PIPADOR REVISION

MRCOG Part 1 Revision Notes

Principles of Blood Transfusion

PHYSIOLOGY • LECTURE 129

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG PART 1 REVISION NOTES | PHYSIOLOGY

129 Principles of Blood Transfusion

Blood groups, compatibility testing, components, anti-D prophylaxis, obstetric haemorrhage and transfusion reactions

O neg	AB	≈ 15%	72 h
Emergency red cells (K-negative for women)	Universal plasma donor	UK population RhD-negative	Anti-D window; sample validity if pregnant

129.1 Physiology underpinning transfusion

■ KEY EQUATIONS

$DO_2 = CO \times CaO_2$ (≈ 1000 mL O_2/min); **$CaO_2 = 1.34 \times Hb \times SaO_2 + 0.023 \times PaO_2$(kPa)** ≈ 20 mL/dL — **Hb is the dominant determinant**; dissolved O_2 is trivial.

Anaemia → ↓ CaO_2 ▶ ↑ CO (↓ viscosity, ↑ HR) ▶ ↑ O_2 extraction ▶ ↑ **2,3-DPG** → right-shifted ODC ▶ ↑ **EPO** → reticulocytosis (3–5 days)

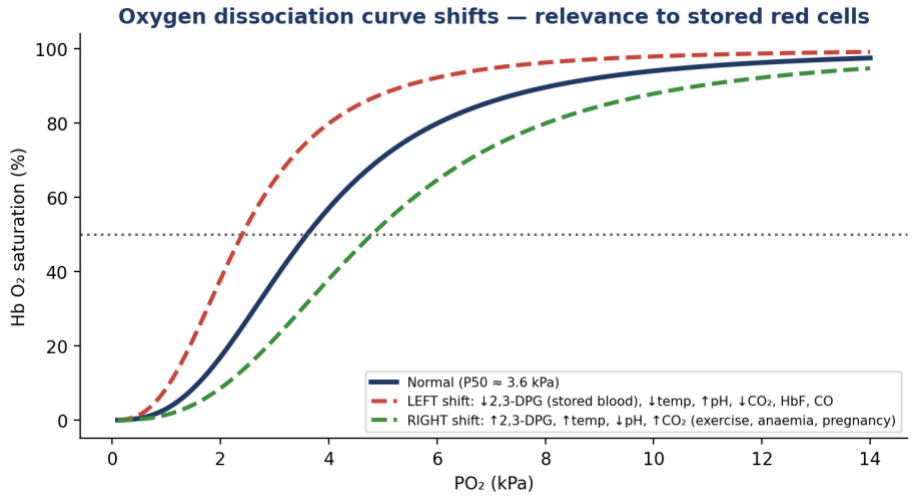


Figure 129.1 — ODC shifts: stored red cells (↓ 2,3-DPG) are left-shifted

↓ 2,3-DPG	↑ K^+	Citrate	SAG-M
Left shift; recovers 24–72 h after transfusion	Hyperkalaemia risk: massive, neonatal, IUT	Binds Ca^{2+} → hypocalcaemia	Leucodepleted, 2–6 °C, 35 days

129.2 Blood group immunology

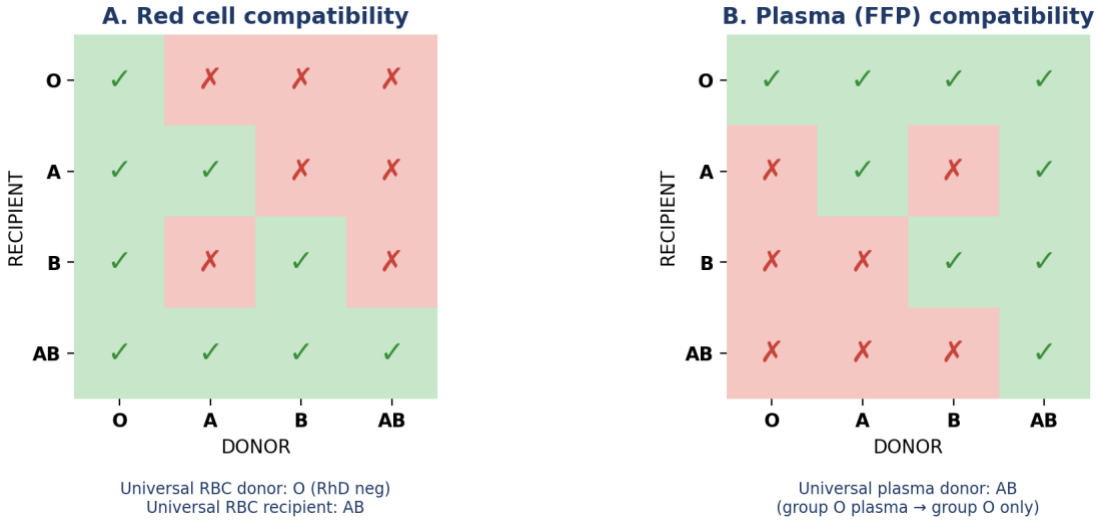


Figure 129.2 — ABO compatibility for red cells and plasma

Group	Antigen	Antibodies	UK frequency
O	None (H)	Anti-A + anti-B	≈ 48%
A	A	Anti-B	≈ 38%
B	B	Anti-A	≈ 10%
AB	A + B	None	≈ 3%

Feature	ABO antibodies	Anti-D (Rh)
Origin	Naturally occurring (from 3–6 months)	Immune — after transfusion or pregnancy
Class	Mainly IgM — complement → intravascular haemolysis	IgG — crosses placenta → HDFN
HDFN	Mild ABO HDFN (group O mothers' IgG); can affect 1st pregnancy	Mild to severe; prevented by anti-D prophylaxis

Antibody in pregnancy	Action (BSH 2016)
Anti-D	< 4 IU/mL HDFN unlikely; 4–15 moderate; > 15 severe — refer to fetal medicine if > 4 or rising
Anti-c	< 7.5 low; 7.5–20 moderate; > 20 IU/mL high risk
Anti-K (Kell)	Suppresses fetal erythropoiesis → refer whatever the titre; check partner
Anti-E, Fy^a, Jk^a	Monitor titres; Kidd → delayed haemolytic reactions
IgM (Lewis, P$_1$, M)	Not significant for HDFN

■ CLINICAL CORRELATION

- Group and antibody screen at **booking and 28 weeks**; monitor sensitised pregnancies with **MCA PSV Doppler** (> 1.5 MoM → fetal anaemia → IUT).
- IUT blood: **O RhD-neg, K-neg, CMV-neg, irradiated, HbS-neg, < 5 days old, Hct 0.70–0.85**, crossmatched with maternal plasma.

129.3 Anti-D prophylaxis

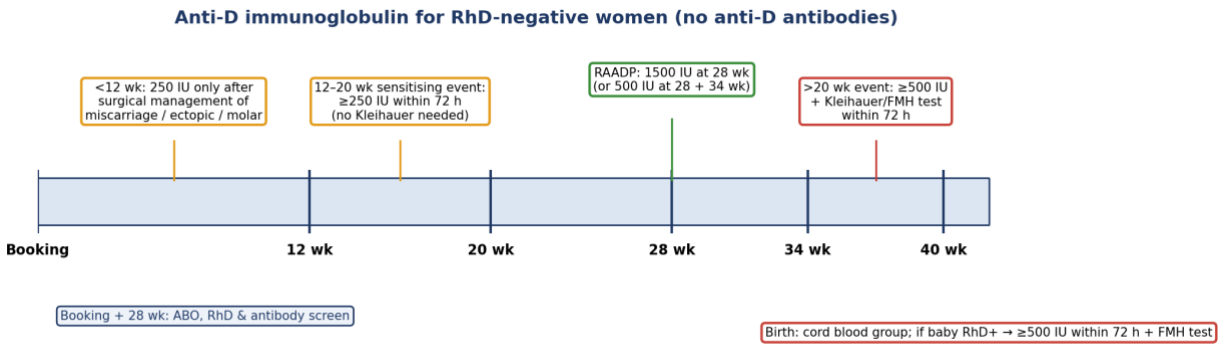


Figure 129.3 — Anti-D for RhD-negative women without immune anti-D

1500 IU	250 IU	500 IU	4 mL
RAADP at 28 wk (or 500 IU at 28 + 34)	Sensitising event < 20 weeks	≥ 20 weeks & postnatal + Kleihauer / FMH test	Fetal red cells covered by 500 IU (+125 IU per extra mL)

- Sensitising events: miscarriage/TOP, ectopic, invasive procedures, APH, **ECV**, abdominal trauma, IUD, delivery. < 12 weeks: only after **surgical** management of miscarriage/ectopic or molar evacuation (NICE NG126).
- Give within **72 h** (some benefit up to 10 days). **Cell-free fetal DNA RhD genotyping** (NICE DG25) avoids unnecessary RAADP. Anti-D is a pooled plasma product — consent.

129.4 Pre-transfusion testing and the safe-transfusion chain

Decision + **consent** ▶ **Sample**: bedside positive ID, hand-labelled ▶ Lab: group & screen ± crossmatch ▶ Collect correct component ▶ Bedside check; obs at 0, **15 min**, end ▶ Report reactions: **SHOT / SABRE**

Test	Purpose	Time
Group & screen	ABO/RhD + IAT screen for antibodies	≈ 40 min
Electronic issue	2 concordant samples + negative screen	≈ 5–10 min
Serological crossmatch	Needed if antibodies present	≈ 45 min+
Emergency	O RhD-neg, K-neg (group-specific in 10–20 min)	Immediate

■ EXAM TIP

- **DAT** = antibody **bound to red cells in vivo** (HDFN, haemolytic reaction). **IAT** = **free antibody in plasma** (antenatal screen, crossmatch).
- Pregnant or transfused in the last 3 months → sample must be **≤ 72 h** old.

129.5 Blood components

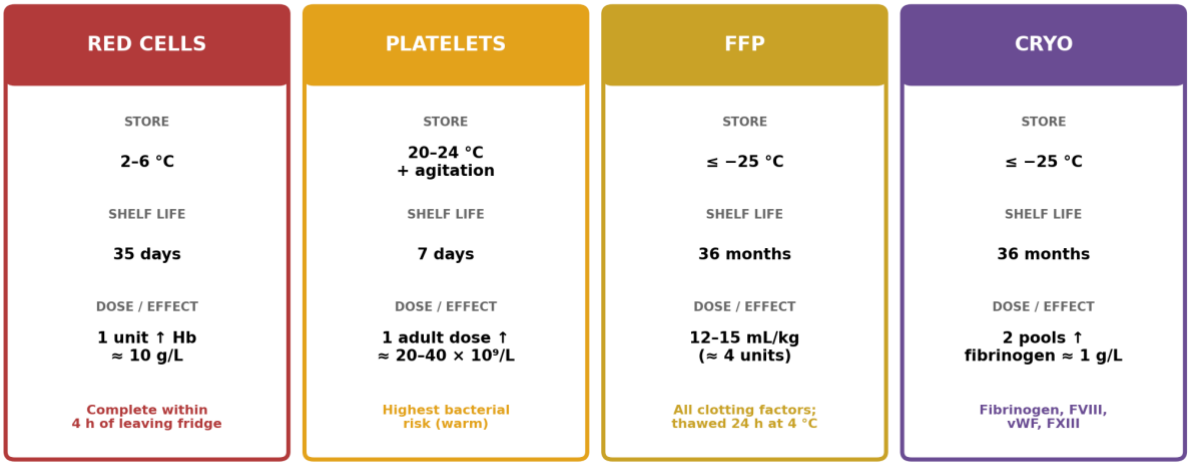


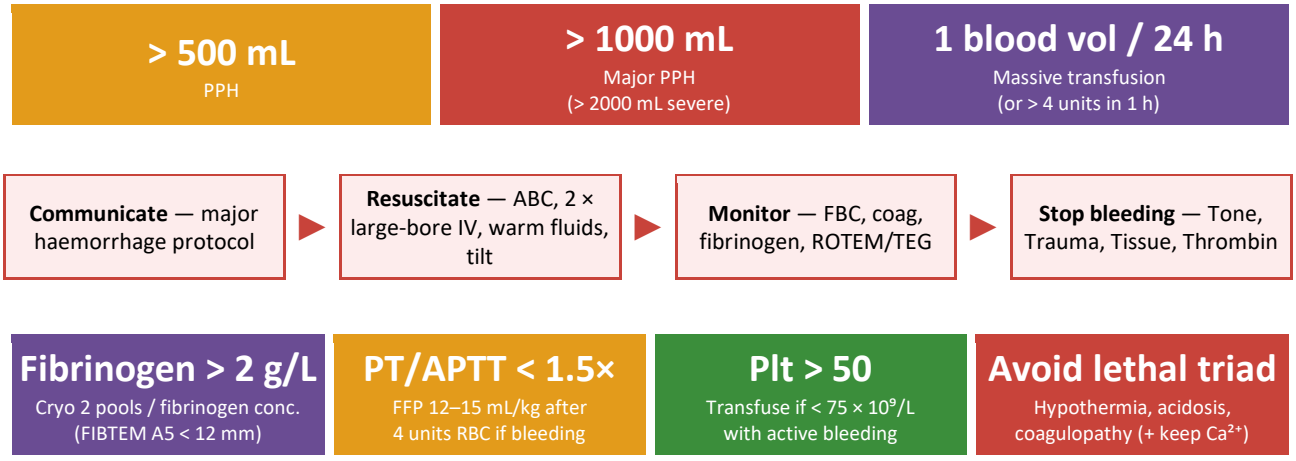
Figure 129.4 — Storage, shelf life and dose of the main components

Special requirement	When
CMV-negative	Elective transfusion in pregnancy, IUT, neonates (≤ 28 days after EDD)
Irradiated (prevents TA-GvHD)	IUT/neonatal exchange, HLA-matched or relatives' donations, Hodgkin, purine analogues
K-negative	Women of childbearing potential (< 50)
RhD-negative platelets	RhD-negative women (if RhD-pos given: 250 IU anti-D covers 5 doses/6 weeks)

Other products: **PCC** (II, VII, IX, X — urgent warfarin reversal), **fibrinogen concentrate**, **albumin**, **IVIg**, anti-D (all fractionated, virally inactivated).

129.6 Thresholds, alternatives and major obstetric haemorrhage

- Prevent: oral iron first-line; **IV iron** if intolerant or > 34 weeks. **RCOG GTG 47**: postpartum Hb < 70 g/L — transfuse on clinical grounds; in labour/immediately postpartum consider if < 80 g/L; **one unit at a time** then reassess.
- Alternatives: **cell salvage** (leucocyte filter; RhD-neg mother of RhD-pos baby → ≥ 1500 IU anti-D + Kleihauer), **tranexamic acid 1 g IV** within 3 h (WOMAN trial; repeat after 30 min if needed).
- **Jehovah's Witnesses**: individual views on fractions and cell salvage — document an **advance decision**; a competent adult may refuse; the fetus has no separate legal rights before birth (English law).



Complications of massive transfusion: dilutional coagulopathy and thrombocytopenia, hypothermia, hypocalcaemia (citrate), hyperkalaemia, acidosis, left-shifted ODC, TACO/TRALI. **Abruption and amniotic fluid embolism** cause early DIC with low fibrinogen — give fibrinogen early.

129.7 Adverse effects of transfusion

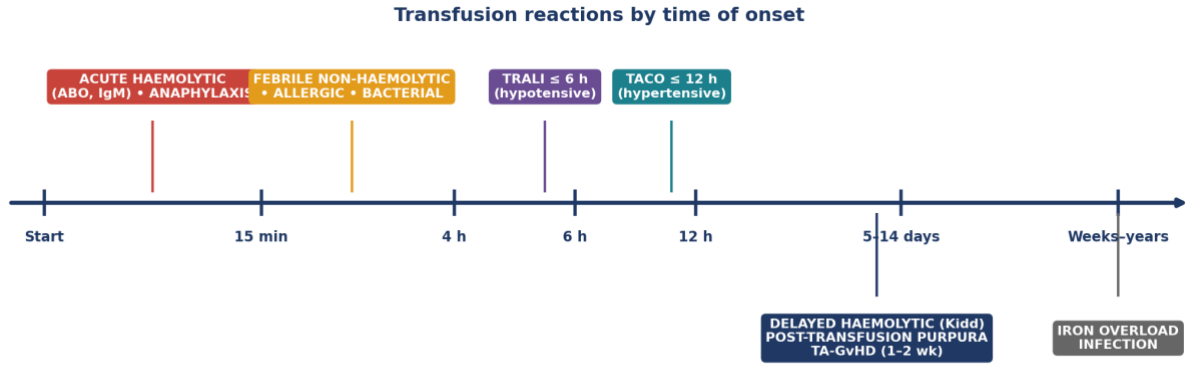


Figure 129.5 — Transfusion reactions by time of onset

Reaction	Mechanism	Key features → management
Acute haemolytic	ABO incompatibility (IgM) — ID error	Fever, loin pain, hypotension, haemoglobinuria, DIC → STOP, keep IV access, check ID, resuscitate, report
Febrile non-haemolytic	Cytokines/leucocyte antibodies	Temp rise < 2 °C → slow, paracetamol, exclude haemolysis/sepsis
Allergic / anaphylaxis	IgE; anti-IgA in IgA deficiency	Urticaria → antihistamine; anaphylaxis → IM adrenaline 0.5 mg
Bacterial	Mainly platelets	Septic shock → cultures, antibiotics
Delayed haemolytic	Anamnestic IgG (Kidd, Rh), 5–14 days	Falling Hb, jaundice, DAT +
Post-transfusion purpura	Anti-HPA-1a, 5–12 days	Severe thrombocytopenia → IVIg
TA-GvHD	Donor T cells	Pancytopenia, > 90% fatal → irradiation prevents

	TACO	TRALI
Mechanism	Volume overload (hydrostatic)	Donor anti-HLA/HNA (multiparous female donors) → capillary leak
Onset	≤ 12 h	≤ 6 h
BP / JVP	Hypertension, ↑ JVP	Hypotension, normal JVP, fever
BNP / diuretic	↑ BNP; responds to diuretic	Normal BNP; diuretics unhelpful
Note	Leading cause of transfusion deaths (SHOT); risk ↑ pre-eclampsia, cardiac disease	Male-donor plasma reduces risk

Governance: valid **consent** (SaBTO) and documentation; **positive patient ID** at every step; report to **SHOT** (voluntary, professional) and **SABRE**/MHRA (legal, BSQR 2005); keep traceability records **30 years**. Most incidents are human-factors errors. Donations are tested for HIV, HBV, HCV, HEV, HTLV and syphilis; all components are leucodepleted.

> ■ **MNEMONIC / MEMORY AID**
>
> **Platelets are the 'warm' component → 'warm = bugs'** (highest bacterial risk). **'Kell kills kids' marrow'** — refer anti-K at any titre. **TACO = Too much (hypertensive); TRALI = leaky (hypotensive).**