GIVE BLOOD Save Lives

Blood Transfusion

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Objective:

- Blood groups
- Indication of blood transfusion
- Blood components
- Blood transfusion complications and treatment
- Alternatives to Blood Products

Color Index:
-Doctor's Notes -Surgery Recall -Doctor's Slides+Davidson -Important
-Extra

Correction File

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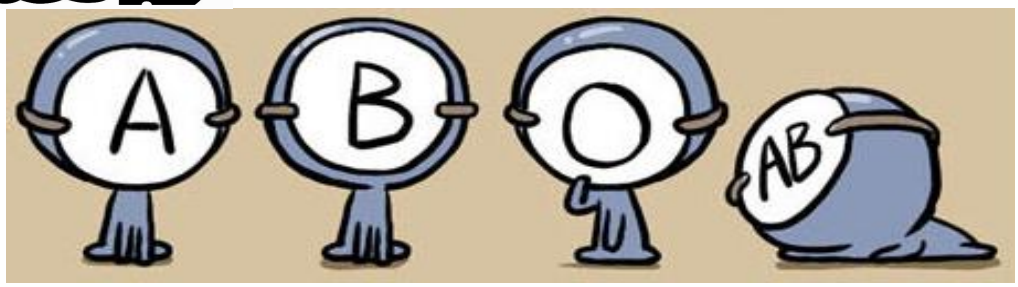
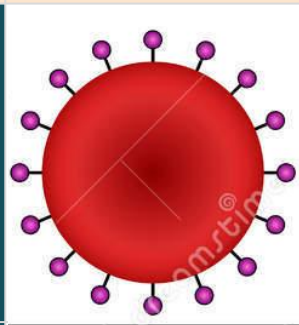
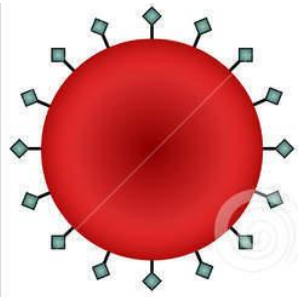
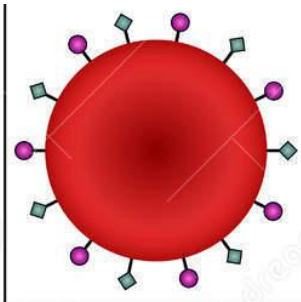
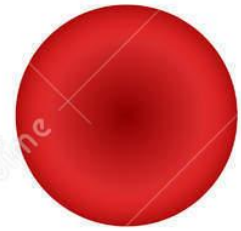
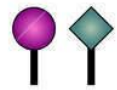
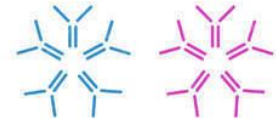


Blood Groups				
Group	**A**	**B**	**AB**	**O**
Red Blood Cell Type				
Antigens Present	 Antigen A	 Antigen B	 Antigen A & B	None
Antibodies Present	 Anti-B	 Anti-A	None	 Anti-A & Anti-B

Note :When female aets antibody of her blood aroup that will lead to either
1- devolved hemolytic transfusion reaction due unproper cross match of blood
2-induce hemolytic disease of newborn (hemolytic transfusion reaction to newborn)
So the baby will have hemolytic disease

Note : - Group O- is the universal donor
Group AB+Nis the universal reception

Blood Banking

Blood Collection:

- Blood centers, process more than 90% of the units collected .
- Traditional allogenic donation methods still predominate, but increasing use is being made of red cell apheresis technology, by which red cells are separated from the blood at the time of collection, with the rest returned to circulation.

> Note : Red Cell Apheresis are prepared to patients will underao major surgery such as scoliosis , spine surgery and patient with total hip replacement

- Blood collection bags contain an anticoagulant-preservative of citrate, phosphate, dextrose, and adenine (CPDA-1)

> Note : These anticoualnats increase shelf life of the blood and Prevent blood coagulation.

- Ensuring a shelf life (viability of at least 70% of the RBCs 24 hours after infusion) of 35 days and hematocrit of 70 to 80% for PRBCs.

> Note :
> - Meaning that these anticoagulants will keep blood for 35 days.
> - Packed RBCs contain 70-80% Hematocrit which means concentrate it RBCs and the viability of RBC at least 70% in 24 hours after infusion.
>
> Normal hematocrit level (hemoglobin level x3) = 40-45

- Additive solutions (Adsol, Nutricel, Optisol) provide additional nutrients, extending maximum storage to 42 days and lowering viscosity, which makes infusion easier.

Here we will quickly mention some points related to blood banks and how do they preserve and store blood.

- Citrate is an anticoagulant that works by binding calcium which prevents the activation of the coagulation cascade (which is triggered by calcium)
  - When we infuse a patient with large amounts of blood, this citrate can cause hypocalcemia
  - Hypocalcemia manifests as tingling/ loss of sensations in the extremities or around the lips
  - This usually goes away by itself as citrate is quickly metabolized. No treatment required

Blood Banking cont.

- Dextrose, adenine, and phosphate are all added to nourish the RBCs

- 2,3-DPG(Biphosphoglycerate) is an intermediate of glycolysis found in the RBCs which functions in releasing oxygen from the hemoglobin into the tissue[1]
  - The P in 2,3-DPG is for phosphate, that is why it is added to preserve blood
  - If the blood unit is stored for a long time, 2,3-DPG levels might decrease which makes the transfused blood unable to release oxygen into the tissues[2]

- The intracellular space (inside the RBCs) is rich in potassium. During blood preservation, some RBCs may lyse which increases the amount of potassium in the blood unit
  - Multiple infusions can result in hyperkalemia

- The storage of RBCs might make them less flexible which might increase resistance to capillary flow
  - Storage impairs red cell function. Transfused blood delivers oxygen to the tissues less efficiently. Stored RBCs are not the same of the RBCs in our circulation
  - Refrigerated at 1 to 6° C (usually 4° C), cell metabolism continues and changes occur .
  - ‹ in pH and in the level of 2,3-DPG.
  - The deformability of RBCs makes them, over time, more spherical and rigid, thereby increasing resistance to capillary flow.
  - Cell leakage of potassium(≈ 6 mEq/U). * So the Packed RBC has high hematocrit (70%_80%)and high potassium (6 mEq/ u) and acidic.

- After blood is donated, the blood bank separates this whole blood into RBCs, platelets, and plasma (i.e. fresh frozen plasma)

[1] Hemoglobin F in the fetus does not respond to 2,3-DPG which makes it able to survive with such low oxygen tension in the uterine arteries.

[2] https://www.ncbi.nlm.nih.gov/pubmed/41684

Blood Typing

These are basic concepts in physiology which we will quickly review here

- ABO blood groups: these are IgM/IgG antibodies that can cause serious hemolytic transfusion reactions if a patient gets an incompatible blood. type Anti B + blood type A ➡coagulation والعكس صحيح
  - ABO grouping requires that the recipient's red cells be tested with anti-A and anti-B serum, and that their serum be tested with A and B red cells.
  - Those with type AB blood form no ABO group antibodies.(universal recipient)
  - Those with type O have antibodies against both.(universal donor)

- Rh antibodies are proteins which might "sensitize" our immune system
  - The idea here is that if someone is Rh negative and we give Rh positive blood for the first time, it is unlikely that there will be a hemolytic reaction because the IgG antibodies are still not made
  - After this, the immune system will start processing the Rh antigen and IgG antibodies vs. the Rh antigen will be present. This is when we must be careful in administering Rh positive blood[3]
  - Rh typing can usually be determined by adding a commercial reagent (anti-D) to recipient RBCs.

- When a patient needs blood, it is not enough to look at ABO groups and give blood, we must perform what is known as cross-matching. This is because a recipient might have antibodies vs. the donor's RBCs for whatever reason. This can be checked by what is known as the Coomb's test
- Identified red blood cell (RBC) :
  - ABO and related carbohydrate antigens (H, P, I, and Lewis), the 48 Rh system antigens and more than 200 non-ABO/Rh antigens.
  - Before transfusion: blood specimen from the patient is sent for the following tests: ABO grouping, Rh typing and an antibody screen for unexpected (non-ABO/Rh) antibodies.

- The "forward type" determines the ABO and Rh phenotype of the recipient's RBC by using antiserum directed against the A, B, and D antigens. To know if positive or negetive.
- The "reverse type" detects isoagglutinins in the patient's serum and should correlate with the ABO phenotype, or forward type.

[3] This is the same concept of the Rh negative mother that gets pregnant with an Rh positive baby; which is called Rh disease, a type of hemolytic disease of the newborn. In this case, we try to prevent the formation of anti Rh antibodies in the mother from the first pregnancy so the mother can safely have another Rh positive baby. Remember that IgG antibodies are the only ones that cross the placenta that is why we care so much about this condition and do not care if the baby is ABO non-compatible. ABO incompatibility results in a mild reaction which presents as mild jaundice but it is not severe as Rh diseases.

Type and Screen*

- The type and screen allows quicker selection of appropriate banked blood for complete crossmatch if a transfusion is ordered.

- When a blood transfusion is ordered, a formal crossmatch is done by mixing recipient serum with donor RBCs as a final compatibility test prior to transfusion.

Cross Match*

- This can be done using a Coombs test (with serum incubated to 37° C), or the more rapid "immediate spin crossmatch" at room temperature, which will detect only ABO incompatibility.

- Thorough Coombs test can detect incompatibilities that were missed with the antibody screen. Coombs test is more safe than spin test

*
- Type and screen ➡ prepare the blood (to be ready) just in case. i.e., cholecystectomy(in case of complications)
- Cross match ➡ prepare the blood (to be ready+100% sure) BUT you have to use it or if not then dispose it. i.e., C-section

Why do we use blood transfusion?

- Increase oxygen carrying capacity (The 1st, main and most important indication. Because in case hypovolemic we can give colloid and other substances to expand the blood)

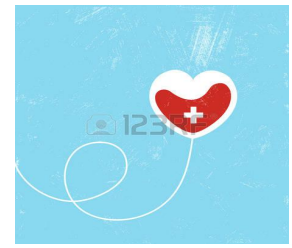
- Restoration of red cell mass. If patient hemoglobin below 7 and there is or isn't bleeding, we have to transfer blood

- Correction of bleeding caused by platelet dysfunction. The most common disease of platelet that indicates of blood transfusion is idiopathic thrombocytopenia. If platelets count less than 5000 and will undergo any surgery, we have to transfer blood

* Giving massive amount of blood transfusion (adverse effect)➡ dilutional thrombocytopenia
* Consumption thrombocytopenia is caused due bleeding or clot in site of body which consumes platelets

- Correction of bleeding caused by factor deficiencies

Principles of Transfusion



- The amount of oxygen that is reaching our organs depends on how much oxygen do we have in our blood, and how much blood is going to the organ (i.e. cardiac output)
- The amount of oxygen in the blood (CaO_2) is mainly determined by the amount of hemoglobin in the blood
    - CaO_2(Oxygen Content) = (Hb[4] x 1.4) x O_2 saturation[5] + 0.003 PaO_2[6]
    - Hemoglobin is multiplied by 1.4 because it is the amount of O_2 carries by each gram/dl of Hb.

* Good Hb level indicates good oxygen delivery.
* Healthy can tolerate decrease in Hb level. If there is decrease in Hb more than (6-7) it is compensated by increasing CO to increase oxgean delivery to the tissue

    - PaO_2 is the amount of oxygen dissolved in the blood. It has a very poor contribution of the blood oxygen content that is why it s multiplied by 0.003

- Cardiac output is stroke volume x heart rate (CO=SV x HR)
- Delivery of oxygen (DO_2) is the oxygen that is delivered to the tissues. Depends on the cardiac output and how much oxygen is in the blood. Patient with IHD and beta blockers with low hemoglobin should give him blood transfusion because they can't tolerate oxgean delivery
    - $DO_2 = CO \times CaO_2$
    - Therefore: $DO_2 = HR \times SV \times CaO_2$
- If HR or SV are unable to compensate, Hb is the main determinant of oxygen content in the blood. Such as in patients using Beta blockers and with IHD
- Before transfusing a patient two people must review the information to decrease error

Administration

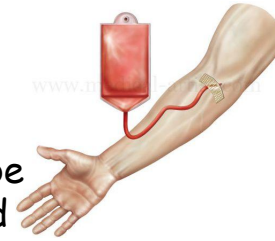
Legal Aspects:

- Two qualified personnel check it at the bedside to prevent a potentially fatal clerical error.
- Recipient and unit identification, confirmation of compatibility, expiration date.
- 60% of transfusions occur perioperatively.
- Responsibility of transfusing perioperatively is with the anesthesiologist

- Urgent transfusion situations require flow rates faster than gravity can provide. By pressure bags
- Pressure bags are available that completely encase the blood bag and apply pressure evenly to the blood bag surface.
- If external pressure is anticipated, large-bore needles are recommended for venous access to prevent hemolysis. If you want use pressure bags, you have to use iv cannula

[4] Hemoglobin in gram per deciliter (g/dl)
[5] O_2 saturation is a percentage % measured by a pulse oximeter
[6] PaO_2 in mmHg

Administration cont.



If only a small-gauge needle (small canula) is available, the transfusion may be diluted with normal saline (Because it is isotonic), but this may cause unwanted volume expansion. * We Don't use lactate ringer's because it contains calcium that lead to stimulate coagulation cascades.

MANAGEMENT

1. Patient's age
2. Severity of symptoms
3. Cause of the deficit
4. Underlying medical condition. Ischemic heart disease can't tolerate Hb 10 and below
5. Ability to compensate for decreased oxygen-carrying capacity, and tissue oxygen requirements are all considered.

* Patient can tolerate blood loss up to 20% ➡ 1 liter. Each 500 ml ➡ with 1 Hb

Clinical evaluation:

1. appearance (pallor, diaphoresis)
2. mentation (alert, confused)
3. heart rate
4. blood pressure
5. nature of the bleeding (active, controlled, uncontrolled)

* If patient with Post part of hemorrhage , first they will Assess the time then send the blood to lab for CBC and blood coagulation (CBC for Hb level and platelets while couglation for PTT and INR)

Laboratory evaluation :

1. Hgb
2. hematocrit
3. platelets
4. clotting functions

When to Transfuse?

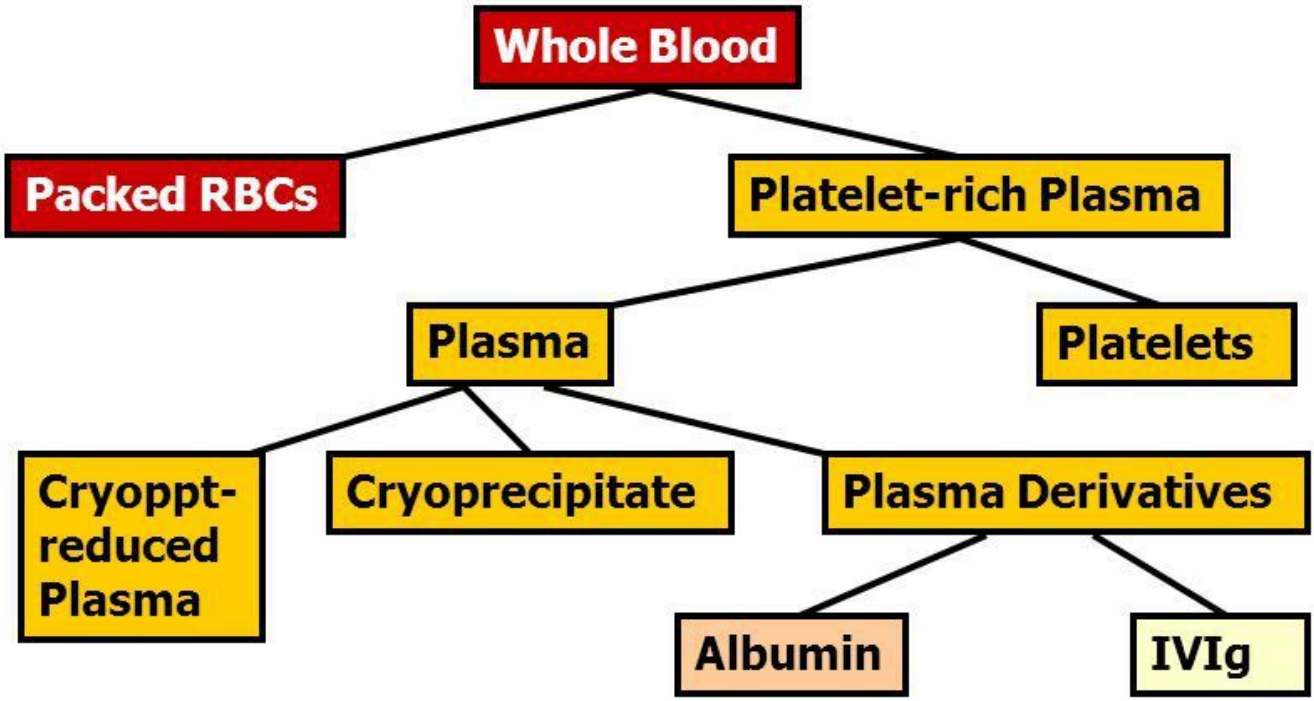
- TRICC (Transfusion Requirements in Critical Care) trial, demonstrated that in the critical care setting, a transfusion threshold of 7 g/dL was as safe as a threshold of 10 g/dL.
- A subgroup analysis generated some concern that patients with ischemic heart disease benefit from higher transfusion threshold

* Why do we separate the blood ?
Because it depends what patient need to give
* When we take blood sample from the patient, we are going to separate blood into two packs :
One : contains RBCs
Second: platelet rich plasma

How do we know when to transfuse blood?[7]

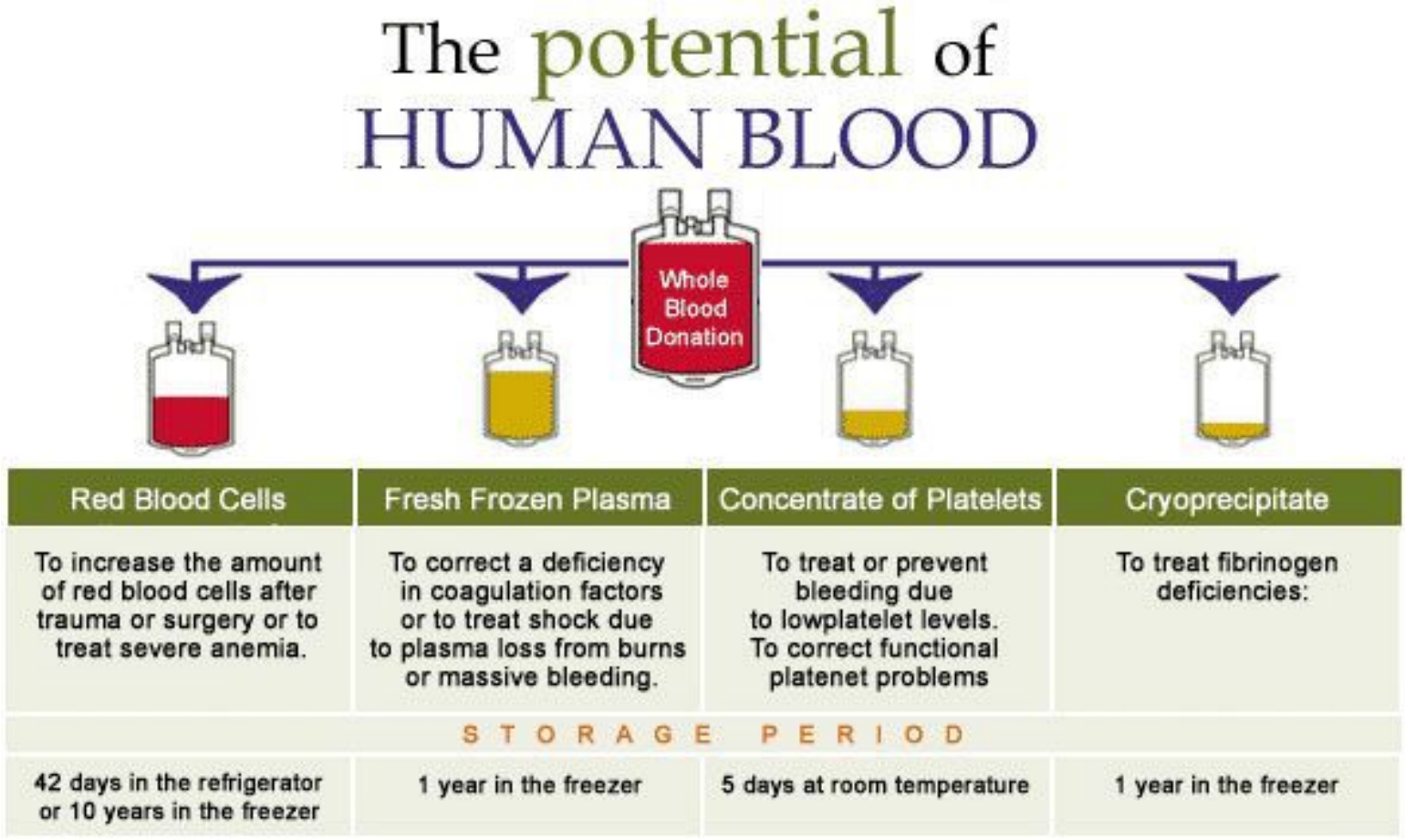
- We can use the patient's volume status as an indication
  - Example: a patient came to the ER after a car accident with a decreased BP, increased heart rate, cold clammy skin, dry mucous membrane, etc. this patient likely lost blood secondary to bleeding from trauma and he might need blood transfusions
- We can also use the hematocrit (HCT) as an indicator
  - HCT is not accurate because it can get diluted or concentrated
    - Example: if we infuse a patient with IV fluids, the RBCs will become diluted and the patient would have a lower HCT
    - A patient who has been sweating all day loses fluids and the HCT may be elevated
  - However, it is a good indication for RBC volume
- For plasma and platelet transfusions we can look at bleeding time, PTT, INR, etc. to see if the patient needs any of these blood products

Blood products



As mentioned, whole blood is not used but separated to its other components such as RBCs, platelets, and plasma (FFP).

- Whole Blood is not as economical as component therapy, although there has recently been renewed interest in the benefits of using fresh whole blood in military field hospitals.
- In modern transfusion medicine is rarely used.



* In case of giving massive blood transfusion such as shock ➡ I should give :
1 unit of packed RBC + 1 unit of fresh frozen plasma + 1 unit of concentrate of platelets add to prevent dilatational thrombocytopenia

* Concentrate platelets we will use it in prevention or treatment of bleeding due platelet disorders

Packed RBCs

- Please note that we can use IV fluids (colloids) to raise a patient's blood pressure. Packed RBCs are used to increase O_2 carrying capacity in the blood and it is not used to raise BP because IV fluids are cheaper and safer.

- American society of anesthesiologists say that packed RBC transfusion should NOT be done if the Hb is >10g/dl and should be done if it is <6g/dl
  - If the Hb is between 6 and 10g/dl the physician can decide depending on the clinical picture. For example a patient with endocarditis might need transfusions at higher levels * If there is blood losing or I expect will be, we will give him

- Ischemic heart disease may render patients more intolerant of anemia, although more research is needed to clarify whether transfusion benefits these patients. * All IHD patient Hb should be 10 and above

Packed RBCs cont.

- Physicians would still transfuse a patient with ongoing hemorrhage and unstable vital signs despite adequate fluid resuscitation, and would occasionally consider withholding transfusion for Hgb levels even lower than 6 g/dL in a young, healthy, asymptomatic patient without ongoing hemorrhage.

- In an average adult, 1 U of PRBCs increases the Hgb by about 1 g/dL or the hematocrit by about 3%

- PRBCs are run through a filter with a large-bore intravenous line with normal saline.

- Lactated Ringer's solution can lead to clotting due to the added calcium, and hemolysis may result with a hypotonic solution.

- Most transfusions are given over 60 to 90 minutes (not longer than 4 hours).

- Unused blood should be returned promptly to the blood bank because any units unrefrigerated for more than 30 minutes are discarded

- RBCs should be infused alone or with a clot filter (that removes the clots that might have occurred during storage) and 0.9% NaCl

- Never give RBCs with dextrose because it is hypotonic and water will then move into the RBCs (osmosis and will cause burst of RBCs)

- The opposite is true with hypertonic solutions: if you give RBCs with hypertonic solutions the RBCs will shrink

- Avoid infusing with Ringer's lactate because it contains calcium which might trigger the coagulation cascade

- RBCs can be transfused with a drip (takes a long time of 4 hours) or with special machines if it is urgent which can transfuse the patient very fastly

- By practical convention, 1 g/dl of hemoglobin = 3% HCT
  - For example our normal Hb on average let us say is 15 g/dl, we would expect the normal HCT to be 15x3= 45%

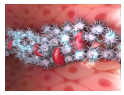
- One unit of packed RBCs should raise the HCT by 3 %
  - Infused a patient with a unit of blood and HCT did not increase properly? Maybe the patient is still bleeding or has hemolysis

Fresh Frozen Plasma

- A unit of FFP typically has a volume of 200 to 250 mL, is ABO compatible, and is given through blood tubing within 2 to 6 hours of thawing
- Contains all clotting factors
- Uses :
  1-Quick reversal of bleeding disorders such as :quick reversal of warfarin toxicity (intramuscular vitamin K can be used but it takes time to show an effect).
  2-To correct deficiency in coagulation factors
  3-To treat shock due plasma loss or massive bleeding
- Storage period about 1 year in freezer
- It should be given in doses calculated to achieve a minimum of 30% of plasma factor concentration, traditionally calculated as 10 to 15 mL/kg of FFP

Note : In case of using massive blood transfusion such as in shock, we have to use 1 packed RBCs, 1 FFP and 1 concentrate of platelets to prevent dilutional thrombocytopenia .

Platelets



- No need to perform cross-matching. It may cause Rh sensitization (IgG antibodies vs. Rh antigen due mixes Rh negative with positive).
- Rh-negative patients should receive Rh-negative platelets while Rh-positive can receive the both.
- Adults standard dose is 4-6 units of platelets (four to six-pack").
- In children it is 1 unit/10kg body weight.
- Uses:
  1-To treat or prevent bleeding due low platelets .
  2-To correct functional platelet problems.
- Storage period about 5 days at room temperature.

Cryoprecipitate

- Cryoprecipitate is a source of fibrinogen, factor VIII, and von Willebrand factor (vWF). It is ideal for supplying fibrinogen to the volume-sensitive patient
- Uses:
  1-When factor VIII concentrates are not available (in hemophilia A), cryoprecipitate may be used since each unit contains approximately 80 units of factor VIII.
  2-Cryoprecipitate may also supply vWF to patients with dysfunctional (type II) or absent (type III) von willebrand disease

  3-To treat fibrinogen deficiency.
- Storage period about 1 year in freezer.

Adverse reactions of blood transfusions

- ❏ The most common reactions are not life threatening, although serious reactions can present with mild symptoms and signs.
- ❏ Reactions can be reduced or prevented by modified (filtered, washed, or irradiated) blood components especially in sickle cell anemia and thalassemia patients
- ❏ Can be divided into immune mediated reactions, and non immune mediated complications such as infections.

Note : Serious adverse reactions could present as mild symptoms and signs.

1-IMMUNE-MEDIATED REACTIONS

A-Acute hemolytic transfusion reactions (AHTR)

- ★ Immune-mediated hemolysis occurs when the recipient has preformed antibodies that lyse donor erythrocytes.
- ★ The ABO isoagglutinins are responsible for the majority of these reactions, although alloantibodies directed against other RBC antigens, i.e., Rh, Kell, and Duffy, may result in hemolysis.
- ★ AHTR present with hypotension, tachypnea, tachycardia, fever, chills, hemoglobinemia, hemoglobinuria, chest and/or flank pain, and discomfort at the infusion site. (blood transfusion should be stopped if patient develops chest pain)
- ★ The immune complexes that result in RBC lysis can cause renal dysfunction and failure.
- ★ Tissue factor released from the lysed erythrocytes may initiate DIC.
- ★ Steps of treatment of AHTR :

1-Transfusion must be stopped immediately.

2-Diuresis should be induced with intravenous fluids and furosemide or mannitol (to wash kidneys).

3- Treat the symptoms one by one.

4-Sent packed RBCs that are used and blood sample of the patient to the lab.

5- Lab investigations :

A- Coagulation studies : like Prothrombin (PT), activated partial thromboplastin (aPTT), fibrinogen and platelet count. (should be measured in patient with hemolytic reactions).

B- Laboratory evaluation for hemolysis : measurement of haptoglobin, lactate dehydrogenase (LDH) and Indirect bilirubin levels.

Note : In case of renal injury due AHTR ⟶ renal will be enlarged + obstructed renal tubes. Hyperosmotic mannitol ⟶ release fluid from renal cells (reduce the enlargement) and open renal tubes.

B-Febrile nonhemolytic transfusion reaction (FNHTR)

- ➢ The most frequent reaction associated with transfusion of blood components
- ➢ Patient have a fever (rise about 1 celsius) with chills and rigors.
- ➢ Treated with antipyretics
- ➢ Why does this happen? The donor's leukocytes have HLA which the recipient attacks. The lysis of WBCs causes fever. Remember that mature RBCs don't have HLA.

C-Allergic transfusion reaction (Mild reaction)

- are related to plasma proteins found in transfused components. (This is a type 1 IgE mediated hypersensitivity reaction against proteins (allergens) present in the donor's blood)
- Common (febrile and allergic transfusion reactions are the most common)
- Patients have urticaria with pruritus and wheezing.
- Mild reactions treated symptomatically by temporarily stopping the transfusion and administering antihistamines : (diphenhydramine, 50 mg orally or IM)

D-Anaphylactic reaction (severe reaction)

- This is a very severe form of allergic transfusion reaction which might lead to anaphylactic shock.
- Symptoms and signs: difficulty in breathing, coughing, nausea and vomiting, hypotension, bronchospasm, loss of consciousness, respiratory arrest, and shock.
- Treated by stopping the transfusion, maintains vascular access and giving epinephrine (0.5–1 mL of 1:1000 dilution subcutaneously),
- Glucocorticoids is used in severe cases

E-Transfusion related acute lung injury

- ❏ Patients get acute respiratory distress syndrome either during or within 6 hours of transfusions.
- ❏ Characterised by respiratory compromise and signs of noncardiogenic pulmonary edema, including bilateral interstitial infiltrates on chest x-ray
- ❏ Treatment is supportive, and patients usually recover without sequelae.

F-Graft vs host disease (GVHD)

- ❏ Graft-versus-host disease (GVHD) is a frequent complication of allogeneic stem cell transplantation, in which lymphocytes from the donor attack the recipient and cannot be eliminated by an immunodeficient host.
- ❏ Mediated by donor T lymphocytes that recognize host HLA antigens as foreign and mount an immune response
- ❏ Clinically presents with diarrhea, fever, cutaneous eruptions, and liver function abnormalities.

2-NONIMMUNOLOGIC REACTIONS

A-Fluid overload

- Blood components are excellent volume expanders ,so transfusion may quickly lead to volume overload.
- Monitoring the rate and volume of the transfusion and using a diuretic can minimize this problem.

B-Hypothermia

- Refrigerated (4°C) or frozen (–18°C or below) blood components can result in hypothermia when rapidly infused.
- Cardiac dysrhythmias can result from exposing the sinoatrial node to cold fluid.
- Use of an in-line warmer will prevent this complication.

C-Electrolyte toxicity

- ❑ RBC leakage during storage increases the concentration of potassium in the unit. (High potassium in blood products → hyperkalemia)
- ❑ Citrate, commonly used to anticoagulate blood components, binds or chelates to calcium and thereby by inhibiting the coagulation cascade. (Citrate in blood pack to prevent clotting→ hypocalcemia)
- ❑ Hypocalcemia, manifested by circumoral numbness and/or tingling sensation of the fingers and toes, may result from multiple rapid transfusions.
- ❑ Citrate is quickly metabolized to bicarbonate, calcium infusion is rarely required in this setting.

D-Iron overload

- Each unit of RBCs contains 200–250 mg of iron.
- Occurs in those who get lots of transfusions (i.e. thalassemia , sickle cell anemia)
- Symptoms and signs of iron overload affecting endocrine, hepatic, and cardiac function are common after 100 units of RBCs have been transfused (total-body iron load of 20 g).
- Preventing this complication by using alternative therapies (e.g., erythropoietin) and judicious transfusion is preferable and cost effective.
- Chelating agents, such as deferoxamine and deferasirox, are available and helpful to prevent this, but the response though is often suboptimal.

E-Infections

- Viral infections : Hepatitis C virus, Human immunodeficiency virus (HIV) type 1, Hepatitis B virus , Cytomegalovirus, chikungunya virus, and Parvovirus B-19.
- Other infectious agents : Various parasites, including those causing malaria, babesiosis, and Chagas disease, can be transmitted by blood transfusion, Dengue, variant Creutzfeldt-Jakob disease, and yellow fever.

Important information from surgical recall

Which electrolytes is most likely to fall with infusion of stored blood? And Why?
-Ionized calcium ; the citrate preservative used for storage of blood binds serum calcium.

What changes occur in the storage of PRBCs?
-Decrease in Ca++ , 2,3-DPG and PMN.
- Increase in K+ and H+ (reduce PH)

What is the thrombocytopenia ?
-Low platelet count (less than 100,000)

How much one unit of PRBCs will increase hematocrit ?
- Hematocrit is Hb level x 3
- about 3-4%

What are common causes of thrombocytopenia in surgical patient?
-Sepsis, H2 blockers, heparin, massive transfusion , DIC, antibiotics , spurious lab value, Swann-Ganz catheter.

What common medication could cause irreversible platelet dysfunction ?
-Aspirin (inhibits cyclooxygenase).

What can be given yo help correct platelet dysfunction from uremia , aspirin or bypass ?
-DDAVP (desmopressin)

What are general guidelines for blood transfusion ?
-Acute blood loss, Hb less than 10 with COPD or CAD, or healthy symptomatic patient with Hb less than 7.

Why not infuse lactated ringer's (LR)?
-calcium in LR may result in coagulation within IV line.

For how long packed RBCs stored ?
-about 6 weeks (42 days).

What is the most common cause of transfusion reaction ?
-ABO incompatibility as result of clerical error.

What are the symptoms of hemolytic transfusion reaction ?
-Fever, chills, nausea , vomiting , hypotension, lumbar pain, chest pain, abnormal bleeding.

What is the treatment for transfusion hemolysis ?
-Stop transfusion, provide fluids, perform diuresis by lasix to protect kidneys, alkalinize urine (bicarbonate) and give pressors as needed.

What component of blood can cause fever ?
-WBCs

When should aspirin administration be discontinued preoperrativly ?
-At 1 week because platelets live 7 to 10 days (must use judgment if patient at risk for MI, stroke because it may be better to continue and use excellent surgical hemostasis in these patients.

What can move the oxyhemoglobin dissociation curve to the right ?
-Acidosis, 2,3- DPG, fever, elevated PCO2 (to the right means greater ability to release the O2 to the tissues.

What is the normal of RBC and platelet?
- RBCs :120 days
- Platelets : 7-10 days

What are the the coagulation factor deficient in hemophilia A and B?
-Hemophilia A : factor 8
-Hemophilia B : factor 9

How hemophilia A and B inherited ?
-sex linked recessive

What is the preoperative treatment of hemophilia A?
-Factor 8 infusion

What is willebrand's disease inherited?
-Is autosomal dominant disease which is caused by deficiency in von willebrand factor (vWF) and factor VIII:C.

What is used to correct willebrand's disease ?
DDAVP or cryoprecipitate

What coagulation study is abnormal in hemophilia A, B and willebrand's disease?
- Hemophilia A : elevated PTT
- Hemophilia B : elevated PTT
- Willebrand's disease : elevated bleeding time

What is the effect of deficiency in protein C, protein S or antithrombin III?
-Hypercoagulable state.

What is the most common inherited hypercoagulable state ?
-Factor V leiden

Thank you