Donor and Patient Care

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Donor and Patient Care

- Assessment and Monitoring
- Replacement Fluids
- Anticoagulation
- Medications and Drug Reactions
- Venous Access
- Fluid Balance
- Age-Related Consideration
- Adverse Reactions
Assessment and Monitoring

- **Therapeutic Apheresis**
  - Assess the indication for the procedure.
    - What is the recommendation from ASFA?
      - *Journal of Clinical Apheresis, Special Issue, Volume 28, Issue 3, 2013*
    - What is the clinical evidence and how will this procedure benefit the patient?
      - How will we measure its efficacy?
      - What is our goal or endpoint?
      - Does the benefit outweigh the risk of therapeutic apheresis?
Assessment and Monitoring

- **Therapeutic Apheresis**
  - **Inpatient**
    - Bedside vs. Apheresis unit
      - Leukoreduction- most likely to have adverse event
      - On-call- will you need resources for assistance?
        - 2 person verification of blood products
        - Adverse Events
  - **Outpatient**
    - Is it appropriate?
    - Can you get insurance approval?
    - Is the patient reliable to return when necessary?
Assessment and Monitoring

- **Therapeutic Apheresis**
  - Sickle cell disease patients receiving red cell exchange
    - Long term illness
      - Highly medicalized patients
      - Disease effects cognitive function – stroke, vascular damage
  - Pain Management
    - Have a plan
      - Should the patient take their normal pain medication prior to arrival?
        - How long will they be there
        - Will the medication last that long
      - Will you give narcotics outpatient?
    - Maintenance vs. urgent/emergent care
      - Is the patient willing to go on a maintenance program?
      - What frequency will they accept vs. need?
      - Can the number of units exchanged make up for less frequent exchanges?
Assessment and Monitoring

- **Therapeutic Apheresis**
  - Pre-Treatment Assessment
    - Medical History
      - Cardiac history - consider patient’s ability to tolerate volume shifts
      - Neurological symptoms
      - Renal Function – consider patient’s ability to tolerate volume shift
      - Hepatic Function - consider citrate metabolism
      - Laboratory Values
        - CBC
        - Chemistry Panel
        - Clotting / Coagulation issues
        - ADAMTS13
    - Medication Review
Assessment and Monitoring

- Therapeutic Apheresis
  - Pre-Treatment Assessment - Allogeneic donor questionnaire for HPC donation
Assessment and Monitoring

- **Therapeutic Apheresis**
  - Pre-Treatment Assessment - Allogeneic stem cell donors
    - Social and familial pressure - may need positive reinforcement
    - Donor Questionnaire for Allogeneic donors
      - No evaluation of past blood donations
      - Recent addition of questions regarding Zika Virus
      - Many times urgent medical need will override deferral status
Assessment and Monitoring

- **Therapeutic Apheresis**
  - Pre-Treatment Exam
    - Physical Exam
      - Baseline vital signs
    - Access Assessment
      - Is peripheral access acceptable or should artificial access be placed?
  - Risk of Infection/ Sepsis
  - Coagulation- consider the number of albumin exchanges in sequence
Assessment and Monitoring

- **Preparing the patient/donor**
  - Informed Consent
  - Patient/donor comfort
    - Keep them at a comfortable temperature, but not too warm
    - If using peripheral access be aware of arm position (have a plan for access issues)
    - Ensure they have distraction available
    - Ensure they have used the rest room just before the start of the procedure
Assessment and Monitoring

- **Therapeutic Apheresis**
  - Intra-procedure monitoring
    - Vasovagal Reaction
      - Syncope, short LOC
      - Hypotension
      - Nausea/ Vomiting
      - Diaphoresis
    - Fluid shift reactions
Assessment and Monitoring

- Therapeutic Apheresis
  - Intra-procedure monitoring
    - Hypocalcaemia
      - Paresthesia of lips and distal extremities, tingling or “buzzing” feeling
      - Muscle cramping, Tetany, Cardiac Arrhythmia – more extreme
      - Ionized calcium
      - Oral repletion with calcium carbonate (Tums®)
      - Calcium Gluconate or Calcium Chloride IV replacement
Assessment and Monitoring

- **Therapeutic Apheresis**
  - Intra-procedure monitoring
    - Transfusion reaction
      - FFP used in TPE procedures
      - Red Cell Exchange
      - Reactions - febrile, hemolytic, septic, allergic and TRALI (Transfusion Related Acute Lung Injury)
      - Fever, chills, rigors, hives, dyspnea, cough, or pulmonary edema
Assessment and Monitoring

• Therapeutic Apheresis
  • Intra-procedure monitoring
    – Hematoma or access problem
      ○ CVCs
      ○ Ports
      ○ Peripheral Access
Assessment and Monitoring

- **Therapeutic Apheresis**
  - Post Procedure
    - Delayed transfusion reaction
    - Coagulopathy
      - Fibrinogen levels reduced, prolonged PT and PTT times
      - Decrease in platelet count
    - Hgb S levels
      - Goal/Target
        - Pre-pheresis values vs. Post-pheresis values
    - Lipid levels
      - LDL
      - HDL
  
In general other labs should not be drawn immediately after pheresis.
Assessment and Monitoring

- **Donor Apheresis**
  - **Pre-Donation Assessment**
    - **Blood Type**
      - Collect what is needed - what is the best product for the donor to donate?
      - Decreased post collection processing
      - Cost vs. whole blood donation and cost over time of possible lost collections
    - **Advantage of single donor platelets**
    - **Gender**
      - TRALI - Plasma from female donors who have had a child or been pregnant in the past. (caused by antigens to human leukocyte antigens or human neutrophilic antigens)
Assessment and Monitoring

- Donor Apheresis
  - Pre-Donation Assessment
Assessment and Monitoring

- Donor Apheresis
  - Pre-Donation Assessment
    - Questionnaire
      - Takes into account deferrals for previous donations
      - Deferrals are absolute
      - Zika virus questions recently added
Donor Apheresis

- Pre-Donation Assessment
  - Total Blood Volume: increased reaction when collecting >10% of TBV
  - Platelet Count
  - Hgb/HCT
  - Annual RBC and Plasma loss
    - RBC loss <1540mL in a rolling calendar year
    - Plasma loss no greater than 12.0L (110-175lbs) or 14.4L (>175lbs) in a rolling calendar year
Assessment and Monitoring

• Donor Apheresis
  • Pre-Donation Assessment
    – Criteria for Donation
      ○ Hgb ≥12.5 g/dL or HCT ≥ 38%
        – HCT 40% for double red cell donation
      ○ Blood Pressure Systolic ≤180 and ≥80; Diastolic ≤100 ≥50
      ○ Pulse ≤100 ≥50
      ○ Temperature ≤99.5F
      ○ Weight ≥110 lbs
        – Double red cell donation
          – 130 for males 5’1”
          – 150 for females 5’5”
      ○ Platelet donor 150 thousand platelets/µL (post-procedure count should not be < 100 thousand platelets/µL)
Assessment and Monitoring

- Pre-Donation Assessment
  - Donation Frequency
    - Platelets: maximum of 24 donations in a rolling 12-month period, with a minimum of 2 days between donations, and no more than 2 procedures in a 7-day period.
      - If a double or triple product is collected, they should be at least 7 days apart.
    - RBCs: every 56 days
    - 2RBC: every 112 days or 16 weeks
    - Plasma: every 28 days (concurrent with other donations)
    - Incomplete or failed procedure deferral periods
Assessment and Monitoring

- **Pre-Donation Assessment**
  - **Plasma Loss**
    - For donors 110-175lbs
      - No more than 500ml per procedure
      - No more than 12L in a rolling calendar year
    - For donors >175lbs
      - No more than 600ml per procedure
      - No more than 14.4L per rolling calendar year
  - **RBC Loss**
    - No more than 1540ml per rolling calendar year
Assessment and Monitoring

- Donor Apheresis
  - Intra-procedure adverse reactions
    - Vasovagal Reaction
      - Pallor, Diaphoresis, lightheaded/dizziness, hypotension
      - Syncope, short LOC
      - Nausea/ Vomiting
      - Convulsion
      - Incontinence
      - Slow, pause or stop the procedure
      - Cold, wet compresses
      - Deep Slow breaths
      - Saline bolus
      - Prevention
        - Muscle tensing exercises
        - Pre donation Hydration
    - Hypersensitivity reactions
      - Hives
      - Uticaria
      - “Scratchy” throat
      - Rare- Anaphylactic reaction
Assessment and Monitoring

◊ **Donor Apheresis**
  • Intra-procedure adverse reactions
    – Hypocalcemia
      ○ Paresthesia of lips and distal extremities, tingling or “buzzing” feeling
      ○ Muscle cramping, Tetany, Cardiac Arrhythmia (long QT interval) – more extreme
      ○ Slow, pause or stop the procedure
      ○ Oral repletion with calcium carbonate (Tums®)
Replacement Fluids

- **Therapeutic Pheresis**
  - None- Leukoreduction, Leukocytapheresis, lipopheresis, photopheresis and donor pheresis
  - TPE
    - 5%Albumin
      - Made with a heat-treated protein isolate from human plasma.
      - Does not contain/replace coagulation factors in the blood.
      - Maintains oncotic pressure
      - Risk- acquired coagulopathy, decrease in fibrinogen, binds to calcium causing hypocalcaemia
    - Plasma (FFP)
      - Used when underlying disease involves a coagulopathy, or the replacement of coagulation factors is needed
      - Risks- transfusion reaction, blood-borne pathogens, citrate in product leads to hypocalcaemia
Replacement Fluids

- Hetastarch
  - Not commonly used in US
  - Non-protein, but maintains oncotic pressure
  - Used in combination with albumin

- Saline
  - Not used as a primary replacement fluid, but can be used in combination with albumin when hyperviscosity is a problem

- Red Cell Exchange
  - Packed Red cells
  - Saline
    - Depletion/ Exchange
Anticoagulation

- **ACD-A**
  - Citrate= Citric acid bound to positively charged cat ion (eg. Sodium citrate)
  - ACDA is Acid Citrate Dextrose A
  - Citrate chelates or binds to calcium leaving fewer ions to participate in the clotting cascade
  - Metabolized by the liver
  - Managing ACD Ratio (Blood:ACD-A) and ACD-A infusion rate

- **Heparin**
  - Prevents clotting by potentiating the activity of plasma antithrombin which inactivates Factors II, IX and X
  - Reverse by protamine
  - Some separation methods require heparin.
  - Risk of heparin induced thrombocytopenia (HIT)
  - Risk bleeding – systemic anticoagulation

- **ACD-Heparin Combination**
  - Adding heparin to ACD can greatly reduce the amount of citrate used
Medications and Drug Interactions

♦ TPE interaction with other drugs
  • Plasma protein bound drugs
    – TPE can be used as treatment for over dosage or removal in sensitivity reactions- Varapimil, Diltiazem.
    – TPE can be used to mitigate PML in patients receiving Tysabri® (natalizumab)
    – Other drugs removed by TPE
      ○ Administer after TPE.
      ○ Supplemental dosing or dosage adjustment may be necessary
      ○ Some are removed in proportion to the blood volume processed.

* Know what is hanging- when you go to ICU know what drugs are running and make recommendations on which drugs should continue to infuse and which should be held during apheresis
Medications and Drug Interactions

- **Antihistamines**
  - decrease reactions through H1 receptor binding, decreasing release of histamines
  - diphenhydramine, loratidine, cetirizine
  - Prevent and treat allergic reactions

- **Corticosteroids**
  - decrease allergic reactions through immune response suppression
  - Solu-cortef, methylprednisolone, hydrocortisone

- **ACE inhibitors**
  - Severe hypotensive events
  - Patient should be off ACE inhibitors for 48-72 hours or procedure should be held if possible
  - Bradykinin is an inflammatory mediator. It is a peptide that causes blood vessels to dilate, and therefore causes blood pressure to fall. A class of drugs called ACE inhibitors, which are used to lower blood pressure, increase bradykinin further lowering blood pressure. Bradykinin dilates blood vessels via the release of prostacyclin, nitric oxide, and Endothelium-Derived Hyperpolarizing Factor.

- **Antihyperstensives**
Medications and Drug Interactions

- **Red Cell Exchange interaction with drugs**
  - May remove some drugs that are bound to red cell proteins

- **Calcium**
  - Calcium Gluconate - 93 mg of elemental calcium per gram, 4.65 mEq/gm; is a vesicant.
  - Calcium Chloride – 272 mg of elemental calcium per gram, 13.6 mEq/gm; IV administration should be centrally only,

- **Potassium**
  - Potassium Chloride – Oral repletion 20-40mEq Daily or 20-40mEq IV

- **Magnesium**

- **Epinephrine**
  - EpiPen
  - Racemic Epinephrine

- **TPA**
  - Declotting
Fluid Balance

- Is the patient dehydrated or fluid overloaded?
  - Dehydration - rapid, thready pulse, decrease urine output, slow capillary refill, decrease in BP
  - Fluid Overload - Edema, wheezing, crackles or dyspnea, increase urine output, increase BP

- What is their reaction history?

- What is their ability to tolerate fluid shifts?
  - Extravascular fluid status
  - What should the fluid balance for the procedure be?

- Consider the ECV (Extracorporeal volume) of the apheresis kit in relation to the patient size and fluid status.
  - A fluid balance change of 10-15% will likely cause a reaction
    - Pediatric or low weight patients
    - Consider a blood or albumin prime and no rinseback

- Special care with patients with renal insufficiency, low EF or liver impairment
  - Consider diverting the prime fluid
Fluid Balance

TBV calculations

*70ml/Kg (adults)

TBV=70ml/kg x weight kg

*Gilcher’s Rules of Five

<table>
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<tr>
<th></th>
<th>Fat</th>
<th>Thin</th>
<th>Normal</th>
<th>Muscular</th>
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<tbody>
<tr>
<td>Male</td>
<td>60ml/kg</td>
<td>65ml/kg</td>
<td>70ml/kg</td>
<td>75ml/kg</td>
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<td>Female</td>
<td>55ml/kg</td>
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<tr>
<td>Infant/Child</td>
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<td></td>
<td>70-80ml/kg</td>
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</tbody>
</table>

* Nadler’s formula

TBV=0.3669 x height$^3$m + 0.03219 x Weight kg +0.6041

Plasma Volume = TBV x (1-HCT)
Peripheral access consideration

- Only option for donor apheresis - is the donor a good candidate for donor apheresis?
- Patient's vein size, elasticity, integrity and location.
  - Will the veins be accessed by others? Will they hold up to the procedure – support the blood flow rates of a typical procedure, and the number of procedures to be performed?
- Can the patient tolerate participating in the procedure?
  - Can the patient keep their arm straight with steel needle inserted for length of the procedure?
  - Can the patient perform muscle contraction in the access arm to assist with blood flow?
  - What is the patient's anxiety level around peripheral needle and IV insertion?
Vascular Access

- Peripheral access considerations
  - Eliminates the risks associated with obtaining central venous access
  - 16 or 17 gauge fistula needle
  - Smallest possible is 20 gauge angiocath for return.
  - Past Medical History
    - Lymph node dissection
    - Previous reaction to blood collection or apheresis
Vascular Access

- Cephalic vein
- Brachial artery
- Radial Artery
- Basilic vein
- Brachial veins
- Median cubital vein
Central Venous Access

- Catheters
  - High flow catheter such as apheresis or dialysis catheter may be used in subclavian, external jugular or femoral (less desirable) veins.
  - Tunneled or non-tunneled based on expected length of therapy
  - Risk- Air embolism, pneumothorax, infection.
  - Catheter care and Removal
Central Venous Access

- Ports
  - Must be power injectable
  - Types of ports
    - 2 Singles- one for access one for return
    - Double Lumen
    - Combination of single lumen and peripheral access
  - Implanted subcutaneously
  - Standard life of a port is decreased if using larger needles.
  - 16 G-1 ½” straight needles
  - Lower risk of infection than CVC
  - Less restrictions on ADLs
  - Average lifespan of port
Vascular Access

- **Grafts and Fistulas**
  - For patients who require chronic apheresis
  - Surgical Procedure
  - Minimum maturation 6 weeks- most take 8-12.
    - Maturation Failures- additional intervention of angioplasty by the vascular surgeon
  - Risks- infiltration, stenosis, thrombosis, bleeding
  - Less risk of infection than central venous access devices

![Diagram of Cephalic vein, Brachial artery, Arterio-venous anastomosis, Vein, Artery, Graft, Arterio-venous graft](image)
Fistulas and Grafts

- Before Use
  - 8-12 weeks needed for development
  - Patients should exercise fistula
  - Check for Thrill and Bruit

- Canulation
  - 1st use-use 17 gauge needle (wet stick) and 18 gauge angiocath
  - Use a tourniquet- creates uniform pressure in the fistula
  - Anchor fistula with thumb and index finger during canulation
  - Do not use clamps
  - Rotate sites
  - Return above access
  - Needles minimum 1” apart
Vascular Access

- **Fistulas and Grafts**
  - Monitoring
    - Stenosis due to turbulence, pseudoaneurysm formation, needle stick injury to vessel
    - Report to vascular team if there is pseudoaneurysm, stenosis (swelling distal to the fistula or accessory vein engorgement), compromised skin over fistula (blebs or blistering), scabs that take a long time to heal or are bigger than puncture
    - Monitor for signs of infection
Age-Related Considerations

• Donors
  • No upper age limit for donation as long as the donor meets the collection criteria
  • Donors as young as 16 can donate with parental permission and 17 without parental permission

• Younger donors have higher incidence of vasovagal reactions
  – Our Practice: Donors under age 18 and under are accepted for donation based on the height and weight requirements in the chart below, indicating an estimate total blood volume of 3.5 Liters or greater.

<table>
<thead>
<tr>
<th>Height</th>
<th>= or&gt;5’6”</th>
<th>5’4”-5’5”</th>
<th>5’2”-5’3”</th>
<th>5’0”-5’1”</th>
<th>4’10”-4’11”</th>
<th>4’8”-4’9”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Weight (male)</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>118</td>
<td>126</td>
</tr>
<tr>
<td>Minimum Weight (female)</td>
<td>110</td>
<td>119</td>
<td>129</td>
<td>137</td>
<td>145</td>
<td>153</td>
</tr>
</tbody>
</table>
Age-Related Considerations

- **Therapeutic apheresis**
  - Citrate Clearance
  - Fluid shift
    - In the elderly, what is their status with regard to extravascular fluid? Lungs, peripheral edema, urine output
  - Patient size and Blood volume
    - ECV should not exceed 15% TBV (don’t forget the blood warmer volume)
    - Consider the Intra-procedure hematocrit
Age-Related Considerations

- **Pediatric considerations**
  - Normal vital sign parameters for age group
  - Age appropriate explanation- demonstration on doll or stuffed animal
    - Age appropriate explanation of symptoms or side effects that may be experienced, and when to tell the nurse.
  - Consent process- should the child be included?
  - Central vs. peripheral access based on age and ability to withstand peripheral procedure
  - Consider use of topical anesthetic in both peripheral and port use
  - Drop in electrolytes is possible- Calcium, Magnesium and Potassium
  - Consider electrolyte removal in large volume TPE exchange
  - Hypothermia- use a blood warmer
Age-Related Considerations

- **Pediatric Considerations**
  - Anticoagulation
    - Higher sensitivity to ACDA and hypocalcaemia than adults, relatively higher inlet flow rates
    - May have immature or impaired hepatic or renal function causing delayed clearance
    - Calcium administration should be weight based
    - Using a combination of Citrate and Heparin can avoid problems with hypocalcaemia and allow for higher inlet rates
      - Allows for lower AC ratio
      - For MNC collections this can lead to cell clumping, and ACD may need to be added to the product
Adverse Reactions

- **Hypocalcemia**
  - **Causes**
    - 3 mechanisms in PLX
      - Removal of ionized calcium with the plasma
      - Binding of calcium by ACD solution
      - Replacement fluid binding calcium ions-citrate in plasma binds the ions and albumin binds ionized calcium on open binding sites.
  - **Symptoms**
    - Early signs- Yawning, tingling / numbness in lips and distal extremities, nausea
    - Moderate- Muscle cramping, buzzing or vibrating feeling, vomiting
    - Severe- tetany, arrhythmia
  - **Treatment**
    - Pause or slow procedure (decrease AC infusion rate)
    - Always collect an ionized calcium level
    - Treat with oral or IV calcium
Adverse Reaction

- **Vasovagal**
  - **Prevention**
    - Proper hydration before donation
    - Muscle Tension Exercises
    - Proper nutrition before donation
    - Low blood volume patients and donors are at higher risk
  - **Symptoms**
    - Mild- Pallor, diaphoresis, lightheadedness, hypotension, increased heart rate
    - Moderate- LOC for short period, vomiting, bradycardia, prolonged symptoms
    - Severe- Prolonged loss of consciousness, incontinence, twitching (seizure-like), Unable to recover for >30 minutes
  - **Treatment**
    - Trendelenberg’s position
    - Cool Compresses on neck, forehead, under arms if necessary
    - Slow deep breathing as opposed to quick shallow breaths
    - Hydration or bolus