STANDARDIZED PROCEDURE
NEONATAL UMBILICAL VESSEL CATHETERIZATION (Neonatal)

I. Definition

To place an indwelling catheter into the umbilical artery or vein in a neonate for the purposes of:

A. Artery

1. Arterial blood sampling.
2. Arterial blood pressure monitoring.
3. Administration of fluids and drugs.
4. Exchange transfusions (removal of blood)

B. Vein

1. Intravenous access for the administration of fluid, drugs, or hypertonic glucose.
2. Monitoring central venous pressure.
3. Venous blood sampling
4. Exchange transfusions

II. Background Information

A. Setting

Inpatient neonatal patients or outpatient during Emergency Transport of neonatal patients.

If appropriate, implement procedural support, if available- make sure Child Life is involved, and use age appropriate language and age appropriate developmental needs with care of children

B. Supervision

The necessity of the procedure will be determined by the Advanced Health Practitioner (AHP) in verbal collaboration with the attending physician or his/her designee. Direct supervision is necessary until competency is determined and the minimum number of procedures is successfully completed, as provided for in the protocol. After that time, the attending physician or his/her designee must be available.

Designee is defined as another attending physician who works directly with the supervising physician and is authorized to oversee the procedures being done by the AHP.

C. Indications

As a general rule, an umbilical vessel should NOT be catheterized solely for the purpose of administering routine parenteral fluids.
In most circumstances, arterial catheters are safer and more useful then venous. However, in some cases, umbilical venous catheters are desirable (e.g., for exchange transfusion, measurement of central venous pressure). Never infuse PRBC's through an umbilical arterial catheter.

D. Precautions/Contraindications

1. Peritonitis

2. Necrotizing Enterocolitis
3. Omphalitis
4. Omphalocele
5. UAC – Evidence of local vascular compromise in lower limbs or buttocks area
6. UVC – portal venous hypertension

The AHP will notify the physician immediately under the following circumstances:

1. Patient decompensation or intolerance to the procedure
2. Outcome of the procedure other than expected

III. Materials

A. Catheter Tray containing:

1. Small curved scissors
2. Curved mosquito hemostat
3. Curved Kelly clamp
4. Angled scissors
5. Iris curved forceps
6. Iris straight forceps
7. Providence curved
8. 4 x 4's
9. 2 x 2's
10. Needle holder
11. Sterile towels
12. Cord Tie

B. Additional Items:

1. Luer stub adapters
2. Scalpel
3. 4.0 silk suture
4. Catheters (3.5 Fr. and 5 Fr.)
5. 10 ml syringe
6. 3-way stopcock
7. Heparinized flush solution
8. ChloraPrep
9. Restraints
10. Hat, mask, sterile gown, and sterile gloves

IV. Neonatal Vessel Catheterization

A. Pre-treatment evaluation

1. Assess need to premedicate infant for pain control and/or sedation. Assess need for further medication throughout the procedure.

2. Check appropriate labs as necessary

B. Set up (if applicable)

1. Sterilely open instrument tray, and add the suitable size catheter. Use a 3.5 Fr. for infants less than 1500 grams, or a 5 Fr. for infants greater than 1500 grams.

2. If the catheter does not come with a leur lock tip, then the flared end of the catheter together with 2 cm of tubing is cut off and an appropriately sized catheter adapter is inserted. The fit must be tight enough to prevent leakage or back up of blood.

3. 5 ml of flush solution are drawn up and attached to the top of the 3-way stopcock. The catheter is connected to the stopcock and filled with flush solution from the syringe. Make sure the stopcock is then turned off to the catheter.

4. The suture and needle are mounted in the needle holder.

5. The operator now drapes the patient, placing the hole in the steridrape over the cord. A sterile towel is placed at the infant's side and another over the legs.

6. The umbilical tape is placed around the base of the cord and tied snugly (but not tightly) in a simple knot. This is to provide for hemostasis should bleeding occur after cutting the cord.

7. Instruments, catheter and attachments and swabs are placed on the sterile towel at the infant's side for ready access.

C. Patient Preparation

1. If time permits, inform the patient/family of the treatment plan, otherwise notify them after the procedure is completed.

2. Restrain extremities for the procedure.

3. Use appropriate sterile technique including gloves, cap, gown and mask.

4. Cleanse umbilical cord and abdomen with ChloraPrep. Allow to dry. Drape area so that only umbilical cord is exposed.

5. Place cord tie around stump of cord and tie loosely; do not put tie on skin. Use scissors or scalpel to cut the umbilical cord 1 cm from skin. If bleeding occurs, tighten cord tie only enough to stop bleeding; the tie may have to be loosened during catheter insertion.

D. Procedure

UMBILICAL ARTERIAL CATHETERS

1. Perform time out with all appropriate steps.

2. Insertion of the Umbilical Arterial Catheter

   a. The cord is elevated vertically using the toothed forceps. The cord is then cut horizontally 1 cm above the skin with a scalpel blade. It is important to avoid a tangential slice. For an approach to the artery, cut from the feet towards the head. For the vein, reverse the approach. Control any bleeding by gentle tension on the umbilical tape.

   b. Grasp the stump of the cord and hold it upright. When the cut surface is blotted, the umbilical vessels can be identified easily. The single large, thin-walled oval vein can be distinguished readily from the two smaller, thick-walled round arteries. Generally, the arteries are constricted so that the lumina appear to be pinpoint in size.

   c. Gently insert the closed tips of the curved iris forceps into the lumen of one artery and allow the spring of the forceps to spread the tips apart and dilate the artery.

   d. Repeat this process several times until the lumen is well dilated and the forceps can be inserted so that the cut end of the artery is at the bend in the forceps. Careful dilatation of the artery is extremely important in successful catheterization of an umbilical artery.

   e. After the artery has been well dilated, insert the catheter into the lumen and advance the catheter directing it toward the pelvis.

   f. Once inserted into the lumen, the catheter may encounter an obstruction at either the level of the anterior abdominal wall or at 5 cm farther at approximately the level of the bladder.

      1. Obstruction can usually be overcome by 30 to 60 seconds of gentle steady pressure (avoid repeated probing or excessive pressure).

      2. If this fails, do not persist in prolonged attempts to catheterize that artery; leave the catheter in the artery and insert another catheter into the other umbilical artery.

   g. If there is no obstruction, or after an obstruction has been overcome by the above procedure, advance the catheter.

   h. Advance the catheter according to the guide in Table I. This should place the catheter tip at about the level of the aortic bifurcation.

   i. At this point, one usually draws a sample of blood for measurement of a blood gas, hematocrit, CBC, and blood culture, as well as measuring blood pressure.

j. After a blood sample has been drawn, flush the catheter with the heparinized solution. Be careful not to inject any air bubbles into the infant. Keep the syringe vertical and withdraw before flushing so that air in the line will rise to the top of the syringe. Do not leave the catheter full of blood while performing the steps below. Observe both legs for evidence of blanching, cyanosis or mottling.

k. Use the cm markings on the catheter to note the distance you have inserted it. A guide for the appropriate distance to insert an umbilical catheter is shown in Table 1.

TABLE 1

Optimum Catheter Length Insertion

Birth Weight (grams)	Distance to Insert UA Catheter (cm)
1000	7
1500	8
2000	9
2500	10

l. Place a purse-string suture in the wall of the cord taking care not to puncture the catheter. Tie the suture; then tie the catheter securely with the ends of the suture. Tape the UA line per ICN procedure.

m. Cover the umbilicus with polymixin-bacitracin ointment on a 2x2 gauze pad; use adhesive tape only on the ends of the pad so that it is not an occlusive dressing. Do not leave the umbilicus exposed to air.

n. The catheter should be taped securely to the skin at the edge of the dressing. If the tape does not adhere well to the skin, cleanse skin with alcohol pad, place strips of skin barrier, then place tape. Tape the catheter to that tape.

o. As soon as possible, begin a continuous infusion through the catheter to prevent blood clotting in the catheter tip. Change the dressing daily and observe the umbilical area for signs of infection.

UMBILICAL VENOUS CATHETERS

1. Perform time out with all appropriate steps.

2. Preparations are similar to those for umbilical arterial catheterization. The vein is the large, thin-walled vessel.

3. If the catheterization is not done immediately after birth, be careful to avoid dislodging clots in the lumen.

4. Remove any visible clots with forceps.

5. When the fluid-filled catheter is first introduced, have a syringe on the stopcock. If withdrawing on the syringe does not produce an easy flow of blood, the catheter may have a clot at the tip.

   a. Do not flush, but withdraw the catheter, maintaining only gentle suction with the syringe. This will remove the clot, and catheterization can then proceed.

6. Throughout this procedure, keep the catheter filled with fluid, and never open it to the atmosphere.

E. Follow-up treatment

Umbilical Arterial Catheter

1. Always check the location of the catheter radiographically. The catheter tip should be placed in the lower abdominal aorta below the origin of the renal and inferior mesenteric arteries and above the bifurcation of the aorta (i.e., at the bottom of, or just below, the 3rd lumbar vertebra).

2. If the catheter is advanced up into the thoracic aorta it is unlikely to pass above the ductus arteriosus and into the arch of the aorta. Rather, it will probably go through the ductus arteriosus and into the pulmonary artery. Blood gas and pressure measurements at this site will be misleading if they are interpreted as being from the aorta.

Umbilical Venous Catheter

1. Always check the location of the catheter radiographically The best location is beyond the ductus venosus in the central venous system (inferior vena cava or right atrium). Placement of a catheter in the portal circulation is undesirable for the following reasons:

   a. Portal venous pressure is always higher than central venous pressure, but by a variable amount. Its measurement gives no useful information about the general cardiovascular state of the infant.

   b. A catheter wedged in a small vein may cause a local area of infarction.

   c. Blood flow is slower in this system than in the inferior vena cava, so that thrombosis or other damage from infusion of hypertonic solutions is more likely.

2. If the catheter passes through the ductus venosus and into the inferior vena cava, it almost always enters the right atrium. If the catheter is advanced farther, it easily

passes through the foramen ovale and enters the left atrium. From there, the catheter may enter the left ventricle or a pulmonary vein. It is unusual for an umbilical venous (UV) catheter to go down the inferior vena cava, past the right atrium into the superior vena cava, or into the right ventricle.

3. In emergent situations, the catheter can be placed 2-3 cm (until blood is returned) and emergency meds can be given (This is below the liver). The catheter should not be left in this placement and should be removed after giving emergency medications.

4. Generally, the best location for the UV catheter tip is above the diaphragm in the inferior vena cava near the right atrium. This gives a satisfactory measure of central venous pressure. A catheter should not be left in the left atrium except in special circumstances and should never be left in a pulmonary vein or the left ventricle. The location of the catheter tip cannot be determined by the length of the catheter inserted. As soon as the catheter is inserted, its placement must be checked radiographically.

F. Termination of treatment

The procedure will be discontinued in the event that the vessel lumen is not seen, catheter is not able to be advanced to the proper location, or there is excessive bleeding. The catheter will be discontinued if it is no longer needed, does not draw blood back, has air in the line that is not able to be drawn back, or compromises the circulation. When the procedure has been completed, again examine both legs for evidence of decreased femoral arterial blood flow (blanching, cyanosis or mottling of the skin, diminished femoral arterial pulses). If there is evidence that there is decreased flow to one or both legs, remove the catheter, after first trying to warm the opposite leg.
The catheter should also be removed if there is persistent damping of the arterial pressure tracing.

G. Potential Complications:

Umbilical Artery Catheters

1. Umbilical artery catheters are relatively large foreign bodies in the comparatively small arterial system of an infant. There are several possible complications which can lead to serious, and sometimes fatal consequences.

   a. Ischemia - the catheter may obstruct flow to the leg(s) (see above) or to the intestine, thus potentially causing necrotizing enterocolitis (NEC). Because of this, infants with umbilical artery catheters should not be fed. If abdominal distention (or other signs of NEC) is noted, the catheter should be removed.

   b. Thrombosis - this is the most common complications of UA catheters. It may cause damping of the arterial pressure tracing, NEC, renal insufficiency, hypertension (renovascular or secondary to aortic obstruction), and signs of decreased blood flow to the legs. If signs of thrombosis are noted, the catheter should be removed.

c. Emboli - these may be air emboli (from small bubbles inadvertently infused through the catheter) or particulate emboli (e.g., from a clot on the catheter). Packed RBC's infused through UA catheters have caused emboli to the spinal cord with resultant paralysis. Therefore, packed RBC's should not be given through a UA catheter. Signs of emboli to the lower extremities are an indication to remove the catheter.

d. Vasospasm - occasionally a leg will blanch after insertion of a UA catheter. If warming the other leg does not relieve vasospasm, remove the catheter.

e. Hemorrhage - This most commonly occurs from inadvertent disconnection of the catheter from the stopcock.

f. Infection - to help avoid this unusual complication, use sterile technique on insertion and keep the cord stump covered with antibiotic ointment and a gauze dressing.

g. Vascular Perforation - this rare complication may occur from use of excessive pressure in attempting to insert a UA catheter. When this occurs, the infant may have massive intra-abdominal hemorrhage and will show signs of hypovolemia and shock.

Umbilical Venous Catheters

1. As with the umbilical artery catheter, there are several possible complications which can lead to serious, and sometimes fatal consequences.

   a. Infection (see under Complications of UA Catheters)

   b. Hemorrhage - this is unusual because the venous system is low pressure.

   c. Air Embolism - this is a potentially catastrophic event. Because negative pressures occur in the thorax during inspiration, air embolism can occur if the catheter is opened to the atmosphere. If the catheter tip is in the right atrium near the foramen ovale or in the left atrium, air emboli will be distributed to the systemic arterial circulation. Both coronary and cerebral circulations have relatively high rates of blood flow and thus may be the site of such emboli.

   d. Thrombosis - this occurs most often with infusion of hypertonic fluids into the portal circulation.

   e. Necrotizing Enterocolitis - this may occur if there is obstruction to the portal venous flow.

IV. Documentation

A. Documentation is in the electronic medical record

1. Documentation of the pretreatment evaluation and any abnormal physical findings.
2. Record the time out, indication for the procedure, procedure, type and size of catheter used, method used, EBL, the outcome, how the patient tolerated the procedure, medications (drug, dose, route, & time) given, complications, and the plan in the note, as well as catheter placement by x-ray.

B. All abnormal findings are reviewed with Attending or supervising physician

V. Competency Assessment

A. Initial Competence

1. The AHP will observe the procedure in its entirety at least once. Under the direct supervision of the attending physician the AHP will perform umbilical vessel catheterization successfully **three** times and will be evaluated for competence and technical skill.
2. The AHP will demonstrate knowledge of the following:
   a. Medical indication and contraindications of umbilical vessel catheterization
   b. Risks and benefits of the procedure
   c. Related anatomy and physiology
   d. Consent process (if applicable)
   e. Steps in performing the procedure
   f. Documentation of the procedure
   g. Ability to interpret results and implications in management.
3. The AHP will ensure the completion of competency sign off documents and send them directly to the medical staff office.

B. Continued proficiency

1. The AHP will demonstrate competence by successful completion of the initial competency.
2. Each candidate will be initially proctored and signed off by an attending physician. AHPs must perform this procedure at least **three** times per year. In cases where this minimum is not met, the AHP must demonstrate skill with this procedure in a simulation or skills lab, or the attending, must again sign off the procedure for the AHP. The AHP will be signed off after demonstrating 100% accuracy in completing the procedure.
3. Demonstration of continued proficiency shall be monitored through the annual evaluation.

4. A clinical practice outcomes log is to be submitted with each renewal of credentials. It will include the number of procedures performed per year and any adverse outcomes. If an adverse outcome occurred, a copy of the procedure note will be submitted.

VII. RESPONSIBILITY

Questions about this procedure should be directed to the Chief Nursing and Patient Care Services Officer at 353-4380.

VIII. HISTORY OF POLICY

Initial policy approved 1986 by CIDP and EMB
Revised 4/89, 1/93, 5/01, 7/03, 12/05, 6/08, 2/11
Revised most recently July 2012 by Subcommittee of the Committee for Interdisciplinary Practice
Reviewed most recently July 2012 by the Committee on Interdisciplinary Practice
Approved most recently July 2012 by the Executive Medical Board and the Governance Advisory Council.