Blood

HEMATOLOGIC DISORDERS

- Disorders of RBCs (erythrocytes) are the anemias.
- Anemias result from: decreased supply of RBCs, the volume of packed RBCs, the quantity of hgb. The end result of each of these is hypoxia (tissues not getting enough oxygen)
- Anemias are classified by etiology and morphology of the specific anemia
  - Etiology classifications
    - Reduced production of RBCs (B-12 deficiency, iron deficiency, thalassemia, aplastic anemia, etc...)
    - Increased destruction of RBCs (sickle cell, trauma, antibodies, chemotherapy)
    - Loss of blood volume (trauma, gastritis, menstruation)
  - Morphology of the anemia is based on erythrocyte size, shape and color
    - normocytic/normochromic (normal size and color)
    - macrocytic/normochromic (large size and normal color)
    - microcytic/hypochromic (small size and pale color)
  - Some anemias are named based on cell shape such as sickle cell and spherocytosis.

BLOOD COMPONENTS

- **Whole Blood** (500 ml/unit)
  - Contains RBCs, plasma, plasma proteins, a little bit of anticoagulant/preservative
  - Whole blood transfusions are rarely indicated
  - Rh-neg can be given to Rh-neg or Rh-pos recipient
  - Blood types MUST MATCH
  - 1 unit increases Hct by 3% and Hgb by 1g/dL
- **RBCs** (250-350 ml/unit or 350-400 ml/unit)
  - Blood typing...MUST MATCH!
    - Type-A donor can match with A or O
    - B can match with B or O
    - O can match only with O
    - AB can match with A, B or O
  - Contains RBCs with CPDA-1 sln
  - The solution may be viscous, so you may need to add NS to achieve optimal flow rate
  - May need leukocyte depletion filter for some pts
  - 1 unit increases Hct by 3%, Hgb by 1g/dL
- **PLT Concentrates** (50-70 ml/unit or 200-400 ml/unit)
  - Single unit PLTs contain a minimum of 5.5×10^{10} PLT in 50-70 ml
  - Single donor PLTs contain minimum of 3.0×10^{11} PLT obtained from single donor...this equates to 6 units. If you use a single donor there are typically fewer complications for the recipient.

    - No ABO or Rh antigens in this concoction (but wait...see the note about plasma below)
    - The PLTs are suspended in 200-400 ml of plasma, so ABO/Rh matching is recommended, especially when the total volume exceeds 150-200 ml).
    - Use only filters specially designed for PLT transfusion
    - 1 unit raises peripheral PLT count by 5,000 to 10,000 mm^3
    - Obtain PLT count at 1 hour and 18-24 hours post infusion
- **Fresh Frozen Plasma** (200-250 ml)
    - Contains 91% water, 7% protein, 2% CHO
    - Blood typing MUST be confirmed!
        - Type A matches with A or AB
        - Type B matches with B or AB
        - AB matches only with AB
        - O matches with A, B, AB or O
        - Rh-pos or Rh-neg with either Rh-pos or Rh-neg
    - Same disease risk as with whole blood
    - For volume expansion, use colloid or crystalloid (saline or albumin)
    - Monitor coagulation fxn (PT and PTT) and/or specific factor assays
- **Cryoprecipitate** (5-10 ml/unit)
    - Contains 50% factor VIII, 20-30% factor XIII, vWF, 250mg fibrinogen in 10-20 ml plasma
    - ABO crossmatching not needed
    - Plasma compatability preferred, but not required
    - If individual bats are used, NS may be needed to rinse residual from bags/tubing.
- **Granulocyte Concentrates** (200-400 ml/unit with PLTS; 100-200 ml/unit without PLTs)
    - Contains granulocytes, lymphocites, RBCs, plasma, PLTs
    - Blood Typing
        - ABO matching is required
        - Rh-neg OK with Rh-pos recipient
    - Granulocytes last less than 24 hours, so infuse ASAP
    - Increased incidence of febrile, non-hemolytic rxns
    - Infuse slowly, observe pt closely
    - Pre-medication with steroids, antihistamine, acetaminophen advised
    - CAUTION! Do not administer amphotericin-B within 4 hours to avoid pulmonary insufficiency (amphotericin B is baaaad stuff...my cat was on it, and it's hard-core!)
    - The expected outcome is resolution of infection and improved condition. Note that you probably won't see an increase in peripheral WBC in adults, but may see it in children.
- **Plasma Derivatives** (250 and 500 ml for the 5% solution; 100 ml for the 25% solution)
    - These are either albumin based or plasma protein factors (PPF)

    - The albumin concoction is 96% albumin and 4% globulin (comes in 5% and 25%)
    - PPF is 83% albumin, 17% globulin...this one is less pure than the albumin mixture and has a higher degree of contamination with other plasma proteins. This one comes in the 5% solution only.
  - Antibodies are destroyed during processing, so compatibility is not a factor.
  - CAUTION! Hypotension is associated with rapid infusion of PPF, and the 25% solution (which is more concentrated) can cause increased BP d/t its ability to draw fluid into intravascular space.
  - Expected outcome is the pt maintains adequate BP and volume.
- **Coagulation Factor Concentrates** (multiple dose vial)
  - Contains Factor VIII and Factor IX
  - Antibodies are destroyed, so compatibility is not a factor
  - Factor VIII and IX assays are conducted to assess the response
  - Factor VIII lacks vWF, so it should NOT be used in Tx of von Willebrand's disease
  - Expected outcome is that the pt achieves hemostasis.

PATHOPHYSIOLOGY OF ANEMIA

- When the pt has anemia, O2 transport is impaired d/t a Hgb level that's too low, or an inadequate # of RBCs. This leads to hypoxia! The body attempts to compensate by:
  - Increasing RBC production
  - Increasing cardiac output by increasing SV or HR
  - Redistrubuting blood from tissues with low oxygen needs to tissues with high oxygen needs
  - Right shift of oxygen-hemoglobin curve to facilitate more O2 removed at tissues at same partial pressure of oxygen.

CLINICAL MANIFESTATIONS OF ANEMIA

- The pt's Hgb level determines the severity of the anemia. Bone marrow specimen may be needed to determine the type of anemia. A peripheral blood smear will determine the size of RBCs
  - Mild = 10-14 g/dL (usually asymptomatic)
  - Moderate = 6-10 g/dL (dyspnea, paliptations, diaphoresis with exertion, chronic fatigue)
  - Severe = <6 g/dL (can be asymptomatic if it develops gradually as is the case with renal failure. Otherwise, the manifestations can be significant problems in multiple body systems. (see pg 2009)
    - General S&S: pallor, severe fatigue, weakness, lightheadedness, fever, exertional dyspnea, headache, vertigo, sensitivity to cold, weight loss
    - Skin: pallor, jaundice, dry skin, brittle nails, spoon-shaped concave nails with longitudinal ridges

- Eyes: blurred vision, sclera jaundice, retinal hemorrhage
- Ears: vertigo, tinnitus
- Mouth: smooth, glossy, bright red and sore tongue
- Lungs: dyspnea, orthopnea
- CV: tachycardia, palpitations, murmurs, angina, HTN, cardiomegaly, intermittent claudication, heart failure, MI
- GI: anorexia, dysphagia, abd pain, hematemsis, tarry stools, hepatomegaly, splenomegaly
- GU: amenorrhea, menorrhagia, decreased fertility, hematuria
- Musculoskeletal: back pain, sternal tenderness, severe bone pain and joint pain
- Nervous: headache, confusion, peripheral neuropathy, paresthesias, loss of balance, mental depression, anxiety, coping difficulties

MEDICAL MANAGEMENT

- The goals of medical management are to:
  - Alleviate or control the cause. This can be achieved in lots of ways: iron supplementation, nutritional therapy, surgery to repair hemorrhage, splenectomy, removal of toxic agents that cause aplasia, stem cell/bone marrow, corticosteroid therapy, immunosuppressive therapy.
  - Relieve manifestations. This can be achieved through O2 therapy (to prevent hypoxia and reduce workload on heart), erythropoietin given subQ, iron replacement (oral preferred...give Vit C at same time and note that it takes bout 6 months. Pt will have black stools, N/V, constipation and/or diarrhea.
  - Prevent complications

  - Blood products from another person = homologous
  - Blood products from same person = autologous
    - Autologous blood transfusion is OK if pt does NOT have bacteremia or leukemia.
    - Blood can be given q 3 days if Hgb level is at or above 11 g/dL
    - Donations must occur within 5 weeks of transfusion date
    - Donations must cease at least 3 days prior
  - Risks with homologous transfusion
    - Hemolytic transfusion rxns
    - Infectious disease
    - Avoid this in pts who might be candidates for bone marrow transplant (BMT) b/c transfusion decreases the probability of a cure.

    - Pts with multiple antibodies against RBC and those with autoimmune disease have a higher risk of complication b/c of crossmatching complexities.
- Transfusion rxns can be acute and delayed.
    - Acute rxns (see pg (2013) can be immunologenic (allergic, acute ahemolytic, anaphylactic, fever), as well as nonimmunogenic (circulatory overload, septicemia).
    - Delayed rxns (see pg 2014) usually occur 7-14 days post-transfusion. They include things like Hep B, Hep C, HIV, GVHD, iron overload and other infections.

TRANSFUSION PROCEDURES

- Step 1: Confirm MD order
- Step 2: Obtain venous access
    - The needle gauge depends on which product you are using.
    - Packed RBCs < 300 g need a 19-gauge needle or larger. If you have to use a smaller needle, then you'd need to dilute the RBCs with NS
    - Components containing a lot of plasma or diluent can be administered at a rapid rate using a smaller gauge needle/catheter. CAUTION: Warming refrigerated blood prior to central line administration is very important!
- Step 3: Prepare for the infusion
    - You can't return blood to the inventory if it has been warmed to more than 10-degrees C, which equates to no more than 30 mins out of monitored storage area.
    - Make sure IV catheter is ready to go and patent (at KVO rate)
    - Take pt's VS. If fever, transfusion may need to be delayed
    - Pre-medicate the pt if necessary (acetaminophen, antihistamines, etc.) Note that if oral, this needs to occur 30-mins prior.
    - Confirm blood acceptability
        - Confirm compatability
        - Verify pt ID
        - Inspect product (make sure A-OK)
- Step 4: Infuse the blood
    - The set usually contains a 170-micromter filter, and most can filter up to 4 units of blood
    - There are 2 tubing configurations
        - Straight (usually has med injection site a few inches from needle)
        - Y-type (easier to add NS to this and to saline flush if transfusion must be interrupted)

    - Blood warmers are used to prevent hypothermia!!!
- Step 5: Monitor pt during transfusion
    - The first 10-15 minutes are critical
    - Problems are usually evident within first 50 ml, so start slowly
    - After 15 mins, if pt is A-OK, increase flow to prescribed rate
    - Take VS again at 15 mins and every hour until 1-hour post transfusion
    - The rate and duration will depend on the product being infused
        - PLT, plasma and cryoprecipitate may be infused rapidly, but be careful of circulatory overload
        - Infusions should not exceed 4 hours in length.
- Step 6: If a rxn occurs
    - Stop the transfusion
    - Keep the IV line open with NS
    - Contact MD and the blood bank
    - Re-check identifying tags and all related info on blood and client
    - Monitor VS and urine output
    - Treat symptoms per MD orders
    - Save blood bag and tubing, send to blood bank for examination
    - Complete transfusion rxn report
    - Obtain blood/urine samples
    - Document!!!

Black, Joyce M., and Jane Hokanson Hawks. *Medical-Surgical Nursing: Clinical Management for Positive Outcomes - Single Volume (Medical Surgical Nursing- 1 Vol (Black/Luckmann))*. St. Louis: Saunders, 2009. Print.

Brady, D. (Director) (2010, January 29). Blood Administration. Advanced Med/Surg. Lecture conducted from CSU Sacramento, Sacramento.