Central Vascular Access
Lesson Description – Mitch Taylor

- Define central venous catheter (CVC) and associated terms.
- Describe the anatomy associated with central line placement.
- Verbalize the differences between the different central venous access devices and identify nursing care associated with each device.
- Discuss indications and nursing care of patients with central venous access devices.
- Identify symptoms of common complications of central venous access devices and nursing interventions to prevent and manage these complications.
- Categorize different IV solutions in terms of isotonic, hypertonic, and hypotonic solutions.
Guidelines

- U.S. Department of Health & Human Services
- Provides a website for national guidelines for evidenced based practice
- National Guideline Clearinghouse
- http://www.guidelines.gov/
GLOSSARY OF TERMS

- **Biocompatibility** - the quality of not having toxic or injurious effects on biological systems. - Dorland's Medical Dictionary

- **Central Venous Catheter** – tip in distal third of the Superior Vena Cava (SVC)

- **Central Venous Tunneled Catheter** – tip in SVC, but insertion is tunneled under the skin before accessing the vein.

- **Distal** - means furthest from the heart (perspective) on the body, but on a catheter, the distal part would be the furthest away from the infusion ports.
Perspective

- For example, when we are talking about hypertonic, isotonic, and hypotonic solutions, we are talking about it from the perspective of inside the vessel.
Isotonic
Isotonic

- The vessel always wants to look like America’s Top Model – perfect or always look isotonic. It will do whatever it needs to accomplish that look.
Hypertonic

Vessel

Cell

Cell

Cell

Cell

Cell
Perspective

- So, a hypertonic solution means it is thicker or more concentrated than what is normally in the vessel.
- And, because the body seeks to normalize things in the vessel, it will send fluid to the vessel to get it to look normal or isotonic again.
- It robs from the cells and tissues to achieve the look of isotonic in the vessel.
- What this does then is add more fluid into the vessels and onto the heart, which the heart sends to the kidneys to urinate out of the body.
Hypertonic

Vessel

More Fluid

Cell

Cell

Cell

Cell

Cell

Cell
A hypotonic solution then does the opposite. It has less stuff or is thinner or is less concentrated than what is normally in the vessel.

So the body will shunt fluid out of the vessel into the cells in order to make the vessel look normal again.

This will reduce the amount of fluid in the vessel and reduce the amount of work on the heart.
Hypotonic

Vessel

Cell

Cell

Cell

Cell

Cell

Cell
Hypotonic
Fluids

- **Isotonic** – 0.9% Normal Saline (NS), Lactated Ringers (LR), (these 2 are recommended most). D5W (but not recommended because the Dextrose is used quickly by the body, leaving a hypotonic solution in the body). You will see many medications reconstituted with D5W, though.

- **Hypotonic** – 0.45% NS (1/2 NS). Because of the above statement, some classify D5W as a hypotonic solution

- **Hypertonic** – 3% NS, D5NS w/20mEq KCL, Mannitol, TPN, Albumin
GLOSSARY OF TERMS

- **Extravascular malpositioning** - the introducer is placed outside of the vessel.
- **Implanted port** - surgically implanted under the skin, that then accesses a vessel.
- **Intravascular malpositioning** - tip of the catheter is coiled in the vessel or follows another vessel going away from the SVC.
GLOSSARY OF TERMS

- **Lymphedema** - swelling of an extremity caused by obstruction of lymphatic vessels.

- **Midline catheter** - catheter with tip placement in or at the junction of the axillary vein. (Treat these as peripheral catheters in determining what type of fluids a patient could receive.)
**GLOSSARY OF TERMS cont.**

- **Peripherally Inserted Central venous Catheter (PICC)** - this is a catheter that is inserted into a peripheral vein at the antecubital vein or above and then is threaded to where the tip ends up in the SVC.

- **Thrombogenicity** - generation or production of thrombosis.
Trendelenburg position – the head is lower than the feet.

Tunneled catheter – a catheter is placed under the skin for a short distance, then enters the vasculature.

Vascular Access Device – a device that accesses the vascular system.

Valsalva Maneuver – a forceful attempt at expiration with mouth, nostrils, and glottis closed. Sometimes known as bearing down.
Broviac catheter

Groshong catheter

Hickman catheter

These last three are brand name catheters that are long term tunneled catheters. Many times you will see the name used instead of the term tunneled catheter.
Common Landmarks of the Chest

- Midsternal Line
- Mid-Clavicular Line
- Sternal Notch
- Anterior Axillary Line
- Angle of Louis or Sternal Angle
- 2nd Intercostal Space
- 4th Intercostal Space
- Mid-Axillary Line
ANATOMY OF THE VASCULAR SYSTEM – The SVC is the placement goal of all central lines.
Choosing the Venous Access Device

- Assessment parameters – why do you need it?
  - Selection Algorithm
    - Start with least invasive.
    - Meds/TPN/Blood Products?
    - Time frame (how long will it be needed?)
    - Urgency (how quick do they need therapy?)
Choosing the Venous Access Device

- Assessment parameters – what would stop you from using a particular device?
  - Conditions that limit placement
    - A-V fistula
    - Lymphedema
    - Obesity
    - Local infection site or near site
    - Scarring, burns
    - Existing site of use for dialysis or chemotherapy
Choosing the Venous Access Device

- Material, check for latex sensitivity if product contains latex. Be aware that different catheters have some different properties.

- Lumens –
  - Single, Double, and Triple lumen catheters are the most common.
  - Incompatible medications can run together in more than one lumen as long as the end of the catheter is in the SVC.
  - This does not refer to piggybacking medications in the same lumen.
  - The Distal port of a central line is where you monitor Central Venous Pressures (CVP). This is the opposite of a Swan-Ganz catheter.
Comparing Catheters

- Short-Term Access Devices
  - PICC Line is temporary, but can be placed for several months.
- Long-Term Access Devices
**Short-Term Access Devices**

- Used for short period of time, > 1 week up to 6 weeks for high volume or vasoactive critical drips or urgent blood replacement.
- Flush with every access 5-10 mL NS or at least 2 times per day. Follow institution policy.
- (Note: H.I.T. – Heparin Induced Thrombocytopenia)
- Make sure lab draws are done with no IV running in the port you are drawing.
- Make sure your draw 5-10 mL off a waste in order to prevent contamination of the specimen before drawing the lab.
- Dressing changes transparent, change 1st 24 hours, then every 7 days or if soiled. Gauze, change every 24-48 hours.
Short Term Triple-Lumen Nontunneled Central Venous Catheter

Each of these types of catheters, there is a proximal port, medial port, and a distal port. In general, each will be marked and may be colored.

Because the end of the catheter stops in the superior vena cava (SVC), the distal port, unlike the Swan, is the port used to monitor CVP.

Proximal – Blood draws, meds, blood component administration

Medial – TPN (or meds if no TPN)

Distal – High volume fluids, meds, viscous fluids, CVP monitoring
Proximal and Distal.

- Distal - means furthest from the heart (perspective) on the body,

- but on a catheter, the distal part would be the furthest away from the infusion ports.
Dialysis Catheter

- Double Lumen catheter for rapid exchange of fluids
- Will say A for arterial and V for venous, but the catheter is in the venous system.
- The catheter has to be “packed” with heparin or sodium citrate to keep from clotting.
This is a Pulmonary Artery Catheter in place. Showing a deflated balloon and a wedged balloon. The catheter rests in the pulmonary artery with the balloon down.
Pulmonary Artery Catheter

- Is a short term diagnostic catheter
- Can be used as a central line for administration of meds/fluids/blood
- Central Venous Pressure is measured in the right atrium (proximal port) instead of the SVC (distal port) like a Triple Lumen catheter.
- Has a sheath that maintains a sterile catheter.
PICC Lines

- Vein selection
  - Cephalic Vein
  - Brachial Vein
  - Basillic Vein
  - Long catheter inserted in an arm vein and threaded up to the SVC.

- Placement – reduces risk of pneumothorax, infection, and air embolism
- Can be in for months to 1 year.
PICC

- **Dressing management**
  - Change dressing first 24 hours, then 7 days (follow institution protocol)

- **Flushing procedure** – any time accessed or BID. Do not use a small syringe (the smaller the syringe the increase in pressure exerted on the catheter). Check and follow hospital protocol. We teach S.A.S.(H). method. Sodium Chloride, Administer Medication, Sodium Chloride, (Heparin – this is becoming more controversial because of the risk of H.I.T.)

- Infusion pumps may need to be used to adm. fluids/blood/TPN.
Picc (Peripherally inserted Central Catheter)

If it is confirmed to be in place as a central line, then it can be used to monitor CVP as well.

This is a catheter, in this case a double lumen catheter, that when placed in the SVC (Superior Vena Cava) can be used for IV therapy for 2 weeks to 12 months.

A chest X-Ray is required to determine placement of the line as a central line. Indications: Multiple venipunctures, antibiotic therapy, chemotherapy, TPN, analgesia, blood products, intermittent inotropic therapy, and fluids.
PICC

- Blood sampling – due to small lumen, it is more difficult to draw without hemolyzing or harming the specimen.
- Blood administration – may be difficult to give fast blood administration through the small lumens.
- Repair – can be repaired.
- Discontinuing PICC
Long-Term Access Devices

- **Tunneled catheters**
  - Broviac
  - Hickman
  - Groshong valve

  Insertion – placed underneath the skin before insertion into a vein to prevent infection.

- For use if needing > 6 month therapy
- Flushing Procedure – follow hospital protocol (flush any time accessing and daily)
- Dressing management – daily with gauze until healed, the may not need a dressing.
Tunneled Long Term IV Catheters like the Hickman, Broviac, or Groshong. These types of catheters are tunneled under the skin, here represented by the dotted lines. These have a balloon just underneath the skin to anchor it in place. It is tunneled underneath the skin to help reduce the risk of infection. Long term therapy of chemotherapy, IV fluids, Antibiotics, medication caustic to the vessels are all indications for use.

One other thing to remember with these catheters. If for some reason, they become dislodged or removed, the insertion site into the vessel, not the insertion site into the skin is where pressure needs to be held to stop the bleeding.
Long-Term Access Devices

- Repair – can be repaired
- Blood sampling – watch what is being given and make sure it is off and a waste is drawn.
- Implanted Ports – underneath the skin
  - Huber Needle
  - Assessing the port – use of fingers to find.
  - Flushing – whenever accessing the port 10 mL of NS then Heparin 5 mL. (follow institution)
  - Deaccessing Port – flush once every 4 weeks if not used.
A long term implantable or subcutaneous vascular access device like a Port-a-Cath is shown here. It stays underneath the skin and is accessed through the skin.
Complications

- Have students come up with a pneumonic for the complications (see hand out examples)
Complications of Central Intravenous Lines:

Mnemonics:

BAD HABITs are Very Hard To Part from
B = Bleeding
A = Air Embolism
D = Dysrhythmias
H = Hematoma
A = Arterial Puncture
B = Brachial Nerve Injury
I = Infection
T = Thromboembolism
V = Venospasm
H = Hemothorax
T = Thoracic Duct Injury
P = Pneumothorax

BAT HIT the BAD Pitcher, Very Hard
B = Bleeding
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Preventing Catheter-Related Infections

- Hand washing
- Insertion - Sterile barriers, mask, gloves, gown, caps, and large drapes
- Skin Prep with Chlorhexidine Gluconate
- Dressing changes as appropriate to keep site visible and dry using sterile technique.
- Use of a Biopatch
- Control Blood Sugars.
Scenario:

- A patient comes into the emergency room as a level 1 trauma, bleeding profusely from the chest tube. 1000mL is out and BP is 65/35. You attempt x 2 and cannot insert an 18g IV catheter. You inform the trauma surgeon and request a central line.

- Which line should be selected and why?

- Start giving 3 liters of fluid wide open, and then blood 3 units of PRBCs, which improves the BP to 93/42. You rush the patient to surgery.

- What type of fluid and why?

- Write a PIE charting.
TPN (Total Parenteral Nutrition)
Lesson Description – Mitch Taylor

- Identify appropriate indications for use of total parenteral nutrition.
- Relate general characteristics of TPN to specific patient situations.
- Apply nursing process considerations for TPN to specific patient situations.
- Describe the nursing care for critically ill clients receiving nutritional support via Total Parenteral Nutrition (TPN) and enteral (tube) feeding.
TPN

- Assessment: Collect data pertinent to the patient who will be receiving total parenteral nutrition therapy.
  - Monitor intake and output for a deficit
    - Dysphagia
    - Bladder and Bowel Elimination
    - Daily Weight
Monitor lab values for abnormalities that would indicate malnutrition and other disease processes that might complicate providing nutrition.

- Electrolytes: Na, Cl, K, Ca (more preferably an ionized Calcium), Mg, and Phosphorus (PO4)
- Albumin (50-60% of Calcium is bound to Albumin, so knowing the Calcium without the Albumin doesn’t tell us anything about whether or not it is malnutrition or just an electrolyte imbalance). Albumin is an indication of long term nutritional status because Albumin’s half-life is about 20 days.
- PreAlbumin – Indicator of recent nutritional status changes. It’s half-life is 2-3 days.
TPN

- Glucose
- CBC – watch for anemia and signs of infection
- Kidney Function Tests (BUN and SCr)
- Liver Function Tests (AST and ALT)
- Triglycerides
- PT/INR (There is no Vitamin K in adult TPN).

Assess for potential medications, procedures, or trauma that might slow GI motility or cause diarrhea/nausea/vomiting.
Nursing Diagnosis

- Nutrition, Imbalanced, Less Than Body Requirements
- Impaired Swallowing

Outcomes Identification

- The patient will maintain ideal body weight or will gain 1-2 pounds per week until ideal body weight is attained.
- The patient will maintain lab values within normal limits.
  - **SODIUM (Na)** - Normal Adult Range: 135-145 mEq/L
  - **POTASSIUM (K)** - Normal Range: 3.5 - 5.5 mEq/L
  - **CALCIUM (Ca)** - Normal Ca: 9-11 mg/dl  Ionized Ca-4.25-5.25mg/dl
Outcomes

- **MAGNESIUM (Mg)** – Normal: Adults 1.8-3 mg/dl
- **ALBUMIN** - 3.5 - 5.0 mg/dl  **PREALBUMIN** – 15-40 mg/dl
- **BUN** 5-25 mg/dl  **Creatinine** 0.5-1.5 mg/dl
- **Triglycerides** - Low risk for cardiovascular disease < 100 mg/dl, High risk > 200 mg/dl
- **Blood Glucose** – 70-125 mg/dl

- The patient will remain free of infection during the course of therapy.
Planning

- Prepare to provide nutrition through an intravenous route.
- Parenteral nutrition is when a person is provided nutrition intravenously and when the gastrointestinal tract cannot be utilized for > 5-7 days.
  - Confirm the type of nutrition orders
    - Peripheral Parenteral Nutrition can be given in a peripheral line
      - Amino Acids concentrations > 4% require a central line
      - Dextrose Solutions containing > 10% require a central line
    - Total Parenteral Nutrition requires a Central Line
      - Requires an inline filter, IV tubing, and an IV pump
      - Lipids (Fats) are liquefied by egg and glycerol – prepare to verify no allergy to eggs
Planning

- Verify report that an intravenous line is a central line if TPN is ordered.
- Prepare to draw baseline labs as ordered by the provider.
- Prepare to check blood glucose with a beside monitor frequently (every 6 hours and prn when changes in condition warrant or when starting and stopping TPN)
- Prepare to verify orders with the TPN bag label when it arrives to confirm every component ordered is correct on the bag.
  - **Amino Acids (protein)** – Used to conserve or rebuild lean body mass and promote healing.
  - **Carbohydrates (sugars and starches)** – Primary source of calories.
  - **Lipids (Fat)** – Secondary source of calories. This is also used for healing, platelet function, and cell wall integrity.
  - **Fluids, electrolytes, vitamins, and trace elements**
Interventions

- **Health Promotion and Maintenance**
  - Provide education to the patient about the need to maintain nutrition for calories and wound healing.
  - Provide education about the need to still attempt to eat orally when cleared by a physician, even if TPN is still being provided.
  - Provide education about the use of an intravenous line, filter, and pump to deliver the nutrition.
  - Explain the need to draw lab frequently and sticks to the fingers for blood sugar monitoring.

- **Psychosocial Integrity**
  - Explain the need to reduce mobility while IV therapy is being administered.
Interventions

- **Safety and Infection Control**
  - Verify that the patient has a central line by report from provider or radiologist.
  - Inspect the site for signs of leaking, redness
  - Verify the order for TPN.
  - Match the orders for TPN with the bag label including all components, date, time, patient, and expiration date.
  - Perform the five rights of medication administration.
  - Verify no allergy to eggs.
  - Draw baseline lab if ordered.
  - Utilize IV tubing, a 1.2 micron filter with lipids (a 0.2 micron filter for all other PN).
  - Verify the TPN bag was refrigerated (should only be removed from refrigeration 1 hour prior to infusion)
Interventions

- **Basic Care and Comfort**
  - Provide support and positioning for comfort and safety
  - Maintain Blood Glucose 80-110 mg/dl (range will vary from institution to institution, but this range is for tight control to prevent hypoglycemic episodes and to prevent risk of infection from elevated Blood Glucose).

- **Pharmacologic Therapy**
  - Calculate dosage rate. In the intensive care, most places will run for 24 hours, but on the floors, may run for a specific time period.
  - Set up tubing, filter, and pump.
  - Administer the parenteral nutrition utilizing sterile procedure.
  - Observe for allergy to components, usually within first 30 minutes.
  - Prevent IV catheter related infections.
Coordination of Care

- Clarify orders that are not understood or that appear to be incorrect or inconsistent with the RN’s scope of practice.
- Communicate with pharmacy with new orders and on delivery of the TPN.
- Communicate any discrepancies with pharmacy regarding labeling and preparation.
- Delegate other responsibilities such as blood sugar monitoring and recording vital signs to nurse techs or nurse aides.
- Communicate with other services that TPN is hanging if patient is scheduled for other procedures.

Evaluation
  - Electrolyte abnormalities – i.e. hypophosphatemia (Refeeding syndrome)
  - Allergy
  - Fluid Volume Overload
  - Hyper/hypoglycemia
As a new graduate, you have been asked to assess a confused patient receiving TPN through a Hickman tunneled catheter. The patient was also started on IV insulin through a peripheral port earlier in the day as the blood sugars were 120s. As you walk in the room, you see the patient is bleeding and has the catheter in hand.
CASE STUDY Questions

- What do you do first?
- Where do you hold pressure?
- What would you like to assess?
- What would you like to stop?
- How could this have been avoided?
- Who needs to be contacted?
- How would you chart this using a PIE note?