GETTING IT BLOODY RIGHT:
CHOOSING THE BEST PRODUCT

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Question 1:
Where do you currently practice?
A. Newfoundland or PEI
B. New Brunswick or Nova Scotia
C. Northwest, Yukon or Nunavut Territory
D. Quebec
E. Ontario
F. Manitoba or Saskatchewan
G. Alberta or British Columbia

Case One: Mrs. B.
- Mrs. B., 36 year old, 30 weeks pregnant, 2\textsuperscript{nd} baby
- Blood type A negative
- Belted driver of minivan, struck
  - Closed head injury
  - Fractured femur
  - R pneumothorax

Case One: Mrs. B.

- Admitted to ICU from OR following internal fixation of femur
  - Intubated and ventilated
  - Sedated
- Preop ultrasound reveals:
  - Male fetus
  - Active movement
  - No evidence of placental abnormality or fetal distress
- FHR is 140-150 upon admission from OR
- Maternal HR 98

Case One: Mrs. B.

- Twelve hours following admission:
  - BP falls to 80/52
  - HR increases to 155
- Abdomen firm to touch
- Bright red vaginal discharge
- NS bolus initiated with little improvement in BP
- Fetal HR no longer detected
- Obstetrics/Ob anesthesia paged STAT

Question 2:
What lab test would be a priority?
A. Fibrinogen
B. Hb
C. INR / PTT
D. Platelet
E. Ionized calcium

Case One: Mrs. B.

- BP 78/48
- Vaginal bleeding has increased
- 2 PRBC ordered as obstetrical team arrives
- Emergency C-section performed at beside
- Extensive intrauterine blood
- Attempts to resuscitate Mrs. B’s son unsuccessful

Case One: Mrs. B.

- BP decreases 60/40 and HR increases to 175
- 4 additional PRBCs administered and 2 units of plasma are ordered
- Hb drawn at the onset of hypotension is 55
- INR/PTT results (drawn from heparinized line) are not available, with lab comments indicating:
  - Additional testing is required
  - Heparin contamination is questioned

Question 3:
What is the most likely cause of the delay in reporting Mrs. B’s INR / PTT results?
A. Lab staff is on break
B. Sample is contaminated with heparin
C. Fibrinogen is extremely low
D. Low hemoglobin is causing INR/PTT interference
E. Citrate contamination from blood transfusions
Case One: Mrs. B.

- The patient continues to bleed and receives a total of 18 PRBC, 14 Plasma and 2 Platelet doses
- Preparations are being made for exploratory OR

Question 4:
What is the most likely cause of Mrs. B’s continued bleeding?
A. Inadequate platelet replacement
B. Low fibrinogen
C. Failure to follow 1:1 ratio of RBC and Plasma
D. Retained placental fragments
E. Rh negative incompatibility between mother and fetus

Question 5:
What product would provide the highest fibrinogen replacement
A. 4 units plasma
B. 1 platelet dose
C. DDAVP
D. Cryoprecipitate
E. Fibrinogen concentrate

Plasma
- FFP/FFP/apheresis
- Contains all of the coagulation factors including fibrinogen
- 1 unit plasma (250mL) = 500mg fibrinogen
- Short half-life of coagulation factors: (4-7 hrs for Factor VII)
  - Optimal effect is achieved within 4 hours of transfusion
  - Limited evidence timing, but recommend administration immediately before procedures with bleeding risk
- Blood administration set required
- Infuse over 30-120 minutes

Cryoprecipitate
- Source of concentrated Fibrinogen
- 1 dose (usually 10 units) = 1500mg fibrinogen in less than100mL
- Also contains Factor VIII and VonWillebrand Factor
- Blood administration set required
Packed Cells (PRBCs)
• Required to transport oxygen to tissues
• PRBCs on their own will not stop bleeding
• PRBCs do not contain clotting factors or platelets

Question 6:
Mrs. B has received 12 units of packed cells. Which one of the following lab tests should be obtained
A. Total protein
B. Blood cultures
C. Ionized calcium
D. Factor VII level
E. Serum albumin
F. A and E

Citrate
• Citrate anticoagulant is present in blood components:
  – Plasma
  – PRBCs
  – Cryo
  – Platelets
• Liver quickly metabolizes citrate to bicarbonate; eliminated by kidney

Citrate
• In massive transfusion with hypoperfusion:
  – AKI can impair bicarbonate elimination (causing theoretical alkalosis)
  – Hepatic failure reduces citrate clearance (causing hypocalcemia)
• Hypocalcemia:
  – Paraesthesia, arrhythmia and/or hypotension
  – Measure ionized calcium
  – Treat with calcium gluconate or chloride if severe

Potassium
• Hyperkalemia:
  – Increases with age of PRBC
  – Renal impairment
  – Follow administration guidelines for children
• Follow ionized calcium, gases and potassium

Pediatric Administration
• Dose:
  – 10-15 ml/kg
  – Transfusion of 15ml/kg is expected to raise Hb 20 g/L
• Volume too large to be safely administered within 4 hours can be divided by Blood Transfusion Lab
Pediatric Administration

- Rate:
  - Start slow (1mL/kg/hr for the first 15 minutes)
  - RECOMMENDED administration rate is 5mL/kg/hr (maximum of 150 mL/hr)
  - Transfusion rate should be patient specific and part of physician order
  - SLOWER rate if risk of circulatory overload / cardiac failure
  - INCREASED rate in hypovolemic shock / bleeding patient

Platelets

Indications:
- Bleeding patients related to:
  - Thrombocytopenia
    - Platelet dysfunction (drug induced)
  - Prophylactic use in non-bleeding patients with platelet counts below 10 X 10^9 secondary to chemotherapy and/or BMT
  - Patients with counts < 50 X 10^9 may require platelets before an invasive procedure or other bleeding risks (e.g., aPC)

Platelets

- One adult dose may be:
  - Pool of 4 units
  - Apheresis/single donor
    - Can be HLA matched or random donor
  - Product determined by Blood Transfusion Lab based on availability
- Infuse one dose over 60 minutes when applicable
- Use blood administration set

- Ideally 1 dose of platelets should increase PLT count by 25 – 50 X 10^9 immediately post-transfusion
- Dependent on consumption, blood loss and refractory status of patient
- Optimal platelet response 10-60 minutes post transfusion

Maternal Hemorrhage

Antepartum
- Placental disorders
- Fetal demise

Post Partum
- Tone - uterine atony (most common)
- Tissue retained placenta, clots, hematoma
- Trauma: vaginal, cervical or uterine injury (laceration, rupture, inversion)
- Thrombin: pre-existing or acquired blood coagulation problems
  - DIC
  - Severe preeclampsia
  - HELLP syndrome
- Therapeutic anticoagulation

Case One: Mrs. B.
- Following D&C and infusion of cryoprecipitate bleeding is controlled
- Patient is extubated the following day
Question 7:
Mrs. B is A negative, and her husband is Rh positive. When would Rh immune globulin be indicated post partum for Mrs. B.?
A. Within one week regardless of baby’s blood type
B. Only if the baby is Rh negative
C. Within 2 hours of delivery
D. Following transfusion of Rh positive platelets

Rh Immune Globulin (RhIg)
• Indications:
  – Any possibility that Rh Positive cells have entered the circulation of an Rh Negative female
    • At 28 weeks gestation
    • Following delivery if baby is Rh Positive
    • Miscarriage/abortion
    • Following amniocentesis
    • Following transfusion of Rh positive platelets (RBCs)
  ♦ Avoid Rh incompatible blood components in:
    ♦ Females birth to end of child-bearing age
    ♦ Young males (institutional variations)

Case Two: Mr. G.
• Mr. G. 78 year old, 80 kg male
• Admitted with melena, abdominal pain, hypotension and respiratory distress
• Background of coronary artery disease and atrial fibrillation
• Medications include aspirin, beta blocker, ace inhibitor and warfarin
• Normal saline is running wide open and investigations reveal the following:

Question 8:
Mr. G is being prepared for urgent OR. Which one of the following orders is the priority?
A. 4 units plasma
B. 1 dose platelets
C. 4 PRBCs and 4 units plasma
D. Cryoprecipitate
E. Prothrombin complex concentrate
F. Vitamin K

Prothrombin Complex Concentrate (PCC)
• 2 products available in Canada
  – Octaplex® by Octapharma
  – Beriplex® by CSL Behring
• PCC’s are manufactured from large pools of human plasma (tested and virally inactivated)
• PCCs contains Factors II, VII, IX, X (Vitamin K dependent factors), Proteins C and S as well as heparin
**PCC Indications**

- Replacement of Vitamin K dependent clotting factors (Factors II, VII, IX, X and protein C and S)
  - Warfarin Inhibits synthesis of Vitamin K dependent clotting factors
  - Indicated for urgent warfarin reversal
- Strategies for INR reduction (goal INR < 1.5):
  - STOP Warfarin therapy (~3 days for effect)
  - Vitamin K orally (12 -24 hours for effect)
  - Vitamin K intravenously (6 -12 hours for effect)
  - Plasma (effect immediately after infusion)
  - PCCs (effect immediately after infusion)

<table>
<thead>
<tr>
<th>Plasma</th>
<th>PCC’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Group specific</td>
<td>• No group required</td>
</tr>
<tr>
<td>• Time required to thaw (25 minutes)</td>
<td>• Time required to reconstitute (15 minutes)</td>
</tr>
<tr>
<td>• Varying content of coagulation factors</td>
<td>• Standardized content of coagulation factors</td>
</tr>
<tr>
<td>• May decrease INR to 1.5 or less</td>
<td>• INR dependably 1.5 or less immediately after infusion</td>
</tr>
<tr>
<td>• Risk of acute reaction (allergic, TACO, TRALI)</td>
<td>• Very low risk of reaction</td>
</tr>
<tr>
<td>• Risk of viral transmission</td>
<td>• Virally inactivated; extremely low risk</td>
</tr>
</tbody>
</table>

**Contraindications to PCCs**

- Contains Heparin: Contraindicated in Heparin Induced Thrombocytopenia (HIT)
- Relative contraindication in patients with increased risk of thrombosis

**Other PCC Considerations**

- **Inadequate factor replacement:**
  - Disseminated intravascular coagulation (DIC)
  - Coagulopathy associated with liver disease
  - Massive transfusions
- Plasma is product of choice when more than just factors II, VII, IX and X required
- Measure INR immediately post-PCC infusion. If INR and PTT still elevated, consider giving plasma
- Avoid rebound INR rise within 6-8 hours post infusion by administering Vitamin K (suggested dose 10 mg IV)

**Question 9:**
Prothrombin complex can be used in which one of the following settings?

A. Acquired vitamin K deficiency  
B. HIT syndrome  
C. Jehovah Witness faith  
D. Aspirin overdose  
E. DIC

**Question 10:**
Mr. K has a high chest tube loss following cardiac surgery and is ordered tranexamic acid. How does it work?

A. Inhibits plasminogen  
B. Stimulates fibrinolytic activity  
C. Activates platelets  
D. Contains synthetic clotting factors
Question 11:
Ten minutes after starting a unit of packed cells, a patient develops shortness of breath, hives and hypotension. Which one of the following steps is the priority?
A. Clamp PRBC infusion and open up saline
B. Confirm patient ID and blood type
C. Slow the rate of infusion and monitor symptoms
D. Clamp blood and manage ABCs

Transfusion Reactions Happen. BE PREPARED!
- Always have a separate saline infusion ready
- Start infusion slowly when appropriate
- Recognize S&S of a reaction: (unexplained) fever, rigors, rash, itching, hives, SOB, hypotension
- If a reaction is suspected, stop blood transfusion immediately
- DON'T flush blood set or filter with saline
- Report to physician and lab; KNOW and follow hospital blood transfusion reaction policy

Types of Reactions
- Most Common:
  - Fever
  - Allergic / Urticarial
  - Transfusion Associated Circulatory Overload (TACO)
- Leading Cause of Transfusion-related death
  - Acute Intravascular Hemolysis
  - Sepsis
  - Transfusion Related Acute Lung Injury (TRALI)
- Additional complications of transfusion
  - Citrate Intoxication (decreased calcium)
  - Hypothermia
  - Increased potassium
- Delayed Transfusion Reactions:
  - Sensitization to Foreign Antigens/Delayed Hemolytic
  - Transmission of Viral Diseases
  - Graft Versus Host Disease (GVHD)
  - Immunomodulatory Effects

Patient Identification is Critical!
- Right patient
- Right specimen label
- Right requisition ID
- Right transfusion

ABO System
- There are only 2 antigens in the ABO system: A and B, therefore only 2 antibodies.
- Antibodies are naturally occurring. If you lack the antigen, you have the antibody

<table>
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<tr>
<th>ABO group</th>
<th>Antigens</th>
<th>Antibodies</th>
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<tbody>
<tr>
<td>O</td>
<td>None</td>
<td>Anti-A, Anti-B</td>
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<tr>
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<td>A and B</td>
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ABO Compatibility Table

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<tr>
<th>Patient Blood Group</th>
<th>Acceptable Red Cells</th>
<th>Acceptable Plasma</th>
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<td>AB</td>
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Question 12:
This presentation will help me in my clinical practice.

A. Yes
B. No
C. Sorry, you woke me