart^{10,11}. “Flicking” of the vein is discouraged in pediatric patients. If stimulation of the vein is still required, it can be done by stroking the vein gently along its length from a proximal to distal direction^{12,13}.

Each potential IV site comes with its own considerations. The veins in the forearm are rarely used in younger children as they may be difficult to see due to the increased adipose tissue mentioned previously. The antecubital fossa is an easier site to cannulate but presents challenges for children who tend to be less compliant and portends catheter kinking and infiltration if an arm-board is not applied to prevent flexion at the elbow². The dorsal hand veins are convenient but often small. The great saphenous vein in the ankle is large and anatomically consistent but if cannulated limits the child’s ability to ambulate. Scalp veins are available but often require a portion of the patient’s head to be shaved.

Choosing a suitable site will depend on a number of factors, including patient characteristics, purpose/context of the IV placement, and intended duration of cannulization.

- Step 2 – Once you have identified your site, apply a tourniquet proximal to the vein using a slipknot so that it can easily be removed later. A common mistake learners make is gripping the ends of the tourniquet, which results in a knot that is too loose, and does not properly occlude the vein.
- Step 3 – Clean the site.

- Step 4 – Immobilize or isolate the chosen IV site and gently put the vein on stretch. This can be done by placing a soft roll of gauze under the elbow to elicit full extension if cannulating an antecubital fossa vein, or by holding the hand firmly with the wrist in flexion if using the dorsal hand veins. If the dorsal foot veins are to be cannulated, hold the foot firmly in plantarflexion. You can then stabilize and the vein by placing your thumb and forefinger at either end and gently stretching the vein.
- Step 5 – Take your needle with its overriding catheter in your dominant hand with your thumb and middle finger on either side and your index finger resting on the top. Line it up with the trajectory of your chosen vein, with the bevel (or opening) of the needle facing toward the ceiling. Now you have your pathway marked and are ready to place the IV.
- Step 6 – insert the needle at a 30-to-45-degree angle to the skin, advancing slowly until a flash of blood is seen in the hub of the catheter. Once this is appreciated, reduce your angle to about 5 degrees and advance the catheter and needle another few millimeters. This helps ensure the catheter tip is in the vein lumen.
- Step 7 – Holding the needle apparatus firmly between your middle finger and thumb, **advance the catheter over the needle** and into the vein by using extension of your index finger.
- Step 8: Occlude the catheter under the skin by maintaining pressure over the IV entry site with your non dominant hand (Do not let go! As doing so opens a direct path between the vein lumen and the end of the catheter through which the patient’s blood will come out). With the catheter tip occluded, remove the tourniquet.
- Step 9: When you are ready to connect the flush, that is when you remove needle. Use the safety apparatus to conceal the needle tip and take note of where you place it, as you will need to dispose of this safely after the procedure is done.
- Step 10: With your non-dominant hand still occluding the catheter, take your 10cc syringe and extension tubing and attach it to the catheter.

- Step 11 – Flush some of the isotonic saline to check for patency of the catheter. The ability to easily flush saline through the catheter with no swelling at the insertion site confirms IV placement.
- Step 12 – You will learn that there are a number of commercially available dressings that are used for IV securement and you will become familiar with multiple throughout your time placing IV's.

Let's revisit our case and our objectives:

Danny's IV is secured and patent, his Intravenous rehydration begins and his parents thank you for your efficiency. You have successfully placed a peripheral IV in a pediatric patient.

In this session we:

- (1) Discussed common indications, contraindications, and complications of PIV placement
- (2) Listed the materials necessary for peripheral IV insertion
- (3) Listed the procedural steps of peripheral IV establishment

This concludes the second of our 2-part series intended to introduce the listener to peripheral IV insertion in the pediatric patient. Thanks for listening, and good luck.

References

- ¹ Ortega R, Sekhar P, Song M, Hansen CJ, Peterson L. Peripheral intravenous cannulation. N Engl J Med. 2008 Nov 20;359(21):26-9.
- ² Unbeck M, Förberg U, Ygge BM, Ehrenberg A, Petzold M, Johansson E. Peripheral venous catheter related complications are common among paediatric and neonatal patients. Acta Paediatrica. 2015 Jun;104(6):566-74.
- ³ Frank RL, Wolfson AB, Grayzel J. Peripheral venous access in adults. UpToDate®[online]. 2016.
- ⁴ Gauderer MW. Vascular access techniques and devices in the pediatric patient. Surgical Clinics of North America. 1992 Dec 1;72(6):1267-84.
- ⁵ Straussberg R, Harel L, Bar-Sever Z, Amir J. Radial osteomyelitis as a complication of venous cannulation. Archives of disease in childhood. 2001 Nov 1;85(5):408-10.

⁶Hügel C (1,2), Reimer E(1,3,4), Görges M(1,4), Chen J(3,4), Poznikoff AK(3,4), West NC(4). Intravenous cannula placement in children for induction of general anesthesia: Prospective audit and identification of success factors.

Paediatric Anesthesia [Internet]. [cited 2022 Mar 24];30(8):874-84

⁷American Academy of Pediatrics. Recognition and management of cardiac arrest. In: Pediatric Advanced Life Support Provider Manual, Chameides L, Samson RA, Schexnayder SM, Hazinski MF (Eds), American Heart Association, Dallas 2011. p.141.

⁸Otani T, Morikawa Y, Hayakawa I, Atsumi Y, Tomari K, Tomobe Y, et al. Ultrasound-guided peripheral intravenous catheter access placement for children in the emergency department. European Journal of Pediatrics [Internet]. 2018 Oct [cited 2022 Mar 24]; 177(10):1443-9

⁹Benkhadra M, Collignon M, Fournel I, Oeuvrard C, Rollin P, Perrin M, et al. Ultrasound guidance allows faster peripheral IV cannulation in children under 3 years of age with difficult venous access: a prospective randomized study. PEDIATRIC ANESTHESIA [Internet]. 2012 May 1 [cited 2022 Mar 24];22(5):449-54

¹⁰Mamaku D, Banerjee A. Methods of obtaining peripheral venous access in difficult situations. Postgraduate medical journal. 1999 Aug 1;75(886):459-62.

¹¹MILLAM DA. Tips for improving your venipuncture techniques. Nursing2021. 1987 Jun 1;17(6):46-9.

¹²Hedges JR, Weinshenker E, Dirksing R. Evaluation of venous distension device: potential aid for intravenous cannulation. Annals of emergency medicine. 1986 May 1;15(5):540-3.

¹³Kindgen-Milles D, Arndt JO. Nitric oxide as a chemical link in the generation of pain from veins in humans. Pain. 1996 Jan 1;64(1):139-42.