

Chapter 1. Red Blood Cells and Platelet Preservation: Historical Perspectives and Current Trends

Multiple Choice

Identify the choice that best completes the statement or answers the question.

- ____ 1. Which metabolic pathway is responsible for generating 90% of the ATP for the RBC?
 - a. Pentose phosphate shunt
 - b. Luebering-Rapoport shunt
 - c. Glycolysis
 - d. Methemoglobin reductase

- ____ 2. A unit of blood was returned to the blood bank before it was spiked. Apparently the patient's IV failed. The unit of blood was outside the blood bank for 35 minutes. Which of the statements below is most accurate?
 - a. The unit of blood should be discarded immediately.
 - b. The unit of blood can be returned to inventory.
 - c. The unit of blood must be transfused within 4 hours or be discarded at the end of that time.
 - d. The unit of blood must be transfused with 24 hours.

- ____ 3. What effect does storage have on platelets?
 - a. Shrinking
 - b. Lysis
 - c. Repulsion
 - d. All of these.

- ____ 4. In the normal hemoglobin-oxygen dissociation curve, what percentage of oxygen is released to the tissues when PO_2 averages 40 mm Hg?
 - a. 75%
 - b. 25%
 - c. 100%
 - d. 50%

- ____ 5. What factors are known to influence platelet metabolism and function?
 - a. Storage temperature
 - b. Initial pH
 - c. Platelet count
 - d. All of the above

- ____ 6. Which of the following red blood cell morphologies may be present on the peripheral blood smear as a result of loss of RBC membrane?
 - a. Spherocytes
 - b. Target cells
 - c. Burr cells
 - d. Schistocytes

- ____ 7. What does the term *autologous* transfusion refer to?
 - a. A parent donating blood for his or her child
 - b. An individual donating blood for a friend
 - c. An individual donating blood for a relative
 - d. An individual donating blood for his or her own transfusion

- ____ 8. What is the primary function of hemoglobin?
 - a. Iron metabolism
 - b. Porphyrin synthesis
 - c. Oxygen transport
 - d. Signal transduction

- ____ 9. All of the following areas of red blood cell biology are crucial for normal erythrocyte survival *except*:
 - a. cellular metabolism.
 - b. RBC membrane.
 - c. site of the ABO antigen attachment.
 - d. hemoglobin structure.

- ____ 10. What is the correct biochemical composition of the RBC membrane?
 - a. 52% protein, 40% lipid, 8% carbohydrate
 - b. 40% protein, 8% lipid, 52% carbohydrate

- c. 8% protein, 52% lipid, 40% carbohydrate
- d. 8% lipid, 40% carbohydrate, 52% protein

- ___ 11. All of the following biochemical changes are associated with loss of red blood cell viability upon storage *except*:
- a. decreased pH.
 - b. loss of red blood cell function.
 - c. increased ATP level.
 - d. decreased glucose consumption.
- ___ 12. Which red blood cell preservative has a storage time of 35 days?
- a. ACD
 - b. CPDA-1
 - c. AS-1
 - d. CPD
- ___ 13. The RBC membrane is relatively permeable to all of the following *except*:
- a. chloride.
 - b. sodium.
 - c. bicarbonate.
 - d. water.
- ___ 14. Red blood cells frozen using the high-concentration glycerol technique are usually stored at
- a. 0°C
 - b. -20°C
 - c. -65°C
 - d. -80°C
- ___ 15. What is the major biochemical consideration in platelet storage?
- a. Glucose metabolism
 - b. Oxygen supply
 - c. Production of carbon dioxide
 - d. Regulation of pH
- ___ 16. What would the hemoglobin-oxygen dissociation curve depict in a patient exhibiting clinical signs of alkalosis?
- a. Normal
 - b. Shift to the left
 - c. Shift to the right
 - d. None of the above
- ___ 17. Name the main lipid components of a red blood cell membrane.
- a. Phospholipid
 - b. Sphingomyelin
 - c. Glycolipid
 - d. Glycophorin A
- ___ 18. The ABO blood groups were discovered in 1901 by whom?
- a. Charles Drew
 - b. Karl Landsteiner
 - c. Loutit and Mollison
 - d. Edward Lindeman
- ___ 19. A standing order of platelets was shipped to your facility by your supplier. It was inadvertently left in the corner of the department until discovered 36 hours later. What would the appropriate action be for the blood banker?
- a. If the temperature in the box was $22 \pm 2^\circ\text{C}$ and the platelet swirl seemed OK, it would be OK to accept the unit into inventory.
 - b. The platelets have fallen outside the supplier's quality assurance. The unit should be discarded because the pH has probably dropped too low and platelet activation has been compromised.
 - c. If the temperature was 1°C to 6°C and the platelet swirl seemed OK, it would be OK to accept the unit into inventory.
 - d. If the platelets appeared OK and passed the platelet swirl test after being placed on the agitator, they could be accepted into the inventory.
- ___ 20. Which metabolic pathway permits the accumulation of 2,3 diphosphoglycerate (2,3-DPG)?
- a. Glycolysis
 - b. Luebering-Rapoport shunt
 - c. Pentose phosphate shunt
 - d. Methemoglobin reductase

- ____ 21. All of the following are consistent with a "shift to the right" of the hemoglobin-oxygen dissociation curve *except*:
- a. increased 2,3-DPG.
 - b. 50% O₂ saturation to tissues.
 - c. decreased 2,3-DPG.
 - d. decreased hemoglobin affinity for O₂.
- ____ 22. Why are platelet transfusions performed?
- a. Therapeutically to stop bleeding
 - b. Prophylactically to prevent bleeding
 - c. Both reasons.
 - d. Neither reason.
- ____ 23. What cryoprotective agent is added to red blood cells upon freezing?
- a. Dextrose
 - b. Adsol
 - c. Glycerol
 - d. All of the above
- ____ 24. If platelets are to be stored for 5 days on a rotator, what is the optimal storage temperature?
- a. 1°C to 6°C
 - b. 20°C to 24°C
 - c. 35°C to 37°C
 - d. 1°C to 10°C
- ____ 25. Platelets are transfused to play which role in hemostasis?
- a. Maintenance of vascular integrity
 - b. Initial arrest of bleeding by platelet plug formation
 - c. Stabilization of the hemostatic plug
 - d. All of the above
- ____ 26. Which of the following best describes "integral" membrane proteins?
- a. Reside at the cytoplasmic surface of membrane
 - b. Span the entire membrane surface
 - c. Form the red blood cell cytoskeleton
 - d. None of the above
- ____ 27. How is stroma-free hemoglobin solution prepared?
- a. Outdated red blood cells are concentrated, and stroma is removed.
 - b. Outdated red blood cells are diluted with saline, and stroma is removed.
 - c. Outdated red blood cells are lysed, and stroma is removed.
 - d. None of the above
- ____ 28. What is the normal life span of an RBC?
- a. 100 days
 - b. 120 days
 - c. 120 hours
 - d. 2 days
- ____ 29. Regarding loss of RBC membrane deformability, all of the following are true *except*:
- a. increase in ATP level.
 - b. decrease in ATP level.
 - c. increase in calcium level.
 - d. decrease in spectrin phosphorylation level.
- ____ 30. One of the most important controls of hemoglobin's affinity for oxygen is:
- a. glucose.
 - b. 2,3-diphosphoglycerate (2,3-DPG).
 - c. K⁺.
 - d. Ca⁺⁺.
- ____ 31. The normal position of the oxygen dissociation curve depends on three ligands normally found within the RBC. Which one of the following is *not* one of these ligands?

- a. H⁺ ions
- b. CO₂
- c. 2,3-diphosphoglycerate (2,3-DPG)
- d. Na⁺

- _____ 32. Which of the following events does *not* occur while RBCs are stored?
- a. 2,3-DPG levels increase.
 - b. Potassium levels increase.
 - c. Hgb has a decreased affinity for oxygen carrying capacity.
 - d. 2,3-DPG *and* potassium levels increase.
- _____ 33. In order to maintain ATP levels in stored blood, _____ can be added to CPD to extend the shelf-life of stored RBCs from 21 days to 35 days. This new preservative is designated as CPDA-1.
- a. mannitol
 - b. adenine saline
 - c. adenine and glucose
 - d. Rejuvenix
- _____ 34. Which type of blood storage container is no longer available for use in the United States because it may limit the viability of RBCs?
- a. Glass bottles
 - b. PVC plastic bags with DEHP
 - c. DEHP-free polyolefin containers
 - d. Latex-free plastic containers
- _____ 35. A rare unit of blood became outdated 48 hours ago but is needed for a patient. Which of the following concepts applies to this situation?
- a. The blood could be rejuvenated by adding Rejuvesol, being washed appropriately, and being transfused within 48 hours.
 - b. The blood could be rejuvenated with Rejuvesol, washed, and given immediately to the patient.
 - c. Once a unit is outdated, it is no longer available for use.
 - d. The unit can be rejuvenated immediately, washed, and stored in the appropriate refrigerator until needed later in the week.
- _____ 36. FDA-approved rejuvenation solution contains all of the following EXCEPT:
- a. adenine
 - b. glycerin
 - c. inosine
 - d. phosphate
- _____ 37. Rejuvenated RBCs may be prepared up to three days after expiration when stored in all of these EXCEPT:
- a. ACD
 - b. AS-1
 - c. CPD
 - d. CPDA-1
- _____ 38. When is the corrected count increment (CCI) of platelets is usually determined?
- a. Immediately prior to transfusion.
 - b. During the transfusion procedure.
 - c. Ten to 60 minutes after transfusion.
 - d. One to two days after transfusion.
- _____ 39. Generally, the quality control measurements required by various accreditation organizations for platelet concentrates include:
- a. platelet concentrate volume and platelet count.
 - b. leukocyte count if claims of leukoreduction are made.
 - c. pH of the unit.
 - d. All of the above
- _____ 40. Which of the following is *not* a major factor that influences platelet shape and activation while the platelet is in storage?

- a. pH
- b. Volume
- c. Agitation
- d. Temperature

- _____ 41. Proper agitation of platelets while they are being stored is:
- a. important because when not agitated properly the platelets will stick together and not perform properly when transfused.
 - b. important because the pH of the stored platelets will increase and the platelets will lose functionality.
 - c. important because the pH of the stored platelets will decrease and the platelets will lose functionality.
 - d. not important because it has been deemed unnecessary by the FDA.
- _____ 42. Which of the following is *not* a commercial system approved by the FDA for screening for bacterial contamination in platelet collections?
- a. BacT/ALERT
 - b. eBDS
 - c. BACTEC
 - d. Scansystems
- _____ 43. Which of the following is a possible future method in pathogen reduction to treat platelet components?
- a. UV light and amotosalen
 - b. Amphotericin B
 - c. Vitamin B₁₂ and UV light
 - d. Penicillin
- _____ 44. Which of the following is licensed additive solutions approved for the storage of red blood cells for 42 days?
- a. Adsol (AS-1)
 - b. Nutricel (AS-3)
 - c. Optisol (AS-5)
 - d. All of the above

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Answer Section

MULTIPLE CHOICE

| | | | |
|------------|--------|------------------------|----------|
| 1. ANS: C | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-3 |
| 2. ANS: C | PTS: 1 | KEY: Taxonomy Level: 3 | LO: 1-6 |
| 3. ANS: B | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-14 |
| 4. ANS: B | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-4 |
| 5. ANS: D | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-14 |
| 6. ANS: A | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-7 |
| 7. ANS: D | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-1 |
| 8. ANS: C | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-2 |
| 9. ANS: C | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-2 |
| 10. ANS: A | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-2 |
| 11. ANS: C | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-7 |
| 12. ANS: B | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-9 |
| 13. ANS: B | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-2 |
| 14. ANS: C | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-6 |
| 15. ANS: D | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-14 |
| 16. ANS: B | PTS: 1 | KEY: Taxonomy Level: 3 | LO: 1-5 |
| 17. ANS: A | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-2 |
| 18. ANS: B | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-1 |
| 19. ANS: B | PTS: 1 | KEY: Taxonomy Level: 3 | LO: 1-16 |
| 20. ANS: B | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-8 |
| 21. ANS: C | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-4 |
| 22. ANS: C | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-15 |
| 23. ANS: C | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-11 |
| 24. ANS: B | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-16 |
| 25. ANS: D | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-15 |
| 26. ANS: B | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-2 |
| 27. ANS: C | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-10 |
| 28. ANS: B | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-2 |
| 29. ANS: A | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-3 |
| 30. ANS: B | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-4 |
| 31. ANS: D | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-4 |
| 32. ANS: A | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-5 |
| 33. ANS: C | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-5 |
| 34. ANS: A | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-9 |
| 35. ANS: B | PTS: 1 | KEY: Taxonomy Level: 3 | LO: 1-12 |
| 36. ANS: B | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-13 |
| 37. ANS: A | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-13 |
| 38. ANS: C | PTS: 1 | KEY: Taxonomy Level: 3 | LO: 1-15 |
| 39. ANS: D | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-19 |
| 40. ANS: B | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-18 |

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|------------|--------|------------------------|----------|
| 41. ANS: C | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-17 |
| 42. ANS: C | PTS: 1 | KEY: Taxonomy Level: 1 | LO: 1-19 |
| 43. ANS: A | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-19 |
| 44. ANS: D | PTS: 1 | KEY: Taxonomy Level: 2 | LO: 1-20 |