

UMBILICAL CORD MODEL FOR UMBILICAL VEIN CATHETERIZATION TRAINING



A Guide to its Construction and Usage

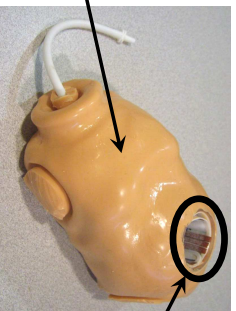
Introduction

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This training model aims to familiarize clinicians with umbilical vein catheterization (UVC). It is meant to be used in conjunction with the American Academy of Pediatrics Neonatal Resuscitation Program – specialized training which is required by 99% of all hospitals that offer labor and delivery services in the United States.

UVC provides painless, direct access to an infant's circulatory system. During emergency, UVC may be performed for intravenous drug delivery, blood transfusion, hemodynamic monitoring, and so on. As UVC can be difficult and traumatic, realistic training is essential.

The model can be divided into two parts as shown in the image below. The *cuff mechanism* serves to clamp a segment of a real human umbilical cord. The cuff pressure can be varied to accommodate various cord sizes and prevent excessive exertion on the cord. The *external support* mimics the infant torso to simulate the actual UVC procedure.



MODEL CONSTRUCTION

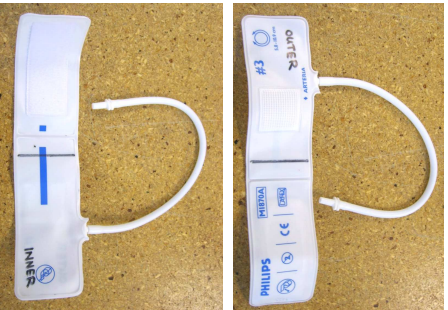
Construction of the model begins with the cuff mechanism, and then the external support. All required materials and tools are tabulated below.

Model Materials	Construction Tools & Materials
Philips M1370A Neorate 3 Blood Pressure Cuff Medela 80ml Breastmilk Freezing & Storage Bottle Norton SX Fine 150 Grit Premium Aluminum Oxide Sandpaper Loctite All Plastics Super Glue (Parts 1 & 2) Smooth-On EcoFlex 0030 Silicone Rubber Smooth-On Silc-Pig Pink Flesh Tone Silicone Dye	Band Saw or Circular Saw or Hack Saw Sandpaper of Half-Round Hand-File Electric Drill with 4.5-mm Drill Bit Permanent Marker 15-cm Ruler Scissors Utility or Exacto Knife Hot Glue Gun Bucket with capacity of at least 1 liter Plaster of Paris Paper Clay Berenguer "Cary Me Home" Baby Doll Rust-Oleum Painter's Touch Gloss (Crystal Clear)

Cuff Mechanism Construction

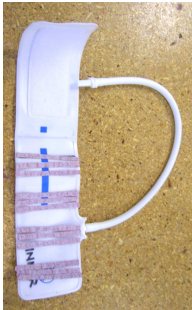


- 1) Make a transverse cut across the 55-ml mark (or 7 cm from the base) of the Medela bottle using a saw.
- 2) Smoothen the cut edge with sandpaper or a hand-file.
- 3) Drill a 4.5-mm hole at the 20-ml mark (or 2.8 cm from the base) of the Medela bottle.



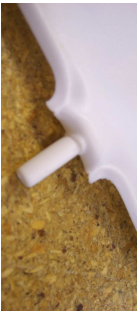
- 4) Locate the Velcro regions on the Philips cuff. Label the hook side "outer" and the loop side "inner".
- 5) Place the cuff flat on the table with the "outer" surface facing upwards and the Velcro end to the left.
- 6) Draw a vertical line 9 cm from the left. This is the glue line.
- 7) Flip the cuff horizontally such that the "inner" surface faces upwards and the Velcro end to the left.
- 8) Draw a vertical line 9 cm from the right. This is the sandpaper line.

- 9) Cut 12 strips of the Norton sandpaper with dimensions of 40 mm by 3 mm.
- 10) Apply part 1 (activator) of the Loctite glue to the smooth side of each sandpaper strip, followed by part 2 (adhesive).
- 11) Stick 4 groups of 3 strips between the sandpaper line and the right edge of the "inner" surface. Each group should be 1 cm apart, while each strip within a group should be 2 mm apart.



- 12) Wrap the cuff such that the left edge of the "inner" surface does not exceed the glue line on the "outer" surface.
- 13) Stick the edge to the glue line using the Loctite glue. Leave to dry for 10 minutes.
- 14) Locate the air tube connection. Note that it has an outer tube and an inner outlet.
- 15) Make a shallow 1-cm slit along the outer tube from the connection, keeping the inner outlet intact.





- 16) Remove the outer tube from the cuff.



- 17) Insert the cuff into the Medela bottle such that the inner outlet passes through the hole at the 20-ml mark.



- 18) Cut off the slit portion of the outer tube and reconnect the outer tube to the inner outlet.



- 19) Seal the hole and the air tube connection with hot glue.



- 20) This completes the cuff mechanism.

External Support Construction



- 1) Remove the head and limbs of the Berenguer doll.
- 2) Make a longitudinal slit along the back of the doll and a circular hole at the back of the doll directly behind the umbilicus.
- 3) Seal the head and limb connections with paper clay.



- 4) Mix 2 parts of plaster of Paris with 3 parts of clean water to make about 1 gallon of plaster. Leave to set for 10 minutes.

- 5) Carefully press the doll into the plaster to form an imprint. Leave to set for another 5 minutes.



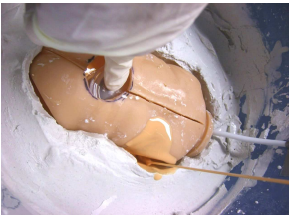
- 6) Carefully remove the doll. Leave to set for 30 minutes.

- 7) Remove the paper clay from the doll.

- 8) Spray-coat the inner surfaces of the doll and the plaster mold using the Rust-Oleum gloss. Leave to dry for 30 minutes.

- 9) Place the cuff mechanism inside the doll such that the cuff touches the ventral wall while the base touches the dorsal wall. Thread the air tube out from the head connection.





- 10) Place the doll and cuff mechanism into the plaster mold. Tape the air tube onto the side of the bucket.
- 11) Prepare 500 ml of silicone rubber by mixing its components in 1:1 volume ratio. Add 5 ml of silicone dye and mix well.
- 12) Carefully fill the doll and the plaster mold with the dyed silicone rubber while holding the cuff mechanism in place. Ensure that the silicone rubber fills the inside of the doll. Leave to cure overnight.



- 13) Carefully remove the cured silicone rubber from the doll and the plaster mold.
- 14) Trim the cast to obtain the desired shape.
- 15) This completes the external support (and the model).

MODEL USAGE

A video is provided with this user manual to depict the proper usage of the model. The user is expected to supply the items listed below in order to use the model.

- 1) a real human umbilical cord
- 2) a 3-way stopcock
- 3) a 50-ml syringe compatible with the stopcock
- 4) a 3.5-F or 5-F catheter
- 5) a 10-ml syringe compatible with the catheter
- 6) a cloth ribbon
- 7) standard surgical tools (scalpel, forceps, gauze, crux, gloves, etc)

Note: The stepwise procedure presented below is more detailed than the video. Also, numbering of the steps may differ, though the general sequence is the same.

- 1) Clean the umbilical cord with gauze.
- 2) Cut off both ends of the cord to remove any dried or shriveled tissue and to expose fresh tissue.
- 3) Section the remaining cords into 6-cm segments.
- 4) Clean the segments with gauze and remove as many blood clots as possible.
- 5) Fix the 50-ml syringe and the air tube of the model to the stopcock.
- 6) Point the knob of the stopcock at the air tube.

- 7) Remove the third cap on the stopcock and draw air into the syringe fully. Replace the cap.
- 8) Point the knob at the cap. This connects air in the syringe to the cuff.
- 9) Check that the cuff is working properly by inflating and deflating it.
- 10) Insert one cord segment into the cuff, leaving about 1 cm exposed.
- 11) Inflate the cuff as much as possible. Quickly point the knob at the air tube to maintain the cuff pressure.
- 12) Gently tug the cord segment to ensure stability.
- 13) Fill the 10-ml syringe with clean water and attach it to the catheter.
- 14) Catheterize the umbilical vein for not more than 1 cm.
- 15) Pump water into the umbilical vein to clear blood clots and check that the vein is not collapsed due to excessive cuff pressure.

- 16) Slightly release the cuff pressure if water does not pass through the umbilical vein. Repeat until water successfully passes through.
- 17) Pump all 10 ml of water to simulate a blood reservoir at the bottom of the cuff mechanism.
- 18) Check that the cord segment is still sufficiently stabilized.
- 19) Tie the cord segment as per standard UVC protocol.
- 20) Catheterize the cord segment until water can be drawn through the catheter.