NEONATAL CENTRAL LINES
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LEARNING OBJECTIVES
- Recognize central lines used in the NICU
- List the recommendations by the regulatory agencies regarding central line maintenance
- Discuss the rationale for use of the various central lines used in the NICU
- Review the complications that can occur from neonatal central lines
- Recall nursing care required for NICU central lines

CENTRAL LINE DEFINITION
- An intravascular catheter that terminates at or close to the heart or in one of the great vessels which is used for infusion, withdrawal of blood, or hemodynamic monitoring
- The following are considered great vessels for the purpose of reporting central-line BSI and counting central-line days in the NHSN system:
  - Aorta
  - Pulmonary artery
  - Superior vena cava
  - Inferior vena cava
  - Brachiocephalic veins
  - Internal jugular veins
  - Subclavian veins
  - External iliac veins
  - Common iliac veins
  - Femoral veins
  - In neonates, the umbilical artery/vein

UVC AND UAC
UVC and UAC

- Most often made of polyvinyl chloride
- Silastic, bonded, and newer plastic catheters also used
- Umbilical catheters available in standard sizes
  - 5F, 3.5F and 2.5F
  - 5F catheter in term infants
  - 3.5F catheter should be used in preterm infants >1000g
  - 2.5F catheter for all neonates <800g and for most <1000g
- Single end hole (side-hole catheters associated with increase in thrombosis)
- Single lumen: vein or artery
- Double or triple-lumen: vein only

UAC and UVC

- Umbilical artery catheter (UAC) and umbilical venous catheter (UVC) placement have become the standard of care in the neonatal intensive care unit
- These catheters allow for rapid and reliable access to the vascular system of critically ill neonates

UVC

- Umbilical vein catheterization may be a life-saving procedure in neonates who require vascular access and resuscitation
- The umbilical vein remains patent and viable for cannulation until approximately 1 week after birth
- After proper placement of the umbilical line, intravenous fluids and medication may be administered to critically ill neonates
- Vein is located in the 12 O’Clock position on the umbilical cord

UVC Placement

- Umbilical vein catheters may be placed in the inferior vena cava above the level of the ductus venosus and below the level of the right atrium (10-12 cm)
- Acts as central venous access, allowing central venous pressure (CVP) monitoring, medication infusions, and the administration of TPN solution
- In an emergency, the catheter is best advanced only 1-2 cm beyond the point at which good blood return is obtained to avoid injecting hyperosmolar fluids into the portal vessels and causing liver necrosis (usual meds are epinephrine and normal saline)
- Once placed, can pull back, but cannot advance

Umbilical Venous Catheter Uses

- Pressors and hypertonic solutions
- Venous blood sampling
- Delivery of blood and blood products
- Low venous lines also used for emergency access and exchange transfusions

UVC Complications

- Infection
- Hemorrhage
- Vessel perforation
- Thrombotic endocarditis
- Sepsis
- Tip accidentally placed in/migrating to the liver can result in portal vein thrombosis and hepatic necrosis
- Creation of a false luminal tract
- Hepatic abscess or necrosis
- Air embolism
- Hemorrhagic infarction in the lungs
- Catheter tip embolism
- Tip placed high in the right atrium can lead to arrhythmias/tamponade
- Broken catheters
An umbilical vein catheter should pass through the umbilical vein into the left portal vein. Then through the ductus venosus into a hepatic vein and the inferior caval vein (IVC). The tip should be positioned in the IVC at the level of the diaphragm (T6-T9).

Umbilical veins are small muscular-walled vessels that carry deoxygenated blood from the fetus to the placenta.

The umbilical arteries course downward to the internal iliac arteries before entering the aorta.

They supply the buttocks and the lower extremities via the latter part of the internal iliac arteries.

**UMBILICAL ARTERIAL CATHETER PLACEMENT**

- There are two potential positions for the UAC.
  - The high position is at the level of thoracic vertebral bodies T6-T9.
  - The low position is at the level of lumbar vertebral bodies L3-L4.
  - The Cochrane Systematic Review suggests that a high position is preferred as it is associated with fewer obvious vascular complications, a probable reduction in the incidence of aortic thrombus, and longer catheter life.

**UAC COMPLICATIONS**

- Vessel perforation
- Peritoneal perforation
- False aneurysm
- False track
- Thrombosis
- Embolism/Infarction
- Vasospasm
- Loss of extremity
- Hypertension
- Paraplegia
- Heart failure (from aortic thrombosis)
- Air embolism

Malpositioned Catheter  Vascular Accident

**UMBILICAL ARTERIES**

- Umbilical arteries are small muscular-walled vessels that carry deoxygenated blood from the fetus to the placenta.
- The umbilical arteries course downward to the internal iliac arteries before entering the aorta.
- They supply the buttocks and the lower extremities via the latter part of the internal iliac arteries.
UAC COMPLICATIONS

- Broken catheter
- Transection of catheter
- Improper grounding of electronic equipment
- Conduction of current through fluid-filled catheter
- Hemorrhage
- Infection
- NEC
- Intestinal necrosis or perforation
- Transection of omphalocele
- Herniation of appendix through umbilical ring
- Cotton fiber embolus
- Wharton-jelly embolus
- Hypernatremia

UAC USES

- Frequent arterial blood gas sampling
- Moderate- severe and worsening respiratory failure
- Continuous arterial blood pressure monitoring
- When non-invasive measurements are unreliable
- Volume expanders & medication

UMBILICAL CATHETER POTENTIAL CONTRAINDICATIONS

- Abdominal wall defects or Infection
  - Omphalocele
  - Gastroschisis
- Bleeding or clotting issues
- Infection
  - Omphalitis
  - Peritonitis
  - Necrotizing enterocolitis
- Vascular compromise
  - Particularly in the lower extremities or buttocks

UAC in high position

UAC in low position
Vasospasm
Thrombosis or emboli
Perforation
Urachus catheterization
Intraventricular hemorrhage
Necrotizing enterocolitis
Sepsis
Hematuria
Hypertension
Hemolysis
Hemorrhage

**Complications Continued**

Sepsis and Thrombosis
- Sepsis incidence noted to be 3% to 16%
- Increases in infants receiving TPN and intralipids
- Thrombosis may lead to thrombotic endocarditis and pulmonary hemorrhagic infarction
- Risk increases with prolonged catheter use
- Requires a constant infusion to prevent clotting

**UAC Complications**

Vasospasm
- Blanching/cyanosis of buttocks/lower extremities
- Thrombus formation or emboli with extensive ischemic injury and limb loss
- Vasospasm may be helped by
  - Warming the unaffected limb, repositioning the catheter to a lower position or catheter removal
- Accidental urachus catheterization can lead to urinary ascites

**PICC**

Peripherally Inserted Central Catheter

Dwells deeper in the vein than a PIV, but never enters the abdominal-thoracic cavity
A midline catheter is a vascular device inserted into a peripheral vein and threaded to an area of greater blood flow in the proximal portion of the extremity, or it can be inserted into a scalp vein and threaded into the external jugular vein
A form of intermediate IV therapy
Should not use if an infant needs a central PICC
Insertion is the same as if for a PICC
Can remain in place 2-4 weeks (mean times 4-11 days)
Do not infuse hyperosmolar solutions via MLC

**Nursing Responsibilities and Umbilical Lines**

- Recognize candidates and anticipate need for set-up
- Collect equipment/supplies
- Set up and breakdown for procedure
- Placement x-ray
- Monitor infant status during procedure
- VS and Respiratory status
- Make sure skin temp probe is uncovered
- Infant positioning for safety and facilitation of procedure
- Sedation
- Pain assessment
- Parental education
- Own the sterile room
- Secure line
- IV set-up: Transducers for central BP including calibration
- Blood draws/Flushes
- Documentation of measurements, procedure, titration
- Infant safety to prevent dislodgement or disconnection
- Assessment for circulatory compromise
PICC LINES
- Used in neonates/infants since introduction more than 3 decades ago to administer:
  - Hyperosmolar solutions
  - Medications
  - Continuous infusions
- Not recommended for:
  - Blood products, but is used for this in many parts of the country
  - Bolus medications with a continuous drip

PICC PLACEMENT CONSIDERATIONS
- A PICC line is a thin, soft, long catheter that is inserted into a vein in the arm, leg or neck
- The tip of the catheter is positioned in a large vein that carries blood into the heart
- The PICC line is used for long-term intravenous antibiotics, nutrition or medications, and for blood draws
- Recommended for NICU patients for which IV therapy will be continued beyond 6 days after removal of a UAC/UVC
- High osmolality and chemical factors such as pH in solutions and meds can cause PIV complications
  - <1500g infants
  - Limited PIV access

PICC CANDIDATES
- Preterm infants less than 1500g
- Require greater than 6 days of IV therapy
- GI disorders
- Limb anomalies
- Infants receiving high osmolar infusions greater than 600 mOsm/kg
- Inadequate PIV access

VEINS TO CONSIDER FOR PICC
- Basilic
- Cephalic
- Saphenous
- Temporal
- Popliteal
- Lesser saphenous
- Femoral vein

CATHETER SELECTION
- 24 to 28 gauge PICCs most commonly placed in neonates
- Smaller catheters don’t allow for routine blood sampling or transfusion
- Select the smallest catheter that will meet your needs

PICC INSERTION COMPLICATIONS
- Infection
- Bleeding/Clotting
- Arterial cannulation
- Arterial perforation
- Arrhythmia
- Hemothorax
- Pneumothorax
- Phlebitis
- Infiltration
- Dermatitis
- Catheter leakage or fracture (internal or external)
- Catheter migration
PICC INSERTION DOCUMENTATION

- Indication for the procedure
- Verification of informed consent
- Time out
- Analgesics, sedatives or local anesthetic given
- Date and time of placement, name of person placing the catheter
- Vein selected
- Number of attempts, use of transillumination or ultrasound, amount of blood loss
- Skin prep and type of dressing/securement device (CHG or PI in ELBW)
- Infant’s tolerance of procedure, complications and actions taken to address them
- Catheter length/insertion distance
- Dressing changes

PICC CARE AND ASSESSMENTS

- Insertion requires 2 people
- Obtain equipment and supplies
- Set-up and break down
- Knowledge of insertion length
- Site and Dressing
- Infusion monitoring
- VS
- Infant status
- Knowledge of complications and relationship to changes in infant status

CENTRAL LINE INFECTIONS

- Every year 250,000 central line associated blood stream infections (CLABSI) are reported by hospitals
- CLABSI not only put the patient at risk for mortality and morbidity, but also increase the length of hospital stay and increase the cost of the hospitalization
- Newborns are disproportionally affected with CLABSI because of their immature immune system, frequent need for central venous access, frequency of handling, and of blood sampling from central lines
- Each time a central line is accessed, the risk for contamination and subsequent infection is increased
- It is estimated that 10%-20% of patients with CLABSI will die

CENTRAL LINE BUNDLE

- Combining all known best practices related to central line management to improve outcomes
  - Hand hygiene
  - Maximal barrier protection for central line insertion
  - Standard sterile line management techniques
  - Chlorhexidine (povidone-iodine for ELBW to prevent chemical burns) solution for site preparation and access
  - Daily review of line and prompt removal

JOINT COMMISSION AND CENTRAL LINES

- NPSG.07.04.01 (2009)
- Implement best practices or evidence-based guidelines to prevent central line-associated bloodstream infections
- This requirement covers short and long term central venous catheters and peripherally inserted central catheter (PICC) lines.
- Implement best practices or evidence-based guidelines to prevent central line-associated bloodstream infections
- This also includes training staff at hire, updating policy and procedure with evidence-based practice and training families about central lines and infection

- CMS, Joint Commission, CDC, AAP, CCQI, IHI
**CLABSI BUNDLES**
- Insertion Bundle
- Maintenance bundle
  - Hub disinfection
  - Daily inspection / monitoring
  - Dressing changes
- Removal Bundle

**INSERTION BUNDLE**
- Perform hand hygiene before insertion
- 2 operators
- Adhere to sterile technique
- Use maximal sterile barrier precautions (i.e., mask, cap, gown, sterile gloves, and sterile full body drape)
- Perform skin antisepsis (2% CHG or PI)
- Choose the best site to minimize infections and mechanical complications
- Cover the site with sterile gauze or sterile, transparent, semipermeable dressings

**MANAGEMENT BUNDLE**

**MINIMIZE ACCESS PORTS**
- Each port of entry is an opportunity for contamination
- Closed medication systems decrease opportunities for contamination
- Sterilize access points prior to entry
- Chlorhexidine gluconate scrub the hub X 15 seconds and allow to dry at least 30 seconds prior to entry
- Bacteria, following entry into a device, can develop biofilm within the device that extends throughout the catheter
- Minimize IV tubing changes (72 hours)
- Consider sterile technique for tubing changes

**CLABSI BUNDLES**

**RECOMMENDATIONS**
- Two operators for dressing change
- Sterile technique
- One operator for hub care
- Sterile technique for dressing change and hub care
- Consider sterile technique for tubing changes
3 ESSENTIALS IN CENTRAL LINE CARE HUB PROTOCOL

- Establishing sterile field: near patient
- Disinfection of the central line hub with chlorhexidine
- Maintaining sterility while attaching syringes or tubing

HUB CARE

- Cleanse hands with soap and water
- Put on gloves
- Establish sterile field under access port with 4x4
- Place syringes on edge of sterile field.
- Scrub access port with chlorhexidine scrubbed for 10 seconds and allow to dry
- Pick up syringe, keeping tip sterile
- Attach syringe to hub, keeping connections sterile
- Administer flush solution, keeping connections sterile

MONITOR NECESSITY OF LINES

- The longer a central line is in place, the greater is the risk of infection
- The primary purpose and ongoing need for the central catheter should be assessed on a daily basis to facilitate its removal in a timely manner

LINE REMOVAL BUNDLE

DISCONTINUATION OF CENTRAL LINE

- Stop IV fluid
- Wash hands and don sterile gloves
- Remove dressing; clean exit site; slowly withdraw catheter
- Hold pressure for 5 minutes
- Place dressing if needed
- Observe area for 1 hour for bleeding or hematoma
- Inspect catheter
- Culture catheter tip

ENSURE COMPLIANCE

- Training to perform the procedures
- Provision of adequate supplies for their execution
- Ongoing monitoring to assure compliance with the program
- Monitoring of central line days
- Monitoring of central line infections
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