FLUID AND BLOOD THERAPY

PURPOSE

To familiarize and acquaint the transfer Paramedic with the skills and knowledge necessary to adequately maintain fluid and blood therapy in the interfacility transfer environment

OBJECTIVES

COGNITIVE

- ☑ List the indications for crystalloid therapy
- ☑ List the indications for colloid therapy
- ☑ Recognize examples of hypertonic, isotonic, and hypotonic crystalloids solutions
- ☑ Recognize examples of colloid solutions
- ☑ List the indications for parenteral therapy
- ☑ Define TPN
- ☑ List the four indications for blood therapy
- ☑ Identify commonly used blood products
- ☑ Identify the four components that blood must be checked for prior to administration
- ☑ State the proper procedure to administer blood
- ☑ List the three major types of reactions associated with blood product administration with their corresponding signs and symptoms
- ☑ Describe the proper patient management for the three major types of blood infusion reactions

PSYCHOMOTOR

- ☑ View and compare the difference between a blood administration set and a standard IV set

AFFECTIVE

- ☑ Defend the need to watch for signs of fluid overload with colloidal administration
- ☑ Explain the rationale for using sterile technique when changing solution bags of TPN
- ☑ Defend the reason why blood is initially infused slowly

CRYSTALLOIDS

OVERVIEW

Oftentimes it may be very confusing, given all of the choices of crystalloid solutions, why patients are placed on certain types of fluids. The choice may seem completely arbitrary, but there is a method to it.

The choice of a crystalloid solution is based on the tonicity (or the concentration) of the fluid with respect to the patient's tonicity. If a patient receives a solution that is higher in concentration than the patient's body fluid, the solution is said to be hypertonic. The net result is that the fluid would be drawn out of the intracellular and interstitial compartments and placed into the intravascular compartment due to osmosis. If a patient receives a fluid that is hypotonic (a lower concentration than the patient), the fluid will follow the osmotic gradient from the intravascular compartment into the cell. It follows then that if a patient receives an isotonic solution no fluid shifting should occur.

What is this concentration then? The concentration is the number of particles (e.g., electrolytes) in a known quantity of liquid. The concentration may be expressed as the osmolality (the term osmolarity may be substituted; although not exactly the same, they are very close). The normal range of osmolality in a person is 275-295. The osmolality may be easily determined by multiplying the patient's Na^+ concentration by two if the patient's blood glucose is within normal limits. If the patient's glucose level is outside of the normal range add two times the Na^+ plus the BUN level divided by five plus the glucose level divided by 20. If the calculated number falls below 275, the patient has too much fluid (they are dilute). If the osmolality of the patient is greater than 295, the patient is dehydrated (they are concentrated).

To determine the concentration in the IV solution merely look at the IV bag as it will be listed on the label. As an illustration, D5/NS has a listed osmolarity of 559 mOsm/L. If a patient has an osmolarity of 260 (which indicates a fluid excess), a hypertonic solution would be called for. Solutions such as D5W/1/2 NS, D5W/NS, D10 W, and 3% Saline would assist in removing the excess fluid from the patient. Oftentimes, a post surgery patient will receive a hypertonic solution to treat the tissue edema that accompanies the operation.

INDICATIONS

- Rehydration and fluid replacement
- Replenish Na^+ and Cl^-
- Provide energy replacement to protect protein stores (glucose containing solutions)

EXAMPLES

ISOTONIC

- Ringer's, Lactated Ringer's, 2.5 % Dextrose/Lactated Ringer's
- .9% Normal Saline

HYPERTONIC

- 10% Dextrose, 20 % Dextrose, 50% Dextrose
- 3% Saline, 5% Saline
- 5% Dextrose/.45% Saline, 5% Dextrose/.9 % Normal Saline, 5% Dextrose/Lactated Ringer's

HYPOTONIC

- 2.5% Dextrose, 5% Dextrose
- .45% Saline

PRECAUTIONS

- Hypertonic solutions should be administered slowly as they could cause CHF
- Monitor flow rate carefully to prevent fluid overload

COLLOIDS

OVERVIEW

Colloids differ from crystalloids in two primary aspects. First, colloids are large particles made up of proteins and second, they are used for rapid expansion of the patient's intravascular volume. Crystalloids may be used to move fluid forwards and backwards across the cellular membrane.

Colloids tend to draw the fluid from the interstitial spaces of the body. A 50 cc container of 25% albumin solution is the equivalent of a 250 cc bolus of fluid.

INDICATIONS

- Rapid replacement of intravascular fluid
- Hypotension
- Correct albumin and protein levels

EXAMPLES

- 5 % Albumin
- 25 % Albumin
- Plasma protein fraction (5 % albumin and globulin in a solution of normal saline)

PRECAUTIONS

- Due to the extreme osmotic gradient these products produce, be alert for signs of fluid overload (CHF and/or pulmonary edema).

PARENTERAL THERAPY

OVERVIEW

These supplements provide calories, fats, amino acids, and/or electrolytes to the patient that exhibits an impaired gastrointestinal tract or for short term nutritional management. The average daily protein (amino acids) requirements of an adult is approximately 1 gram/kg of body weight. The body requires within the area of 1,600 cal/day for daily maintenance. If the daily caloric intake drops below 400 cal/day, the body begins to use its own source of protein.

INDICATIONS

- Provide calories
- Spare the body's protein
- Maintenance of nutritional status

EXAMPLES

- Amino acids
- Fat emulsions
- Total parenteral nutrition (TPN)

PRECAUTIONS

- Fat emulsions are incompatible with electrolyte solutions.
- Watch for adverse reactions to fat emulsion therapy, such as nausea, vomiting, headache, dyspnea and allergic reactions.
- Avoid using an in-line filter for the administration of fats
- Use an IV pump for TPN administration due to the possibility of inducing hyperosmolality
- Due to the high glucose content of TPN (and subsequently the chance for bacterial growth), sterile technique is called for when changing IV bag solutions.

- Glucose intolerance may occur with TPN administration due to the inability of the pancreas to handle the extra sugar load. Generally this occurs at the onset of treatment; however, close monitoring of the patient's glucose level is necessary. If the patient is found to be glucose intolerant insulin will be added to the mixture.

BLOOD AND BLOOD PRODUCT THERAPY

OVERVIEW

Blood volume in the adult is about 75 ml/kg and constitutes approximately 8 % of a person's total body weight. If a test tube were placed in a centrifuge and allowed to spin down, the two major portions of blood would be readily apparent.

Plasma (a straw colored liquid also known as the supernatant) would be on the surface and would be about 55% of the total volume. The plasma is composed of 91 % water, 7 % proteins (fibrinogens, albumins and globulins), and 2 % electrolytes, nutrients, and hormones. The majority of these plasma proteins are manufactured in the liver.

At the bottom of the test tube would lie the formed elements. These are made up of the red blood cells (which are the overwhelming majority of the formed elements), white blood cells, and platelets. A very thin band will separate the plasma from the red blood cells. This is the volume of white blood cells and platelets present. The amount of red blood cells is known as the hematocrit.

The formed elements are produced from stem cells that are located in the red bone marrow. During fetal development, the liver and spleen produce the cells for the embryo. As the individual progresses into adolescence the femur and the tibia become additional sources. In adulthood, the primary source is in the marrow located in the bones of the head and trunk (sternum, ribs and vertebrae). Although the cross sectional area of bone marrow may appear small, it is actually one of the three largest organs in the body (the skin and the liver are the other two). Production of red blood cells may be stimulated by the release of erythropoietin. Thrombopoietin assists in the production of platelets. Several humoral factors aid in the release of white blood cells from the stem cells.

There are 13 known clotting factors and they are designated by roman numerals. The numbering of these agents occurred in the order in which they were discovered. Unfortunately, the Roman numeral classification does not follow the order in which the clotting factors are activated. A predictable and reliable sequence of events occurs in which one factor is activated and, in turn, activates the next factor. The process continues along the chain until a stable clot is formed. The absence of just one factor disrupts the clotting mechanism and the clot will not form.
Certain diseases cause greatly prolonged coagulation times due to the absence of one of the 13 clotting factors. Von Willebrand's disease, also known as hemophilia Type A, presents in a patient who is deficient in factor VIII. A patient with Christmas disease, hemophilia Type B, lacks clotting factor IX. Both of these diseases are hereditary in nature. Other conditions

which prolong or inhibit clotting are thrombocytopenia (a reduction in platelet production) which may be caused by a variety of events, radiation, drug therapy, etc. Finally, a vitamin K deficiency will increase clotting times. Although vitamin K does not act directly on either the intrinsic or extrinsic clotting pathways, it is required for prothrombin synthesis in the liver.

In blood therapy, it is critical that the patient receive the proper type of blood in order to avoid an adverse reaction. The present ABO system, along with the Rh (rhesus) system provides a safe way to determine which patient receives what type of blood. If a person receives blood of a different type other than their own, agglutination (clumping of red blood cells) may occur. This is due to the glycoproteins which exist on the surface of the red blood cells coming in contact with specific agglutinins.

INDICATIONS

- Decreasing hemoglobin
- Decreasing hematocrit
- Large volume/blood loss
- Increase the oxygen carrying capacity

TYPE OF BLOOD PRODUCTS

- Common
  - ✓ Packed red blood cells
  - ❖ Erythrocytes and 100 ml of plasma
  - ✓ Platelets
  - ❖ Plasma volume of 50 ml
  - ✓ Fresh frozen plasma
  - ❖ Volume of 200 to 250 ml, contains all coagulation factors, but no platelets
  - ✓ Whole blood
  - ❖ Volume of 500 ml, missing factors VII and V, no platelets
- Uncommon
  - ✓ Cryoprecipitate
  - ❖ Plasma volume of 10 to 25 ml including factor VIII and fibrinogen
  - ✓ Clotting factors

BLOOD MUST BE CHECKED FOR:

- The right patient
- The right blood product
- The right blood type
- Expiration date

POINTS TO CONSIDER

- Use an 18 gauge needle or larger
- Flush tubing with normal saline
  - ✓ D5W causes hemolysis
  - ✓ Lactated Ringer's cannot be used due to the presence of calcium chloride

- Be sure to use a blood administration set
- Blood can never be “piggybacked” with anything else
- Start infusion slowly

✓ No more than 1 drop every 5 seconds initially
✓ 5 - 10 ml of blood required to initiate a reaction
✓ If no reaction takes place within 15 minutes increase rate
✓ Try to complete transfusion in one to one and one-half hours
✓ Blood can only remain at room temperature for four hours
✓ Never reuse the same administration set if the patient needs another unit of blood
✓ If a reaction does occur, stop the infusion and save the blood
✓ Avoid pressure infusing of blood

TYPES OF REACTIONS AND/OR COMPLICATIONS

CIRCULATORY OVERLOAD

Signs and Symptoms:

- Dyspnea, Coughing, Cyanosis
- Headache, Sudden anxiety
- Significant increase in systolic blood pressure
- Jugular vein distention
- Pulmonary edema followed later by peripheral edema

Treatment

- Stop the infusion
- IV Normal Saline at KVO
- Place patient sitting upright
- Oxygen
- Consider diuretics, analgesics and aminophylline (cardiac asthma)

FEBRILE REACTION (NON-HEMOLYTIC)

- Most common reaction with blood transfusions
- Caused by mild immune type reaction to material (WBC, platelets, etc.) in the donors blood
- Usually occurs within 30 minutes

Signs and Symptoms

- Elevated temperature
- Chills
- Stable vital signs except for the elevated temperature

Management

- Stop the transfusion
- Change the tubing
- Maintain venous access with normal saline
- Aspirin or Tylenol for fever
- Document

✓ Episode
✓ Time
✓ Amount of blood given
✓ Treatment performed

If only a mild febrile reaction occurred, the decision to restart the transfusion may be made by medical control.

ALLERGIC REACTION

- More common in patients with history of receiving multiple transfusions
- More common in patients with a history of allergies
- Reactions may be grouped into two classifications, mild and severe

Mild

Signs and Symptoms

- Aching joints
- Urticaria
- Mild fever

Management

- Stop the transfusion and change tubing
- Benadryl 50 mg IM or IV
- Maintain IV Normal Saline
- Aspirin or Tylenol for fever

Severe

Signs and Symptoms

- Occurs after a few ml of blood or blood products have been infused
- Absence of fever
- Wheezing and coughing
- Tracheal edema
- Respiratory distress
- GI complaints
- Signs and symptoms of anaphylaxis

Management

- Stop the transfusion and change tubing
- IV fluids to support blood pressure as needed
- Epinephrine .3 to .5 ml 1 :1000 SQ (or 3 to 5 ml 1:10,000 IV)
- Benadryl 50 mg IV
- Consider steroids and aminophylline

Never restart a transfusion after an apparent anaphylactic event