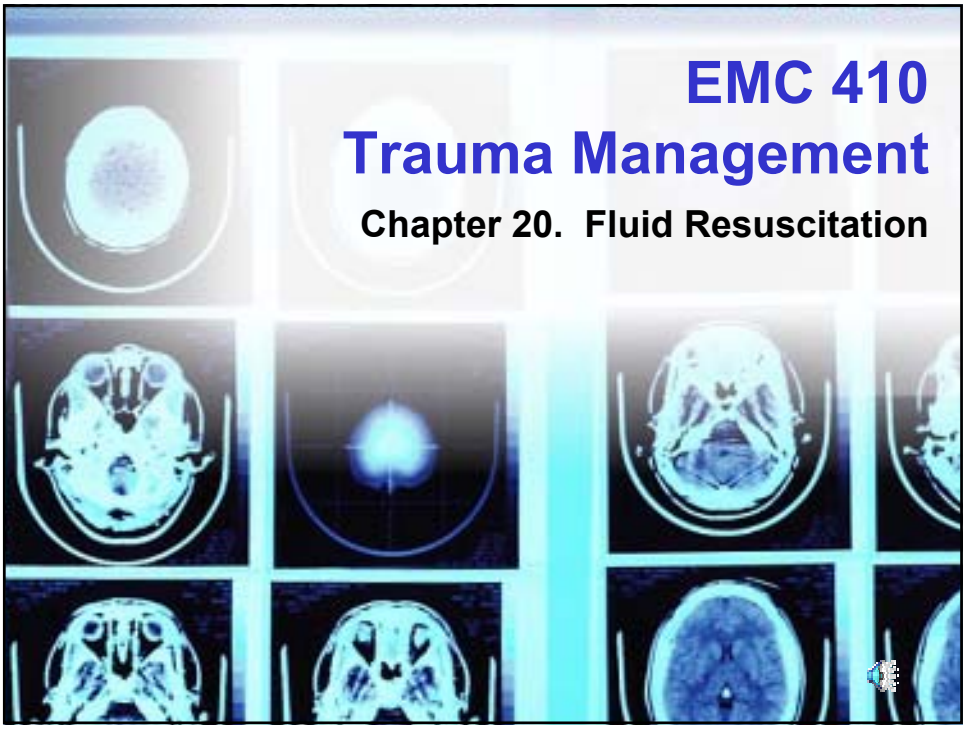


EMC 410
Trauma Management
Chapter 20. Fluid Resuscitation

Unit Objectives

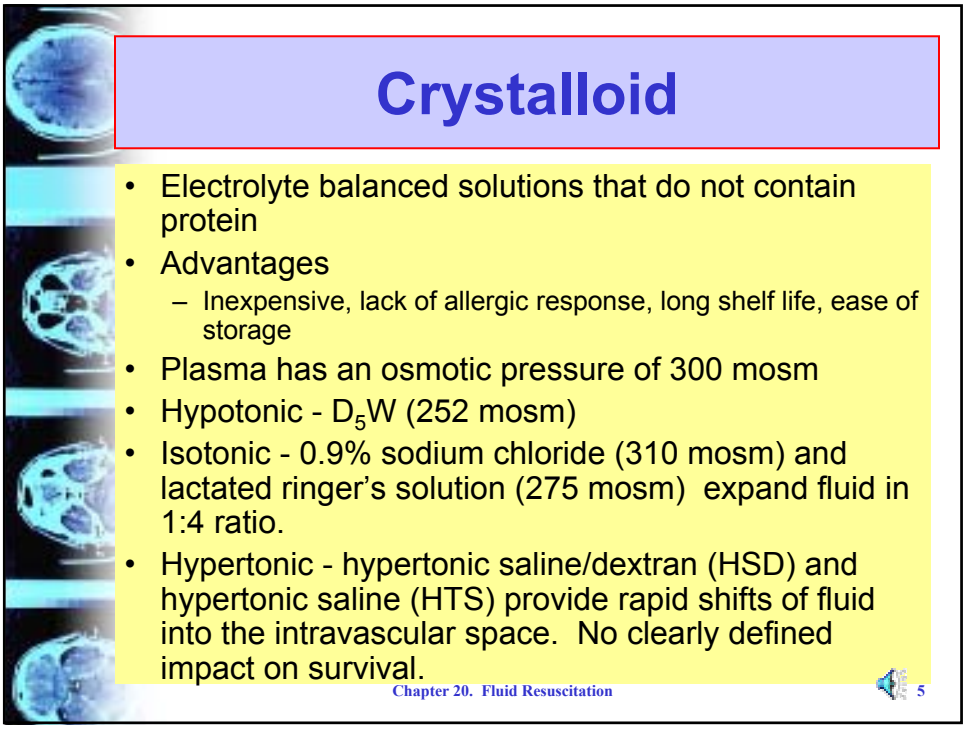
- **Upon completion of this chapter, you should be able to:**
  - Name the different blood groups and types in humans and their approximate percentages in the U.S. population.
  - Describe the basic blood components that may be utilized in emergency medicine and the indications for the use of each product.
  - Explain how the decision to use blood resuscitation is made.
  - Describe the term autotransfusion and the role it plays in transfusion medicine.
  - Describe the selection of blood in an emergency situation.
  - Define the advantages and disadvantages of blood substitutes.
  - List the rationale in the choice of needle size, filter type, and concurrent fluids utilized in a transfusion.

Unit Objectives continued

- Describe the more common transfusion reactions and the treatment for each.
- Compare and contrast crystalloid and colloid solutions.
- Discuss the existing controversy over fluid resuscitation in the hemorrhaging patient.
- Explain the various techniques that can be used to insert large-bore catheters.
- List the most common sites used for venous access.
- Explain the technique for adult intraosseous infusions.
- Explain the procedure for intravenous access using the Seldinger technique.
- Explain the techniques for external jugular cannulation, femoral vein cannulation, and saphenous vein cutdown.

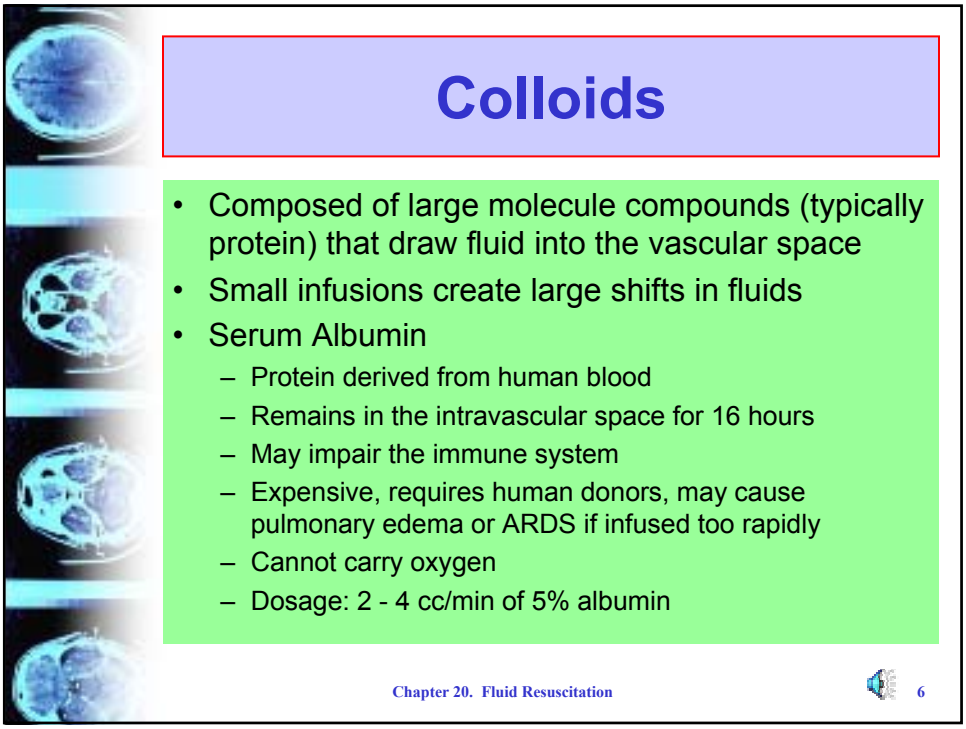
Introduction

- Blood pressure is maintained by manipulating the colloid osmotic pressure and vasoconstriction
- Blood is also shunted from the kidneys and digestive tract to conserve both oxygen and energy.
- Crystalloid infusion has a long history in field treatment of trauma
- Crystalloids maintain circulating volume but offer no mechanism for transporting oxygen
- Fluid resuscitation, like PASG application, is very controversial in terms of the initial management of the trauma victim.



Crystalloid

- Electrolyte balanced solutions that do not contain protein
- Advantages
  - Inexpensive, lack of allergic response, long shelf life, ease of storage
- Plasma has an osmotic pressure of 300 mosm
- Hypotonic - D_5W (252 mosm)
- Isotonic - 0.9% sodium chloride (310 mosm) and lactated ringer's solution (275 mosm) expand fluid in 1:4 ratio.
- Hypertonic - hypertonic saline/dextran (HSD) and hypertonic saline (HTS) provide rapid shifts of fluid into the intravascular space. No clearly defined impact on survival.



Colloids

- Composed of large molecule compounds (typically protein) that draw fluid into the vascular space
- Small infusions create large shifts in fluids
- Serum Albumin
  - Protein derived from human blood
  - Remains in the intravascular space for 16 hours
  - May impair the immune system
  - Expensive, requires human donors, may cause pulmonary edema or ARDS if infused too rapidly
  - Cannot carry oxygen
  - Dosage: 2 - 4 cc/min of 5% albumin

Colloids continued

- **Dextran**
  - Large, synthetic glucose polymer
  - 12 - 24 hour dwell time
  - Small infusion results in large fluid shifts
  - Less expensive than albumin
  - Lacks disease risks of albumin
  - May impair immune system
  - Interferes with coagulation
  - Interferes with cross-matching for blood and with glucose values
  - Lacks ability to carry oxygen
  - Available as dextran 40 or dextran 70
  - Dosage: 2 mg/kg

Colloids continued

- **Hydroxyethyl Starch (hetastarch or Hespan)**
  - Large, synthetic molecule
  - Interferes with coagulation
  - 24 hour dwell time
  - Dosage: 20 cc/kg
  - 1:1 replacement ratio

Blood Substitutes

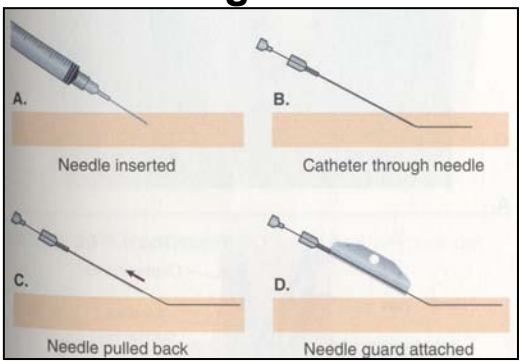
- Stroma-free hemoglobin
  - Experimental
  - Old RBCs with cell membranes removed
  - Designed to transport oxygen
  - Difficulty with releasing oxygen to the tissues
  - Free hemoglobin in circulation is toxic to some organs
- Perflourocarbons
  - Experimental
  - No need for cross-matching
  - Carry oxygen to the cells and remove carbon dioxide
  - Rapidly excreted which means infusion must be constant
  - Stored frozen and must be reconstituted before use

Crystalloids, Colloids, and Blood

- Controversial with no conclusive evidence of effectiveness of crystalloids and colloids
- Timing of fluid administration
- Rate of fluid administration
- Increased bleeding and hemodilution
- Presently, only blood transports oxygen

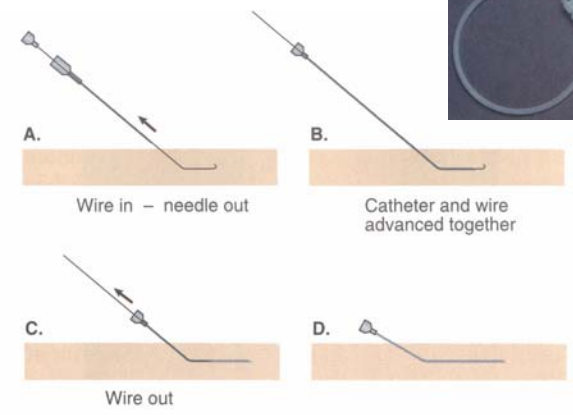
Administration of Crystalloids and Colloids

- Catheter over the needle
- Catheter through the needle



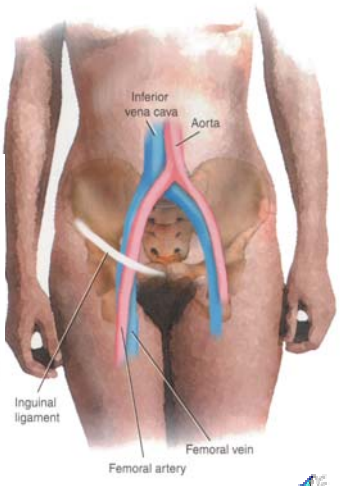
Administration of Crystalloids and Colloids

- Seldinger technique



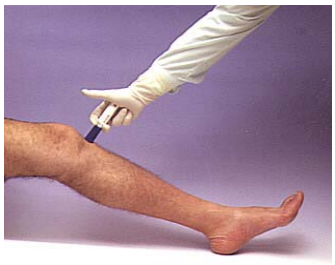
Administration of Crystalloids and Colloids

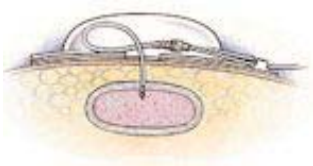
- **Sites**
  - Antecubital
  - External jugular
  - Internal jugular
  - Femoral



Administration of Crystalloids and Colloids

– Adult IO





Administration of Crystalloids and Colloids

– Saphenous vein cutdown

A

B

C

D

History of Blood Therapy

- First human to human transfusion in London in 1818
- Early experimentation plagued by reactions and death
- ABO blood groups discovered in 1901

ABO Group	Antigens on Red Cells	Antibodies in Plasma
A	A	B
B	B	A
AB	A and B	None
O	None	A and B

Basics of Blood Therapy

- **Packed Red Cells**
  - Most commonly used component in trauma
  - Made by removing plasma from whole blood
  - Anticoagulants added
  - 21 day shelf life
  - Stored at 1 - 6 degrees C
  - Used to increase oxygen carrying capacity in the setting of acute blood loss
  - One unit equals 250 cc

Basics of Blood Therapy continued

- **Whole blood**
  - Entire unit of blood including all cells and plasma
  - Increases oxygen carrying capacity and volume
  - Fresh whole blood is best choice in acute hemorrhage because it contains viable platelets and coagulation factors necessary for clotting
  - Rarely stocked in many hospital blood banks
- **Fresh Frozen Plasma (FFP)**
  - Contains all coagulation factors present in the blood stream
  - Coagulation factors are destroyed upon storage in blood
  - Plasma is removed from whole blood and quickly frozen to preserve clotting factors
  - Primarily used to treat coagulation deficiencies
  - Not used to expand plasma volume, but may be used in the treatment of burns to repair damaged capillaries

Basics of Blood Therapy continued

- **Platelets**
  - Play an essential role in hemostasis and maintenance of capillary integrity
  - Prepared by centrifuging fresh whole blood or through platelet pheresis
  - Stored at 20 - 24 degrees C
  - Can be stored for up to 5 days
  - Used in patients suffering from thrombocytopenia

Blood Selection for Trauma Situations

- Normally, the patient's blood is grouped (A,B,O, AB), typed (Rh +/-), crossmatched (compatibility), and screened for antibodies that may cause an adverse reaction. This process takes up to1 hour.
- Type and screen may be used when transfusion is unlikely
- Emergency Release of Blood
  - O Negative Packed Cells
  - Group and Type Specific
    - Requires 15 minutes
  - Autotransfusion
    - Autologous (donated and stored)
    - Autotransfusion (recovered, filtered and washed)

Blood Administration

- Must be infused with normal saline
- Must be filtered
- Must be infused through catheters of at least 18 gauge
- Patient identification is imperative.
- Inspect the product for impurities.
- Obtain a set of vital signs (including temperature).
- Infuse slowly during the first 15 minutes.
- Change blood filters every 2 units.
- Observe site for signs of infiltration and phlebitis.
- Monitor patients closely for signs of reaction.
- Infuse within 4 hours of hanging.

Complications of Transfusions

- **Febrile Reaction**
  - Most common, mild reaction
  - Occur more often in patients who have previous reactions
  - S&S
    - Fever
    - Chills
    - Hypotension (rare)
    - Dyspnea (rare)
    - Tachycardia (rare)
  - Treatment
    - Stop the infusion
    - Keep IV open with normal saline
    - Aspirin or acetaminophen may be ordered

Complications of Transfusions continued

- **Allergic Reaction**
  - Second most common reaction
  - Usually not dangerous but can cause discomfort for the patient
  - S&S
    - Itching
    - Redness
    - Hives
    - Fever (sometimes)
  - Treatment
    - Stop the transfusion
    - Keep IV open with normal saline
    - Be prepared to administer benadryl, theophylline, epinephrine or steroids

Complications of Transfusions continued

- **Anaphylactic**
  - Similar to allergic reactions but more severe
  - S&S
    - Rapid onset (within first few cc's of transfusion)
    - Flushing
    - Bronchial spasms
    - Urticaria
    - Shock
    - Hypotension
    - Dyspnea
    - Angioedema
    - Nausea
    - Decreased LOC
    - Fever is NOT observed
  - Treatment
    - Same as for allergic reaction, plus oxygen and IV fluids

Complications of Transfusions continued

- **Circulatory overload**
  - Not usually a concern in trauma, but may occur in pediatrics, geriatrics, and patients with chronic anemia
  - S&S
    - Chest pain
    - Coughing
    - Cyanosis
    - Tachycardia
    - Dyspnea
    - Hypertension
  - Treatment
    - Stop the transfusion
    - Keep IV open with normal saline
    - Oxygen
    - Diuretics

Complications of Transfusions continued

- **Hemolytic Reactions**
  - Destruction of red blood cells
    - Intravascular hemolysis
      - Occurs rapidly releasing hemoglobin into circulating blood
      - Life-threatening
    - Red cell lysis
      - Does not occur intravascularly
      - No release of hemoglobin
      - Milder reaction
  - Hemolytic reaction severity is dose related

Complications of Transfusions continued

- **Acute Hemolytic Reaction**
  - Almost always due to an ABO incompatibility and almost always the result of clerical error
  - S&S
    - Fever
    - Chills
    - DIC
    - Nausea
    - Chest pain
    - Dyspnea
    - Flank pain
    - Hypotension
    - Abdominal pain
    - Flushing
    - Hemoglobinuria
    - Acute renal failure

Complications of Transfusions continued

- **Acute Hemolytic Reaction continued**
  - Treatment
    - Stop the transfusion
    - Keep IV open with normal saline
    - Infuse IV fluids to maintain renal perfusion and treat shock
    - Pressure support may be necessary using vasopressors

Complications of Transfusions continued

- **Delayed Hemolytic Reaction**
  - Milder reaction that occurs in patients previously Sensitized during pregnancy or previous transfusions
  - May occur 1 to 14 days following transfusion
  - Results in lysing of transfused cells
  - S&S
    - Fever
    - Chills (sometimes)
    - Anemia
    - Mild jaundice
  - Treatment
    - Usually not required
    - When required, same as for acute hemolytic reaction