Transfusion

1. transfusionmodule5 2014

1.1 Transfusion Triggers

1.2 Blood Banking Process

- 450-500cc blood removed from donor
- Preservative = CPDA
  - Anti-coagulated with Citrate
  - Buffered by Phosphate
  - Metabolism provided by Dextrose
  - Adenine for ATP synthesis
- Blood grouped: ABO & Rh
- Screened for Viruses
1.3 Blood Component Separation

Blood Component Separation

- Whole blood not transfused in USA
- Donation separated by centrifuge:
  - Packed Red Blood Cells (PRBC)
  - Platelets-stored at room temp
  - Fresh Frozen Plasma (FFP)
    - Frozen after separated
    - Then thawed to precipitate out cryoproteins
    - A 2nd Centrifugation separates the FFP and cryoprecipitate

1.4 Packed Red Blood Cells

Packed Red Blood Cells

- Stored at 4°C in CPDA-AS
- AS = additive solution
  - Basically more preservatives
  - Adds 7 days of preservation
- Stored up to 42 days
- Donor and Recipient
  - Typed for ABO compatibility
  - Screened for 20 common RBC antibodies
  - Only cross-matched if “+” screen

1.5 What is true regarding blood storage?

(Multiple Choice, 10 points, unlimited attempts permitted)
1. What is true regarding blood storage?

- a. Citrate is used to keep blood anti-coagulated
- b. Phosphate is used to buffer the pH
- c. Dextrose is used for cellular metabolism
- d. Adenine is used for ATP creation
- e. All of the above are true

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**Feedback when correct:**

That's right! You selected the correct response.

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You did not select the correct response.
Correct (Slide Layer)

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- d. Adenosine is used to prevent cell damage
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![Correct](image)

Incorrect (Slide Layer)

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![Incorrect](image)
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**Correct (Slide Layer)**

2. Which of the following is true?

- a. Whole blood is often used in the US
- b. PRBC can not be stored for greater than 1 month
- d. Platelets
- e. Cryoprecipitate

![Correct](image-url)
Incorrect (Slide Layer)

2. Which of the following is true?

- a. Whole blood is often used in the US
- b. PRBC can not be stored for greater than 1 month
- d. Platelets are stored for longer than 1 month
- e. Cryoprecipitate is stored for longer than 1 month

Incorrect

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Continue

Try Again (Slide Layer)

2. Which of the following is true?

- a. Whole blood is often used in the US
- b. PRBC can not be stored for greater than 1 month
- d. Platelets are stored for longer than 1 month
- e. Cryoprecipitate is stored for longer than 1 month

Incorrect

That is incorrect. Please try again.

Try Again
1.7 When to transfuse PRBC?

When to transfuse PRBC

- The goal is to maintain Aerobic respiration
- Cells need oxygen to create ATP in the Kreb's cycle and Electron Transport Chain within mitochondria
- Transfusion trigger is a balance to optimize oxygen delivery while minimizing transfusion risks

1.8 Oxygen Delivery

Oxygen Delivery

- DO2 (delivery of oxygen)= CO x CaO2
  - CO (cardiac output) = HR x SV
  - CaO2 (carrying capacity of oxygen) =
    \(\text{Hgb} \times 1.34 \times \text{SaO2} + \text{PaO2} \times .003\)
- DO2 = 800-1200mL / min (average 70kg person)
- VO2 (oxygen consumption) = 200-300mL/min (resting 70kg person)
- ERO2 (extraction ration of oxygen) = 25%
  - = VO2 / DO2
1.9 Additional Considerations Affecting Oxygen Delivery

**Additional Considerations Affecting Oxygen Delivery**

- RBC characteristics
  - Affinity to O₂ (O₂-hgb curve)
  - Assist in O₂ on-/off-loading
- Intracellular O₂ consumption
  - VO₂ varies on metabolic activity
- Rheology
  - Flow characteristics of blood effect blood transport
  - “Viscosity”
- Value of PaO₂
  - Controversial impact due to low value

1.10 Oxygen-Hemoglobin Curve

**Oxygen-Hemoglobin Curve**

- Saturation of Hgb based on the partial pressure of O₂ in the blood
- **Right** shift indicates that a larger partial pressure of oxygen is needed to maintain a 50% Hgb saturation
  - Hgb with less affinity for oxygen
  - More O₂ delivered to the tissues
- **Left** shift indicates that a smaller partial pressure of oxygen is needed to maintain a 50% Hgb saturation
  - Hgb with a high affinity for oxygen
1.11 Oxygen Delivery Compensatory Mechanisms

Oxygen Delivery Compensatory Mechanisms

- Increase ERO2
  - Extract more than 25% of oxygen from each Hgb
- Sympathetic surge
- Redistribution of intravascular compartments
  - Augments preload by recruiting more blood
  - Positive chronotropic and isotropic effect on CO
- Renin-Angiotensin-Aldosterone / ADH
  - Redistribution of intravascular compartments
  - Fluid retention augments preload
- RBC characteristics
  - 2,3-DPG decreasing Hgb affinity for oxygen

1.12 Which of the following is false regarding Oxygen Delivery?

(Multiple Choice, 10 points, unlimited attempts permitted)

3. Which of the following is false regarding Oxygen Delivery?

- a. Blood viscosity has no impact on oxygen delivery
- b. Extraction ratio is based on oxygen consumption over oxygen delivery
- c. Normal extraction ratio of oxygen is 25%
- d. Oxygen consumption depends on metabolic activity

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Correct (Slide Layer)
1.13 Which is true of the oxygen-hemoglobin curve?

(Multiple Choice, 10 points, unlimited attempts permitted)
4. Which is true of the oxygen-hemoglobin curve?

- a. When right shifted it increases oxygen affinity
- b. When left shifted it decreases oxygen affinity
- c. Chronic anemia will shift the curve to the right
- d. The partial pressure of oxygen depends on the hemoglobin saturation

**Correct Choice**

- a. When right shifted it increases oxygen affinity
- b. When left shifted it decreases oxygen affinity

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Correct (Slide Layer)

4. Which is true of the oxygen-hemoglobin curve?

- a. When right shifted it increases oxygen affinity
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- c. Chronic hypoxia
- d. The p50 is lowered in chronic hyperoxia

Correct
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Incorrect (Slide Layer)

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Continue
Try Again (Slide Layer)

4. Which is true of the oxygen-hemoglobin curve?

- a. When right shifted it increases oxygen affinity
- b. When left shifted it decreases oxygen affinity
- c. Chronic
- d. The point of oxygen extraction

Incorrect
That is incorrect. Please try again.

Try Again

1.14 Critical Oxygen Delivery Point

Critical Oxygen Delivery Point

(Read Right to Left)

- As you deliver less oxygen:
  - Consume same O2
  - Return to heart less O2
  - Extract more from each Hgb

- Critical Delivery Inflection point:
  - O2 consumption becomes delivery dependent
  - No more "luxury perfusion"
  - Anaerobic oxygenation begins
1.15 Critical Oxygen Delivery Point

Critical Oxygen Delivery Point (DO₂ crit)

1.16 PRBC Trigger Threshold

PRBC Trigger Threshold

- Decision to transfuse PRBC is based on understanding the critical inflection point (DO₂ crit)
- Too far from this point and you are exposing the patient to all the risks associated with blood transfusions without any benefit
- Too far into this point you have begun anaerobic respiration
1.17 *Indications of DO2crit*

- Decreased mixed oxygenation value from pulmonary artery catheter
- Increased lactic acid
  - Decreased bicarbonate value (reflecting lactic acid)
  - Decreased pH (reflecting lactic acid)
- Evidence of end-organ ischemia
  - ECG changes
  - Regional wall motion changes on echocardiography
  - Chest pain
  - Confusion and dizziness

1.18 *The Critical Point on the Oxygen Delivery Graph...*

(Multiple Choice, 10 points, unlimited attempts permitted)

- a. Reflects the point where oxygen consumption becomes delivery dependent
- b. Reveals the point where the body is incapable of compensating for decreasing O2 delivery
- c. Shows where the body shifts from aerobic to anaerobic metabolism
- d. Places organs in jeopardy of ischemia
- e. All of the above are true

Correct Choice

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**Correct (Slide Layer)**
Incorrect (Slide Layer)

5. The Critical Point on the Oxygen Delivery Graph...
   a. Reflects the point where oxygen consumption becomes delivery dependent
   b. Reveals the key factor influencing central hemodynamics during O2 delivery
   c. Shows where the system starts to fail
   d. Places oxygen delivery in a critical context
   e. All of the above

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You did not select the correct response.

Continue

Try Again (Slide Layer)

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   b. Reveals the key factor influencing central hemodynamics during O2 delivery
   c. Shows where the system starts to fail
   d. Places oxygen delivery in a critical context
   e. All of the above

Incorrect
That is incorrect. Please try again.

Try Again
1.19 What about...?

What about...?

- Vital Signs
  - Changes indicate compensatory mechanisms
  - Are those changes detrimental to patient?
- Urine output
  - Fluid conservation is key to maintaining CO
  - How long/severe is the kidney being underperfused?
- Hemoglobin or Hematocrit is low?
  - Need to consider the overall CO, CaO2, and VO2, not just one number

1.20 Regarding the detection of inadequate oxygen delivery...

(Multiple Choice, 10 points, unlimited attempts permitted)

6. Regarding the detection of inadequate oxygen delivery...

- a. Vital signs reliably show end-organ ischemia
- b. Urine output reveals end-organ ischemia
- c. Regional wall motion abnormalities reveals end-organ ischemia
- d. A low hct reliably shows end-organ ischemia
- e. A low pH reliably shows end-organ ischemia

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e. A low pH reliably shows end-organ ischemia

Correct

That's right! You selected the correct response.

Continue
6. Regarding the detection of inadequate oxygen delivery...

- a. Vital signs reliably show end-organ ischemia
- b. Unstable vital signs
- c. Registered vital signs show a significant increase
- d. A lower heart rate
- e. A lower blood pressure

Incorrect

You did not select the correct response.

Try Again

That is incorrect. Please try again.

Try Again
1.21 First....

First....

- Make sure the patient is euvolumic
- Animals can tolerate major blood loss as long as their intravascular storage compartment is replete
- Have you attempted to replace the intravascular system with crystalloids?

1.22 Always keep in mind...

Always keep in mind...

- Transfusion triggers vary widely across patient populations
- Consider differences:
  - A healthy 20yo
  - A 75yo with severe CAD
  - A single ventricle neonate
  - A critically ill mechanically ventilated patient
- Need to understand the complex pathophysiology of these different populations in order to appropriately transfuse them
1.23 Transfusion Considerations

- Is the patient Euvolumic?
- Is the patient critically ill / mechanically ventilated?
- Does the patient have coexisting comorbidities?
  - Cardiac
  - Pulmonary
  - Cerebral vascular
- Is this Acute or Chronic anemia?
- The decision to transfuse never rests solely on a Hgb value!
  - That being said, the Hgb value is usually between 6-9g/dL prior to transfusing depending on patient idiosyncrasies.

1.24 Before you transfusion any patient, you should...

(Multiple Choice, 10 points, unlimited attempts permitted)

7. Before you transfusion any patient, you should...

- a. Verify that the patient in euvolumic
- b. Recognize that the patient is in jeopardy of having oxygen consumption greater than oxygen delivery
- c. Recognize any patient comorbidities that may warrant different desirable Hgb values
- d. You should do all of the above
- e. You should just transfuse 2 units

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X d. You should do all of the above

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Feedback when correct:

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Correct (Slide Layer)
7. Before you transfusion any patient, you should...

- a. Verify that the patient in euvolumic
- b. Record the amount of blood transfusion greater
- c. Record that the platelet value is not desirable
- d. You should just transfuse 2 units
- e. You should just transfuse 2 units

Incorrect

You did not select the correct response.

Try Again

That is incorrect. Please try again.

Try Again
1.25 Untitled Slide

Clinical practice guideline: Red blood cell transfusion in adult trauma and critical care

Crit Care Med 2009 Vol. 37, No. 12

1.26 What’s the Big Deal?

What’s the Big Deal? Just give 2 Units!

Risks of blood product transfusion:
- Incompatibility reactions
- Transfusion Transmitted Infections (TTI)
- Transfusion Related Acute Lung Injury (TRALI)
- Transfusion Related ImmunoModulation (TRIM)
- Transfusion Associated Cardiac Overload (TACO)
- Electrolyte derangements
- pH changes
- Temperature decrease
- Alloimmunization
- Depressed Erythropoiesis
- ... 

1.27 Regarding the risks of transfusion of PRBC...

(Multiple Choice, 10 points, unlimited attempts permitted)
8. Regarding the risks of transfusion of PRBC...

- a. Lung injury is not a concern
- b. Cardiac overload does not need consideration
- c. Immunosuppression is a major problem
- d. Increases erythropoiesis
- e. Rarely transmits CMV or EBV

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   Incorrect
   You did not select the correct response.
   Continue
8. Regarding the risks of transfusion of PRBC...

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- b. Cardiac dysrhythmia
- c. Immune response
- d. Infection
- e. Rare

Incorrect.
That is incorrect. Please try again.

Try Again

1.28 Coagulation Overview

Coagulation Overview

- **Primary hemostasis**
  - Injured endothelium exposes tissue factor and damaged collagen
  - vWF binds to collagen and to circulating platelets
  - Pits change from spherical to spindle shaped and release granules
  - Pits aggregate to form platelet plug

- **Secondary hemostasis**
  - Tissue Factor (TF) on damaged endothelium activates FVII
  - PT surface serves as platform for coagulation "cascade"
  - TF-FVII activates FX, which activates FV
  - This complex then activates Thrombin
  - Thrombin cleaves fibrinogen to fibrin
  - Platelets receptors conform to bind to fibrin
  - Platelets cross-link fibrin which cross links with factor XIII
1.29 Coagulation

Coagulation


1.30 Fresh Frozen Plasma

Fresh Frozen Plasma

- Traditionally isolated by centrifugation
- Apheresis is now often used
  - Plasma extracted from donor while the RBCs remain
  - Platelet rich plasma
  - Frozen after apheresis
- Needs to be ABO matched
- Remember type AB is the universal plasma donor
1.31 Fresh Frozen Plasma Facts

Fresh Frozen Plasma Facts

- Contains all coagulation factors (enzymes)
- 1 ml has about 1 unit of each coagulation enzyme
- 1 ml has about 1 mg of fibrinogen
  - 1 unit has about 300-400 mg
  - 4 units has about 1200-1500 mg = 1 pooled cryoprecipitate bag
- Upon warming factors V and VIII deplete rapidly
  - Called “labile” factors because of sensitivity

1.32 Indications for FFP

Indications for FFP

1. Replacement of isolated factor deficiencies
   - IF isolated recombinants are not available
2. Reversal of Warfarin effect for emergency procedure or blood loss
3. Massive Blood Transfusion
   - IF > 1:2 Blood Volumes over a few hours
   - Best strategy is to be guided by Thromboelastogram (TEG)
4. Antithrombin III deficiency
   - IF recombinant is not available
5. Treatment of Immunodeficiencies
   - IF purified Immunoglobulins are not available
6. Treatment of thrombotic thrombocytopenic purpura
1.33 FFP dosage

- 1mL / 1 kg will give 1% of Factors (enzymes)
- Normal coagulation calls for 30% of coagulation enzymes
- For an average 70kg person with coagulopathy
  - Assume 5-10% Enzymatic activity... but could be worse or better
  - Want 20% more so need 20mL / kg = 1400mL
    - Equals 4-6 units of FFP
- 15-20mL/kg is an average dosage for FFP transfusion

1.34 Which is true about fresh frozen plasma?

(Multiple Choice, 10 points, unlimited attempts permitted)

9. Which is true about fresh frozen plasma?

- a. Can be centrifuged from donated whole blood
- b. Can be apheresed from donor patients
- c. Needs to be ABO typed
- d. Has AB as the universal donor
- e. All of the above are true

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Feedback when incorrect:
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Correct (Slide Layer)
1.35 Regarding FFP dosage...

(Multiple Choice, 10 points, unlimited attempts permitted)
10. Regarding FFP dosage...

- a. Starting dosage is about 2 units for 70kg person
- b. Normal enzymatic changes are 1mL/kg/1% change
- c. INR will always reveal the appropriate dosing
- d. Normal enzymatic changes are 10mL/kg/1% change

**Correct Choice**

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Correct (Slide Layer)

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Correct
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Incorrect (Slide Layer)

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- c. INR
- d. Normal

Incorrect
You did not select the correct response.
1.36 Never give FFP as Volume Replacement!

1.37 Which of the following is not an indication for transfusion of FFP?

(Multiple Choice, 10 points, unlimited attempts permitted)
11. Which of the following is not an indication for transfusion of FFP?

- a. Massive resuscitation with ongoing bleeding
- b. TTP
- c. Volume resuscitation
- d. Elevated INR and emergency operation
- e. Anti-thrombin III deficiency with recombinant availability

Correct Choice

a. Massive resuscitation with ongoing bleeding
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Incorrect
Try Again (Slide Layer)

1.38 Platelets

Platelets

- Traditionally from centrifugation of whole blood
- Apheresis or “single donor” now more common
  - Less risk because not pooled from multiple sources
  - Will contain some factor rich plasma
- Stored at room temperature
  - Increases bacterial growth susceptibility
- Freezing or warming will make them nonviable
- Storage time = 3-5 days
1.39 Platelet transfusion triggers

Platelet transfusion triggers

- Normal platelet count 150-350 000
- <10,000-20,000 for a nonbleeding patient without a source of potential bleeding
- <50,000 for most operations
- <70,000-100,000 for neurosurgical bleeding where any amount of bleeding is catastrophic
- Platelet count does NOT assess platelet function
  - Need to consider quality as well as quantity
  - Consider Platelet mapping or TEG

1.40 Which of the following is true regarding platelets?

(Multiple Choice, 10 points, unlimited attempts permitted)

12. Which of the following is true regarding platelets?

- a. Storing at room temperature protects from bacterial growth
- b. Shelf life of stored platelets is 2 weeks
- c. Platelets can be pooled from multiple donors or apheresed from a single donor
- d. Freezing platelets improves shelf-life
- e. Only the quantity of platelets matter, not the quality

Correct Choice

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- e. Only the quantity of platelets matter, not the quality

Correct

That's right! You selected the correct response.
1.41 When transfusing platelets, which of the following is false?

(Multiple Choice, 10 points, unlimited attempts permitted)
13. When transfusing platelets, which of the following is false?

- a. Transfuse platelets if less than 5K
- b. Transfuse platelets for an operation if less than 50K
- c. Normal platelet amount is over 150K
- d. Only transfuse platelets if the patient is bleeding
- e. Transfuse platelets if less than 70K and any bleeding would lead to catastrophic consequences

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Transfuse platelets if less than 5K</td>
</tr>
<tr>
<td>b. Transfuse platelets for an operation if less than 50K</td>
</tr>
<tr>
<td>c. Normal platelet amount is over 150K</td>
</tr>
<tr>
<td><strong>X</strong> d. Only transfuse platelets if the patient is bleeding</td>
</tr>
<tr>
<td>e. Transfuse platelets if less than 70K and any bleeding would lead to catastrophic consequences</td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.
13. When transfusing platelets, which of the following is false?

- a. Transfuse platelets if less than 5K
- b. Transfuse platelets if less than 10K
- c. Not transfuse if less than 10K
- d. Only transfuse if less than 20K
- e. Transfuse platelets if less than 5K and catabolism

Incorrect.

That is incorrect. Please try again.

---

1.42 Cryoprecipitate

Cryoprecipitate

- As FFP is thawed from frozen, cryo precipitates out first
- Originally developed for hemophiliacs
  - Because Cryo is rich in Factor VIII and vWF
- Now mostly used as a source of fibrinogen
- Each pooled unit has 4 major parts
  - Fibrinogen: 1200 - 1500 mg
  - VIII: 800-1000 units
  - vWF: 800 - 1000 units
  - XII
1.43 Cryoprecipitate transfusion triggers

Cryoprecipitate transfusion triggers

- Fibrinogen is necessary to make fibrin
  - Fibrin cross-links on platelets to form clot
  - FXIII cross-links fibrin polymers to strengthen fibrin clot
- Minimum concentration of fibrinogen needed is controversial
  - Traditionally, Fibrinogen < 100mg/dL should be replaced
  - Newer studies suggest replacing fibrinogen <200mg/dL
  - OB patients may need a level of >300mg/dL

1.44 Which of the following is true about cryo?

(Multiple Choice, 10 points, unlimited attempts permitted)

14. Which of the following is true about cryo?

- a. Contains Factor XIII
- b. Contains factor VIII and vWF
- c. 1 unit of cryo has the same amount of fibrinogen as 4-6 units of FFP
- d. Precipitates from frozen FFP after being thawed
- e. All of the above are true

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Contains Factor XIII</td>
</tr>
</tbody>
</table>
b. Contains factor VIII and vWF

c. 1 unit of cryo has the same amount of fibrinogen as 4-6 units of FFP

d. Precipitates from frozen FFP after being thawed

X e. All of the above are true

Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response.

Correct (Slide Layer)
14. Which of the following is true about cryo?

- a. Contains Factor XIII
- b. Contains Factor VIII
- c. 1 unit of cryoprecipitate equals 2 units of FFP
- d. Precipitated from platelet-rich plasma
- e. All of the above

Incorrect
You did not select the correct response.

Try Again
That is incorrect. Please try again.
1.45 Clot Dissolution = Fibrinolysis

- Begins with tPA, which activates plasminogen to plasmin
- Plasmin binds to fibrin polymers at lysine residue
- Breaks fibrin polymers into two D-Dimers
- Anti-fibrinolytics
  - e-aminocaproic acid & transexamic acid
  - lysine analogs
  - Competitive antagonists

1.46 Factor concentrates

- PCC = procoagulant concentrates
  - 3 factor types: II, IX, X, variable amount of heparin
  - 4 factor types: II, VII, IX, X, variable amount of heparin
  - Approved for rapid reversal of anti-vitamin K medications in life threatening bleeding
  - Come in 30-40cc dosage
- Recombinant FVIIa
  - Developed for hemophiliacs with replacement inhibitors
  - Sets off Tissue Factor pathway
Thank you for completing the educational portion of this module. You will now be required to take a 10 question quiz and you must obtain an 80% or better to pass. You will not be allowed to return to the module content once you begin the quiz.

Please click Next to begin.

**1.48 What is false regarding blood storage?**

*(Multiple Choice, 10 points, 1 attempt permitted)*

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Citrate is used to keep blood anti-coagulated</td>
</tr>
</tbody>
</table>
b. Phosphate is used to buffer the pH

X c. Dextrose is used to maintain oncotic pressure

d. Adenine is used for ATP creation

e. All of the above are true

Feedback when correct:
That's right! You selected the correct response.

Feedback when incorrect:
You did not select the correct response.

Correct (Slide Layer)
1.49 What is true regarding blood storage?

(Multiple Choice, 10 points, 1 attempt permitted)

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. CPDA allows blood to preserve for 49 days</td>
</tr>
<tr>
<td>b. Additive solution increase preservation for 2 months</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>c. Whole blood is often transfused in the US</td>
</tr>
<tr>
<td>d. Adenine is used for buffering</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td>e. Blood is less effective delivering blood after preservation</td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.

**Correct (Slide Layer)**

2. What is true regarding blood storage?

- a. CPDA allows blood to preserve for 49 days
- b. Additive solution increase preservation for 2 months
- c. Whole blood is often transfused in the US
- d. Adenine is used for buffering
- e. Blood is less effective delivering blood after preservation

Correct

That's right! You selected the correct response.

Continue
1.50 Which of the following is true regarding Oxygen Delivery?

(Multiple Choice, 10 points, 1 attempt permitted)

<table>
<thead>
<tr>
<th>Correct Choice</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Dissolved arterial oxygen has an uncertain significance to cellular metabolism</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>b. Rheology impacts oxygen delivery</td>
<td></td>
</tr>
<tr>
<td>c. Extraction ration is based on oxygen consumption over oxygen delivery</td>
<td></td>
</tr>
<tr>
<td>d. Normal extraction ratio of oxygen is 25%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>e. All of the above are true</td>
</tr>
</tbody>
</table>

**Feedback when correct:**
That's right! You selected the correct response.

**Feedback when incorrect:**
You did not select the correct response.
1.51 Which is true about the oxygen-hemoglobin curve?

(Multiple Choice, 10 points, 1 attempt permitted)

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. When right shifted decreases oxygen affinity</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>b.</td>
</tr>
<tr>
<td>c.</td>
</tr>
<tr>
<td>d.</td>
</tr>
<tr>
<td>X</td>
</tr>
</tbody>
</table>

**Feedback when correct:**
That's right! You selected the correct response.

**Feedback when incorrect:**
You did not select the correct response.

**Correct (Slide Layer)**

```
4. Which is true about the oxygen-hemoglobin curve?

- a. When right shifted decreases oxygen affinity
- b. When left shift increases oxygen affinity
- c. Acidosis will shift the curve to the right
- d. The partial pressure of oxygen depends on the hemoglobin saturation
- e. All of the above are true

Correct
That's right! You selected the correct response.
```
4. Which is true about the oxygen-hemoglobin curve?

- a. When right shifted decreases oxygen affinity
- b. When left shift increases oxygen affinity
- c. Acidosis shifts the curve to the right
- d. The curve is sigmoidal
- e. All of the above are true

Incorrect (Slide Layer)

1.52 At the critical point on the Oxygen Delivery graph...

(Multiple Choice, 10 points, 1 attempt permitted)

5. At the critical point on the Oxygen Delivery graph...

- a. Oxygen consumption becomes delivery dependent
- b. The body is no longer able to compensate for decreasing oxygen delivery
- c. The body shifts from aerobic to anaerobic metabolism
- d. Leads to cell death
- e. All of the above are true

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
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<tbody>
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<td></td>
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<td></td>
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<td>---</td>
<td>---</td>
</tr>
<tr>
<td>b.</td>
<td>The body is no longer able to compensate for decreasing oxygen delivery</td>
</tr>
<tr>
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<td>The body shifts from aerobic to anaerobic metabolism</td>
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<td>X</td>
<td>e. All of the above are true</td>
</tr>
</tbody>
</table>

Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response.

Correct (Slide Layer)
Incorrect (Slide Layer)

5. At the critical point on the Oxygen Delivery graph...
   - a. Oxygen consumption becomes delivery dependent
   - b. The body is no longer able to compensate for decreasing oxygen delivery
   - c. The
   - d. Learn
   - e. All of the above

1.53 6. Before you transfusion any patient, you should...

(Multiple Choice, 10 points, 1 attempt permitted)

6. Before you transfusion any patient, you should...
   - a. Verify that the urine output
   - b. Recognize that the patient is in jeopardy of having oxygen consumption greater then oxygen delivery
   - c. Use Hgb values as a universal trigger
   - d. You should do all of the above
   - e. You should just transfuse 2 units

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a. Verify that the urine output</td>
</tr>
</tbody>
</table>
X  

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td><strong>b.</strong> Recognize that the patient is in jeopardy of having oxygen consumption greater than oxygen delivery</td>
<td></td>
</tr>
<tr>
<td>c. Use Hgb values as a universal trigger</td>
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</tr>
<tr>
<td>d. You should do all of the above</td>
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</tr>
<tr>
<td>e. You should just transfuse 2 units</td>
<td></td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That’s right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.

**Correct (Slide Layer)**

![Image](image-url)
1.54 Regarding the detection of inadequate oxygen delivery...

(Multiple Choice, 10 points, 1 attempt permitted)

Correct Choice

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Vital signs reliably show end-organ ischemia</td>
</tr>
</tbody>
</table>
b. Urine output reveals end-organ ischemia

c. Regional Wall motion abnormalities reveals end-organ ischemia

d. A low hct reliably shows end-organ ischemia

e. A low pH reliably shows end-organ ischemia

Feedback when correct:
That's right! You selected the correct response.

Feedback when incorrect:
You did not select the correct response.

Correct (Slide Layer)
1.55 Regarding the risks of transfusion of PRBC...

(Multiple Choice, 10 points, 1 attempt permitted)

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>a. Lung injury is a concern</td>
</tr>
</tbody>
</table>
b. Cardiac overload is always well tolerated

c. Immunosuppression has not been recognized as a problem

d. Increases erythropoiesis

e. None of the above are true

Feedback when correct:
That's right! You selected the correct response.

Feedback when incorrect:
You did not select the correct response.

Correct (Slide Layer)
1.56 Which one of the following is an indication for transfusion of FFP?

(Multiple Choice, 10 points, 1 attempt permitted)

<table>
<thead>
<tr>
<th>Correct Choice</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Massive resuscitation with ongoing bleeding</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>b. TTP</td>
<td></td>
</tr>
<tr>
<td>c. isolated factor deficiency without recombinant options</td>
<td></td>
</tr>
<tr>
<td>d. Elevated INR and emergency operation</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>e. All are indications for FFP</td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.

**Correct (Slide Layer)**

9. Which one of the following is an indication for transfusion of FFP?

- a. Massive resuscitation with ongoing bleeding
- b. TTP
- c. isolated factor deficiency without recombinant options
- d. Elevated INR and emergency operation
- e. All are indications for FFP

Correct

That's right! You selected the correct response.

Continue
1.57 Which of the following is true about cryo?

(Multiple Choice, 10 points, 1 attempt permitted)

Correct Choice

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Contains factor X</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>b. Contains factor VII</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Feedback when correct:**
That's right! You selected the correct response.

**Feedback when incorrect:**
You did not select the correct response.

**Correct (Slide Layer)**
Incorrect (Slide Layer)

10. Which of the following is true about cryo?
   a. Contains factor X
   b. Contains factor VII
   c. 1 unit of FFP
   d. Prepared to be frozen
   e. All of the above

   Incorrect
   You did not select the correct response.
   Continue

1.58 Results Slide

(Results Slide, 0 points, 1 attempt permitted)
<table>
<thead>
<tr>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.48 What is false regarding blood storage?</td>
</tr>
<tr>
<td>1.49 What is true regarding blood storage?</td>
</tr>
<tr>
<td>1.50 Which of the following is true regarding Oxygen Delivery?</td>
</tr>
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<td>1.55 Regarding the risks of transfusion of PRBC...</td>
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</tbody>
</table>

Result slide properties

Passing Score 80%
Success (Slide Layer)

Results

Your Score: 

Passing Score:

Result:

Congratulations, you passed.

Retry Quiz  Exit Module

Failure (Slide Layer)

Results

Your Score: 

Passing Score:

Result:

You did not pass.

Retry Quiz  Exit Module