



"In the name of Allah, Most Gracious, Most Merciful"

BLOOD TRANSFUSION



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Blood Transfusion: **OBJECTIVES**

- ❖ Introduction.
- ❖ Sources of Blood Transfusion
- ❖ Blood groups
- ❖ Transfusion Triggers
- ❖ Blood & Component Transfusion
- ❖ Complications of Blood transfusions
- ❖ Summary



Blood Transfusion: **INTRODUCTION**

- **Definition:**

- Is the transfer of **Blood** or **Blood Products** from one person (**Donor**)

- ⇒ into another **Person's Blood**, (**Recipient**).

Blood Transfusion: **INTRODUCTION**

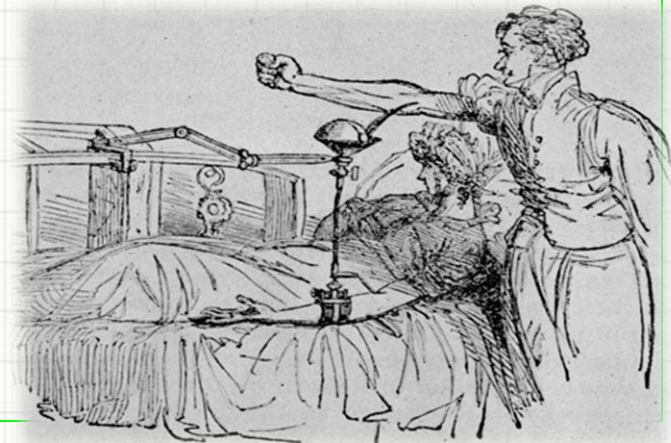
Q.) *What are the sources of blood?*

1. Autologous blood:

– Using your own blood.

2. Donor blood (Allogenic):

– Using someone else's blood.



Blood Transfusion: **SOURCES**

1. Autologous blood:

- a) **Pre**operative donation.
- b) **Intra**operative autologous transfusion.
- c) **Post**operative autologous transfusion.
- d) Hemodilution.
- e) Apheresis.

2. Donor blood (Allogenic).

- a) Volunteer blood
- b) Designed donor blood

Description

Indication

Advantage

Disadvantage

Blood Transfusion: **SOURCES**

1. Autologous blood:

a) Preoperative donation:

- **Description:**
 - By donating your own blood before surgery.
 - The blood bank draws your blood and stores it until you need it.
- **Indications**
 - This option is only for elective procedures.
- **Advantages:**
 - Eliminating / minimizing the need for someone else's blood.
- **Disadvantage:**
 - It requires advanced planning which may delay surgery.
 - Some medical conditions may prevent the pre-op donation.
 - Non suitable for emergency situations.

Blood Transfusion: **SOURCES**

1. Autologous blood:

b) Intraoperative autologous transfusion.

- **Description:**

- It is a method of *“Recycling Your Blood”* during surgery.
- Blood loss during surgery is filtered, and put back during surgery.

- **Indications**

- This can be done in **Emergency and Elective** surgeries.

- **Advantages:**

- Eliminating or minimizing the need for someone else's blood.
- Large amounts of blood can be recycled.

- **Disadvantage:**

- This process cannot be used if **Cancer or Infection** is present

Blood Transfusion: **SOURCES**

1. Autologous blood:

c) Postoperative autologous transfusion.

- **Description:**

- Also, it is a type of “*Recycling Your Blood*” after surgery.
- Blood lost after surgery is collected, filtered and returned to your body. (*Cell Saver*)

- **Indications**

- This can be done in **Emergency and Elective** surgeries.

- **Advantages:**

- Eliminating or minimizing the need for someone else's blood.

- **Disadvantage:**

- This process cannot be used if cancer or infection is present

Blood Transfusion: **SOURCES**

1. Autologous blood:

d) Hemodilution.

- **Description:**

- Donating pt's own blood During or Immediately before surgery,
- Some of pt's blood is taken and replaced with IV fluids.
- After surgery, this blood is filtered and returned to the pt.
- This process dilutes pt's blood, so he loses less concentrated blood.

- **Indications**

- This option is only for elective procedures.

- **Advantages:**

- Eliminating or minimizing the need for someone else's blood.

- **Disadvantage:**

- Only a limited amount of blood can be removed,
- Certain medical conditions may prevent the use of this technique.

Blood Transfusion: **SOURCES**

1. Autologous blood:

e) Apheresis.

- **Description:**

- donating pt's own Platelets and Plasma.
- Before surgery, pt's platelets and plasma, are withdrawn, filtered and returned to the pt. when he need it later.

- **Indications**

- This option is only for elective procedures.

- **Advantages:**

- Eliminating the need for donor platelets and plasma.

- **Disadvantage:**

- Some medical conditions may prevent apheresis.
- And in actual practice it has limited applications.

Blood Transfusion: **SOURCES**

1. Autologous blood:

- a) Preoperative donation.
- b) Intraoperative autologous transfusion.
- c) Postoperative autologous transfusion.
- d) Hemodilution.
- e) Apheresis.

2. Donor blood (Allogenic).

- a) Volunteer blood
- b) Designed donor blood

Description

Indication

Advantage

Disadvantage

Blood Transfusion: **SOURCES**

2. Donor blood (Allogenic):

a) Volunteer blood:

- **Description:**
 - Blood collected from the community blood supply (*e.g blood banks*).
- **Indication:**
 - Both Elective & Emergency situations.
- **Advantages:**
 - This has the advantage of being readily available,
 - And can be life-saving when your own blood is not available.
- **Disadvantage:**
 - There is a risk of disease transmission e.g hepatitis & AIDS
 - Allergic reactions.

Blood Transfusion: **SOURCES**

2. Donor blood:

b) Designated donor blood:

- **Description:**
 - Blood is collected from the donors you select (*e.g. friends or family*).
 - You can select people with your own blood type &
 - And you feel safe donors.
- **Indications:**
 - Usually elective procedures
 - May be in less emergency category (CAT 2 or 3)
- **Advantages:**
 - Can be life-saving when volunteer donor blood is not available,
 - Or when your own blood is not available.
- **Disadvantages:**
 - There is still a risk of disease transmission, e.g. hepatitis & AIDS
 - Allergic reactions.
 - This process usually requires several days for advanced donation.

Blood Transfusion: **BLOOD BANK**

- **Blood bank:**

1. Collect,
2. Screening,
3. Test,
4. Store blood,
5. Prepare blood & components.



Blood Transfusion: **BLOOD BANK**

- **Anticoagulants in the Blood:**

- Blood collection bags contain an anticoagulant-preservatives:

Citrate, Phosphate, Dextrose & Adenine (CPDA-1)

- Ensuring a shelf life of 35 days
- And hematocrit of 70 to 80% for PRBCs.

- **Additive solutions (Adsol, Nutricel, Optisol):**

- Provide additional nutrients,
- Extending maximum storage to 42 days,
- ↓ Viscosity → makes infusion easier.

Blood Transfusion: **BLOOD BANK**

- **Storage of the Blood:**

- Storage impairs red cell function.

- Transfused blood delivers less oxygen to the tissues.

- 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 more **Spherical & Rigid**,

- ⇒ ↑ resistance to capillary flow.

- Cell leakage of K^+ (≈ 6 mEq/U).

Blood Transfusion: **BLOOD BANK**

Blood Type:

- Patient's Blood is sent for the following tests:
 - **ABO grouping:**
 - The recipient's **RBCs** be tested with **anti-A & anti-B serum**,
 - Their **serum** be tested with **A & B red cells**
 - **Rh typing:**
 - Adding "**Anti-D**" → recipient **RBCs**
 - **Antibody screen for unexpected (non-ABO/Rh) antibodies.**


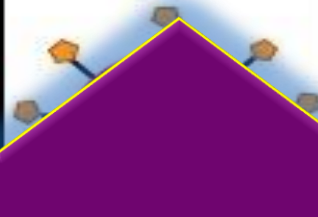



Blood Transfusion: “ABO” Grouping

- In addition, each person's blood is either:
 - Rh-positive:
 - Can receive Rh-ve or Rh+ve blood.
 - Rh-negative:
 - Should only receive Rh-negative blood
 - Can be used for emergencies.

O+	39.0%
A+	34.0%
B+	8.5%
AB+	3.5%
O-	6.6%
A-	6.3%
B-	1.5%
AB-	1.0%

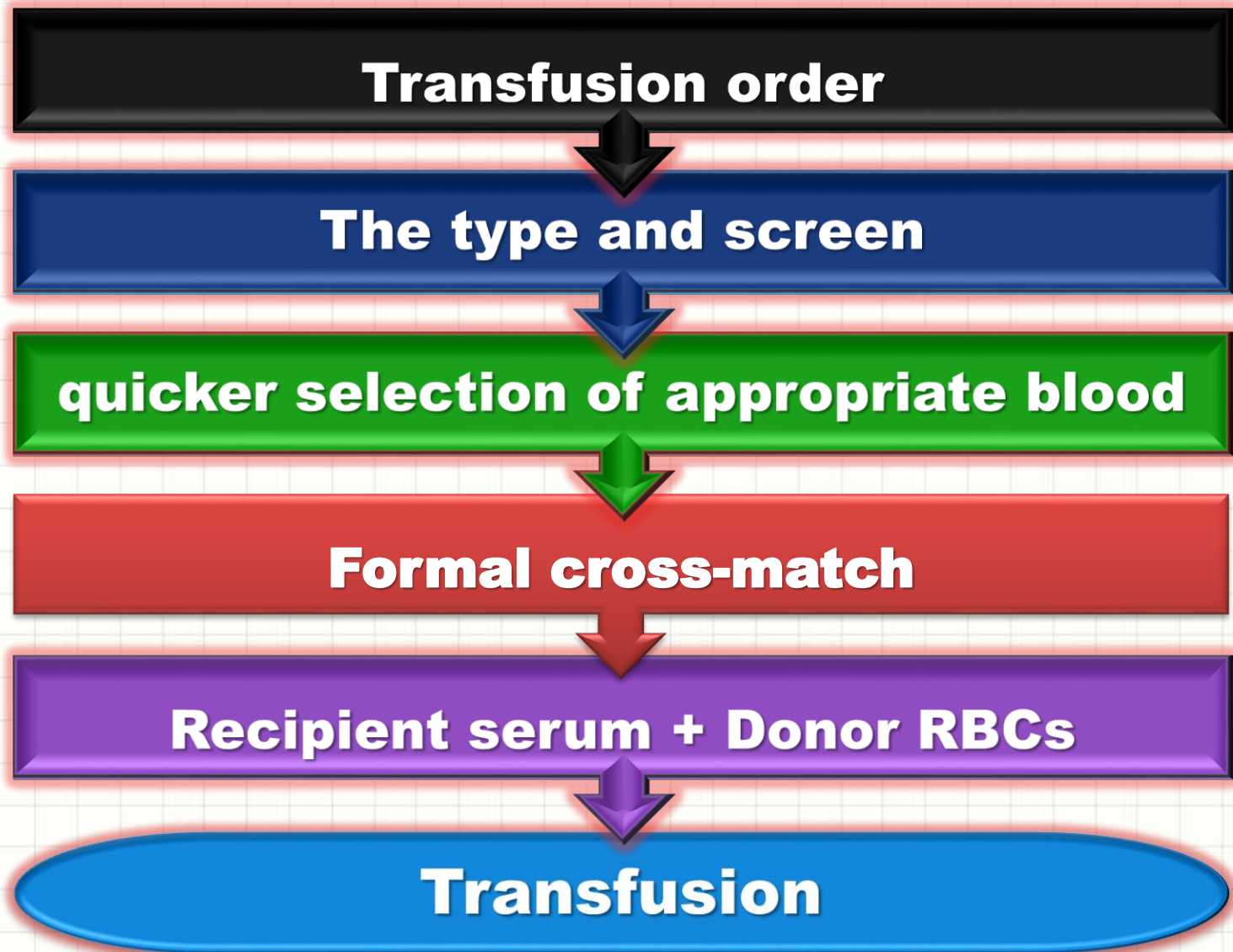
Q.) How many blood group we have?

Blood Transfusion: "ABO" Grouping

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies in Plasma				 Anti-B and Anti-A
Antigens in Red Blood Cell	A antigen	B antigen	A and B antigens	None
Donates	A & AB	B & AB	AB	A, B, AB & O
Receives	A & O	B & O	A, B, O & AB	O

O Rh -ve

Blood Transfusion: **Type & Screen**



Blood & Products Transfusion

Q.) Why ?

- Increase “**Oxygen Carrying Capacity**”
- Restoration of “**Red Cell Mass**”
- Correction on “**Anemia**”
- Correction of “**Bleeding**” caused by:
 - “**Platelet Dysfunction**”
 - “**Factor Deficiencies**”

Q.) How ?

Oxygen Delivery

- Oxygen Delivery (DO_2):

“Is the oxygen that is delivered to the tissues”

$$DO_2 = COP \times CaO_2$$

(Cardiac Output \times Arterial Oxygen Content)

- Oxygen Content (CaO_2):

$$= (Hb \times 1.39) O_2 \text{ Saturation} + PaO_2(0.003)$$

“Hb” is the main determinant of CaO_2 in the blood.

Oxygen Delivery (cont.)

$$DO_2 = COP \times CaO_2$$



Cardiac Output = “HR” (Heart Rate) \times “SV” (Stroke Volume)

- *Therefore:*



$$DO_2 = \text{“HR} \times \text{SV”} \times CaO_2$$

- If **HR** or **SV** are unable to compensate,
- **Hb** is the major determinant factor in **DO₂**

Blood Transfusion: **Administration**

- **Legal Aspects:**

- 60% of transfusions occur perioperatively.
 - Responsibility of “*Perioperative Transfusion*” is with the *Anesthesiologist*
 - “**2**” qualified staff → check the blood
 - Identification: “**Recipient and Unit**”
 - Confirmation of: “**Compatibility & Expiration Date**”
- *To prevent a potentially fatal & critical error.*

Blood Transfusion: Administration

- Legal Aspects: Q. ???

You are now an investigator for KCUH e-OVR INC-16266



kkuheovr@KSU.EDU.SA

Wed 10/18, 10:06 AM

Salah N Tallawy ▾

You have been assigned as an investigator for KCUH e-OVR INC-16266.

The details are:

Form number: INC-16266

Description:

IT WAS IDENTIFIED BY THE CIRCULATING NURSE PHILOMINA THAT BLOOD IS GIVEN TO THE WRONG PATIENT BY THE PERFUSIONIST , 2 PATIENTS WERE POSTED FOR CARDIAC SURGERY. BLOOD WERE O +VE FOR BOTH PATIENT...DURING BYPASS OR 13 PATIENTS(HATIM NASSER--10025456) BLOOD GIVEN TO O R 45 PATIENT (ZAHRA OTHMAN--10148933)

Please go to <http://10.135.196.38/Datix/live/index.php?action=incident&recordid=17066> to view it.

Blood Transfusion: **Administration**

- **Urgent transfusion:**
 - **Require flow rates faster than gravity can provide.**

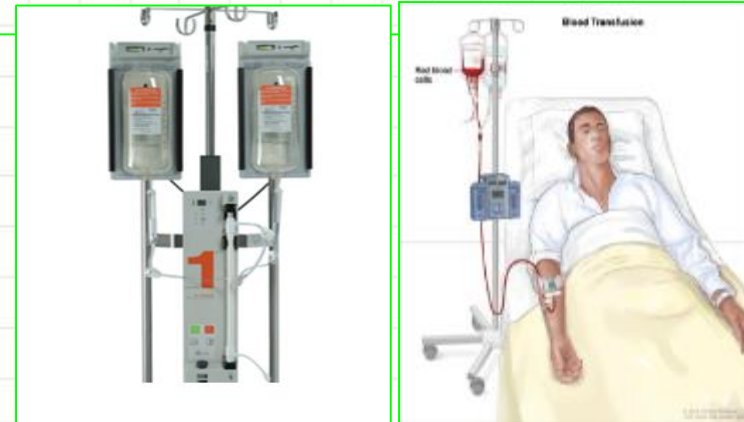
1.) Pressure bags:

→ Apply pressure evenly to the blood bag surface.

2.) Level (1) transfusion system.

- *If external pressure is anticipated:*

→ **Large-bore “IV cannula” is recommended to prevent hemolysis.**



Blood Transfusion: **Managements**

1. Patient's age,
2. Severity of symptoms,
3. Cause of the deficit,
4. Underlying medical condition,
5. Ability to compensate for:
 - ↓ "O₂ carrying capacity"
6. Tissue oxygen requirements.

Determinant Factors

Blood Transfusion: **Managements**

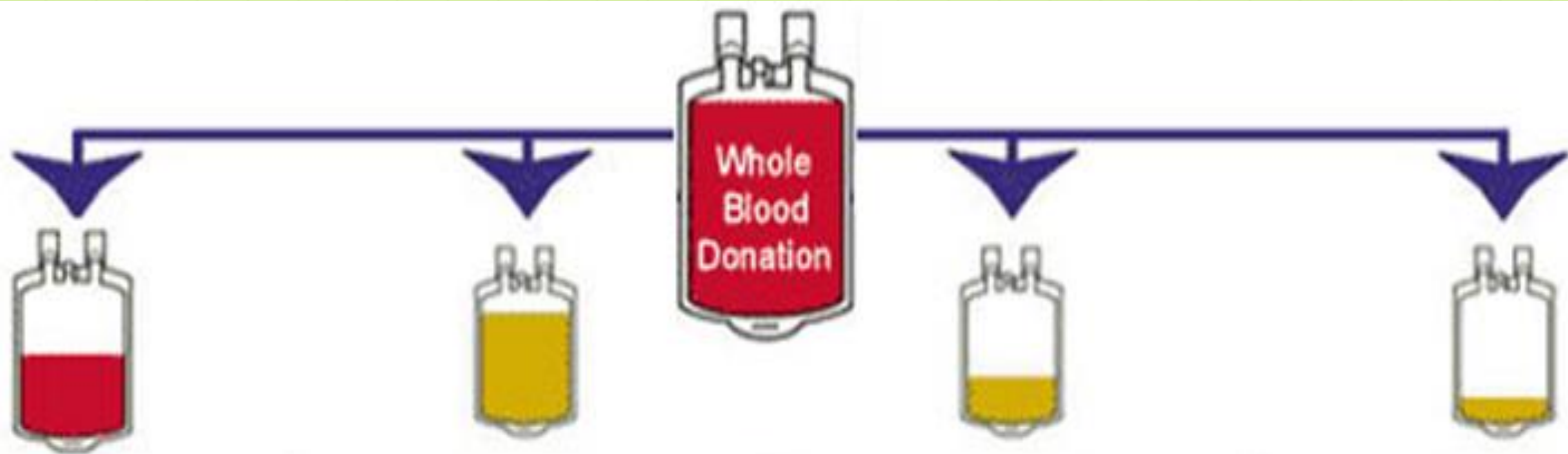
- **Clinical evaluation:**

1. Appearance (**pallor, diaphoresis**),
2. Mentation (**alert, confused**),
3. Heart Rate,
4. Blood Pressure,
5. Nature of the bleeding: (**active, controlled, rate**)

- **Laboratory evaluation :**

1. CBC
 - Hb,
 - Hematocrit,
 - Platelets,
2. Coagulation profile.

Blood & Blood Products



Red Blood Cells

To increase the amount of red blood cells after trauma or surgery or to treat severe anemia.

Fresh Frozen Plasma

To correct a deficiency in coagulation factors or to treat shock due to plasma loss from burns or massive bleeding.

Concentrate of Platelets

To treat or prevent bleeding due to low platelet levels. To correct functional platelet problems

Cryoprecipitate

To treat fibrinogen deficiencies:

STORAGE PERIOD

42 days in the refrigerator or 10 years in the freezer

1 year in the freezer

5 days at room temperature

1 year in the freezer

When to Transfuse ?

Transfusion Requirements In Critical Care Trial “TRICC”

- 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”**
 - more intolerant of anemia,
 - *benefit from higher transfusion threshold.*

Blood & Blood Products

Packed Red Blood Cells “PRBCs”

- **PRBCs** → improve **DO₂** to tissues.
- *American Society of Anesthesiologists “ASA”*
 1. Transfusion is rarely needed with **Hb ≥ 10 g/dL** .
 2. Always needed when the **Hb ≤ 6 g/dL**.
 3. Patients with: **Hb (6 – 10) mg/dL**
 - require careful clinical judgment.

Blood & Blood Products

- **Whole Blood:**

- It is not as economical as component therapy,
- In modern transfusion medicine is rarely used.

Although,

- *There has recently been renewed interest in the benefits of using fresh whole blood in “Military Field Hospitals”.*

Blood & Blood Products

PRBCS

- “1” U of PRBCs:
 - ↑ the Hb → 1 g/dL
 - or the hematocrit → 3%.
- PRBCs are run through a filter with a large-bore IV line.
 - → With normal saline.
 - ☒ Lactated Ringer’s → clotting due to the added Ca^{++}
 - ☒ Hypotonic solution → hemolysis.
- Most transfusions are given: 60 – 90 min & (not > 4 h).

Blood & Blood Products

Fresh Frozen Plasma “FFP”

- “1” u “FFP” = 200 – 250 ml.
- “FFP” is ABO compatible.
- “FFP” → through blood tubing.
- within 2 to 6 hrs of thawing.
- It contains all clotting factors.
- **Dose of “FFP”**
 - It should be given to achieve a minimum of 30% of plasma factor conc.
 - Calculated as 10 to 15 mL/kg.



Blood & Blood Products

Platelets

- Cross-matching is unnecessary,

But,

- *Rh-negative patients should receive Rh-negative platelets.*
- **Platelets dose:**
 - **Adults: 4 to 6 U (6 packs of platelets).**
 - **Children: 1 U/10 kg body weight.**



Blood & Blood Products

Cryoprecipitate



- **Cryoprecipitate is a source of:**
 - Fibrinogen, Factor VIII, and vonWillebrand factor (vWF).
 - It is ideal for supplying **fibrinogen** to the volume-sensitive patient.
- ***When factor VIII concentrates are not available,***
 - Cryoprecipitate may be used
 - (each unit contains \approx 80 units of factor VIII)

Adverse Reactions of Blood Transfusion

- 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 Blood Components.**
 e.g (filtered, washed, or irradiated)

Adverse Reactions of Blood Transfusion

IMMUNE-MEDIATED REACTIONS

I) 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,

Adverse Reactions of Blood Transfusion

- **Presentation of AHTR:**

- **Clinical:**

- Hypotension, tachycardia, tachypnea,
 - Fever, chills,
 - Chest / flank pain,
 - Discomfort at the infusion site.

- **Laboratory:**

- CBC → Hemoglobinemia, ?
 - Urine → Hemoglobinuria. ?

Adverse Reactions of Blood Transfusion

- **The laboratory evaluation for hemolysis :**
 1. **Serum haptoglobin,**
 2. **Lactate dehydrogenase (LDH),**
 3. **Indirect bilirubin levels**
 4. **Coagulation studies e.g.**
 - **Prothrombin Time (PT),**
 - **Activated Partial Thromboplastin Time (aPTT),**
 - **Fibrinogen and Platelet Count.**

Adverse Reactions of Blood Transfusion

- **Managements of AHTR:**
 - Transfusion must be stopped immediately,
 - IV access maintained, IV fluids started
 - The reaction reported to the blood bank.
 - The immune complexes that result in RBC lysis can cause renal dysfunction and failure.
 - So, Diuresis should be induced with:
 - IV fluids and furosemide or mannitol.
 - Tissue factor released from the lysed RBCs → **DIC.**

Adverse Reactions of Blood Transfusion

II.) Febrile Non-Hemolytic Transfusion Reaction

“FNHTR”

- The most frequent reaction associated with the transfusion of cellular blood components.
- These reactions are characterized by:
 - Chills and rigors
 - Rise in temperature ($\geq 1^{\circ}\text{C}$).

Adverse Reactions of Blood Transfusion

III. Allergic Reactions:

- It is mainly related to plasma proteins found in transfused components.
- *Mild reactions treated symptomatically by:*
 - Temporarily stopping the transfusion
 - And administering antihistamines
e.g. (diphenhydramine, 50 mg orally or IM).

Adverse Reactions of Blood Transfusion

IV. Anaphylactic reaction

- This severe reaction presents after transfusion of a few ml of the blood component.
- **Symptoms and signs:**
 - Difficulty in breathing, Coughing & Bronchospasm
 - Nausea and Vomiting,
 - Hypotension,
 - Shock, Loss of consciousness & Respiratory arrest.
- **Managements:**
 - Stopping the transfusion,
 - Maintaining vascular access, IV fluids
 - Administering epinephrine (0.5–1 mL of 1:1000) S.C.
 - Glucocorticoids may be required in severe cases.
 - O₂ & symptomatic ttt

Adverse Reactions of Blood Transfusion

V. Graft-versus-host disease (GVHD)

- It is a frequent complication of:
 - **“Allogeneic Stem Cell Transplantation”**
- In which T- Lymphocytes from the donor attack the immune-deficient host.
- Manifested clinically by:
 - **Fever & a characteristic cutaneous eruption,**
 - **Diarrhea, and liver function abnormalities.**

Adverse Reactions of Blood Transfusion

VI.) Transfusion-related “Acute Lung Injury”:

- **Presents as:**
 - Acute respiratory distress,
 - During or within 6 h of transfusion.
- **Characterized by:**
 - Respiratory compromise,
 - Signs of non-cardiogenic pulmonary edema,
 - X-ray chest → bilateral interstitial infiltrates.
- **Treatment:**
 - Mainly supportive ttt,
 - Patients usually recover without complications,

Adverse Reactions of Blood Transfusion

VII.) NON-IMMUNOLOGIC REACTIONS:

1. Fluid overload

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

Adverse Reactions of Blood Transfusion

VII.) NON-IMMUNOLOGIC REACTIONS:

2. 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.

Adverse Reactions of Blood Transfusion

3. Electrolyte toxicity

- RBC leakage during storage:
 - ↑ the conc. of potassium.
- Citrate → chelates calcium
 - thereby inhibits the coagulation cascade.
- Multiple & Rapid Transfusions:
 - Hypocalcemia, manifested by:
 - circumoral numbness and/or tingling sensation of the fingers and toes.

** Citrate is quickly metabolized → Bicarbonate,*

So, Calcium infusion is seldom required in this setting.

Adverse Reactions of Blood Transfusion

4. Iron overload (*Hemochromatosis*)

- 1 unit of RBCs = 200–250 mg of iron.
- Symptoms and signs:
 - Affecting endocrine, hepatic, and cardiac function are common after large # of RBC units (*e.g. Thalassemia*).
- Preventing this complication:
 - By using alternative therapies (*e.g. Erythropoietin*).
 - Chelating agents: e.g.
 - Deferoxamine and deferasirox, are available,
 - But the response though is often suboptimal.

Adverse Reactions of Blood Transfusion

VIII.) INFECTIOUS COMPLICATIONS

1. Viral infections

- a) Hepatitis C virus
- b) Human immunodeficiency virus type 1
- c) Hepatitis B virus
- d) Cytomegalovirus
- e) Parvovirus B-19

2. Bacterial contamination

Adverse Reactions of Blood Transfusion

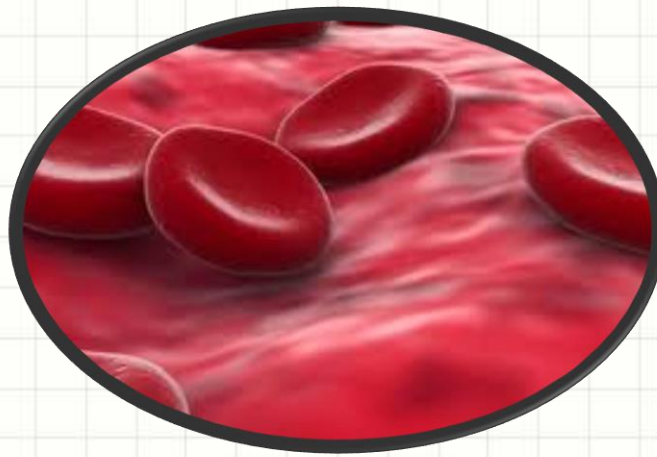
3. Other infectious agents

- Various parasites, including those causing malaria, babesiosis, and Chagas disease.
- Dengue, chikungunya virus, variant Creutzfeldt-Jakob disease, and yellow fever.

**** Geographic migration and travel of donors shift the incidence of these rare infections.***

Blood Transfusion: **Summary**

- Blood transfusion → can be a life saving measure.
- Types → Autologous & Allogenic.
- Blood bank plays the major role e.g.
 - Collection, Screening & testing and Storing of blood
- The majority of blood transfusion:
 - perioperative sitting.
- No transfusion is → a “Zero-risk Event”.
- Errors and bacterial contamination remain potential complications even with
 - Autologous transfusions.



Thank You

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