

Title: Applications in Transfusion Medicine – A CBL Exercise

Purpose: At the conclusion of this exercise, students will be able to apply basic principles of transfusion medicine in health care settings, recognizing when and how blood products are utilized and what problems may arise in their usage. This exercise is primarily application along with explanatory basic pathophysiology. It is geared toward beginning students in health sciences, including medical, nursing, and physician's assistant students who would be working in clinical settings in which use of blood products may be encountered. They may work as a team to recognize, treat, and monitor patient care situations with use of blood products. Thus, this exercise may be appropriate as an interprofessional educational activity.

Learning Objectives: At the end of this exercise, the student will be able to:

1. Describe the indications for usage of the following blood products: packed red blood cells, platelets, fresh frozen plasma, and cryoprecipitate. Define "massive transfusion," and describe the metabolic derangements.
2. Describe and distinguish the following transfusion reactions: hemolytic, febrile, anaphylactic, circulatory overload, and transfusion-related acute lung injury (TRALI).
3. Define the infectious disease risks of blood products, including bacterial contamination, viral hepatitis B and C, HIV, HTLV, CMV, and malaria.
4. Define the meaning of and rationale for type and screen, and type and crossmatch, for blood products and explain the appropriate settings and processes for emergency release of blood and the use of "universal donor" blood.
5. Define alloimmunization in the context of hemolytic disease of the newborn. Describe the role of prenatal compatibility testing. Explain the role of Rh immune globulin prophylaxis in preventing hemolytic disease of the newborn.
6. Explain the clinical use of apheresis procedures, and give an example of how it is used.

Group Discussion Exercise:**Case 1:**

History: F.R. is a 17 year-old Caucasian male who is brought into the Trauma wing of the Emergency Department by EMS following a motor vehicle accident. F.R. is unresponsive and cyanotic, around his lips, but he does have carotid and femoral pulses.

Physical Examination: Vital signs are P 115 bpm, BP 80/40 mm Hg, T 37.6 C, and RR 24. Physical examination finds large lacerations and scrapes throughout, a compound fracture of his right femur, and a digital rectal exam that is positive for occult blood. Bruising and petechiae are also noted, mostly around the fracture site. PERRLA and Neuromuscular exam is intact.

Laboratory Data:	Patient	Normal Ranges
Hemoglobin	5 g/dl	(14.6 – 17.8 g/dL)
Hematocrit	15%	(40.8 – 51.9%)
Platelet count	35	(177 – 408 K/mL)
Prothrombin time (PT)	30 seconds	12-15.5 seconds
INR	2.4	
Partial thromboplastin time	50 seconds	24 – 35 seconds
Fibrinogen	30	(150 – 430 mg/dL)
D-Dimer	5	(0 – 0.4 microgram/mL)

The peripheral blood smears show schistocytes.

Course: Multiple large bore IV access lines are established, and 6 units of PRBCs are infused with 0.9% normal saline. He also receives platelets and FFP.

Case 1 Questions:

Q1.1 What is the assessment for F.R, and how will his case be followed and managed from this point forward?

Q1.2 What are the indications for and potential complications of massive PRBC transfusion?

Q1.3 What are the indications for and potential complications of platelet transfusion?

Q1.4 What are the indications for use of FFP?

Case 2:

History: D.L. is a 65 year-old African American female with osteoarthritis of the right hip. She has no other major medical problems. She has 4 living children who are healthy. She has no known drug allergies. She is taking no medications other than acetaminophen for her constant pain.

She is scheduled for a right total hip arthroplasty. A preoperative workup shows a normal prothrombin time, partial thromboplastin time, white blood cell count, and platelet count. Her hemoglobin is 12 g/dL and hematocrit 36%. A blood type and screen is obtained and she is O positive with antibody screen negative.

During the operation she begins to bleed. An order for 4 units of PRBCs is sent, and since no crossmatched units are on reserve, a release is given for type specific blood. She receives 4 units of PRBCs intra-operatively. She stabilizes and the surgery proceeds without any further complications.

Course: Over the next 4 hours while recovering in the PACU, she develops respiratory distress and becomes tachypneic with a RR of 34/min. On auscultation of her chest there are crackles heard in all lung fields. Other vitals sign are T 36.8 C, P 100 bpm, and BP 90/60 mm Hg. Her O₂ saturation is 60% and she is cyanotic.

Laboratory Data: Blood draws show a hematocrit of 26%, platelet count of 135,000/mL and WBC count of 8000/mL.

Portable AP Chest X-ray reveals substantial pulmonary edema with bilateral infiltrates. An assessment is made, and swift interventions are enacted in order to prevent further progression of the disease.

Case 2 Questions:

Q2.1 What is the assessment for D.L.?

Q2.2 Describe the pathophysiology of the disease.

Q2.3 How could this have been prevented?

Q2.4 What type of transfusion reaction might have occurred if her temperature incrementally increased s/p transfusion?

Q2.5 What type of transfusion reaction might have occurred if she experienced pruritus and hives?

Q2.6 What type of transfusion reaction might have occurred if her urine and serum were pink?

Case 3:

History: T.H. is a 30-year-old Caucasian female who is currently undergoing chemotherapy for Hodgkin Lymphoma, nodular sclerosis type, stage 2, involving her chest.

Laboratory studies last month showed her hemoglobin 8.5 g/dL with a hematocrit 26% platelet count 130,000/mL, and WBC count 2700/mL.

She is now getting another round of chemotherapy. While at the infusion center, she suddenly feels faint and collapses. Upon arrival in the Emergency Department, vital signs show temperature 37 C, pulse 100/min, respiratory rate 30/min, and blood pressure 100/60 lying and 80/50 mm Hg sitting.

Laboratory Data:	Patient	Normal Ranges
Hemoglobin	7 g/dL	(12.1-15.9 g/dL)
Hematocrit	21%	(34.3-46.6%)
Platelet count	10,000/mL	(177 – 408 K/mL)
WBC	1000/mL	(3.2-10.6 K/mL)
PT	14 seconds	12-15.5 seconds
INR	1.1	
PTT	25 seconds	24-35 seconds

She is admitted to the oncology ward. A cross match is ordered, and she is A positive. Two units of PRBCs are given, and she receives 6 single donor platelet units. These are transfused over the course of an hour without complication. Her post-transfusion hematocrit is 27% and platelet count 45,000/mL. Later that evening while resting, she experiences a temperature spike to 38 C, with a pulse of 122 bpm and a BP of 97/60 mm Hg. There are no signs of hemorrhage. Blood cultures are drawn, which ultimately come back positive, and a regimen of broad-spectrum antibiotics are begun.

Case 3 Questions:

Q3.1 What are the differential diagnoses?

Q3.2 Is there an increased risk for infection and/or sepsis based upon the treatments she received?

Q3.3 What are the risks for the blood products she received?

Q3.4 What are the risks for other infectious agents?

Q3.5 What is routinely done to minimize these risks?

Q3.6 What are some emerging infections that must be considered?

Case 4:

History: E.P. is a 27 year-old Asian G3, P2 who is currently 36 weeks pregnant. Her first pregnancy was uneventful and ended with the birth of a healthy male at term. Her second pregnancy, however, ended 3 weeks prematurely with the birth of female infant with mild neonatal jaundice that responded to phototherapy. Blood typing of the mother at that time revealed she was blood type A Rh (+). However, her spouse was blood type O Rh (-).

Now in her third pregnancy, E.P. has an uneventful prenatal course. A Coombs test is negative. She gives birth at 38 weeks to a neonate that is not jaundiced. However, the delivery is not without complications. The placenta cannot be delivered. She experiences massive hemorrhaging due to placenta accreta, and her hematocrit falls to 20%.

Other Laboratory Data:	Patient	Normal Ranges
Hemoglobin	6.4 g/dL	(12.1-15.9 g/dL)
Platelet count	200 K/mL	(177-408 K/mL)
WBC	8 K/mL	(3.2-10.6 K/mL)
PT	12 seconds	12-15.5 seconds
INR	1.0	
PTT	24 seconds	24-35 seconds

While being crossmatched for PRBCs, 6 of 10 units are found to incompatible. A comprehensive workup is done for irregular antibodies.

Case 4 Questions:

Q4.1 What is the assessment?

Q4.2 What was the role of the prior pregnancies in contributing to the formation of the irregular antibodies?

Q4.3 What is the most common alloimmunization associated with pregnancy? How can it be prevented?

Q4.4 Describe the process of obtaining compatible blood. How is blood obtained for persons with rare blood types?

Case 5:

History: A 57-year-old African-American previously healthy male has been experiencing malaise and increasing weakness upon exertion for the last 3 months. He has difficulty keeping his eyes open, along with diplopia, by the end of the day. He feels better, with more strength, following a night's sleep. He has no other major medical problems.

He suddenly experiences difficulty breathing and is brought into the Emergency Department by EMS. Vital signs are T 36 C, P 90 bpm, BP 130/95 mm Hg, and RR 32/min. Oxygen saturation is decreased and a workup is begun for COPD.

Imaging Studies: A portable AP chest X-ray is normal with sparse infiltrates, but the lateral view has a suspicious shadowing in the anterior mediastinum. A subsequent CT is done, and a large, anterior mediastinal mass is visualized.

Laboratory Data: A CBC reveals a WBC WNL, but the automated differential shows an increasingly large percentage of lymphocytes. Further testing finds a high titer of anti-AchR IgG.

His respiratory status worsens, and he is placed on a ventilator.

Case 5 Questions:

Q5.1 What is the assessment?

Q5.2 What is the mass?

Q5.3 What emergent blood treatment is most indicated?

Q5.4 For what are other conditions could this therapy be used?

Q5.5 What blood product is often obtained using the method for this therapy?