Access for Medications

Correct Priorities

Historically in ACLS, drugs were administered by the intravenous (IV) or endotracheal (ET) route. But new science and consensus opinion have prioritized both access routes and drug administration. Remember, no drug given during cardiac arrest has been shown to improve survival to hospital discharge or improve neurologic function after cardiac arrest.

- High-quality CPR and early defibrillation are the top priorities during cardiac arrest.
- Drug administration is of secondary importance.
- Insertion of an advanced airway whether for drug administration or ventilation, unless bag-mask ventilation is ineffective, is of secondary importance. Absorption of drugs given by the ET route is unpredictable, and optimal dosing is unknown. For this reason the IO route is preferred when IV access is not available.

Intravenous Route

A peripheral IV is preferred for drug and fluid administration. Central line access is not needed during most resuscitation attempts. Attempts to insert a central line may interrupt CPR. In addition, CPR can cause complications during central line insertion, such as vascular laceration, hematomas, and bleeding. Insertion of a central line in a noncompressible area of a vein is a relative contraindication to fibrinolytic therapy (eg, for the patient with an STEMI and sudden cardiac arrest).

Establishing a peripheral line should not require interruption of CPR. And drugs typically require 1 to 2 minutes to reach the central circulation when given by the peripheral IV route. Keep this in mind during CPR. The drug you give based on a rhythm check will not take effect until it is flushed into the patient and has been circulated by the blood flow generated during CPR.

If you choose the peripheral venous route, give the drug by bolus injection and follow with a 20-mL bolus of IV fluid. Elevate the extremity for 10 to 20 seconds to facilitate delivery of the drug to the central circulation.

Intraosseous Route

Use the IO route to deliver drugs and fluids during resuscitation if IV access is unavailable. IO access is safe and effective for fluid resuscitation, drug delivery, and blood sampling for laboratory evaluation. IO access can be established in all age groups.

Any drug or fluid that can be given by the IV route can also be given by the IO route. The IO route is preferred over the ET route.

IO cannulation provides access to a noncollapsible venous plexus in bone marrow. This vascular network provides a rapid, safe, and reliable route for administration of drugs, crystalloids, colloids, and blood during resuscitation. It is often possible to achieve IO access in 30 to 60 seconds. The technique uses a rigid needle, preferably a specially designed IO or bone marrow needle. Use of an IO needle with stylet may be preferred to use of a needle without stylet because the stylet prevents obstruction of the needle with cortical bone during insertion. Butterfly needles and standard hypodermic needles also can be used.

Endotracheal Route

The IV and IO routes of administration are preferred over the ET route of administration during CPR. When considering use of the ET route during CPR, keep these concepts in mind:

- The optimal dose of most drugs given by the ET route is unknown.
- The typical dose of drugs administered by the ET route is 2 to 2½ times the dose given by the IV route.
- To give drugs via the ET route, dilute the dose in 5 to 10 mL of water or normal saline and inject the drug directly into the endotracheal tube. Follow with several positive-pressure breaths.
- You can give the following drugs by the ET route during cardiac arrest: atropine, vasopressin, epinephrine, and lidocaine. The memory aid NAVEL is often used to recall drugs that can be given by the ET route. Arrest drugs that can be given are: atropine (A), epinephrine (E), vasopressin (V) and lidocaine (L). "N" stands for naloxone, which is often used for respiratory depressions due to opioids. Note that the drug absorption and drug effect are much less predictable when drugs are administered by the ET rather than by the IV/IO route.

Part 2—Intravenous Access

Using Peripheral Veins for IV Access

The most common sites for IV access are in the hands and arms. Favored sites are the dorsum of the hands, the wrists, and the antecubital fossae. Ideally only the antecubital veins should be used for drug administration during CPR.

Anatomy: Upper Extremities (Figure 27)

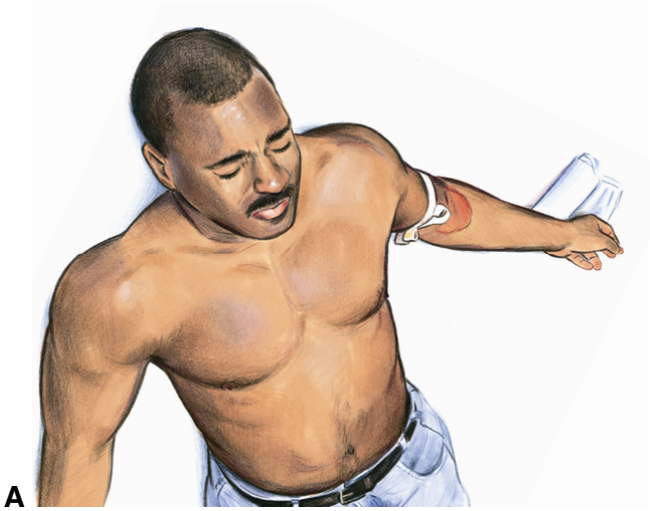
Starting at the radial side of the wrist, a thick vein, the superficial radial vein, runs laterally up to the antecubital fossa and joins the median cephalic vein to form the cephalic vein. Superficial veins on the ulnar aspect of the forearm run to the elbow and join the median basilic vein to form the basilic vein. The cephalic vein of the forearm bifurcates into a Y in the antecubital fossa, becoming the median cephalic (laterally) and the median basilic (medially).

The basilic vein passes up the inner side of the arm, where it joins the brachial vein to become the axillary vein. The cephalic vein continues laterally up the arm, crosses anteriorly, and courses deep between the pectoralis major and deltoid muscles. After a sharp angulation it joins the axillary vein at a 90° angle. This sharp angulation makes the cephalic vein unsuitable for insertion of central venous pulmonary artery catheters.

Technique: Antecubital Venipuncture

The largest surface veins of the arm are in the antecubital fossa. Select these veins first for access if the patient is in circulatory collapse or cardiac arrest (Figure 27). Select a point between the junctions of 2 antecubital veins. The vein is more stable here, and venipuncture is more often successful.

Self-contained kits allow easy central venous access, so today providers rarely use peripheral leg veins for vascular access.



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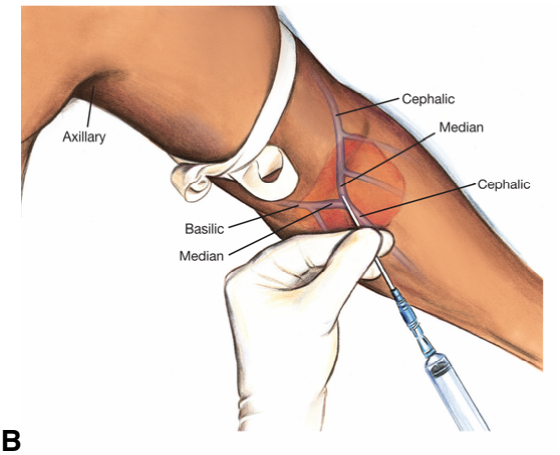

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Figure 27. Antecubital venipuncture. **A,** Scene perspective from a distance. **B,** Close-up view of antecubital area: anatomy of veins of upper extremity.

General IV Principles

Once you gain vascular access, follow these important principles for administering IV therapy:

- After a cardiac arrest patient becomes stable, remove the cannula inserted emergently and replace it with a new one under sterile conditions. Strict aseptic technique is compromised in most emergency venipunctures, where speed is essential. This compromise is particularly likely when emergency vascular access is established outside the hospital, because personnel and equipment are limited.
- IV solutions are usually packaged in nonbreakable plastic bottles or bags. Squeeze plastic bags before use to detect punctures that may lead to contamination of the contents.
- Avoid adding drugs that may be adsorbed by the plastic bag or tubing (eg, IV nitroglycerin). If you must administer these drugs without specialty infusion systems, allow for drug adsorption when you titrate the drug administration rate.
- Ideally set the rate of infusion to at least 10 mL/h to keep the IV line open.
- Saline lock catheter systems are particularly useful for patients who have spontaneous circulation and require drug injections but not IV volume infusion.
- Most contemporary systems use needleless injection sites. These systems permit drug and flush infusions without the use of needles and the associated risk of needle sticks.
- Avoid letting the arm with the IV access hang off the bed. Place the arm at the level of heart or slightly above the heart, to facilitate delivery of fluids and medications to the central circulation.
- During cardiac arrest follow all peripherally administered drugs with a bolus of at least 20 mL of IV flush solution. This flush will facilitate delivery to the central circulation. Elevate the extremity for 10 to 20 seconds to facilitate drug delivery to the central circulation.
- Be aware of complications common to all IV techniques. Local complications include hematomas, cellulitis, thrombosis, and phlebitis. Systemic complications include sepsis, pulmonary thromboembolism, air embolism, and catheter fragment embolism.

Part 3—Intraosseous Access

Introduction

When venous access cannot be rapidly achieved, intraosseous (IO) access can serve as a rapid, safe, and reliable route for administration of drugs, crystalloids, colloids, and blood. IO cannulation provides access to a noncollapsible venous plexus in bone marrow and can often be achieved in 30 to 60 seconds. This vascular access technique is suitable for all age groups, from preterm neonates through adulthood.

Needles

The technique uses a rigid needle, preferably a specially designed IO or Jamshidi-type bone marrow needle. An IO needle with stylet is preferred to one without a stylet because the stylet can prevent obstruction of the needle by cortical bone during insertion. Commercial kits with specially designed needles are available.

In the past the higher bone density in older children and adults made it difficult for smaller IO needles to penetrate the bone without bending. With the development of IO cannula systems for adults, IO access is now easier to obtain in older children and adults.

Sites

Many sites are appropriate for IO infusion. For young children, the proximal tibia, just below the growth plate, is the most common site used. In older children and adults, successful IO insertion sites include the sternum, the distal tibia just above the medial malleolus, the lateral or medial malleolus, the distal radius and distal ulna, the distal femur, and the anterior-superior iliac spine.

Indications and Administration

Resuscitation drugs, fluids, and blood products can be administered safely by the IO route. Continuous catecholamine infusions can also be provided by this route.

The onset of action and drug levels following IO infusion during CPR are comparable to those for vascular routes of administration, including central venous access. When providing drugs and fluids by the IO route, remember the following:

- Flush all IO medications with 5 to 10 mL of normal saline to facilitate delivery into the central circulation.
- Administer viscous drugs and solutions and fluid for rapid volume resuscitation under pressure using an infusion pump, pressure bag, or forceful manual pressure to overcome the resistance of the emissary veins.

Some have expressed concern that high-pressure infusion of blood might induce hemolysis. But animal studies have failed to document this problem.

Complications

Complications of IO infusion include tibial fracture, lower extremity compartment syndrome or severe extravasation of drugs, and osteomyelitis. But <1% of patients have complications after IO infusion. Careful technique helps to prevent complications.

Contraindications

Absolute contraindications to IO access are as follows:

- Fractures and crush injuries near the access site
- Conditions in which the bone is fragile, such as osteogenesis imperfecta
- Previous attempts to establish access in the same bone

Avoid IO cannulation if infection is present in overlying tissues.

Equipment Needed

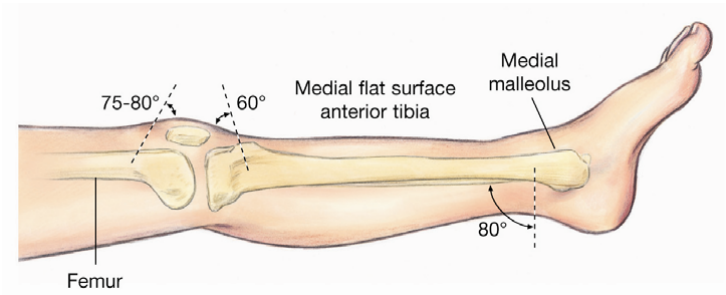
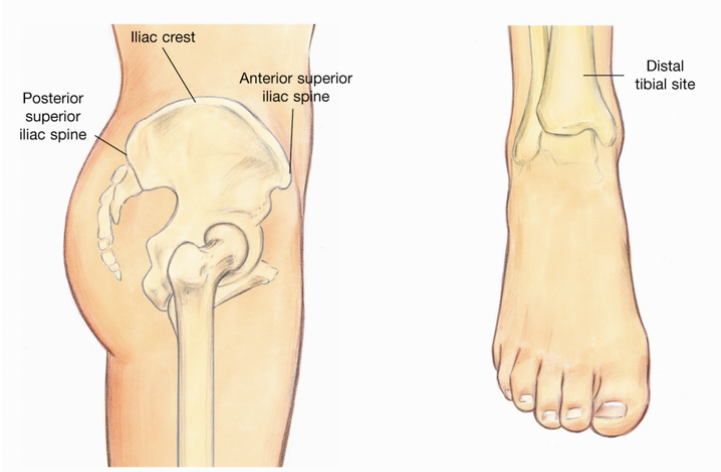
The following equipment is needed to establish IO access:

- Gloves
- Skin disinfectant
- IO needle (16 or 18 gauge) or bone marrow needle
- Tape
- Syringe
- Isotonic crystalloid fluid and intravenous tubing

Procedure

The steps to establish IO using the tibial tuberosity as an access site example are as follows:

Step	Action
1	• Always use universal precautions when attempting vascular access. Disinfect the overlying skin and surrounding area with an appropriate agent. • Identify the tibial tuberosity just below the knee joint. The insertion site is the flat part of the tibia, 1 or 2 finger widths below and medial to this bony prominence. Figure 28 shows sites for IO access.
2	• The stylet should remain in place during insertion to prevent the needle from becoming clogged with bone or tissue. • Stabilize the leg to facilitate needle insertion. *Do not place your hand behind the leg*.

3	• Insert the needle so that it is perpendicular to the tibia. (When placing an IO needle in other locations, aim slightly away from the nearest joint space to reduce the risk of injury to the epiphysis or joint but keep the needle as perpendicular to the bone as possible to avoid bending.) *TWIST, DON'T PUSH, THE NEEDLE.* • Use a twisting motion with gentle but firm pressure. Some IO needles have threads. These threads must be turned clockwise and screwed into the bone.
4	Continue inserting the needle through the cortical bone until there is a sudden release of resistance. (This release occurs as the needle enters the marrow space.) If the needle is placed correctly, it will stand easily without support.
	A 
	B **C**  **Figure 28. A,** Locations for IO insertion in the distal tibia and the femur. **B,** Location for IO insertion in the iliac crest. **C,** Location for IO insertion in the distal tibia.

5	• Remove the stylet and attach a syringe. • Aspiration of bone marrow contents and blood in the hub of the needle confirms appropriate placement. You may send this blood to the lab for study. (Note: Blood or bone marrow may *not* be aspirated in every case.) • Infuse a small volume of saline and observe for swelling at the insertion site. Also check the extremity behind the insertion site in case the needle has penetrated into and through the posterior cortical bone. Fluid should easily infuse with saline injection from the syringe with no evidence of swelling at the site. • If the test injection is unsuccessful (ie, you observe infiltration/swelling at or near the insertion site), remove the needle and attempt the procedure on *another bone*. If the cortex of the bone is penetrated, placing another needle in the same extremity will permit fluids and drugs to escape from the original hole and infiltrate the soft tissues, potentially causing injury.
6	There are a number of methods to stabilize the needle. Place tape over the flange of the needle to provide support. Position gauze padding on both sides of the needle for additional support.
7	When connecting IV tubing, tape it to the skin to avoid displacing the needle by placing tension on the tubing.
8	Volume resuscitation can be delivered via a stopcock attached to extension tubing or by infusion of fluid under pressure. When using a pressurized fluid bag, take care to avoid air embolism. Other methods include the following: • Use a syringe bolus via a medication port in the IV tubing (3-way stopcock not needed). • Attach a saline lock to the IO cannula and then provide syringe boluses through the lock.
9	Any medication that can be administered by the IV route can be given by the IO route, including vasoactive drug infusions (eg, epinephrine drip). All medications should be followed with a saline flush.

Follow-up

Follow-up is important after you establish IO access. Use these guidelines:

- Check the site frequently for signs of swelling.
- Check the site often for needle displacement. Delivery of fluids or drugs through a displaced needle may cause severe complications (eg, tissue necrosis or compartment syndrome).
- Replace the IO access with vascular access as soon as reasonable. IO needles are intended for short-term use, generally <24 hours. Replacement with long-term vascular access is usually done in the intensive care unit.