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 $5.5 \times 10^{10}$ PLT in 50-70 ml
  - Single donor PLTs contain minimum of $3.0 \times 10^{11}$ 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 compatibility 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
  • Redistributing 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, palipitations, 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, hematemesis, 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 hemolytic, 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-micrometer 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!!!