LPN IV Series: Blood and Blood Products Transfusion

2.00 Contact Hours

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Purpose/Goals

Contact hours for LPNs in any state are earned by completing this course. This is part of a series of 24 contact hours of courses to prepare for LPN IV Certification in Florida. Florida certification participants must schedule a 6-hour live presentation and return demonstration to complete IV Certification. The live presentation is not provided by CEUFast.com.

Participants will be able to manage patients receiving blood and blood components, including the identification of adverse reactions, and indications and contraindications for use.

Objectives

Upon completion of this course, the participant will be able to:

1. Identify various types of blood and blood products and the reasons for their administration to a patient
2. Identify the risks of blood transfusion
3. Discuss procedures to reduce the risk of blood transfusion reactions
4. Discuss nursing interventions for the patient with a transfusion reaction
5. Identify the essential steps necessary in the safe administration of blood and blood products to a patient

Introduction

Transfusions of blood and blood products may be necessary to treat severe thrombocytopenia, leucopenia, and anemia resulting from a disease process or from treatment. Whole blood, packed red blood cells and other blood products replenish volume, oxygen-carrying capacity, platelet volume, and clotting factors. This life-saving procedure can be life-threatening if not carefully performed in accordance with facility policy and safe nursing practice.

Because of the potentially life-threatening consequences of blood incompatibility and the safety concerns about disease transmission through blood products, transfusion therapy has been limited to occasions when it is absolutely necessary. In addition, various techniques before

transfusion have been instituted to reduce the chance of error. The Food and Drug Administration (FDA), Joint Commission (JC), and the American Association of Blood Banks (AABB) regulate blood product procurement, storage, preparation, and testing.

Blood Components

Whole Blood consists of red blood cells (RBC), plasma, plasma proteins, and about 60 mL anticoagulant/preservative solution in a total volume of about 500 mL.

Packed RBCs consists primarily of RBCs, a small amount of plasma, and about 100 mL anticoagulant/preservative solution in a total volume of about 250 to 300 mL/unit. RBCs restore or maintain oxygen carrying capacity while preventing fluid overload, and reducing the risk of metabolic complications from whole blood transfusion. The average adult dose administered is 2 units; pediatric doses are generally calculated as 5 to 15 mL/kg. Packed RBCs are typically contaminated with white blood cells (WBC) that may increase the risk of minor transfusion reactions and alloimmunization. WBCs are also called leukocytes.

Leukocyte poor RBCs have 70% of WBCs removed by washing or freezing the product in the blood bank or using a small-pore filter during administration. This product prevents febrile reactions from leukocyte antibodies.

WBCs (granulocyte concentrates) consist of a minimum of 1 X 1010 granulocytes, variable amounts of lymphocytes (usually less than 10% of the total number of WBCs), 6 to 10 units of platelets, 30 to 50 mL RBCs, and 200 to 400 mL plasma. It is obtained via apheresis, generally of multiple donors. The dosage is usually 1 unit daily for approximately 5 to 10 days, discontinuing if no therapeutic response. The process for WBC transfusion is the same as red cell transfusion. Premedication with antihistamines, acetaminophen, steroids, or meperidine may be required to prevent an adverse reaction.

ALERT

WBCs must be infused within 24 hours of collection; because WBCs have a short survival time and therapeutic benefit is directly related to dose and viability.

ALERT

Do not administer amphotericin B immediately before or after WBC transfusion because pulmonary insufficiency has been reported with concurrent administration. Many institutions recommend a 4-hour gap to avoid this risk.

Plasma consists of platelets suspended in plasma. Products vary according to the number of units (each unit is a minimum of 5.5 X 1010 platelets), and the volume of plasma is 50 – 400 mL.

Plasma (Fresh or Fresh Frozen) consists of water (91%), plasma proteins including essential clotting factors (7%), and carbohydrate (2%). Each unit is the volume removed from a unit of whole blood (200-250 mL. Plasma restores clotting factors, except platelets, and expands plasma volume. Storage in liquid state results in the loss of labile clotting factors V and VIII so that only

plasma that has been fresh frozen can be used to treat factor V and VIII deficiencies. The dosage depends on clinical situation and assessment of prothrombin time (PT), partial thromboplastin time (PTT), or a specific factor assays.

Platelets may be obtained by centrifuging multiple units of whole blood and expressing off the platelet-rich plasma (multiple-donor platelets) or from a single volunteer platelet donor using automated cell separation techniques (aphaeresis). The use of single donor products decreases the number of donor exposures, thus decreasing the risk of alloimmunization and transfusion-transmitted disease. Platelet transfusions are usually a 6 unit IV bolus infused over 20 to 30 minutes. Dosage is generally 1 unit of platelets for each 10 kg; however, patients who are actively bleeding or undergoing surgical procedures may require more.

ALERT

Platelets must not be refrigerated.

Patients may become alloimmunized to human leukocyte antigens (HLA) through exposure to multiple platelet products. Apheresis products form HLA-matched platelet donors may be necessary. However, HLA-matched transfusions are often difficult to obtain due to the tremendous number of possible HLA combinations in the population.

Cryoprecipitate consists of certain clotting factors suspended in 10 to 20 mL plasma. Each unit contains approximately 80 to 120 units of factor VII (antihemophilic and von Willebrand factors), 250 mg fibrinogen, and 20% to 30% of the factor XIII present in a unit of whole blood. Indications include correction of deficiencies of factor VIII (i.e., hemophilia A and von Willebrand's disease), factor XIII, and fibrinogen (i.e., DIC). The adult dosage is generally 10 units, which may be repeated every 8 to 12 hours until the deficiency is corrected or until hemostasis is achieved.

Blood Component	Indications
Whole blood	• Blood volume loss from hemorrhage, trauma, or burns • Exchange transfusion in sickle cell disease
Packed RBCs	• Anemia • Blood volume loss from hemorrhage, trauma, or burns
Leukocyte poor RBCs (70% of leukocytes removed)	• Same as packed RBCs for the following reasons: ◦ Immunocompromised patients ◦ Restores RBCs in patients who have had two or more nonhemolytic febrile reactions
WBCs (leukocytes)	• Life-treatening bacterial or fungal infection unresponsive to other therapy in patients with severe neutropenia • granulocytopenia

Platelets	• Bleeding caused by decreased circulating platelets • Bleeding caused by functionally abnormal platelets ◦ Improves platelet count preoperatively in a patient whose count is less than 50,000

FFP (fresh frozen plasma)	• Helps control bleeding due to blood loss in blood clotting disorders related to:
	  ◦ liver disease and failure
	  ◦ disseminated intravascular coagulation (DIC)
	  ◦ dilutional coagulopathy resulting from massive blood replacement
	  ◦ congenital or acquired clotting factor deficincies
	  ◦ undetermined coagulation factor deficiency
	  ◦ replace a specific factor when that factor is not available
	  ◦ warfarin reversal

Albumin 5% (buffered saline) or Albumin 25% (salt-poor)	• Volume lost because of shock due to burns, trauma, surgery, or infections • Hypoproteinemia
Factor VIII concentrate	• Hemophilia A • Willebrand's disease
Cryoprecipitate	• Factor VI11 deficiency • Fibrinogen disorders • Factor XIII deficiency

Blood Transfusion Options

Autologous Transfusion

Autologous transfusion is the transfusion of the patient's own blood. Autologous transfusion eliminates the risks of alloimmunization, immune-mediated transfusion reactions, and transmission of disease, making it the safest transfusion choice.

Before elective procedures, the patient may donate blood to be set aside for later transfusion. Autologous RBCs can also be salvaged during some surgical procedures or after trauma-induced hemorrhage by use of automated cell-saver devices or manual suction equipment. Autologous blood products must be clearly labeled and identified.

Homologous Transfusion

By far the most common option, volunteer donors' blood products are assigned randomly to patients. This is a homologous transfusion. Before donation, volunteer donors receive information about the process, potential adverse reactions, tests that will be performed on donated blood, post-donation instructions, and education regarding risk for human immunodeficiency virus (HIV) infection and signs and symptoms. Donors are screened against eligibility criteria designed to protect both donors.

Directed Transfusion

In directed transfusion, blood products are donated by an individual for transfusion to a specified recipient. This option may be used in certain circumstances (e.g., a parent providing sole transfusion support for a child), but in general there is no evidence that directed donation reduces transfusion risks.

Alternatives to Blood Transfusion

Erythropoietin or iron can be taken to avoid transfusion in some cases; but, it takes days to months to replace blood cells. Antifibrinolytics drugs can decrease the amount of bleeding during surgery but cannot replace lost platelets or clotting factors.

Blood Compatibility

Because recipient blood reacts to donor blood, a type and crossmatch must be done to establish compatibility. Any incompatibility can cause a potentially life-threatening emergency .

The surface membrane of the RBC is characterized by the presence or absence of glycoproteins known as antigens. The major antigens in the ABO system are inherited. Blood transfusions can introduce other antigens and antibodies into the body. Most are harmless, but any transfusion could cause a reaction. Only two antigenic systems, ABO and Rh, require routine cross-matching before the transfusion.

ALERT

Solutions other than 0.9% saline and ALL medications are incompatible with blood products, which will result in agglutination or hemolysis.

ABO Antigens

The ABO blood group system is clinically the most significant because A and B antigens elicit the strongest immune response. The presence or absence of A and B antigens on the RBC membrane determines the individual's ABO group. The ability to make A or B antigens is inherited. Antibody formation in the absence of specific exposure to antigen is unique to the ABO system. An antibody directed against the missing antigen(s) is produced by the age of 3 months in neonates.[1]

Blood Group	Antigen on RBC	Antibody in Plasma	Approximate Frequency of Occurrence in Population

Blood Group	Antigen on RBC	Antibody in Plasma	Approximate Frequency of Occurrence in Population
A	A	Anti-B	45%
B	B	Anti-A	8%
AB	A and B	None	3%
O	None	Anti-A and Anti-B	44%

Antibodies

Antibodies (immunoglobulins) are proteins produced by B-lymphocytes. The interaction of antibodies and ABO antigens trigger an immune response. The extent of the immune response depends on the quantity of antibody and antigen.

When mismatching occurs, antibodies against the A and B antigens attach to the surfaces of the recipients RBCs, leading to a hemolytic reaction.

The universal donor is type O negative, and the universal recipient is AB positive.

Other Red Blood Cell Antigens

Non-ABO RBC antigen-antibody reactions usually do not produce powerful immediate hemolytic reactions, but several do have clinical significance. After A and B, D is the most immunogenic antigen. It is part of the Rhesus system, which includes C, D and E antigens.

D (Rh)-negative individuals do not develop anti-D in the absence of specific exposure, but there is a high incidence of antibody development (alloimmunization) after exposure to D. Two common methods of sensitization to these RBC antigens are by transfusion or fetomaternal hemorrhage during pregnancy and delivery. Anti-D can complicate future transfusions and pregnancies. For the D (Rh)-negative individual, exposure to D should be avoided by the use of Rh-negative blood products. In the case of Rh-negative mother and Rh-positive fetuses, exposure to D can be treated using Rh immunoglobulins, which will prevent anti-D formation.

xposures to RBC antigens from other antigenic systems (such as Lewis, Kidd or Duffy) may also cause alloimmunization. This may become clinically significant in individuals receiving multiple blood products over a long period.

Possible Risks of Receiving a Blood Transfusion

1. Hemolytic Reaction[1]
    - Cause: The person giving the blood and the person receiving the blood do not have matching blood.
    - Effect: Fever, chills, blood in urine, kidneys shutting down Death occurs in approximately 1 out of 100,000 transfusions.
2. Febrile Reaction

- Cause: The body reacting to the blood given to the patient
- Effect: Fever, chills that stop after the transfusion is stopped There is no lasting effect

3. Allergic Reaction
    - Cause: The body reacting to the blood being given to the patient
    - Effect: Itching, hives, and sometimes breathing problems. These are treated with medication, and the transfusion is stopped. There is no lasting effect.
4. Hepatitis
    - Cause: A virus that is carried in the blood of the person donating the blood that is given to the person receiving the blood
    - Effect: Only a few people will have the symptoms of Hepatitis. A few people with Hepatitis can go on to have liver disease including Cirrhosis of the liver.
    - Risk: Hepatitis A – very rare
        - Hepatitis B – 1: 63,000 to 1: 200,000 transfusions
        - Hepatitis C – 1: 250,000 to 1: 500,000 transfusions
5. AIDS
    - Cause: A virus that is carried in the blood of the person donating the blood that is given to the person receiving the blood that is now called HIV Due to present testing done on all the blood given, the possibility of blood having the AIDS virus has been almost eliminated.
    - Effect: HIV infection and AIDS
    - Risk: 1: 913,000 transfusions
6. CMV (Cytomegalovirus)
    - Cause: A virus that is carried in the blood of the person donating the blood that is given to the person receiving the blood. This is only a risk to people with low resistance to disease and newborn infants.
    - Effect: This virus may infect lungs, kidneys and nerve tissues in those patients with low resistance.
    - Risk: 1: 7,500 transfusions
7. HTLV-1
    - Cause: A virus that is carried in the blood of the person donating the blood that is given to the person receiving the blood. It is believed that it is a very low rate of being given – similar to the rate for HIV.
    - Effect: 1 to 3% of those infected may go on to have a rare form of Leukemia or
    - Risk: 1: 641,000 transfusions in susceptible patient

Transfusion Reactions

Most blood transfusions cause no adverse reaction; however, even with the assurance of pretransfusion crossmatching, blood transfusions may produce some adverse effects.

Hemolytic transfusion reaction results because antibodies in the recipient's plasma react with antigens in donor RBCs. This leads to donor cell agglutination (clumping) and capillary occlusion (clot), blocking oxygen and blood flow to vital organs. Eventually, the red cells break down and release free hemoglobin into plasma and urine. This free hemoglobin may block the renal tubules resulting in renal failure.

Although the mechanism of an allergic transfusion reaction is unknown, it probably results from the reaction of allergens in donor blood with antibodies in the recipient blood. Febrile transfusion reaction occurs because the recipient has a sensitivity to the donor leukocytes or platelets. Bacterial transfusion reaction is a contamination of donor blood, usually by gram-negative organisms. Circulatory overload occurs because the rate or volume of the transfusion exceeds the circulatory systems capacity.[1]

TYPE	SIGNS & SYMPTOMS
Hemolytic	Chills, fever, backache, headache, restlessness, anxiety, nausea, vomiting, chest pain, tachycardia, dyspnea, hypotension, cyanosis, hemoglobinemia, hemoglobinuria, oliguria, anuria, jaundice, vascular collapse
Allergic	Urticaria, pruritis, chills, nausea, vomiting, headache, nasal congestion, wheezing, in more severe reactions: bronchospasm, severe dyspnea, laryngeal edema, circulatory collapse
Febrile	Fever, chills, flushing, back pain, malaise, tachycardia, headache, confusion, nausea, vomiting
Bacterial	Fever, chills, abdominal and extremity pain, vomiting, hypotension, bloody diarrhea
Circulatory overload	Cough, chest pain, dyspnea, distended neck veins, tachycardia, cyanosis, frothy sputum, pleural rales, hemoptysis

Severe transfusion reactions usually occur within 15 minutes of beginning the transfusion. On a rare occasion, a reaction will not occur until a week or more afterward. If the patient should experience unexplained tiredness, fever, darker than normal urine color, or yellowing of the whites of the eyes within 3 months of the transfusion, the patient should consult a physician.

Interventions

If you suspect a transfusion reaction[1]:

1. STOP the transfusion immediately!
2. Change the tubing
3. Start a Normal Saline infusion at 10cc/hr
4. Notify the blood bank, the physician, and the nursing supervisor
5. Monitor the patient's vital signs every 10-15 minutes or more frequently, depending on the severity of the symptoms
6. Insert a foley catheter and monitor urinary output every hour for oliguria, anuria.
7. Collect a urine specimen
    1. If the first post transfusion urine, mark on the specimen "possible blood transfusion". The lab tests this specimen for presence of hemoglobin, which indicates a hemolytic reaction.
8. Obtain an order for BUN, Creatinine, and bilirubin because they will indicate renal damage

9. Return remaining blood, tubing, and Normal Saline to the blood bank for repeat compatibility testing
10. Administer medications per physician order
    1. SQ Epinephrine to counteract allergic response
    2. Mannitol (osmotic diuretic) to decrease risk of kidney damage
    3. Bicarbonate IV to alkalize urine and help prevent and decrease precipitation of hemoglobin
11. Make the patient as comfortable as possible and provide reassurance

If a transfusion reaction is anticipated, prophylactic treatment with antihistamines and/or antipyretics may be given preceding blood administration.

Documentation

1. Time and date of transfusion reaction
2. Type and amount of blood infused
3. Clinical signs and symptoms of reaction in order of occurrence
4. Complete set of vital signs and frequency
5. Specimens to lab
6. Any interventions provided
7. Patient response to interventions
8. Complete transfusion reaction form
9. Date and time physician was notified and orders received.

Blood Product Screening

Serologic testing

Routine laboratory testing is performed to assess the compatibility of a particular blood product with the recipient before release of the blood product from the blood bank. These tests include:

- ABO group and Rh type: determines the presence of A, B, and D antigens on the surface of the patient's RBCs.
- Direct Coombs' test: determines the presence of antibody attached to the patient's RBCs.
- Crossmatch (compatibility test): detects agglutination of donor RBCs caused by antibodies in the patient's serum.
- Indirect Coombs' test: identifies the presence of lower molecular weight antibodies (IgG) directed against blood group antigens.

Screening for Infectious Diseases

Routine laboratory testing is performed to identify antigens or antibodies in donor blood that may indicate prior exposure to specific blood-borne diseases. Such testing supplements other principles of donation designed to decrease the risk of disease transmission via blood products, including the use of volunteer donors, the exclusion of high-risk populations, and the screening of donors via health and social history. Specific conditions screened for include:

- Hepatitis: tests for the presence of hepatitis B surface antigen and most recently, hepatitis C, the most common non-A and, non-B hepatitis.

- Syphilis: tests for the presence of antibody against the spirochete
- Bacteria: contamination of blood products with bacteria may occur during and after collection of blood.
    - This risk is managed by maintenance of sterile technique during phlebotomy and blood processing procedures, correct storage techniques, visual inspection of blood products, and limitation on shelf life.
- Cytomegalovirus (CMV): tests for the presence of antibody against CMV
    - Approximately 50% of blood donors have been exposed to CMV and 10% carry CMV virus in white blood cells.
    - Patients with impaired immune function (e.g., bone marrow and organ transplant recipients, premature babies) are at risk for CMV infection from transfused blood.
- HIV tests for the presence of antibody against HIV, which indicates prior exposure to the virus.
    - All blood products in the United States have been screened since the test first became available in 1985.
    - Because antibody to the virus is not produced until at least 6 weeks after exposure, donor screening and exclusion of high-risk groups (e.g., homosexual men, intravenous drug abusers, prostitutes, and sexual partners of high-risk individuals) remain important parts of preventing transmission of HIV via blood products.
    - A low risk of HIV transmission (estimated to be 1/100,000 units of blood) remains.

Administering a Blood Transfusion

Equipment

1. Blood administration set - primed
2. Normal Saline
3. Informed consent
4. Venipuncture equipment
5. Blood filter – primed

Essential Steps:1

1. Validate the physician's order
2. Ensure informed consent has been obtained prior to getting the blood from the lab and before the transfusion except in extreme emergencies.
3. Explain the procedure to patient and provide patient education.
4. Start an IV using an 18-gauge catheter
    - Avoid using anything smaller than a 20 gauge except in the neonatal population
    - Attach normal saline to the needle hub and start infusion at 10cc/hr
5. Get a complete set of vital signs before blood infusion is begun.
    - A temperature of greater than 100 should be called to the physician before proceeding with the transfusion
6. Obtain blood/blood product from the blood bank
    - Check expiration date
    - Observe for abnormal color, red cell clumping, gas bubbles, and extraneous material.
    - Return abnormal/ outdated blood to the blood bank

7. Verify all information and document with another healthcare professional
    - Compare name and number on patient's ID bracelet with that on blood bag label
    - Check blood bag ID number and ABO and Rh compatibility
8. Begin transfusion within 30 minutes of obtaining product from the blood bank
9. Begin transfusion slowly, approximately 20ggts/minute in first 15-30 minutes
    - Observe for signs and symptoms of transfusion reaction
    - Take a complete set of vital signs after 15 minutes into transfusion
    - If no signs of transfusion reaction, increase rate to the ordered rate
    - Take a complete set of vital signs 30 minutes into transfusion.
10. Complete the transfusion within 4 hours
    - Take a complete set of vital signs
    - Flush main line with Normal Saline to clear tubing and IV catheter
    - Discontinue blood bag and dispose of according to hospital policy

Documentation:

- Signatures verifying blood on blood confirmation slip.
- Date, time of transfusion
- Type and volume of product infused.
- Patient response
- Any interventions done for transfusion reaction

Transfusion Tips

- Obtain the blood product just before transfusion. Never use the unit refrigerator for storage until ready. Remember, you have 30 minutes from blood bank pick up until initiation of infusion. If the 30 minutes is exceeded, return the unit to the blood bank.
- Use only Normal Saline solution. Dextrose solutions cause red blood cells to clump, swell, and hemolyze. Lactated Ringers contain calcium that counteracts anticoagulants in the blood bag.
- Use appropriate in-line filters. Replace the filters and administration set after each unit.
- A blood filter is a device attached to a unit of blood or components, between the bag and the patient, which is designed to retain blood clots, white cells and debris. The Blood Bank will provide the appropriate blood filter if needed.
- Filter use is recommended during rapid, massive transfusion of whole blood or packed RBCs to prevent pulmonary complications. Filters may also decrease the incidence of febrile transfusion reactions by removing many of the leukocytes. Special leukocyte-depletion filters are available for use with platelet products that remove 80% to 95% of leukocytes and retain 80% of the platelets.
- Transfusions must be infused within 4 hours. The minimum transfusion is 2 hours except in an emergency.
- Provide psychological support, explain all procedures, and reassure the patient and his/her family.

✔Take Test

Your approval agency or organization requires you to take the test.

References

1. Nettina, Sandra M., “The Lippincott Manual of Nursing Practice” 11th Ed. Wolter Kluwer, Philadelphia, 2019.