Blood Components
&
Blood Transfusion

■ Important and/or MCQ ■ Team Note

We added the doctors notes on the slides, and **corrected** a couple of mistakes that where in the slides (female section)!!

Good Luck =)

Surgery Team

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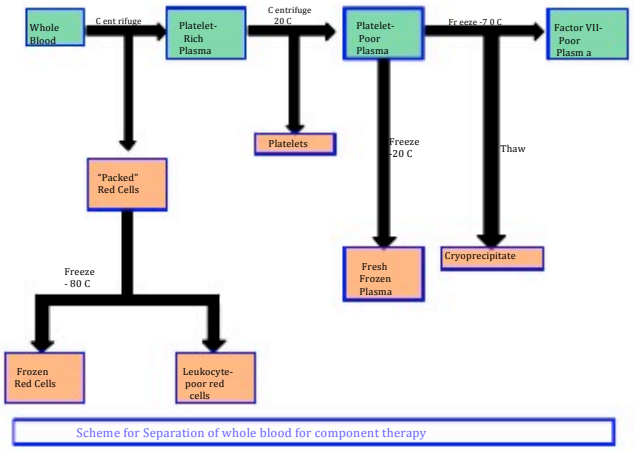
Blood Products &Blood Transfusion

History of Transfusions

Blood transfused in humans since mid-1600's so it's not something new
1828 – First successful transfusion
1900 – Landsteiner described ABO groups
1916 – First use of blood storage
1939 – Levine described the Rh factor



Objectives [questions come from the objectives]

Blood components
Indications for transfusion
Safe delivery
Complications

Blood Components (MCQ)

Prepared from Whole blood collection
Whole blood is separated by differential centrifugation:
WBCs
Red Blood Cells (RBC's)
Platelets
Plasma
- Cryoprecipitate
- Others

Others include Plasma proteins—IVIg, Coagulation Factors, albumin, Anti-D, Growth Factors, Colloid volume expanders

There are types of Blood Transfusions (indications): (MCQ)

- Whole blood ➜ In cases of severe hypervolemia due to bleeding from surgery or trauma. [Patient needs volume expansion]
- RBCs ➜ In severe anemia or mild bleeding
- PLTs ➜ In cases of severe thrombocytopenia
- WBCs ➜ (granulocyte) transfusion for patients with severe leukocytosis or immunocompromised who doesn't response to antibiotic.
- Plasma & FFP ➜ "has coagulation factor" we give it when we have deficiency (ex: factor v, VIII, hemophilia)

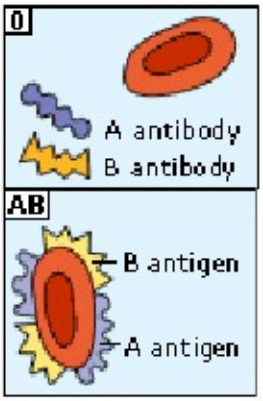
Important notes:

- Why we need RBC for anemic patients? Because RBCs have O carrier capacity "we notice shortness of breath and tachycardia in anemic patients."
- Whole blood transfusion is excellent when it is fresh but if it is frozen (storage) there will be risk of coagulopathy.
Storage of whole blood hypocalcaemia (precipitate Ca) + affect coagulation factor especially factor V & VIII (MCQ)
- In surgery they order RBCs + plasma + platelet.

-platelets , Fresh frozen plasma and Cryoprecipitate are given to improve homeostasis.

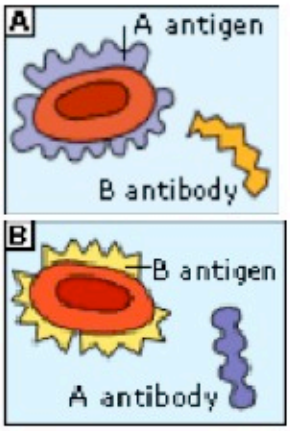
- Before going through with the blood transfusion we take blood sample from the donor to:

1- Do screening test to avoid transmitted infection (viruses)
2- Blood group ABO testing (do it in RBC, whole blood but not in plasma or platelet)
3- Cross match test (Rh test) [If there is an Rh group antigen ➜ it is (+ve), if there is not then it is (-ve)]



O ➜ no antigen [they cannot receive from other group but they give to all blood groups].

AB ➜ No antibody [that's why they can receive from any blood groups].



Antigen A, antibody B

Antigen B, antibody A

Whole Blood

Storage
4° C for up to 35 days (MCQ), transported in 1-10 centigrade.
- With mannitol, Adsol or Nutrisol lives up to 42 days.
Indications
- Massive Blood Loss/Trauma/Exchange Transfusion (thalassemia, sickle cell anemia)
Considerations
- Use filter as platelets and coagulation factors will not be active after 3-5 days
- Donor and recipient must be ABO identical (IMP)

Why we should consider filter in blood transfusion?

To avoid any clot or debris and transmission of a virus ➜ we do it for whole blood, FFP and RBC.
Platelets do not have to undergo filtering otherwise it will be damaged.
Filter size = 170 micro.
In case of immunocompromised patients or in severe infections the filter size is usually = 20-40 micro.

RBC Concentrate(packed)

Storage
- 4° C for up to 42 days, can be frozen

Indications
- Many indications, ex: severe anemia, hypoxia, mild bleeding, etc…

Considerations
- Recipient must not have antibodies to donor RBC's
(note: patients can develop antibodies over time) ➜ Identical ABO
- Usual dose 10 cc/kg (will increase Hgb by 2.5 gm/dl) MCQ
- Usually transfuse over 2-4 hours (slower for chronic anemia)

- Packed cells should never be given directly, they must be diluted with saline (imagine packed cells as a bag of honey which is hyperosmolar)
- Also never dilate the cells with ringers lactate it has Ca++ and that kills the RBCs
- Remember that the life span of RBC depends on the preservative used.

Platelets

Storage
- Up to 5 days at 20-24° [its half life is 1 - 7 days].

Indications
- Thrombocytopenia, Plt <15,000
- Bleeding and Plt <50,000 [because it increases volume expansion]
- Invasive procedure and Plt <50,000 [because it increases volume expansion].

Considerations
- Contain Leukocytes and cytokines

NOTE: One unit of platelet transfusion increases PLT count up to 5000-10,000 (MCQ)

**Platelets storage at room temp. so no need to warm it. (unlike the whole blood & RBCs we have to warm to avoid hypothermia)

Platelets: No need for warming, nor filtering [it will inactivate it and damage it], nor ABO testing. (IMP)

Plasma and Fresh Frozen Plasma (FFP)

Contents—Coagulation Factors (1unit/ml)

Storage
- FFP--12 months at –18 degrees or colder [we should warm it before we give it to the patient]
- We should give it to the patient in 2 hours when we order it because it has short half life.

Indications
- Coagulation Factor deficiency [ex: factor v, VIII, hemophlia], fibrinogen replacement, DIC, liver disease, exchange transfusion, massive transfusion

Considerations

- Plasma recipient doesn't need to be RBC ABO compatible with the donor.

Needs viral screening because there is a high risk for viral transfer [MUST BE FILTERED]
One unit of FFP increases coagulation factors 2-3% (MCQ)

Leukocyte Reduction Filters [doctor skipped this]

Used for prevention of transfusion reactions
Filter used with RBC's, Platelets, FFP, Cryoprecipitate
Other plasma proteins (albumin, colloid expanders, factors, etc.) do not need filters—
NEVER use filters with stem cell/bone marrow infusions
May reduce RBC's by 5-10%

RBC Transfusions

1. Preparations

Type
-Typing of RBC's for ABO and Rh are determined for both donor and recipient
- If Rh antigen factor is present it is Rh +, if not it is Rh -

Screen
-Screen RBC's for atypical antibodies
-Approximately 1-2% of patients have antibodies
- Viral screening (IMP)

Crossmatch
- Donor cells and recipient serum are mixed and evaluated for agglutination to prevent hemolysis reaction after the transfusion.
- Duration: 30- 45 minutes for the results to be ready

P.S: In case of ER we don't have enough time to do cross matching, we just give the patient O negative

2. Administration

Before administering the blood we should check the blood pack for : (IMP)

1. Patient name
2. Hospital number
3. ABO and Rh compatibility
4. Expiration date

Should be checked by 2 people in the operation room.
**The most common cause of death after blood transfusion is because of ABO incompatibility and the most common cause of that is labeling error.

Dose:

- Usual dose of 10 cc/kg infused over 2-4 hours (slowly) >> to avoid massive blood transfusion.
- Maximum dose 15-20 cc/kg can be given to hemodynamically stable patient.

Procedure:

1. Use IV line of size 20 gage (or larger) canula to prevent hemolysis and breakdown of RBC and we need to check if its working before we use it on the patient.
2. Warm the blood to prevent hypothermia ➜ either by putting it in warm water or by a warming machine.

- May need Premedication [Tylenol and/or Benadryl] ➜ the first possible complication is increase in temperature (hyperthermia) so we give this medication to adjust it.
- Filter use—routinely leukodepleted
- Monitoring—VS q 15 minutes (Vital Signs every 15 min.), clinical status.
- Do NOT mix with medications

Complications:

- Rapid infusion may result in Pulmonary edema, hypothermia esp. if it is not warmed,
  - Transfusion Reaction

Transfusion Complications (IMP)

1. Acute Transfusion Reactions (ATR's) = Hemolytic Reaction
2. Chronic Transfusion Reactions
3. Transfusion related infections
4. Transfusion related Acute Lung injury (TRALI).

**Transmitted diseases can be transmitted during blood transfusion (MCQ)

Acute Transfusion Reactions

Hemolytic Reactions (AHTR)
Febrile Reactions (FNHTR)
Allergic Reactions
Transfusion Related Acute Lung Injury (TRALI)
Coagulopathy with Massive transfusions (IMP)
Bacteremia

Frequency of Transfusion Reactions

Adverse Effect	Frequency	Comments
Acute Hemolytic Rxn	1 in 25,000	Red cells only
Anaphylactic hypotensive	1 in 150,000	Including IgA
Febrile Nonhemolytic	1 in 200	Common
Allergic	1 in 1,000	Common
Delayed Hemolytic	1 in 2,500	Red cells only
RBC alloimmunization	1 in 100	Red cells only
WBC/Plt alloimmunization	1 in 10	WBC and Plt only

1. Acute Hemolytic Transfusion Reactions (AHTR) (IMP)

Most Important Complication

Occurs when incompatible RBC's (usually ABO or Rh) are transfused into a recipient who has pre-formed antibodies

Antibodies activate the complement system, causing intravascular hemolysis.

Symptoms occur within minutes of starting the transfusion.

This hemolytic reaction can occur with as little as 1-2cc of RBC's (IMP).

Labeling error is most common problem.

Can be fatal

Symptoms of AHTR:

High fever/chills, Hypotension, Back/abdominal pain, Oliguria, Dyspnea, Dark urine, Pallor

What to do If an AHTR occurs? (IMP)

STOP TRANSFUSION

ABC's

Maintain IV access and run IVF (NS or LR)

Monitor and maintain BP/pulse

What to do if an AHTR occurs (briefly)?

1/STOP TRANSFUSION

2/ABC's

3/Maintain IV access and run IVF (NS or LR)

4/Monitor and maintain BP/pulse

5/Give diuretic

6/Obtain blood and urine for transfusion reaction workup

7/Send remaining blood back to Blood Bank

Blood Bank Work-up of AHTR (IMP)

Check paperwork to assure no errors.

Check plasma for hemoglobin and hematocrit.

Repeat cross match.

Repeat Blood group typing

Blood culture

Monitoring in AHTR [doctor skipped it]

Monitor patient clinical status and vital signs

Monitor renal status (BUN, creatinine)

Monitor coagulation status (DIC panel– PT/PTT, fibrinogen, D-dimer/FDP, Plt, Antithrombin-III)

Monitor for signs of hemolysis (LDH, bili, haptoglobin)

2. Febrile Non-hemolytic Transfusion Reactions (FNHTR)

Definition--Rise in patient temperature >1°C (associated with transfusion without other fever precipitating factors)

Occurs with approx. 1% of PRBC transfusions and approx. 20% of Platelets transfusions.

What to do If an FNHTR occurs?

STOP TRANSFUSION

Use of Antipyretics—responds to Tylenol

Use of Corticosteroids for severe reactions

Use of Narcotics for shaking chills

Future considerations

- May prevent reaction with leukocyte filter
- Use single donor platelets
- Use fresh platelets
- Washed RBC's or platelets

The doctor said in short: stop transfusion, check ABO compatibility and papers, if there is no precipitating factors, give Tylenol and continue the blood transfusion

Washed Blood Products (skipped)

PRBC's (packed RBCs) or platelets washed with saline
Indicated to prevent recurrent or severe reactions
Washed RBC's must be used within 24 hours
RBC dose may be decreased by 10-20% by washing

3. Allergic Non-hemolytic Transfusion Reactions

Etiology
- May be due to plasma proteins or blood preservative/anticoagulant.

Presents with urticaria and wheezing.
Treatment (IMP)

- Mild reactions—Can be continued after Benadryl
- Severe reactions—Must STOP transfusion and may require steroids or epinephrine

Prevention—Premedication (Antihistamines)

Transfusion Related Acute Lung Injury (TRALI)

Clinical syndrome similar to ARDS
Occurs 1-6 hours after receiving plasma-containing blood products.
Caused by WBC antibodies present in donor blood that result in pulmonary leukocytosis
Treatment is supportive
High mortality
There will be damage to alveoli by the donor WBCs and antibodies causing pulmonary leukocytosis, the lung will be white because of this reaction.

Massive transfusions (IMP)

Giving the patient >1 unit of blood volume within 2 hours
(Unit of blood volume = 70 ML/kg)***
Results into:
1-Pulmonary edema, hypothermia especially if blood is not warmed.
2-Coagulopathy (IMP) may occur after transfusion of massive amounts of blood (trauma/surgery), caused by failure to replace plasma- stored blood has less coagulating factors, which leads to coagulopathy.
{Thrombocytopenia due to decreased platelets number comparing to the increased blood volume-->cause more bleeding}

3-Electrolyte abnormalities
- Due to citrate binding of Calcium (Hypocalcaemia).
- Also due to breakdown of stored RBC's.

- May cause metabolic acidosis (electrolyte imbalance)

Bacterial Contamination

More common and more severe with platelet transfusion (platelets are stored at room temperature)
Organisms
- Platelets—Gram (+) organisms, ie: Staph/Strep
- RBC's—Yersinia, enterobacter

Risk increases as blood products age (use fresh products for immunocompromised)

Chronic Transfusion Reactions

Delayed, might take 2-20 days for reaction to start.
Alloimmunization
Transfusion Associated Graft Verses Host Disease (GVHD)
Iron Overload
Transfusion Transmitted Infection

Transfusion Associated Infections (MCQ)

1) Hepatitis C
2) Hepatitis B
3) HIV
4) CMV

**CMV can be diminished by leukoreduction, which is indicated for immunocompromised patients.

SUMMARY (IMP)

	Platelets	FFP	Packed RBC	Whole Blood
Storage	Up to 5 days at 20-24° [warm]	at -18 degree or colder up to 12 months [cold]	4° for up to 42 days [cold]	4° for up to 35 days [cold]
Needs of warming	NO NEED	NEED	NEED	NEED
Needs of filter	NO NEED	NEED	NEED	NEED
Needs of ABO	NO NEED	NO NEED	NEED	NEED
Indication	• Thrombocytopenia & Plt (<15,000) • Bleeding and Plt (<50,000) • Invasive procedure and Plt (<50,000) • 1unit of platelet transfusion can increase platelet count up to 5000-10000	• Coagulation Factor deficiency • fibrinogen replacement • DIC • liver disease • exchange transfusion • massive transfusion	• mild bld loss • severe anemia & hypoxia to Improve O_2 capacity	• Massive Blood Loss • Trauma • Exchange Transfusion (e.g thalacemia)
Notes	• Half life of platelets in the body 1-7days	• There is a risk of virus transmitted disease • 1 unit of FFP can increase coagulation factor up to 2-3% • Given within 2 h of order	• Usual dose (10 cc/kg) will increase Hgb by 2.5 gm/dl • Dose administration infusion (slowly) over 2-4 Hrs	• Filter = 170 micro

CROSSMATCH should be done before any transfusion (take 30-45 min)

Disadvantages of Blood storage:

1- Precipitation of Ca^{++} (Hypocalcaemia).

2- Affecting on coagulation factors mainly 5 & 8.