BT
Part 1B

University of Baghdad/ College of Medicine Jan 2024

University of Baghdad
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Title: BLOOD TRANSFUSION – Part 1B

Grade: 4

Module: PATHOLOGY (Hematology)

Speaker: Professor Dr. Haithem Ahmed Al-Rubaie

MBChB (1985)

FIBMS-Hematopathology (1998)

DEPARTMENT OF PATHOLOGY AND FORENSIC MEDICINE

28 Jan - 14 Feb 2024

Blood Transfusion (Part 1B)

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BT part 1B

Learning Objectives: at the end of this lecture, the student will be able to:

1. **Identify the Red cell Ags and blood group Abs.**
2. **Differentiate between direct and indirect antiglobulin tests.**
3. **Indicate the use of blood warmers**
4. **Identify the anticoagulants used in blood banks.**
5. **Commit to the time limits of infusion of blood components.**
6. **Record the transfusion and Monitor a transfused patient.**

CONTENTS:

- Red cell antigens
- Antibodies to RBC Antigens
- Antiglobulin test (Coombs test)
- Anticoagulant Preservative Solutions
- Blood warmers
- Time limits for infusion of blood component
- Recording the transfusion in the patient’s notes

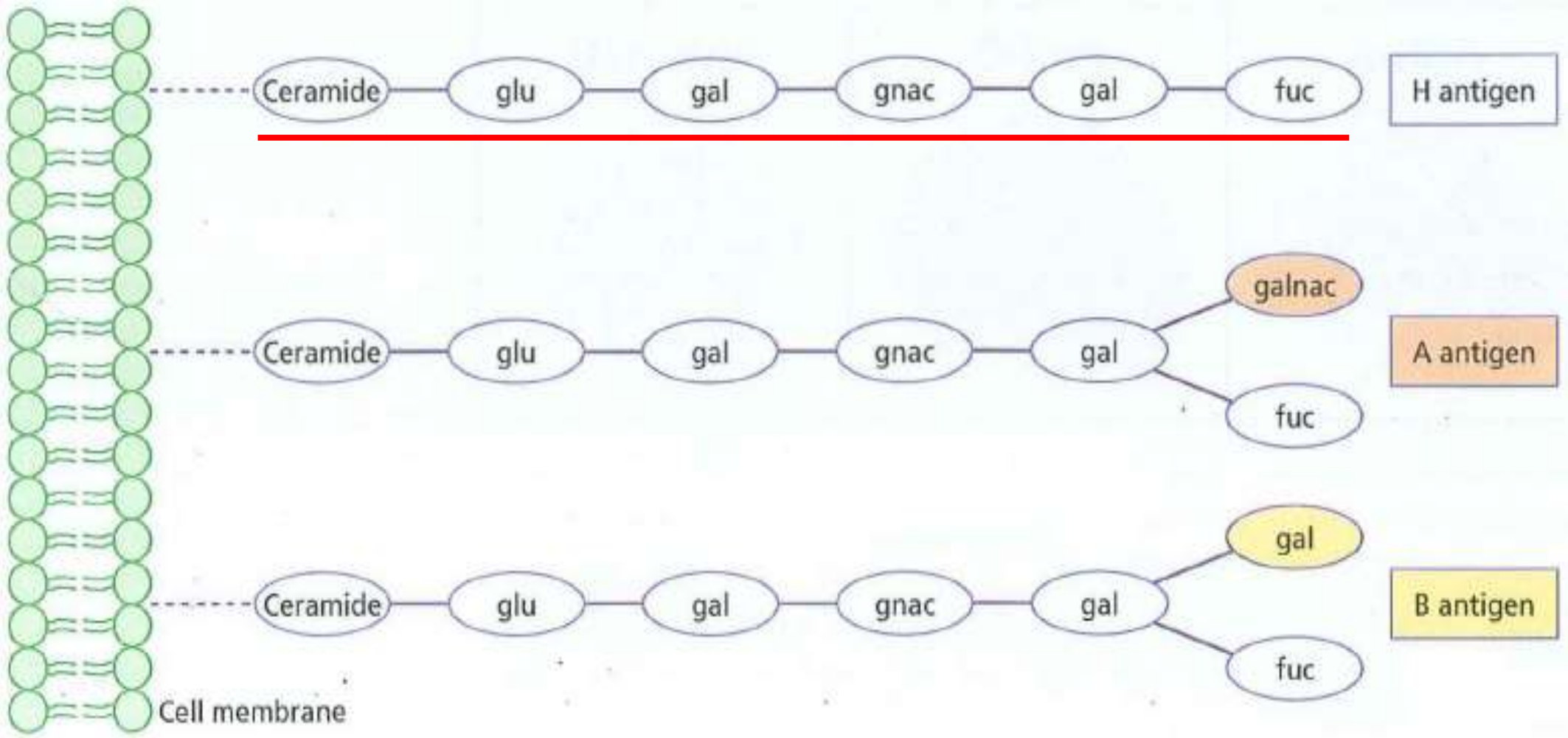
ABO and Rh systems

Red cell antigens
&
Antibodies to Blood Group Antigens

Red cell antigens

- **Different blood group Antigens vary greatly in their clinical significance with the *ABO and Rh groups being the most important*.**

- Some other systems are present.



Structure of ABO blood group antigens. Each consists of a chain of sugars attached to lipids or proteins which are an integral part of the RC membrane. The **H** antigen of the O blood group has a terminal **L-fucose** (fuc). The **A** antigen has an additional **N-acetyl galactosamine** (galnac), and the **B** antigen has an additional **D-galactose** (gal). glu, glucose.

Antibodies to RBC Antigens

Individuals who lack a particular blood group Ag may produce Abs reacting with that Ag which may lead to a transfusion reaction.

The types of Antibodies to RBC Antigens are either:

A. ***Naturally-occurring antibodies*** such as anti-A from blood group B individuals and anti-B from blood group A individuals are predominantly IgM antibodies to A and B antigens, respectively.

B. Immune antibodies:

- Develop in response to blood transfusion or transplacental passage during pregnancy of fetal red cells possessing Ags that the mother lacks.

- These are commonly IgG and are capable of transplacental passage from mother to fetus.

- The *RhD* gene may be either:
  - Present (RhD +ve) or
  - Absent (RhD -ve).

- **Anti-D is the most common immune Ab of clinical relevance.**

- Anti-C, anti-c, anti-E, and anti-e are occasionally seen.

- **All may cause both hemolytic transfusion reactions (HTRs) and hemolytic disease of fetus and newborn (HDFN).**

RhIg (Anti-D injection 1500 IU) should be given to the RhD-negative mother within 72 hours after delivery if the newborn is RhD-positive.

- > 80% of D-negative recipients of a **whole unit** of D-positive red cells make anti-D.

- 17% of D-negative women will be immunized by **one pregnancy** with RhD-positive offspring.

Antiglobulin test (Coombs test)

➢ The Direct Antiglobulin Test (DAT):

It is used for detecting Ab or complement on the RC surface where sensitization has occurred ***in vivo*.** A positive DAT occurs in:

- **Hemolytic disease of fetus and newborn (HDFN).**
- **Autoimmune or drug-induced immune hemolytic anemia (AIHA)**
- **Hemolytic transfusion reactions (HTR)**

➢ The Indirect Antiglobulin Test (IAT):

It is used to detect Abs that have coated the RCs *in vitro.*

It is mainly used in:

- **Crossmatch: screening of the recipient's serum for alloantibodies to donor RBCs Ags.**
- **Ab screen: detecting alloantibodies in a pregnant woman's serum towards fetal RBCs Ags.**
- **Ab titer to follow the increase in alloantibodies in a pregnant woman.**

Anticoagulant Preservative Solutions

The purpose of anticoagulants used for the collection and storage of blood, and additive solutions, is to reduce the progressive loss of viability of the red cells to a minimum.

- The anticoagulants used include:

Anticoagulant Preservative Solutions

used for whole blood and RBC storage at 1°C to 6°C

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Name	Abbreviation	Storage Time (Days)
Acid citrate-dextrose (formula A)	ACD-A	21
Citrate-phosphate dextrose	CPD	21
Citrate-phosphate-double-dextrose	CP2D	21
Citrate-phosphate-dextrose-adenine	CPDA-1 (25% more dextrose)	35
Saline-adenine-glucose-mannitol	CPD-SAGM	42
Saline-adenine-glucose-citrate-phosphate	CP2D-AS-3	42

CPDA-1

Citrate (sodium citrate/citric acid)	Chelates calcium; prevents clotting.
Monobasic sodium **P**hosphate	Maintains pH during storage; Necessary for maintenance of adequate levels of 2,3-DPG.
Dextrose	Substrate for ATP production (cellular energy).
Adenine	Production of ATP by stimulating glycolysis (extends shelf-life from 21 to 35 days).

Blood donation is taken by an aseptic technique into plastic packs designed to hold 450 ± 45 ml of blood, mixed with 63 ml of the anticoagulant.

The ratio of anticoagulant to blood must be maintained at the optimal level of **1:7.**

The citrate, in the anticoagulant, combines with blood calcium, and thus anti-coagulates the blood.

The infusion (administration) set is changed:

- At least 12-hourly during blood component infusion.
- In a very warm climate, change the set more frequently and,
- Usually after every four units of blood.

BLOOD WARMERS:

- Cardiac irregularities, and ventricular fibrillation, may result from transfusion of large quantities of cold blood (temperature may fall from 37°C to 34.8°C) increasing morbidity and mortality.
- The hypothermia is increased when blood is transfused through a central venous device directly into the right atrium.

- Blood warmers are rarely needed during routine transfusions.
- Warming devices should be validated, and maintained and testing of alarms should be performed.
- Warming blood to temperatures > 42°C may cause hemolysis.

Blood components should not be warmed by placing them in a microwave, on a heat source, in hot water, or by using devices that are not FDA-approved as this could lead to hemolysis of the red cells which could be life-threatening.

However, keeping the patient warm is probably more important than warming the infused blood.

Indications of using warmed blood:

Large volume rapid transfusions:

- Adults: > 50 mL/ kg/ hour (1 unit within 5-10 min)
- Children: > 15 mL/ kg/ hour

Exchange transfusion in infants

Patients with clinically significant cold agglutinins (opinions vary on the utility of blood warmers in patients with cold agglutinins).

TIME LIMITS FOR INFUSION

	Start infusion	Complete infusion
Whole blood or red cells	Within 30 minutes of removing pack from refrigerator	Within 4 hours * (or less in high ambient temperature)
Platelet concentrates	Immediately	Within 20 minutes
Fresh frozen plasma and cryoprecipitate	As soon as possible	Within 20 minutes

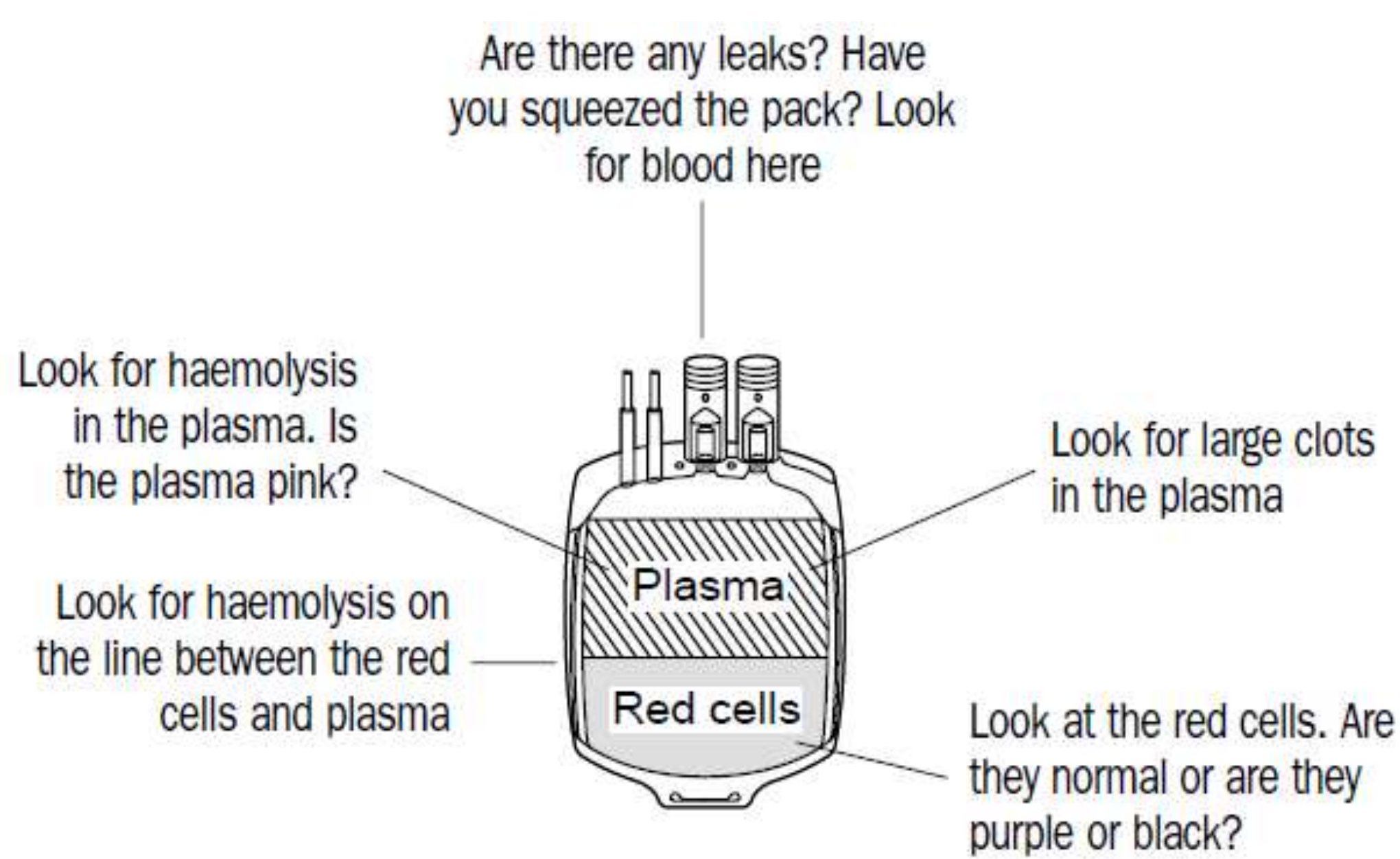
*Must be administered within 4-6 hours if the component has warmed to above 10°C after storage, or otherwise must be destroyed.

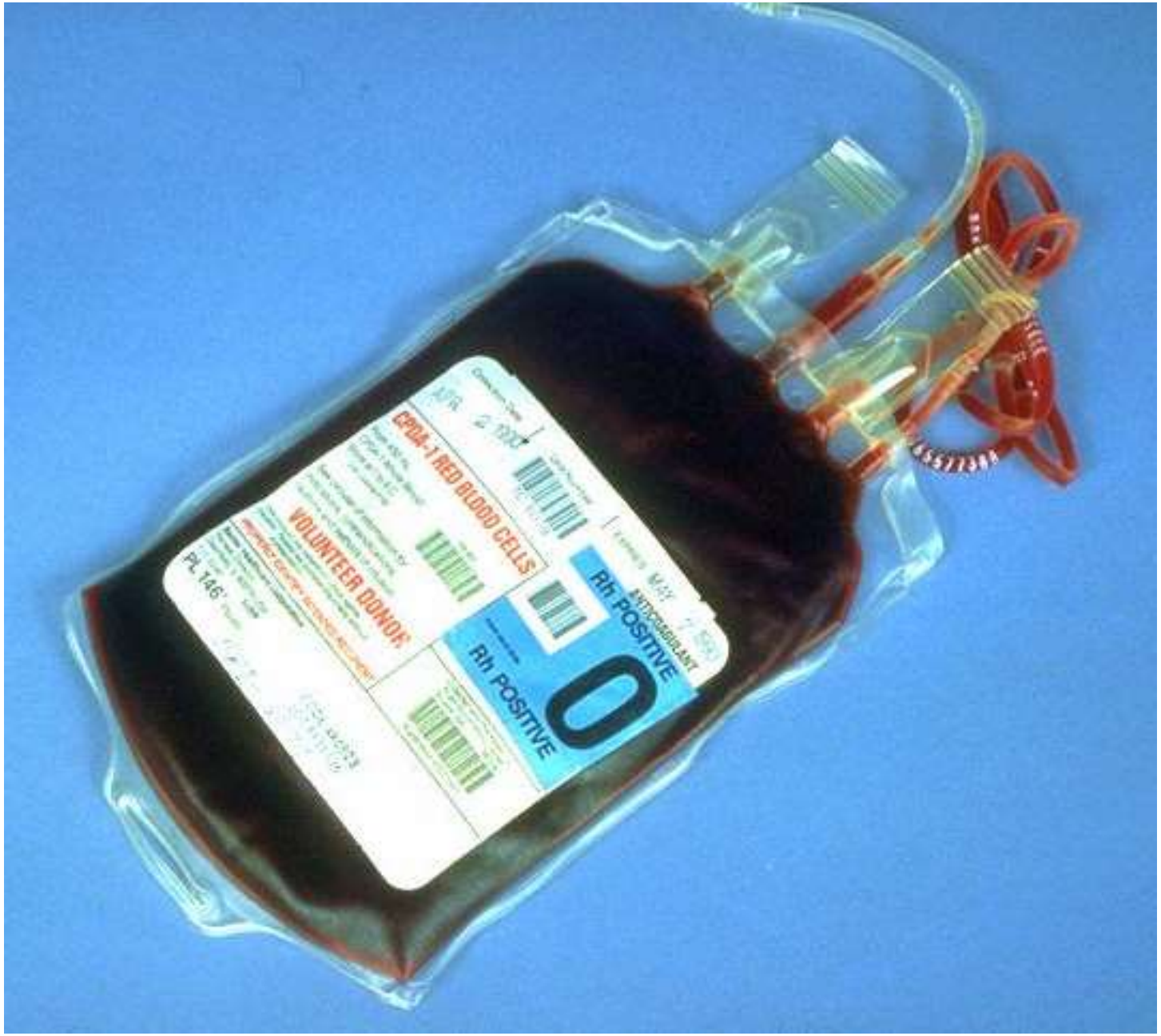
* Must be destroyed if the temperature of 25 °C has been exceeded.

The Whole blood or Packed red cells should be kept refrigerated at 2-6 °C.

The upper limit of 6 °C is essential to minimize the growth of any bacterial contamination in the unit of blood.

The lower limit of 2 °C is essential to prevent hemolysis, which can cause fatal bleeding problems or renal failure.


Are there any leaks? Have you squeezed the pack? Look for blood here
Look for haemolysis in the plasma. Is the plasma pink?
Look for large clots in the plasma
Plasma
Look for haemolysis on the line between the red cells and plasma
Red cells
Look at the red cells. Are they normal or are they purple or black?


CPDA-1 RED BLOOD CELLS
VOLUNTEER DONOR
Rh POSITIVE
O
Rh POSITIVE
ANTICOAGULANT

RECORDING THE TRANSFUSION
in patient's notes

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1. Inform the patient and/or relatives about the proposed transfusion.
   - The Reason for transfusion.
   - Signature of the **prescribing clinician**.

RECORDING THE TRANSFUSION
in patient's notes

2. **Pre-transfusion checks** of:
   - Patient's identity
   - Blood pack
   - Compatibility label
   - Signature of the person performing the pre-transfusion check.

RECORDING THE TRANSFUSION
in patient's notes

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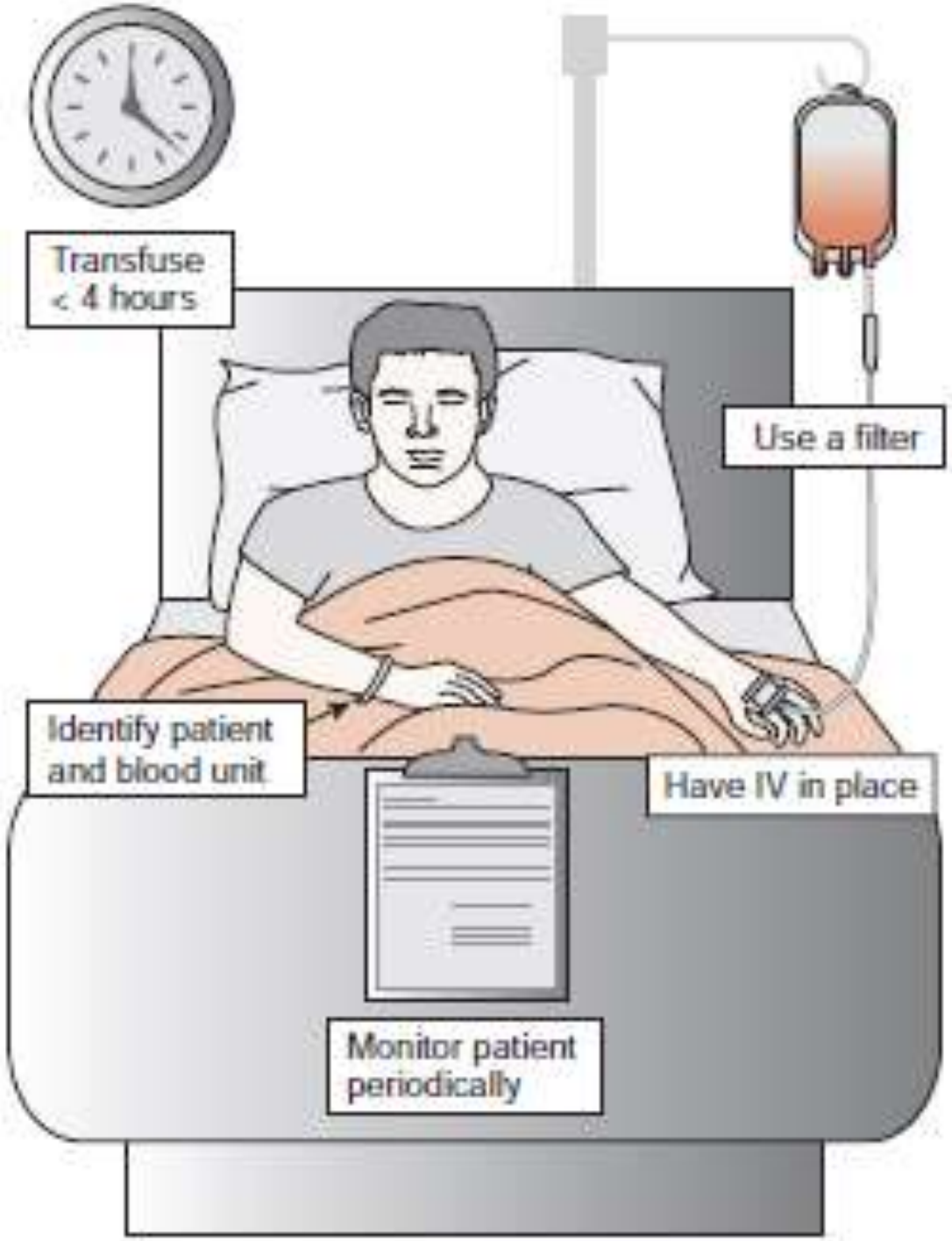
3. **The transfusion:**
   - Type and volume of each product transfused
   - Blood group of each unit transfused
   - Time at which the transfusion of each unit commenced
   - Signature of the doctor
4. **Monitoring** of the patient before, during, and after the transfusion.
5. **Record any transfusion reactions.**


Transfuse
< 4 hours
Use a filter
Identify patient
and blood unit
Have IV in place
Monitor patient
periodically

MONITORING THE TRANSFUSED PATIENT

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1. When to MONITOR the patient?

(for each unit of blood transfused)

- Before starting the transfusion
- As soon as the transfusion is started
- 15 minutes after starting the transfusion
- At least every hour during transfusion
- On completion of the transfusion
- 4 hours after completing the transfusion.

MONITORING THE TRANSFUSED PATIENT

2. What to MONITOR at each of these stages?

Record the following vital parameters on the patient's chart:

- Patient's general appearance
- Temperature
- Heart rate
- Blood pressure
- Respiratory rate
- Fluid balance:
  - — Oral and IV fluid intake
  - — Urinary output.

MONITORING THE TRANSFUSED PATIENT

3. Record:

- Time the transfusion is started
- Time the transfusion is completed
- Volume and type of all products transfused
- Any adverse effects.

Summary

- Naturally occurring IgM Abs occur in ABO groups, and immune-occurring IgG Abs develop as a consequence of exposure to RBC Ags.
- AGT has important clinical applications.
- Blood warmers are rarely needed during routine transfusions.
- Pre-transfusion check and monitoring of the vital signs are of utmost importance in the early diagnosis of complications.

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End of BT part 1B