

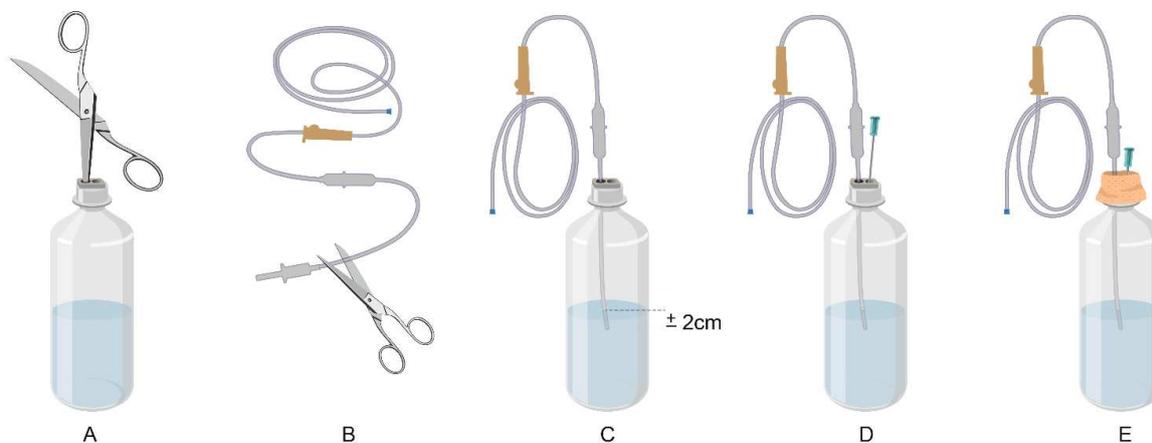
Instruction manual: Underwater seal drain

1. Necessary equipment



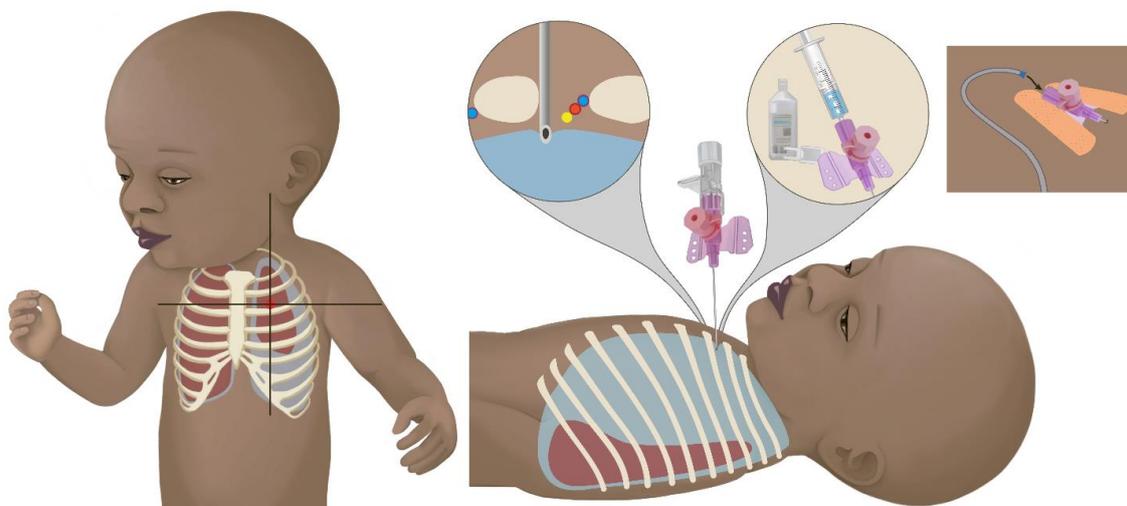
A: intravenous (IV) bag **B:** IV tubing system **C:** peripheral venous catheter **D:** hollow needle
E: scissors **F:** plasters **G:** syringe **H:** sterile liquid (e.g. NaCl 0.9%)

2. Preparations



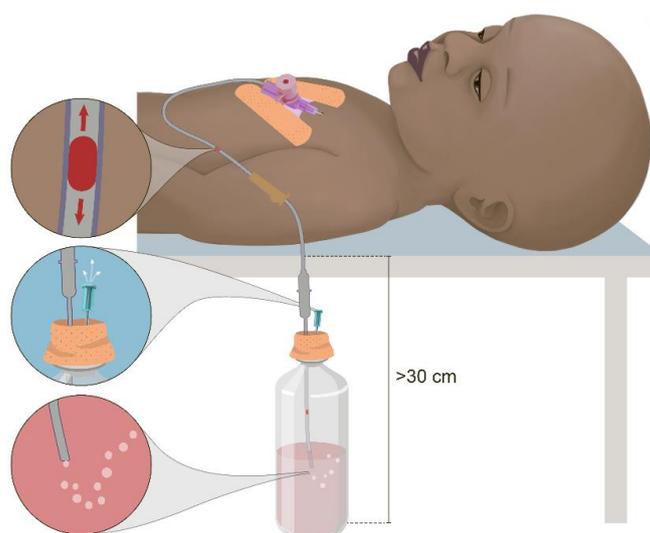
A: Half empty the IV bag and enlarge the opening of the rubber aperture. **B:** Cut the plastic gauge off the IV tubing system. **C:** Insert the plastic end (where the plastic gauge was cut off) into the IV bag through the newly enlarged opening of the rubber aperture. This step can be difficult and may require some dexterity as well as patience. Make sure that the plastic tube is fully emerged into the liquid (± 2 cm). **D:** Place the hollow needle into the second opening of the rubber aperture of the IV bag as an air release valve. **E:** Wrap the plaster around the opening of the IV bag to secure the plastic tube and the needle.

3. Thoracentesis



After thorough disinfection of the skin, insert the peripheral venous catheter perpendicularly into the mid-scapular line at the upper border of the rib of the second intercostal space sparing the intercostal vessels and nerves. Retrieve the needle of the peripheral venous catheter. You should hear air escaping. Connect the syringe (partially filled with sterile liquid) to the catheter, aspirate and check for bubbles. If the bubble test is positive, insert the plastic catheter fully into the chest. Otherwise, improve the position of the catheter. Once the catheter is positioned correctly, fix the catheter well to the skin using plasters and connect the IV tubing system to the venous catheter.

4. Drainage



Place the IV bottle below the patient for negative pressure. If the air does not drain spontaneously, you can squeeze the drip chamber to create negative pressure. Check for oscillation in the tube (e.g. by observing drops of blood moving back and forth in the tube). You should now see bubbles in the IV bag and may even hear air being released from the needle.

Supplement 1 – Merscher Alves *et al.*