Transfusion Related Emergencies

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ABSTRACT:

Audience: This exercise is appropriate for all emergency medicine learners (residents and medical students) and learners from other specialties (internal medicine, family medicine, anesthesia).

Introduction: About 85 million red blood cell units are transfused worldwide each year. Transfusion reactions can complicate up to 8% of blood transfusions and can range from benign to life threatening. An emergency physician must be able to discuss the risks and benefits of blood transfusion with patients, as well as manage the associated complications of blood transfusion.

Objectives: At the end of this didactic session, the learner will be able to: 1) list the various transfusion reactions and their approximate incidence; 2) understand the pathophysiology behind each transfusion reaction; 3) describe the management for each type of transfusion reaction; and 4) discuss the plan for prevention of future transfusion reactions.

Method: This is a classic team based learning exercise (cTBL).

Topics: Transfusion reactions, red blood cells, fresh frozen plasma, platelets, transfusion related acute lung injury (TRALI), transfusion associated circulatory overload (TACO), acute hemolytic transfusion reaction (AHTR), delayed extravascular hemolytic transfusion reaction (DHTR), anaphylaxis and urticarial transfusion reactions, sepsis, hepatitis C, hepatitis B, human immunodeficiency virus (HIV).

USER GUIDE

List of Resources:

Learner Audience:
Medical students, interns, junior residents, senior residents. Also: internal medicine residents, family medicine residents, anesthesiology residents, surgery residents.

Time Required for Implementation:
Instructor Preparation: 1-2 hours
Learner Responsible Content: 30 minutes
In Class Time: 1.5-2 hours

Recommended Number of Learners per Instructor:
Up to 100 learners per instructor

Topics:
Transfusion reactions, red blood cells, fresh frozen plasma, platelets, transfusion related acute lung injury (TRALI), transfusion associated circulatory overload (TACO), acute hemolytic transfusion reaction (AHTR), delayed extravascular hemolytic transfusion reaction (DHTR), anaphylaxis and urticarial transfusion reactions, sepsis, hepatitis C, hepatitis B, human immunodeficiency virus (HIV).

Objectives:
At the end of this didactic session, learners will be able to:

1. List the various transfusion reactions and their approximate incidence
2. Understand the pathophysiology behind each transfusion reaction
3. Describe the management for each type of transfusion reaction
4. Discuss the plan for prevention of future transfusion reactions.

Linked objectives and methods:
For the first objective, the learner will need to list each transfusion reaction during the group application exercise (GAE). The GAE will also require learners to answer which component in the donor and recipient blood is responsible for each transfusion reaction, thereby promoting understanding of the reaction's pathophysiology. The learner will answer how to manage each transfusion during the GAE. This knowledge will be solidified during the post-test. The fourth objective will be achieved as learners discuss how to prevent future transfusion reactions during the GAE; knowledge of this concept is further tested during the post-test.

Recommended pre-reading for instructor:
The instructor should read through all keys and explanations accompanying this article. We also suggest he or she read at least one of the following articles. The instructor would benefit from reading more than one, however.

- Savage WJ. Transfusion reactions. *Hematol Oncol Clin N Am*. 2016;30(3):619-634. doi: 10.1016/j.hoc.2016.01.012
- Tran M-H, Ward DC. Blood component therapy. *Osteopath Fam Phys.* 2015;7(3):21-33.
- Perrotta PL, Snyder EL. Non-infectious complications of transfusion therapy. *Blood Rev.* 2001;15(2):69-83. doi: 10.1054/blre.2001.0151
- Silvergleid AJ. Approach to the patient with a suspected acute transfusion reaction. In: Kleinman S, ed. *UpToDate.* Waltham, MA: UpToDate, Inc. https://www.uptodate.com/contents/approach-to-the-patient-with-a-suspected-acute-transfusion-reaction. Updated December 2015. Accessed June 20, 2016.
- Silvergleid AJ. Immunologic blood transfusion reactions. In: Kleinman S, ed. *UpToDate.* Waltham, MA: UpToDate, Inc. https://www.uptodate.com/contents/immunologic-transfusion-reactions. Updated December 2015. Accessed June 20, 2016.

The following articles may also be useful in developing expertise for the instructor:

- Carson JL, Grossman BJ, Kleinman S, Tinmouth AT, Marques MB, Fung MK, et al. Red blood cell transfusions: a clinical practice guideline from the AABB. *Ann Intern Med.* 2012;157(1):49-58. doi: 10.7326/0003-4819-157-1-201206190-00429
- Eder AF, Dy BA, Perez JM, Rambaud M, Benjamin RJ. The residual risk of transfusion-related acute lung injury at the American Red Cross (2008-2011): limitations of a predominantly male-donor plasma mitigation strategy. *Transfusion.* 2015;53(7):1442-1449. doi: 10.1111/j.1537-2995.2012.03935.x
- Kleinman S, Kor DJ. Transfusion-related acute lung injury (TRALI). In: Tirnauer JS, ed. *UpToDate.* Waltham, MA: UpToDate, Inc. https://www.uptodate.com/contents/transfusion-related-

acute-lung-injury-trali. Updated December 2015. Accessed June 20, 2016.
- US Food and Drug Administration. Fatalities reported to FDA following blood collection and transfusion. Annual Summary for Fiscal Year 2015. http://www.fda.gov/downloads/BiologicsBloodVaccines/SafetyAvailability/ReportaProblem/TransfusionDonationFatalities/UCM459461.pdf. Accessed June 20, 2016.

Learner responsible content (LRC):
Learners should read one of the following articles:
- Savage WJ. Transfusion reactions. *Hematol Oncol Clin N Am*. 2016;30(3):619-634. doi: 10.1016/j.hoc.2016.01.012
- Tran M-H, Ward DC. Blood component therapy. *Osteopath Fam Phys.* 2015;7(3):21-33.
- Perrotta PL, Snyder EL. Non-infectious complications of transfusion therapy. *Blood Rev.* 2001;15(2):69-83. doi: 10.1054/blre.2001.0151

Results and tips for successful implementation:
This cTBL was first implemented during residency conference, at which 40 learners were present (senior residents to medical students). The exercise received extremely positive feedback. Learners appreciated the review of an important topic that is not covered often during didactics. They felt that the format was engaging and high yield. After the session, we sought the expertise of a content expert (Dr. Tran), to ensure that all content was accurate.

Prepare:
1. Read all instructor pre-reading.
2. One week in advance, post on a learning management system or e-mail the pre-reading (one of the following articles) for or to your learners. The iRAT is based on the Savage WJ article, so if not using this article, change the iRAT to say "according to Tran or Perrotta" instead.
   - Savage WJ. Transfusion reactions. *Hematol Oncol Clin N Am*. 2016;30(3):619-634. doi: 10.1016/j.hoc.2016.01.012
   - Tran M-H, Ward DC. Blood component therapy. *Osteopath Fam Phys.* 2015;7(3):21-33.
   - Perrotta PL, Snyder EL. Non-infectious complications of transfusion therapy. *Blood Rev.* 2001;15(2):69-83. doi: 10.1054/blre.2001.0151
3. Prepare the gRATs by making it an IF/AT (immediate feedback/assessment technique, see example with article gRAT). You will need to buy square or rectangle scratch-off label stickers (www.amazon.com) to prepare a gRAT-IF/AT for each group. Cut the scratch-off stickers to the appropriate size and place the scratch-off stickers over the letter choices on the gRAT. (During the exercise, groups will scratch off their answer choice and get immediate feedback as to whether they got the right answer).
4. The post-test can be done in any format (paper or online), but we recommend having learners take the post-test as a Kahoot! (Some of the question stems are shortened in order to fit Kahoot's 95 character limit.) The link to the Kahoot! is: https://play.kahoot.it/#/k/ecc82c2b-7f0d-449e-b8b4-cefea75c1200 or you may create your own at www.getkahoot.com. If the link does not work, log in to Kahoot and search public kahoots for: Transfusion Related Emergencies, JETem. You will want sound plugged in to the computer running the Kahoot. Each of your learners will need a device to participate (tablet, computer, or iPhone/Android phone).
5. If using a Kahoot! post-test, the classroom will need a projector (or large monitor) and computer. Otherwise this session does not need any materials besides those listed below.

For the in-classroom didactic session, you will also need to prepare the following:
1. One copy of team numbers (one number per team)
2. One copy of the iRAT for each learner
3. One copy of the gRAT for each team (4 learners per team), using scratch-off stickers (available at www.amazon.com)
4. One copy of the group application exercise for each team
5. One copy of the group application exercise key for each instructor (usually just one instructor)
6. One copy of the iRAT key with explanations for each instructor
7. One copy of the post-test for each learner (or link to the Kahoot! in the classroom).

In class implementation:
1. Learners will start the session by taking the iRAT. Give your learners 5-10 minutes to complete the iRAT. Learners should not be allowed to use the article or other material during the iRAT.
2. Once learners have completed the iRAT, break learners up into groups of four. We recommend evenly distributing the number of senior and junior learners in each group. The instructor should assign the groups, rather than having the learners self-select. If faculty are present, put at least one faculty member at each table.
3. The session is best implemented in small round or square tables, with four learners at each table.

4. Give each group one copy of the gRAT and a team number. Give the groups 10 minutes to complete the gRAT IF/AT. This is also done "closed book." Instruct the learners to scratch off ONLY the best answer. The goal is for each group to have the least number of answer choices scratched off (in other words, make sure learners don't just scratch off all answers to find out the answer quickly). For question #1, have the groups write their answers, then scratch off the answers. Walk around the room to ensure learners are on task and do not have any questions.
5. Go over the gRAT answers as a group. Call on one leader (by calling their team number) from each group to answer each gRAT question. Provide explanations and answer any further questions learners have (10 minutes).
6. Give each group one copy of the GAE. Give groups 30 minutes to complete the GAE. We suggest having half of the groups start on the last question and working their way backwards, in case groups do not have time to complete all portions (in our experience, however, 30-45 minutes was sufficient time for all groups to finish). Groups may use the article, textbooks, or online materials during the GAE.
7. Once all groups have finished the GAE, call on group leaders to answer each GAE question (one group leader answers all parts of each question). Discuss answers and clarify any areas of confusion for learners.
8. After you have discussed all GAE answers, have each learner complete a post-test. We recommend doing the post-test as a Kahoot! https://play.kahoot.it/#/k/ecc82c2b-7f0d-449e-b8b4-cefea75c1200 with a prize for the winner (at our residency, we have paper "medals" for the Kahoot winner; these medals go on the residency bulletin board).

Content:

- iRAT
- gRAT
- GAE
- Post-test
- RAT Key
- GAE Key
- Post-test Key

References/suggestions for further reading:

1. Savage WJ. Transfusion reactions. *Hematol Oncol Clin N Am*. 2016;30(3):619-634. doi: 10.1016/j.hoc.2016.01.012
2. Tran M-H and Ward DC. Blood component therapy. *Osteopath Fam Phys.* 2015;7(3):21-33.
3. Perrotta PL, Snyder EL. Non-infectious complications of transfusion therapy. *Blood Rev.* 2001;15(2):69-83. doi: 10.1054/blre.2001.0151
4. Carson JL, Grossman BJ, Kleinman S, Tinmouth AT, Marques MB, Fung MK, et al. Red blood cell transfusions: a clinical practice guideline from the AABB. *Ann Intern Med.* 2012;157(1):49-58. doi: 10.7326/0003-4819-157-1-201206190-00429
5. Eder AF, Dy BA, Perez JM, Rambaud M, Benjamin RJ. The residual risk of transfusion-related acute lung injury at the American Red Cross (2008-2011): limitations of a predominantly male-donor plasma mitigation strategy. *Transfusion.* 2015;53(7):1442-1449. doi: 10.1111/j.1537-2995.2012.03935.x
6. Silvergleid AJ. Approach to the patient with a suspected acute transfusion reaction. In: Kleinman S, ed. *UpToDate.* Waltham, MA: UpToDate, Inc. https://www.uptodate.com/contents/approach-to-the-patient-with-a-suspected-acute-transfusion-reaction. Updated December 2015. Accessed June 20, 2016.
7. Silvergleid AJ. Immunologic blood transfusion reactions. In: Kleinman S, ed. *UpToDate.* Waltham, MA: UpToDate, Inc. https://www.uptodate.com/contents/immunologic-transfusion-reactions. Updated December 2015. Accessed June 20, 2016.
8. Kleinman S, Kor DJ. Transfusion-related acute lung injury (TRALI). In: Tirnauer JS, ed. *UpToDate.* Waltham, MA: UpToDate, Inc. https://www.uptodate.com/contents/transfusion-related-acute-lung-injury-trali. Updated December 2015. Accessed June 20, 2016.
9. US Food and Drug Administration. Fatalities reported to FDA following blood collection and transfusion. Annual Summary for Fiscal Year 2015. http://www.fda.gov/downloads/BiologicsBloodVaccines/SafetyAvailability/ReportaProblem/TransfusionDonationFatalities/UCM459461.pdf. Accessed June 20, 2016.
10. Kaufman RM, Assman SF, Triulzi DJ, Strauss RG, Ness P, Granger S, Slichter SJ. Transfusion-related adverse events in the platelet dose study. *Transfusion.* 2015;55(1):144-153.
11. Linden JV, Wagner K, Voytovich AE, Sheehan J. Transfusion errors in New York State: an analysis of 10 years' experience. *Transfusion.* 2000;40(10):1207-1213.
12. Pomper GJ. Febrile, allergic, and nonimmune transfusion reactions. In: Simon TL, Snyder EL, Solheim BG, et al. eds. *Rossi's Principles of Transfusion Medicine*. 4th ed. Oxford: Wiley-Blackwell; 2009:826-846.
13. Klein HG, Anstee DJ. Haemolytic transfusion reactions. In: *Mollison's Blood Transfusion in Clinical Medicine*. 11th ed. Oxford: Wiley-Blackwell; 2005:458.

Transfusion Related Emergencies: Individual Readiness Assessment Test (iRAT)

1. You are consenting a patient for a blood transfusion. She would like to know the approximate risk of hepatitis B and C and HIV transmission. According to Savage, you tell her that the risks for each are:

   Hepatitis B:

   Hepatitis C:

   HIV:

2. Of the following, which is the most common complication of blood transfusions?

   a. Acute hemolytic transfusion reaction (AHTR)
   b. Delayed hemolytic transfusion reaction (DHTR)
   c. Transfusion associated circulatory overload (TACO)
   d. Transfusion related acute lung injury (TRALI)
   e. Transmission of hepatitis B virus

3. According to the 2014 FDA report called: Fatalities Reported to FDA Following Blood Collection and Transfusion, which is quoted in Savage, which of the following was the leading cause of transfusion-related death 2010-2014?

   a. Acute hemolytic transfusion reaction (AHTR)
   b. Delayed hemolytic transfusion reaction (DHTR)
   c. Gram-negative bacteremia
   d. Transfusion associated circulatory overload (TACO)
   e. Transfusion related acute lung injury (TRALI)

Osborn M, et al. Transfusion Related Emergencies. JETem 2016. 1(2):T26-64.
https://doi.org/10.21980/J86P4V

4. Approximately how many fatalities reported to the FDA are directly attributable to blood transfusions each year in the United States.

   a. 4
   b. 40
   c. 4,000
   d. 400,000

5. Which of the following blood products have the highest risk of bacterial contamination?

   a. Plasma
   b. Platelets
   c. Red blood cells

6. Delayed hemolytic transfusion reactions (DHTRs) usually occur in patients who have never received blood transfusions before.

   a. True
   b. False

7. A 63 year-old male, on warfarin, presents after a head trauma. On CT, he is found to have a subdural hematoma. His INR is 9.0. You would like to reverse his warfarin with fresh frozen plasma (FFP) and counsel him regarding the risk of blood transfusions, including a risk of transfusion related acute lung injury (TRALI) of approximately 1:200,000. You know that the risk of TRALI would be higher if the donor plasma were from:

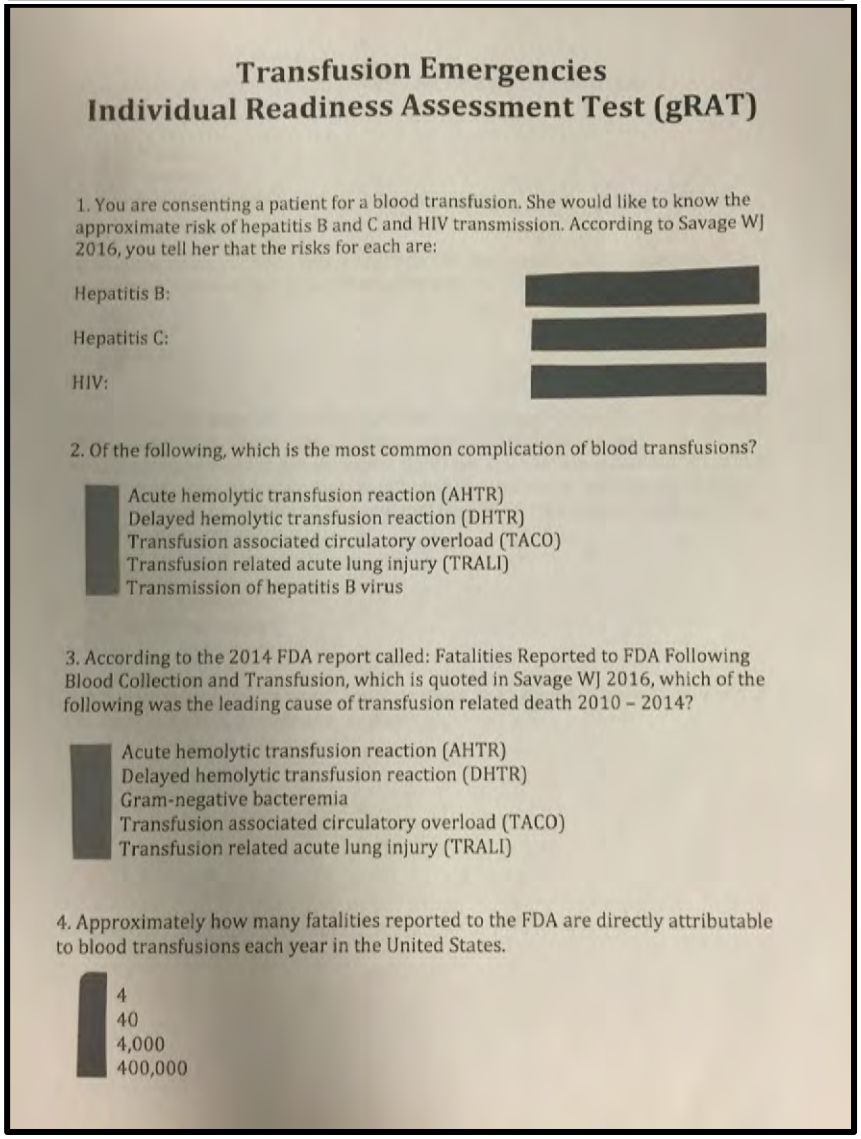
   a. A 10 year-old female elementary school student
   b. A 30 year-old female stay-at-home mom
   c. A 40 year-old male with a history of IV drug abuse
   d. A 60 year-old male, retired, with a history of coronary artery disease

8. A patient who receives type O negative blood in an emergency situation is still at risk for a hemolytic transfusion reaction.

   a. True
   b. False

LEARNER MATERIALS

The subsequent gRAT is intended to be an IF/AT. Ideally, you will purchase "scratch-off label stickers" (available at amazon.com) and place the stickers over the index letters as shown below. If you do not want to create an IF/AT form, you can print the iRAT instead for your gRAT



Transfusion Emergencies
Individual Readiness Assessment Test (gRAT)

1. You are consenting a patient for a blood transfusion. She would like to know the approximate risk of hepatitis B and C and HIV transmission. According to Savage WJ 2016, you tell her that the risks for each are:

Hepatitis B: [redacted]

Hepatitis C: [redacted]

HIV: [redacted]

2. Of the following, which is the most common complication of blood transfusions?

[redacted]
Acute hemolytic transfusion reaction (AHTR)
Delayed hemolytic transfusion reaction (DHTR)
Transfusion associated circulatory overload (TACO)
Transfusion related acute lung injury (TRALI)
Transmission of hepatitis B virus

3. According to the 2014 FDA report called: Fatalities Reported to FDA Following Blood Collection and Transfusion, which is quoted in Savage WJ 2016, which of the following was the leading cause of transfusion related death 2010 – 2014?

[redacted]
Acute hemolytic transfusion reaction (AHTR)
Delayed hemolytic transfusion reaction (DHTR)
Gram-negative bacteremia
Transfusion associated circulatory overload (TACO)
Transfusion related acute lung injury (TRALI)

4. Approximately how many fatalities reported to the FDA are directly attributable to blood transfusions each year in the United States.

[redacted]
4
40
4,000
400,000

Transfusion Related Emergencies: Group Readiness Assessment Test (gRAT)

1. You are consenting a patient for a blood transfusion. She would like to know the approximate risk of hepatitis B and C and HIV transmission. According to Savage, you tell her that the risks for each are:

Hepatitis B:	1:300,000
Hepatitis C:	Less than 1:2,000,000
HIV:	Less than 1:2,000,000

2. Of the following, which is the most common complication of blood transfusions?

   a. Acute hemolytic transfusion reaction (AHTR)
   b. Delayed hemolytic transfusion reaction (DHTR)
   v. Transfusion associated circulatory overload (TACO)
   c. Transfusion related acute lung injury (TRALI)
   d. Transmission of hepatitis B virus

3. According to the 2014 FDA report called: Fatalities Reported to FDA Following Blood Collection and Transfusion, which is quoted in Savage, which of the following was the leading cause of transfusion related death 2010 – 2014?

   a. Acute hemolytic transfusion reaction (AHTR)
   b. Delayed hemolytic transfusion reaction (DHTR)
   c. Gram-negative bacteremia
   d. Transfusion associated circulatory overload (TACO)
   v. Transfusion related acute lung injury (TRALI)

Osborn M, et al. Transfusion Related Emergencies. JETem 2016. 1(2):T26-64.
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4. Approximately how many fatalities reported to the FDA are directly attributable to blood transfusions each year in the United States?

   a. 4
   v. 40
   c. 4,000
   d. 400,000

5. Which of the following blood products have the highest risk of bacterial contamination?

   a. Plasma
   v. Platelets
   c. Red blood cells

6. Delayed hemolytic transfusion reactions (DHTRs) usually occur in patients who have never received blood transfusions before.

   a. True
   v. False

7. A 63 year-old male, on warfarin, presents after a head trauma. On CT, he is found to have a subdural hematoma. His INR is 9.0. You would like to reverse his warfarin with fresh frozen plasma (FFP) and counsel him regarding the risk of blood transfusions, including a risk of transfusion related acute lung injury (TRALI) of approximately 1:200,000. You know that the risk of TRALI would be higher if the donor plasma were from:

   a. A 10 year-old female elementary school student
   v. A 30 year-old female stay at home mom
   c. A 40 year-old male with a history of IV drug abuse
   d. A 60 year-old male, retired, with a history of coronary artery disease

8. A patient who receives type O negative blood in an emergency situation is still at risk for a hemolytic transfusion reaction.

   v. True
   b. False

Transfusion Related Emergencies: Group Application Exercise

Case #1:
A 26 year-old female is undergoing transfusion for symptomatic anemia secondary to menorrhagia. Five minutes into the transfusion, the patient begins to complain of severe pain in her right arm (the site of her IV), chest and back pain. Her temperature is 39C. Twenty minutes later, she starts oozing from the site of her IV and notices that her urine is very dark.

Diagnosis:	
Signs and Symptoms:	Incidence:
How to treat:	Timing (with relationship to transfusion):
How to prevent:	Culprit component in RECIPIENT blood:
Other notes:	Culprit component in DONOR blood:

Osborn M, et al. Transfusion Related Emergencies. JETem 2016. 1(2):T26-64.
https://doi.org/10.21980/J86P4V

LEARNER MATERIALS

Case #2:

A 40 year-old female with a history of lupus chronic anemia was on vacation last week and required a blood transfusion at an outside hospital. She is complaining of worsening fatigue and dark urine. Her hemoglobin is 5 g/dL and her urine dipstick is positive for hemoglobin.

Diagnosis:	
Signs and Symptoms:	Incidence:
How to treat:	Timing (with relationship to transfusion):
How to prevent:	Culprit component in RECIPIENT blood:
Other notes:	Culprit component in DONOR blood:

LEARNER MATERIALS

Case #3:

A 60 year-old female with breast cancer, on chemotherapy, is undergoing blood transfusion. During her transfusion, she develops fevers (40C), rigors, and hypotension. She develops severe body aches. Her blood pressure remains low despite fluid resuscitation. The direct antiglobulin test (DAT) in the blood bank is negative and the nurse confirms the patient has the correct blood sample.

Diagnosis:	
Signs and Symptoms:	Incidence:
How to treat:	Timing (with relationship to transfusion):
How to prevent:	Culprit component in RECIPIENT blood: N/A
Other notes:	Culprit component in DONOR blood:

LEARNER MATERIALS

Case #4:

A 20 year-old female is undergoing blood transfusion for chronic anemia. During the transfusion, her temperature climbs to 38.5C and she develops chills. You immediately stop the transfusion. The blood bank performs a direct antiglobulin test, which is negative. The gram stain is also negative. The patient's symptoms improve with acetaminophen.

Diagnosis:	
Signs and Symptoms:	Incidence:
How to treat:	Timing (with relationship to transfusion):
How to prevent:	Culprit component in RECIPIENT blood:
Other notes:	Culprit component in DONOR blood:

LEARNER MATERIALS

Case #5:
A 50 year-old female undergoing blood transfusion develops skin flushing, pruritis, and tongue swelling.

Diagnosis:	
Signs and Symptoms:	Incidence:
How to treat:	Timing (with relationship to transfusion):
How to prevent:	Culprit component in RECIPIENT blood: Anaphylaxis: Urticarial:
Other notes (pathophysiology, other notes):	Culprit component in DONOR blood:

LEARNER MATERIALS

Case #6:

A 40 year-old previously healthy female is undergoing blood transfusion for acute upper GI bleed. Approximately 30 minutes later, the patient develops shortness of breath and hypoxia to 86% on room air. A chest x-ray shows new bilateral infiltrates and a normal heart size.

Diagnosis:	
Signs and Symptoms:	Incidence:
How to treat:	Timing (with relationship to transfusion):
How to prevent:	Culprit component in RECIPIENT blood:
Other notes (pathophysiology, other notes):	Culprit component in DONOR blood:

LEARNER MATERIALS

Case #7:

A 65 year-old male with a history of congestive heart failure and chronic renal insufficiency is undergoing a blood transfusion for anemia of chronic disease. Shortly after the transfusion, he develops shortness of breath, hypoxia, JVD, and diffuse rales on examination.

Diagnosis:	
Signs and Symptoms:	Incidence:
How to treat:	Timing (with relationship to transfusion):
How to prevent:	Culprit component in RECIPIENT blood: N/A
Other notes (pathophysiology, other notes):	Culprit component in DONOR blood: N/A

LEARNER MATERIALS

Case #8:

A 50 year-old hospitalized Japanese female requires blood transfusion for a lower GI bleed and hemoglobin of 5.2 g/dL. She initially refuses blood transfusion, but agrees if her sister can donate the blood (directed donation). Eight days after undergoing blood transfusion, she develops rash, elevated liver function tests, and worsening anemia, thrombocytopenia, and leukopenia.

Diagnosis:	
Signs and Symptoms:	Incidence:
How to treat:	Timing (with relationship to transfusion):
How to prevent:	Culprit component in RECIPIENT blood:
Other notes (pathophysiology, other notes):	Culprit component in DONOR blood:

Transfusion Related Emergencies: Post-Test

https://play.kahoot.it/#/k/ecc82c2b-7f0d-449e-b8b4-cefea75c1200

If the link does not work, log in to Kahoot! and search public kahoots for: Transfusion Related Emergencies, JETem.

1. Patients with _____ should get irradiated blood.

    a. a history of febrile non-hemolytic transfusion reactions
    b. a transfusion from a first-degree relative
    c. IgA deficiency
    d. O negative blood type

2. Which of the following will probably prevent a febrile non-hemolytic transfusion reaction?

    a. Diphenhydramine
    b. Irradiated blood
    c. Leukoreduced blood
    d. Washed blood

3. Who should get washed RBCs?

    a. Immunocompromised patients
    b. Patients receiving blood from a first-degree relative
    c. Patients with a history of anti-Kidd antibodies
    d. Patients with an IgA deficiency

4. Irradiated blood prevents which of the following?

    a. Acute hemolytic transfusion reactions
    b. Febrile non-hemolytic transfusion reactions
    c. Transfusion associated graft vs. host disease
    d. Transfusion related acute lung injury

5. What is thought to be responsible for transfusion related acute lung injuries (TRALIs)?

    a. A medical error
    b. Anti-HLA or anti-HNA antibodies in the donor blood
    c. Anti-Kidd or anti-Jk antibodies in the recipient
    d. Underlying cardiac or renal dysfunction

6. A 50 year-old male is receiving a blood transfusion and begins to have severe pain at the site of his IV, back pain, and fever. What is the most appropriate next step?

    a. Acetaminophen
    b. Diphenhydramine
    c. Normal saline bolus
    d. Stop the transfusion

7. A 30 year-old female develops hives during her transfusion. She has no fever. The blood bank states that the direct antibody test (DAT) is negative. Her symptoms improve after diphenhydramine. What is the most appropriate next step?

    a. Administer epinephrine 0.5 mg IM 1:1000.
    b. Restart the transfusion with the original blood unit
    c. Restart the transfusion with a new blood unit
    d. Restart the transfusion with a unit of washed RBCs

8. Who is at greatest risk for Transfusion Associated Circulatory Overload (TACO)

    a. A patient with a history of chronic anemia and congestive heart failure
    b. A patient with a history of human immunodeficiency virus (HIV)
    c. A patient with a history of TRALI to previous transfusion
    d. A trauma patient who is exsanguinating from a gunshot wound

9. Acute hemolytic transfusion reactions are most commonly due to:

    a. Excessive antibody production in the donor
    b. Immunodeficiency in the recipient
    c. Medical error
    d. Underlying renal or cardiac disease

INSTRUCTOR MATERIALS

Answer keys to all exercises with explanations, are on the following pages.

Learners: please do not proceed.

INSTRUCTOR MATERIALS

Transfusion Related Emergencies: Readiness Assessment Test Answer Key (RAT Key)

1. You are consenting a patient for a blood transfusion. She would like to know the approximate risk of hepatitis B and C and HIV transmission. According to Savage, you tell her that the risks for each are:

   Hepatitis B**:** **1:300,000**

   Hepatitis C: Less than **1:2,000,000**

   HIV: Less than **1: 2,000,000**

2. Of the following, which is the most common complication of blood transfusions?

   a. Acute hemolytic transfusion reaction (AHTR)
   b. Delayed hemolytic transfusion reaction (DHTR)
   c. Transfusion associated circulatory overload (TACO)
   d. Transfusion related acute lung injury (TRALI)
   e. Transmission of hepatitis B virus

The incidence of TACO is between 1:12.5-1:68, according to Tran, et al. The incidence of AHTR is 1:76,000, DHTR is 1:4000 (Tran), TRALI is 1:200,000 (Eder) and hepatitis B is 1:300,000 (Savage).

3. According to the 2014 FDA report called: Fatalities Reported to FDA Following Blood Collection and Transfusion (which is quoted in Savage), which of the following was the leading cause of transfusion related death 2010 – 2014?

   a. Acute hemolytic transfusion reaction (AHTR)
   b. Delayed hemolytic transfusion reaction (DHTR)
   c. Gram-negative bacteremia
   d. Transfusion associated circulatory overload (TACO)
   e. Transfusion related acute lung injury (TRALI)

According to the FDA report, TRALI was the leading cause of death in fiscal years 2010-2014, accounting for 41% of all fatalities reported to FDA (72 of 176), followed by TACO (22%), AHTR due to non-ABO incompatibility (14%), and AHTR due to ABO incompatibility (7%). According to Tran, et al, the incidence of fatal AHTR is 1:1.8 million. Approximately 1 in 100,000 platelets (1 in 5 are fatal, but platelets are transfused less often than RBCs) and 1 in 5 million RBC units (1 in 2 are fatal) cause transfusion-transmitted bacteremia. According to the FDA report, microbial infection was related to 15 (9%) transfusion related deaths between 2010-2014 (FDA). Anaphylaxis related deaths accounted for 10 (6%) deaths (none of which were IgA deficiency related).

4. Approximately how many fatalities reported to the FDA are directly attributable to blood transfusions each year in the United States?

    a. 4
    b. 40
    c. 4,000
    d. 400,000

According to the FDA, there are approximately 40 transfusion related deaths each year in the United States.

5. Which of the following blood products have the highest risk of bacterial contamination?

    a. Plasma
    b. Platelets
    c. Red blood cells

Platelets have the highest incidence of bacterial contamination because they are stored at room temperature.

6. Delayed hemolytic transfusion reactions (DHTRs) usually occur in patients who have never received blood transfusions before.

    a. True
    b. False

INSTRUCTOR MATERIALS

Delayed transfusion reactions are most commonly due to recipient IgG that is present because of previous exposure to red blood cell antigens during blood transfusion or childbirth. Recipient blood is routinely screened for non-ABO antibodies, but non-ABO antibodies (e.g anti-Kidd, anti-Duffy, etc.) may be present at levels below the threshold for detection. When the recipient is re-exposed to this antigen during blood transfusion, the recipient may experience a delayed transfusion reaction.

7. A 63 year-old male, on warfarin, presents after a head trauma. On CT, he is found to have a subdural hematoma. His INR is 9.0. You would like to reverse his warfarin with fresh frozen plasma (FFP) and counsel him regarding the risk of blood transfusions, including a risk of transfusion related acute lung injury (TRALI) of approximately 1:200,000. You know that the risk of TRALI would be higher if the donor plasma were from:

    a. A 10 year-old female elementary school student
    b. A 30 year-old female stay-at-home mom
    c. A 40 year-old male with a history of IV drug abuse
    d. A 60 year-old male, retired, with a history of coronary artery disease

According to Eder et al, the incidence of TRALI is reduced to 1:200,000 when female donors are taken out of the donor pool; this is especially true for multiparous females.

8. True or False: A patient who receives type O negative blood in an emergency situation is still at risk for a hemolytic transfusion reaction.

True. Generally speaking, ABO incompatibility causes the most severe hemolytic reaction because anti-A and anti-B antibodies possess potent complement fixating capacity, leading to activation of the complement cascade causing the assembly and deposition of Membrane Attack Complex on the red cell surface (Klein). Of all transfusion related deaths reported to the FDA between 2010-2014, 13 were due to ABO incompatibility. Rh (D, C, E, c, and e) and other red blood cell antigens (e.g. Kidd, Duffy, etc.) more commonly cause a delayed transfusion reaction or hemolytic disease of the newborn secondary to IgG antibodies to Rh or other red blood cell antigens. An acute hemolytic transfusion reaction, however, is still possible. Of the transfusion related deaths in 2010-2014, 3 were due to anti-Rh antibodies (C, c, cE) and the remainder (25) were due to other antibodies, including anti-Fy, -C, -c, -Jk^a, -Kell, -Jk^b, -Js^{-b}, Co^a, or a combination of antibodies.

INSTRUCTOR MATERIALS

Transfusion Related Emergencies: Group Application Exercise Answer Key (GAE Key)

Case #1:

A 26 year-old female is undergoing transfusion for symptomatic anemia secondary to menorrhagia. Five minutes into the transfusion, the patient begins to complain of severe pain in her right arm (the site of her IV), chest and back pain. Her temperature is 39C. Twenty minutes later, she starts oozing from the site of her IV and notices that her urine is very dark.

Diagnosis: Acute Hemolytic Transfusion Reaction (AHTR)	
Signs and Symptoms: *Fevers, chest pain, dizziness, infusion site pain, back pain, tachycardia, dyspnea, hypotension, shock, DIC, renal failure, indirect hyperbilirubinemia. Hemoglobinemia (red plasma), hemoglobinuria (red/dark urine), low haptoglobin , elevated LDH (Savage).*	Incidence: Symptomatic: *1: 76,000 (Tran, Linden)* *Fatal: 1:1.8 million (Tran, Linden).*
How to treat: *Stop the transfusion, IV fluids, alkalized IV fluids, maintain high urine output, consider diuretics.*	Timing (with relationship to transfusion): *Immediately, up to 24 hours.*
How to prevent: *Blood bank protocols, safeguards, and training to prevent this medical error.*	Culprit component in RECIPIENT blood: *IgM & IgG to donor antigens (anti-A, anti-B).*
Other notes (pathophysiology, other notes)	Culprit component in DONOR blood: *Donor RBC antigen (A or B or rarely other antigens).*

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Case #2:

A 40 year-old female with a history of lupus chronic anemia was on vacation last week and required a blood transfusion at an outside hospital. She is complaining of worsening fatigue and dark urine. Her hemoglobin is 5 g/dL and her urine dipstick is positive for hemoglobin.

Diagnosis: Delayed Extravascular Hemolytic Transfusion Reaction (DHTR)	
Signs and Symptoms: *Anemia, unconjugated hyperbilirubinemia, newly positive direct antiglobulin test (DAT, Direct Coombs), falling haptoglobin (Perrotta).*	Incidence: *1: 4000 (Perrotta).*
How to treat: *Supportive care.*	Timing (with relationship to transfusion): *3-10 days following transfusion (Savage).*
How to prevent: *"Antigen negative" units, flagging blood in the blood bank.*	Culprit component in RECIPIENT blood: *Anti-Kidd (Jk) Anti-Rh (E, C, c); Anti-Kell (K); Anti-Duffy (Fy) antibodies (Perrotta).*
Other notes (pathophysiology, other notes): *Antibody is usually initially present in recipient serum, but is below the limits of detection (secondary exposure causes increased antibody); rarely this can occur on first exposure.*	Culprit component in DONOR blood: *Donor Kidd, Rh, Kell, Duffy on RBCs.*

INSTRUCTOR MATERIALS

Case #3:

A 60 year-old female with breast cancer, on chemotherapy, is undergoing blood transfusion. During her transfusion, she develops fevers (40C), rigors, and hypotension. She develops severe body aches. Her blood pressure remains low despite fluid resuscitation. The direct antiglobulin test (DAT) in the blood bank is negative and the nurse confirms the patient has the correct blood sample.

Diagnosis: Bacteremia/Sepsis	
Signs and Symptoms: *Fever, rigors, flushing, abdominal pain, myalgias, DIC, renal failure, shock (Savage).* *How to distinguish from AHTR: Bacteremia should have no hemoglobinuria or Hemoglobinemia.*	Incidence: *Platelets: 1: 100,000 (Savage)* *RBCs: 1:5 million (Savage).*
How to treat: *Stop transfusion, samples sent to the blood bank for DAT, hemolysis check, and Gram stain/culture (Savage), IV antibiotics, fluid resuscitation.*	Timing (with relationship to transfusion): *Immediate or several hours later (Savage).*
How to prevent: *Anti-septic practices in blood bank, refrigerating at appropriate temperature, time limits on blood products, avoiding donation from patients with symptoms.*	Culprit component in RECIPIENT blood: *N/A*
Other notes (pathophysiology, other notes): *Highest incidence among platelets because they are stored at room temperature (Savage).*	Culprit component in DONOR blood: *RBCs: Pseudomonas, Yersinia, Enterobacter, Flavobacterium;* *Platelets: Skin flora.*

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Case #4:

A 20 year-old female is undergoing blood transfusion for chronic anemia. During the transfusion, her temperature climbs to 38.5C and she develops chills. You immediately stop the transfusion. The blood bank performs a direct antiglobulin test, which is negative. The gram stain is also negative. The patient's symptoms improve with acetaminophen.

Diagnosis: Febrile Non-Hemolytic Transfusion Reaction (FNHTR)	
Signs and Symptoms: *Temperature rise of 1C to greater than 38C, rigors, chills, hypotension, low oxygen saturation, dyspnea (Perrotta).*	Incidence: *1:222 – 1:909 (Tran, Pompner, Simon)* *(Savage article: 1%)*
How to treat: *Stop transfusion and send to blood bank for testing to ensure it is not an AHTR.* *Consider premedication with acetaminophen for patients in whom fever would complicate the clinical picture (Savage).* *Meperidine for chills.*	Timing (with relationship to transfusion): *Within minutes or hours afterwards (Perrotta).*
How to prevent: *-Premedicate with acetaminophen (diphenhydramine is not useful)* *-Leukoreduced blood products (75% of products already are per Silvergleid AJ, Immunologic blood transfusion reactions)* *-Premedication with steroids several hours before transfusion may also be useful.*	Culprit component in RECIPIENT blood: *Cytotoxic antibodies (class I HLA or granulocyte specific antibodies)* *(Interaction of Ab-Ag complex leads to cytokine release).*
Other notes (pathophysiology, other notes): *Most common with platelets.* *Consider other causes (acute hemolysis, sepsis).* *Leukoreduction is also useful for preventing or delaying HLA alloimmunization and CMV transmission (Savage).* *Many centers leukoreduce all blood.*	Culprit component in DONOR blood: *HLA and/or leukocyte specific antigens on WBCs.*

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Case #5:
A 50 year-old female, undergoing blood transfusion develops skin flushing, pruritis, and tongue swelling.

Diagnosis: Allergic Transfusion Reactions (Anaphylaxis and Urticarial)	
Signs and Symptoms: *Flushing, urticarial, pruritis, angioedema, hypotension, bronchospasm, stridor, abdominal pain, emesis (Savage).*	Incidence: *3% (Savage); 1:52 (Tran, Kaufman)* *Anaphylaxis 1:20,000 to 1:50,000 (UTD Silver)*
How to treat: *Stop transfusion.* *Administer diphenhydramine.* *If no fever, resume transmission, but stop again if symptoms resume.* *If symptoms restart, get a new unit of blood.* *Anaphylaxis: Epinephrine, maintain airway.*	Timing (with relationship to transfusion): *During or up to 4 hours following (Savage).*
How to prevent: *Washed RBCs (Residual donor plasma is removed and replaced by saline) or plasma-reduced and/or washed platelets.* *Consider corticosteroids in advance of transfusion.* *Consider IgA deficient blood products (if confirmed anti-IgA).* *Consider IgA/anti-IgA testing for patients with a history of anaphylactic reactions.*	Culprit component in RECIPIENT blood: *Anaphylaxis:* *IgG anti-IgA antibodies* *Anti-haptoglobin antibodies (anhaptoglobinemia)* *Other antibodies that have caused anaphylaxis to the recipient in past (e.g. peanuts).* *Urticarial:* *IgE antibodies.*

Other notes (pathophysiology, other notes): *Congenital IgA deficiency: Patients with class specific antibodies to IgA should receive components without IgA (Perrotta).* *There has been at least one case of a peanut antigen causing anaphylaxis in a patient with previous peanut allergy (UTD, Silver).*	Culprit component in DONOR blood: *Anaphylaxis:* *IgA, haptoglobin, other antigens (a donor who recently ate peanuts).* *Urticarial:* *Soluble allergenic substances, plasma protein.*

INSTRUCTOR MATERIALS

Case #6:

A 40 year-old previously healthy female is undergoing blood transfusion for acute upper GI bleed. Approximately 30 minutes later, the patient develops shortness of breath and hypoxia to 86% on room air. A chest x-ray shows new bilateral infiltrates and a normal heart size.

Diagnosis: Transfusion Related Acute Lung Injury (TRALI)	
Signs and Symptoms: *Dyspnea, non-cardiogenic pulmonary edema, chills, fever, hypotension.* *Diagnose based on ARDS criteria + associated blood transfusion <6 hours: Hypoxia (PaO2/FiO2 ratio of <300 mmHg), new, bilateral infiltrates on post-transfusion CXR, non-cardiogenic (PCWP<18 or CVP≤15mmHg), no other risk factors for acute lung injury).*	Incidence: *1:10,000 (Toy, et al. Blood 2012);* *Plasma: 1:200,000 (Eder); 1:40,000 for AB plasma (Eder).*
How to treat: *Stop transfusion.* *Oxygen.* *CPAP, BIPAP, or mechanical ventilation.* *Similar treatment as ARDS.*	Timing (with relationship to transfusion): *Must be within 6 hours, but usually within 2 hours.*
How to prevent: *Donor deferral programs for multiparous donors (American Red Cross has not been able to defer AB donors because of the limited supply of AB donors) (Eder 2013).* *Eliminating donors who are implicated in TRALI reactions from blood donation (Savage).* *Avoid receiving plasma from the implicated donor in the future.*	Culprit component in RECIPIENT blood: *Neutrophils are activated by donor antibodies.*
Other notes (pathophysiology, other notes): *Highest from whole blood and plasma.* *Leading cause of transfusion related fatality (Savage).*	Culprit component in DONOR blood: *Contain anti-HLA or anti-human neutrophil antigen (HNA) antibodies.*

INSTRUCTOR MATERIALS

Case #7:

A 65 year-old male with a history of congestive heart failure and chronic renal insufficiency is undergoing a blood transfusion for anemia of chronic disease. Shortly after the transfusion, he develops shortness of breath, hypoxia, JVD, and diffuse rales on examination.

Diagnosis: Transfusion Associated Circulatory Overload (TACO)	
Signs and Symptoms: *Cardiogenic pulmonary edema, cough, dyspnea, chest tightness.* *High risk: Patients with cardiac or renal failure.* *Post-transfusion pro-brain natriuretic peptide (NT-proBNP) may be 50% higher than pre-transfusion values.*	Incidence: *1:12.5 to 1:68.*
How to treat: *Stop the transfusion.* *Diuretics (Savage).*	Timing (with relationship to transfusion): *Within 2 hours (up to 6).*
How to prevent: *Slow rates of transfusion (less than 3ml/kg per hour) and lower to 1ml/kg per hour for patients at risk for fluid overload.* *Diuresis.*	Culprit component in RECIPIENT blood: *Compromised cardiopulmonary status.*
Other notes (pathophysiology, other notes): *The maximum time for a transfusion is 4 hours, unless the blood bank divides the blood into separate aliquots).* *At risk: Elderly, infants, cardiac and renal insufficiency.*	Culprit component in DONOR blood: *N/A*

INSTRUCTOR MATERIALS

Case #8:

A 50 year-old hospitalized Japanese female requires blood transfusion for a lower GI bleed and hemoglobin of 5.2 g/dL. She initially refuses blood transfusion, but agrees if her sister can donate the blood (directed donation). Eight days after undergoing blood transfusion, she develops rash, elevated liver function tests, and worsening anemia, thrombocytopenia, and leukopenia.

Diagnosis: Transfusion Associated Graft vs. Host Disease (TA GvHD)	
Signs and Symptoms: *Rash, abdominal pain, diarrhea, elevated LFTs, bone marrow suppression. Skin biopsy can confirm.*	Incidence: *Very low, only two cases reported to FDA between 2010- 2014 (Savage).*
How to treat: *Difficult to treat, almost always fatal.* *Treatments that have been tried without success: steroids, azathrioprine, anti-thymocyte globulin, methotrexate, cyclosporine (Silverglied – GvH).*	Timing (with relationship to transfusion): *2-30 days after transfusion.*
How to prevent: *Irradiating blood with 2500cGy.*	Culprit component in RECIPIENT blood: *Immunocompromised (i.e. no WBCs to fight off donor T and NK cells) or recipient is heterozygous for HLA antigen (therefore does not make antibodies to either antigen or donor WBCs).*

Other notes (pathophysiology, other notes): *Usually donor lymphocytes are destroyed by the recipient's immune system; however in certain cases (immunosuppressed or heterozygozity for HLA antigen), this does not occur.* *Candidates for blood irradiation* *-Neonates* *-Hematologic malignancies* *-Cancer patients who are marrow/stem cell transplant candidates* *-Cancer patients on high dose chemotherapy* *-Blood transfusion from first degree relative (directed donation)* *-Patients with immunodeficiencies, but not AIDS* *Fresh frozen plasma should not cause GvH; however, fresh liquid plasma may have residual WBCs.*	Culprit component in DONOR blood: *T and NK cells attack recipient.* *Donor is homozygous for HLA antigen.*

INSTRUCTOR MATERIALS

Transfusion Related Emergencies: Post-Test Answer Key

1. Patients with _____ should get irradiated blood.

    a. a history of febrile non-hemolytic transfusion reactions
    b. a transfusion from a first-degree relative
    c. IgA deficiency
    d. O negative blood type

Explanation: Irradiated blood prevents transfusion-associated graft vs. host disease (GvHD). GvHD occurs when donor white blood cells (T and NK) attack recipient white blood cells. Patients who are heterozygous for a certain HLA antigens may be at risk when they receive blood from a homozygous donor. This is because the homozygous donor recognizes one of the recipient's HLA antigens as foreign; however, the recipient's white blood cells do not recognize the donor HLA antigens as foreign (since they share an HLA antigen). Individuals receiving blood from a close relative are more likely to share HLA antigens and are therefore at risk for GvHD.

Immunocompromised individuals are also at risk for GvHD because their white blood cells may not be able to destroy donor white blood cells.

Individuals who should receive irradiated blood are the following: (Perrotta)

Infants <1250 g.
Fetuses receiving intrauterine blood transfusion.
Neonates on ECMO or getting exchange transfusions.
Patients with congenital immunodeficiency.
Autologous and allogenic bone marrow/stem cell transplant patients and candidates.
Hematologic malignancies (leukemia, lymphoma, aplastic anemia).
Patients with solid tumors on high-dose chemotherapy (neuroblastoma, medulloblastoma, rhabdomyosarcoma).
Patients receiving first-degree relative directed donation.

2. Which of the following will probably prevent a febrile non-hemolytic transfusion reaction?

    a. Diphenhydramine
    b. Irradiated blood
    c. Leukoreduced blood
    d. Washed blood

Explanation: Febrile non-hemolytic transfusion reactions are secondary to HLA or leukocyte specific antigens in the donor blood reacting with anti-class I HLA or granulocyte specific antibodies in the recipient, thereby initiating cytokine release. Therefore, leukoreduced blood should help prevent febrile non-hemolytic transfusion reactions by decreasing the number of white blood cells in the donor blood. Early premedication with steroids and acetaminophen for patients with a history of febrile non-hemolytic transfusion reactions may also help.

3. Who should get washed RBCs?

    a. Immunocompromised patients
    b. Patients receiving blood from a first-degree relative
    c. Patients with a history of anti-Kidd antibodies
    d. Patients with an IgA deficiency

Explanation: Patients with IgA deficiency may experience an anaphylactic transfusion reaction because of recipient IgG anti-IgA antibodies reacting to donor IgA. Washing red blood cells refers to a process by which residual donor plasma is removed and replaced by saline.

4. Irradiated blood prevents which of the following?

    a. Acute hemolytic transfusion reactions
    b. Febrile non-hemolytic transfusion reactions
    c. Transfusion associated graft vs. host disease
    d. Transfusion related acute lung injury

See explanation for question 1.

5. What is thought to be responsible for transfusion related acute lung injuries (TRALIs)?

    a. A medical error
    b. Anti-HLA or anti-HNA antibodies in the donor blood
    c. Anti-Kidd or anti-Jk antibodies in the recipient
    d. Underlying cardiac or renal dysfunction

Explanation: TRALI is caused by anti-HLA or anti-HNA (human neutrophil antigen) antibodies in the donor blood. Pregnancy causes patients to develop these antibodies and therefore blood from multiparous females can cause a high rate of TRALI. For this reason, blood from female donors has been taken out of many donor pools, which has decreased the overall rate for TRALI. Some blood types, such as AB, have not seen a similar drop in TRALI rates; since this blood type is so rare, it relies on a female donor pool to provide a high enough volume for blood banks. Many cases of TRALI have been traced back to a single blood donor who expresses anti-HLA or anti-HNA antibodies.

6. A 50 year-old male is receiving a blood transfusion and begins to have severe pain at the site of his IV, back pain, and fever. What is the most appropriate next step? (Optional Kahoot shorter stem: A 50 yo male, receiving a blood transfusion, starts having pain & fever. What is the next step?)

    a. Acetaminophen
    b. Diphenhydramine
    c. Normal saline bolus
    d. Stop the transfusion

Explanation: For patients who develop pain or fever during blood transfusion, the transfusion should immediately be stopped in order to ensure that the patient is not having an acute hemolytic transfusion reaction, which is one of the most serious complications of blood transfusion. Normal saline bolus is appropriate, but stopping the transfusion is the most important next step to prevent future harm.

7. A 30 year-old female develops hives during her transfusion. She has no fever. The blood bank states that the direct antibody test (DAT) is negative. Her symptoms improve after diphenhydramine. What is the most appropriate next step? (Optional Kahoot shorter stem: A pt. develops hives, no fever. BB confirms the blood ok. Sxs improve after Benadryl. Next step?)

    a. Administer epinephrine 0.5 mg IM 1:1000.
    b. Restart the transfusion with the original blood unit
    c. Restart the transfusion with a new blood unit
    d. Restart the transfusion with a unit of washed RBCs

Explanation: The patient developed an allergic transfusion reaction. Assuming all other transfusion reactions have been ruled out, the blood may be restarted with the original unit. If the patient develops symptoms again, the transfusion should be stopped and she should be given a new (washed) unit of blood.

8. Who is at greatest risk for Transfusion Associated Circulatory Overload (TACO)

    a. A patient with a history of chronic anemia and congestive heart failure
    b. A patient with a history of human immunodeficiency virus (HIV)
    c. A patient with a history of TRALI to previous transfusion
    d. A trauma patient who is exsanguinating from a gunshot wound

Explanation: Patients with underlying congestive heart failure and renal insufficiency are at highest risk for TACO. A trauma patient may receive a high volume of blood, but because of acute blood loss, patients are usually not at risk for TACO. If the physician is concerned about TACO in a patient, they should consider slowing the rate of transfusion to occur over four or more hours. A single unit cannot be transfused over a time period longer than 4 hours, unless the blood bank separates the blood and stores it. Blood “goes bad” after 4 hours.

9. Acute hemolytic transfusion reactions are most commonly due to:
    a. Excessive antibody production in the donor
    b. Immunodeficiency in the recipient
    c. Medical error
    d. Underlying renal or cardiac disease

Explanation: Acute hemolytic transfusion reactions are due to ABO incompatibility, which is secondary to a blood bank error, an error during administration, or improper labeling of blood tubes. Other non-ABO antibodies usually cause delayed transfusion reactions, but are also screened for during the blood screening process.