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Manual of Neonatal Procedures

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Foreword
Gianluca Terrin

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CHAPTER 3

Umbilical Artery and Venous Catheterization

INTRODUCTION

The ethos of modern day management of the sick neonate has increasingly become "proactive" rather than "reactive". Today, more decisions in the NICU are taken based on the hard evidence of quantitative measurements than was prevalent two decades ago. Inherent in this transformation is the trend for greater intensive monitoring and invasive management, an essential part of which is a reliable access to the vascular space. The availability of high quality, sophisticated lines has made it possible to access the vascular space in the smallest of neonates in a manner which, till recently, was possible only in larger children and adults. In the neonate, the umbilical vessels provide easily accessible (arterial and venous) access (Fig. 3.1).

UMBILICAL ARTERIAL ACCESS

Indications

- Arterial access is used in sick neonates for continuous intra-arterial blood pressure recording.
- Frequent blood gas determinations.
- Isovolumetric exchange transfusion in unstable neonates.

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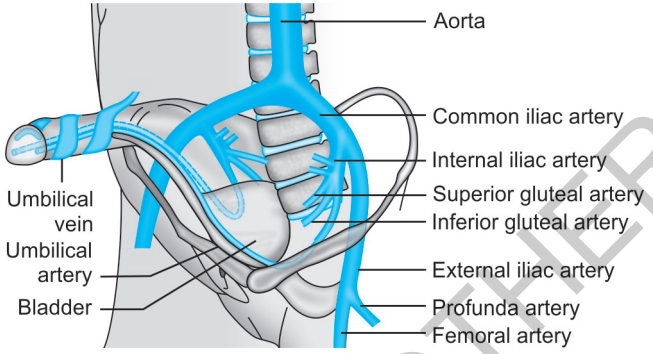


Fig. 3.1 Anatomy of umbilical arteries

Contraindications

- Omphalitis
- Necrotizing enterocolitis
- Peritonitis/acute abdomen
- Omphalocele
- Evidence of vascular compromise of lower limbs or buttock areas.

Equipment

- Gloves, gown and mask
- Antiseptic solution (alcohol, iodine) Sterilize gauze
- Syringes 5 mL, 10 mL
- Cord tie
- Sterile drape with central hole
- Scalpel
- Toothed forceps, iris forceps
- Silk suture with needle Band Aid, leucoplast.

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- Umbilical artery catheter
  For birth weight < 1,250 g–3.5 FG
  > 1,250 g–5.0 FG

Pressure transducer assembly for invasive blood pressure monitoring.

Technique

- Choose the position of the catheter the *high* position at T6-9 or *low* position below L2 avoiding the origin of the renal arteries.
- Measure shoulder umbilical length. Shoulder umbilical length is the perpendicular distance between parallel horizontal lines at the level of the umbilicus and through the distal end of the clavicles. Estimate length of catheter to be inserted in Figure 3.2.

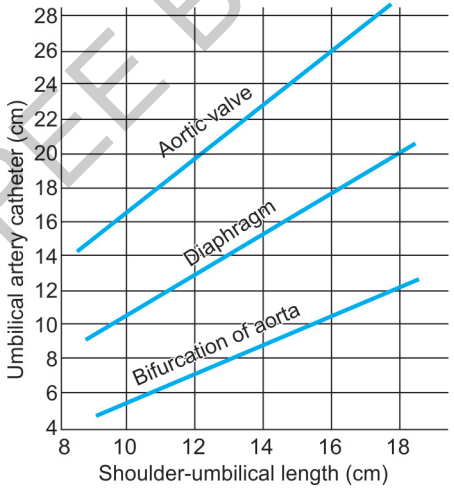
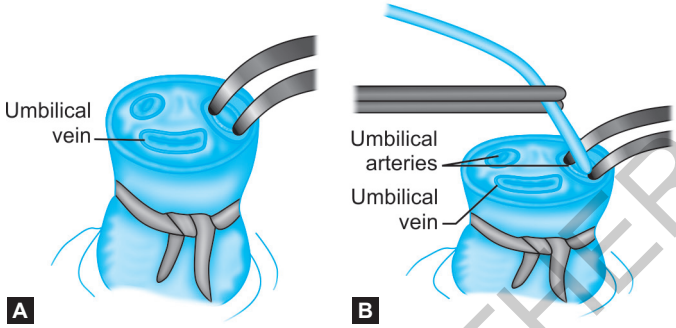


Fig. 3.2 Graph for estimation of umbilical artery catheter length

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- Wash hands thoroughly.
- Wear sterile gown, mask and gloves.
- Attach stopcock to hub of catheter and fill system with flush solution. Turn stopcock "off" to catheter.
- Ask assistant to hold the cord with sterile gauze.
- Prepare cord and surrounding skin up to a radius of 5 cm with alcohol-iodine-alcohol swabs.
- Drape area around cord.
- Using tie made from sterile gauze, tie at base of cord. Tighten to prevent bleeding.
- Cut cord horizontally with scalpel about 1–1.5 cm from skin.
- Squeeze the cord between thumb and fingers for two minutes. This will cause umbilical arterial wall to dilate due to hypoxia thus making cannulation easy.
- Identify arteries as smaller, thick-walled and white structure. They may protrude slightly from the cut surface.
- Grasp cord stump, using toothed forceps, at a point close to the artery to be catheterized.
- Introduce one of points of curved iris forceps into lumen of artery and insert to a depth of 0.5 cm.
- Remove forceps and bring points together before introducing them once more into lumen (Fig. 3.3A).
- Insert gently to a depth of 1 cm (up to the curved shoulder of forceps), keeping points together. Allow points to sprang apart and maintain forceps in position for 15–30 seconds. Release cord and remove toothed forceps, while keeping curved iris forceps within artery.
- Grasp catheter 1 cm from tip, between free thumb and forefinger, or with curved iris forceps.
- Insert catheter into lumen of artery, between prongs of dilating forceps (Fig. 3.3B).
- After inserting for 5–7 cm aspirate to verify intraluminal position and clear the aspirated blood by injecting 0.5 mL of saline. Insert the catheter till the desired length. Add length of umbilical stump to the length of catheter obtained from graph.

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Figs 3.3A and B Dilatation of umbilical artery

- Remove umbilical tie and place purse string suture around base of cord and not through skin or blood vessels. Fix the catheter with Roman shoe string knots or through leukoplast applied over the catheter near the umbilical stump.
- Obtain X-ray to identify catheter position.
- Connect to pressure transducer via three-way stopcock and run continuous heparinized saline to keep it patent.

Monitoring

- Check lower limb color and pulses.
- Check buttocks/perineum for discoloration.

Care of Arterial Lines

Umbilical arterial line should be fixed by a purse string suture, followed by a clear transparent dressing. Peripheral arterial lines are best fixed using transparent adhesive dressings. A three-way stopcock attached to the hub of the line permits easy sampling as well as provision of continuous infusion and intra-arterial

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monitoring of blood pressure. Flushing the line after sampling is a must.

All arterial lines should be clearly labeled. Hypertonic solutions, calcium and pressor agents should not be infused into them. The patency of the arterial lines should be ensured by flushing it continuously with 1–2 mL/hour of saline containing 0.5–1 unit/mL of heparin. The line should be monitored for evidence of inflammation, distal ischemia and local infection. Capillary circulation, temperature of the distal limb, and pulses should be meticulously examined and recorded.

Complications and their Management

Arterial lines may be complicated by ischemia due to spasm or thrombosis. This may take the form of ischemic necrosis of the leg or gluteal region and renal arterial thrombosis in case of umbilical arterial line. Necrotizing enterocolitis has also been described. Sudden cyanosis or pallor of a part below umbilicus especially a limb or toes may be related to embolism or spasm. Warm opposite leg with warm (not hot) towel. If no return to normal color within 5 min or if gluteal region involved prepare to remove line.

Precautions

- Avoid use of feeding tubes as catheters.
- Take time to dilate lumen of artery before attempting to insert catheter.
- Catheter should not be forced past an obstruction.
- Never advance catheter once placed and secured.
- Avoid covering the umbilicus with dressing this may delay recognition of bleeding or catheter displacement.
- Confirm catheter position by X-ray.
- Be sure catheter is secure.
- Take care not to allow air to enter catheter. Always have catheter fluid-filled and attached to closed stopcock prior.

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UMBILICAL VENOUS CATHETERIZATION

The umbilical vein can be catheterized easily up to about 10–12 days of age or till the umbilical cord falls. A size 5F for birth weight < 3.5 kg and size 6 or 7 for bigger infants can be used for umbilical venous catheterization. The length of insertion depends on the requirement and can be assessed by shoulder-umbilical distance (Fig. 3.4). Preparation for procedures is same as that for umbilical arterial cannulation except that vein does not require dilatation. The vein can be easily identified as the large bore, thin walled, single vessel of its type, seen on cutting the umbilical cord. Catheter is introduced and directed into the vein, which takes an upward course, crosses the ductus venosus and enters the inferior vena cava (Fig. 3.5). During insertion, the catheter may enter one of the hepatic veins. In that case, the catheter should be withdrawn and reintroduced with rotatory movement.

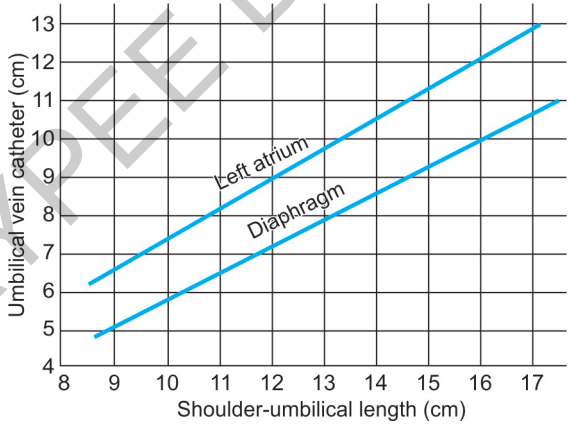


Fig. 3.4 Graph for estimation of umbilical venous catheter length

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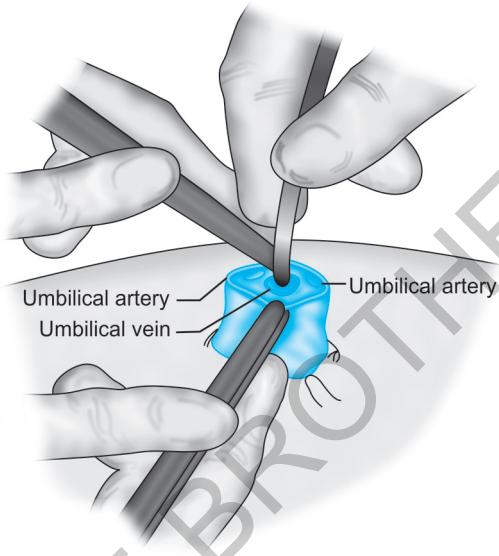


Fig. 3.5 Catheterization of umbilical vein

Complications

Complications of umbilical venous catheterizations include portal vein thrombosis, hepatic necrosis, infection, thrombosis of the inferior vena cava and necrotizing enterocolitis.

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- Written in straightforward, clear, simple and lucid language
- Provides simplified illustrations, tables and the flow charts for better understanding of the subject
- Provides extensive insight of each topic with a focus on basic concepts
- Helpful for postgraduate students of pediatrics, nursing staff working in neonatal intensive care, neonatologist as well as general pediatricians with an interest in neonatology to supplement their knowledge and get more clarity on this subject



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