CrackCast Episode 7 – Blood and Blood Components

Episode Overview:

1) Describe the 3 categories of blood antigens
2) Who is the universal donor and why?
3) Define massive transfusion
4) List 5 physiologic complications of massive transfusion
5) What are the indications for the administration of
    - pRBCs
    - FFP
    - Platelets
    - Cryoprecipitate
6) List 6 complications of blood transfusions and their management

Wisecracks:

1) What are the components of octaplex? When is it indicated?
2) What is FEIBA?
3) List the three types of plasma that are available from the blood bank?
4) What are the absolute and off-label uses for recombinant factor VII?
5) Which products are most likely to result in sepsis?
6) What is a hyperhemolytic crisis?

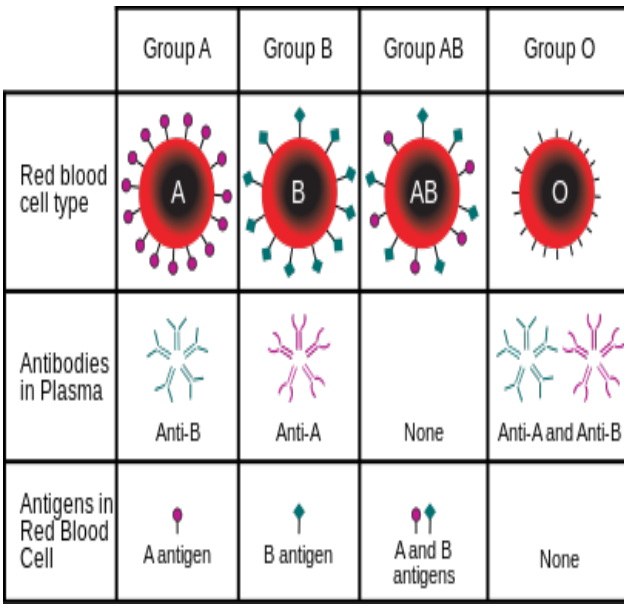
1) Describe the 3 categories of blood antigens

The whole goal of blood typing is to match ABO type, Rh antibodies, and over 200 other antigens with a suitable donor to avoid immune and nonimmune transfusion reactions

The 3 categories of blood antigens are:
A
B
AB

* Group O has no a blood antigen type, because it is the absence of antigens

That being said, there is also the Rhesus (Rh) system which has over 50 antigens, of which the D antigen is the most important
This becomes important in the woman who is A-, and is miscarrying….she should have no anti-D antibodies naturally. But she will have anti-B antibodies in the plasma….more on that in upcoming chapters!



2) Who is the universal donor and why?

Blood type O:

- They have no antigens on their RBC's and can give their blood to anyone without fear of ABO incompatibility
- The universal recipient is AB+
- Let's think through this again: they have A and B antigens on their RBC's, but they won't have any antibodies in the plasma
- The + Rh status means that they have Rh D antigens, and no Rh D antibodies (can receive both RhD + or RhD- blood)

3) Define massive transfusion

Infusion of >10 units of blood in 24 hour period

4) List 5 physiologic complications of massive transfusion

- Complications
    - hypothermia -- > increased clotting time
    - electrolyte abnormalities
        - hypomagnesemia
        - hypocalcemia (citrate binds calcium)
        - hyper/hypo K+
    - acidosis (from shock and/or excess citrate)
    - coagulopathy
    - thrombocytopenia

5) What are the indications for the administration of: pRBCs, FFP, platelets, and cryoprecipitate

- **pRBCs – Packed Red Blood Cells**
    - goal is to improve oxygen delivery and improve intracellular oxygen consumption
    - 1 unit = 450 ml = increases Hgb by ~10
    - in pediatrics give 10 ml/kg

- need to infuse with NS only
- given over 60 mins to max 4 hrs
- TRICC trial suggests that in critical care setting the hgb threshold for transfusion is <70 (in general if not actively hemorrhaging)
- FOCUS trial for hip fractures support blood transfusion if Hgb <80

- **FFP – Fresh Frozen Plasma**
  - contains all the natural clotting factors
  - can be spun down to various components depending on the indication
  - 1 unit = 250 ml
  - must be ABO compatible
  - Indications
    - massive transfusion in trauma
    - coagulopathy of trauma
    - hemorrhage in DIC or liver cirrhotics
    - plasma exchange in TTP
    - emergency reversal in warfarin - if you don't have octaplex
      - 10-30 ml/kg
  - not indicated in non-urgent Vit. K antagonism or volume expansion

- **Platelets**
  - Rh- patients need Rh- platelets
  - patients needing frequent transfusions may need leuko-reduced platelets
  - indications
    - platelet count <10 (very little bleeding risk until platelets drop below 5)
  - Dose
    - "six pack" - 6 units of platelets (raises platelets 40-60 points)
  - Very few large studies to support specific transfusion recommendations
    - General rules for platelet transfusion before procedures:
      - LP : > 10
      - central line placement: >20-30
      - major surgery: > 50
      - neuro Sx or retinal Sx: > 100
    - patients with anemia are more prone to bleeding
  - platelets are ineffective in immune-mediated thrombocytopenia
    - ITP
    - TTP

- **Cryoprecipitate – "Cryo"**
  - Contains:
    - fibrinogen, fibronectin
    - vWF
    - factor VIII, XIII,
  - Indications:

(1) bleeding with a low fibrinogen level
(2) dysfibrinogenemia
(3) bleeding in von Willebrand's disease that in unresponsive to DDAVP and no Factor VIII around

Think of cryoprecipitate as a filtered version of FFP (more rarely used) and now becoming obsolete due to advances in factor concentration technology...may be useful for patients who are deficient in fibrinogen.

6) List 6 complications of blood transfusions and their management

Rosen's breaks the complications associated with blood transfusions into:

1) immune mediated adverse effects
2) non-immune mediated adverse effects

Immune mediate adverse effects:

- Can be either acute or delayed

Acute:

<u>Intravascular hemolytic transfusion reaction</u>

- MOST serious complication due to ABO incompatibility
    - biochemically it can present with hemoglobinemia and hemoglobinuria
        - but the patients usually have:
            - fevers, chills, headache, N/V, joint and low back pain, chest restriction, pain at the site of infusion, feeling of impending doom
        - Hypotension, DIC, fevers,
        - Treatment
            - STOP the infusion, change tubing, crystalloid fluids
            - send samples to the lab

<u>Transfusion related acute lung injury (TRALI)</u>

- **leading cause of transfusion related mortality**
    - "new acute lung injury: bilateral pulmonary edema and hypoxemia" within 6 hrs of the transfusion
- presentation
    - non-cardiogenic pulmonary edema, dyspnea, hypoxia
    - bilateral chest infiltrates, fever
- treatment
    - stop transfusion
    - provide resp. support,
        - very little benefit to diuretics

    - usual recovery is 4 days

Allergic reactions

- range in severity from urticaria to anaphylaxis
- Treat:
    - antihistamine, and anaphylaxis care PRN
    - STOP the transfusion
- rarely full anaphylaxis can occur with IgA deficiency (use washed RBC's)

Febrile transfusion reaction

- most common and least serious reaction
- defined by a rise in patients temperature by at least 1 deg. C
- Treatment
    - analgesics, antipyretics, antihistamines

Delayed:

EXTRAvascular hemolytic transfusion reaction

- result from non-ABO mediated immune reaction
    - extravascular hemolysis occurs days-weeks later
- fever, anemia, jaundice, oliguria

Transfusion associated graft vs. host disease

- RARE
    - life threatening >90% mortality
    - transfused lymphocytes proliferate and attack the recipient
- presentation
    - 3-30 days post transfusion: fever, erythematous rash, diarrhea, elevated liver enzymes, pancytopenia,
- treatment:
    - bone marrow transplant
- prevention
    - most blood products are gamma irradiated to kill lymphocytes especially in patients who are immunodeficient (leukemias, lymphomas)

Non-immune mediated adverse effects

- Can be either acute or chronic

Acute

Transfusion Associated Circulatory Overload (TACO)

- high risk patients: chronic anemias who are already normovolemic and elderly
- treatment: infuse over 4 hrs, consider using diuretics

Bacterial Contamination

- most commonly Yersinia enterocolitica
    - rare 1:1 million units transfused
- platelets carry higher risk of infection (pooled from 6 people)
- symptoms
    - during transfusion: rigors, vomiting, abdominal cramps, fever, shock, renal failure, DIC
- treatment
    - stop the transfusion, obtain blood cultures, give broad-spectrum antibiotics

Chronic

Transmitted Viruses

- Hep C and HIV
    - 1: 1-2 million
- Hep B:
    - 1: 200 000
- CMV
    - Rare – those with allogeneic stem cell or solid organ transplants are at higher risk
        - these patients should receive CMV-neg. blood

Wisecracks:

1) What are the components of octaplex (Prothrombin Complex Concentrate - PCC)? When is it indicated?

Octaplex is generically known as Prothrombin Complex Concentrates (PCC) and is usually a 3 or 4 component HUMAN blood product

- it contains:
    - Factors II, VII, IX, X (1972 - what warfarin blocks) as well as Protein C and S.
    - other names include: Beriplex and Kcentra
    - It is used to reverse SEVERE bleeding in the warfarin anticoagulated patient and is dosed in units per KG (usually 50u/kg)
    - Strict indications for warfarin anticoagulated patient:
        1) life threatening hemorrhage from anywhere
        2) any intracranial hemorrhage
        3) any spinal hemorrhage
        4) needed emergent surgery
    - it usually works in about 1 hour
        - the step wise approach for serious or life-threatening bleeding with any INR on a warfarinised patient is:
            (1) hold the warfarin

(2) give 10 mg Vitamin K by IV infusion
(3) give PCC (may need approval from hematologist)

2) What is FEIBA?

It stands for "factor eight inhibitor bypassing activity"

- it is an ACTIVATED form of prothrombin complex concentrate
- it's used to treat serious bleeding in hemophilia A with inhibitors
- let's stop there... any more specific indications should be discussed with your friendly hematologist!!

3) List the three types of plasma that are available from the blood bank?

1. fresh frozen plasma
2. cryoprecipitate
3. cryo-poor plasma (depleted of vWF, Factors VIII, XIII, fibrinogen, fibronectin)

4) What are the absolute and off-label uses for recombinant factor VII?

- Absolute:
  - treat bleeding in patients with:
    - hemophilia A or B with inhibitors for 8 or 9
    - acquired hemophilia
    - congenital factor VII deficiency
- off-label
  - management of **intractable** bleeding in non-hemophiliac patients
    - many examples:
      - vWD, warfarin associated bleeding, coagulopathy of liver dysfunction, post-traumatic hemorrhage, etc.

5) Which products are most likely to result in sepsis?

Plasma – it is stored at room temperature

6) What is a hyperhemolytic crisis?

It is essentially a hemolytic crisis, but this can occur in people with sickle cell disease and G6PD

7) Breaking down transfusion reactions another way: ACUTE vs DELAYED

ACUTE reactions

1) ABO incompatibility - ie. INTRAvascular hemolytic transfusion reaction
2) TRALI
3) TACO
4) bacterial contamination
5) allergic reaction
6) febrile transfusion reaction

DELAYED reactions - all of which are severe but we probably won't see

1) graft vs. host disease
2) EXTRAvascular hemolytic transfusion reaction
3) viral transmission:
    HepC,B, HIV, CMV