PIPADOR REVISION

MRCOG Part 1 Revision Notes

Fetal Haematology

PHYSIOLOGY • LECTURE 136

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG PART 1 REVISION NOTES | PHYSIOLOGY

136 Fetal Haematology

Haematopoiesis, haemoglobin switching, fetal and neonatal blood indices, fetal anaemia, platelets and coagulation

140–200 g/L	60–80%	60–90 days	1 mg IM
Hb at term birth (mean ≈ 170)	HbF at birth	Neonatal red cell lifespan (term)	Vitamin K at birth

■ KEY FACTS: Learning objectives

- Describe the sites and timing of fetal haematopoiesis and haemoglobin switching.
- Describe fetal and neonatal blood indices and the physiological changes after birth.
- Describe fetal platelets and coagulation, including vitamin K deficiency bleeding.
- Explain the causes, assessment and management of fetal anaemia and thrombocytopenia (HDFN, parvovirus, NAIT).
- Relate fetal haematology to neonatal jaundice and polycythaemia.

136.1 Sites of haematopoiesis

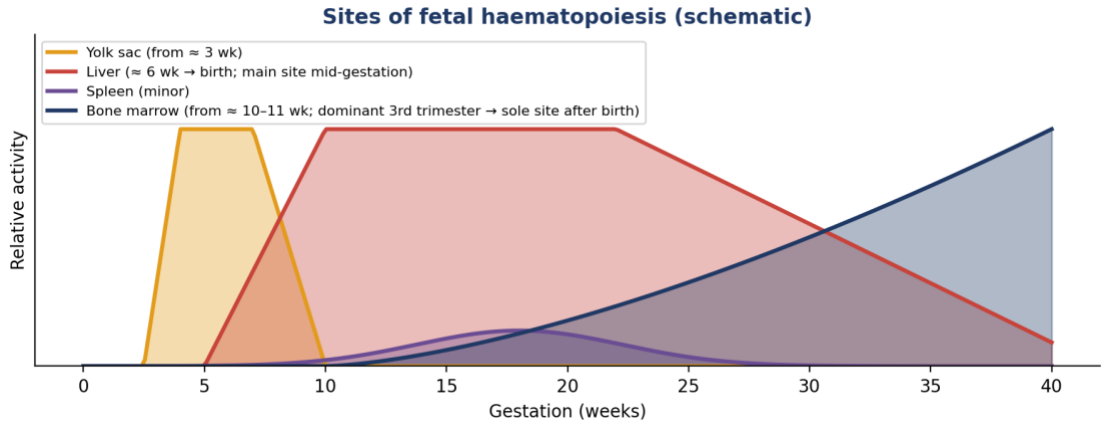


Figure 136.1 — Yolk sac, liver, spleen and bone marrow phases of fetal haematopoiesis

Phase	Timing	Features
Mesoblastic (yolk sac)	From ≈ day 16–19 (3 wk) to ≈ 8–10 wk	Blood islands; large nucleated primitive red cells; embryonic haemoglobins
Hepatic	From ≈ 6 wk; main site 2nd trimester; declines towards term	Definitive erythropoiesis; HbF; EPO initially produced by the fetal liver
Splenic	≈ 10–28 wk (minor)	Contributes little; mainly lymphoid later
Medullary (bone marrow)	From ≈ 10–11 wk; dominant in 3rd trimester; sole site after birth	Persistent hepatic/splenic haematopoiesis in severe fetal anaemia → hepatosplenomegaly, hydrops

136.2 Haemoglobin switching

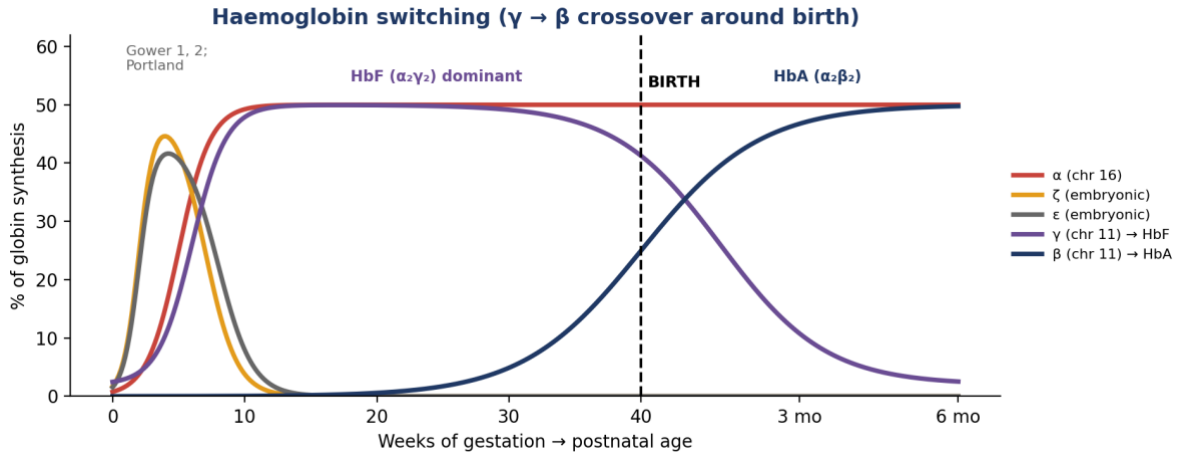


Figure 136.2 — Globin chain synthesis before and after birth

Gower 1, 2, Portland	HbF $\alpha_2\gamma_2$	β ↑ from 30–32 wk	HbA > 95%
Embryonic Hbs (ζ, ε chains)	Dominant from ≈ 10 wk; P50 ≈ 2.5 kPa	Switch controlled by BCL11A	by ≈ 6–12 months

■ CLINICAL CORRELATION

- **β-thalassaemia major and sickle cell disease present at 3–6 months**, as HbF falls — newborn bloodspot screening detects them at day 5.
- **α-thalassaemia major (Hb Bart's, γ_4)** cannot form HbF → severe anaemia and **hydrops fetalis** in utero; maternal risk of severe pre-eclampsia ('mirror syndrome').
- HbF resists acid elution — the basis of the **Kleihauer–Betke test** for fetomaternal haemorrhage (Lecture 129).

136.3 Fetal and neonatal blood indices

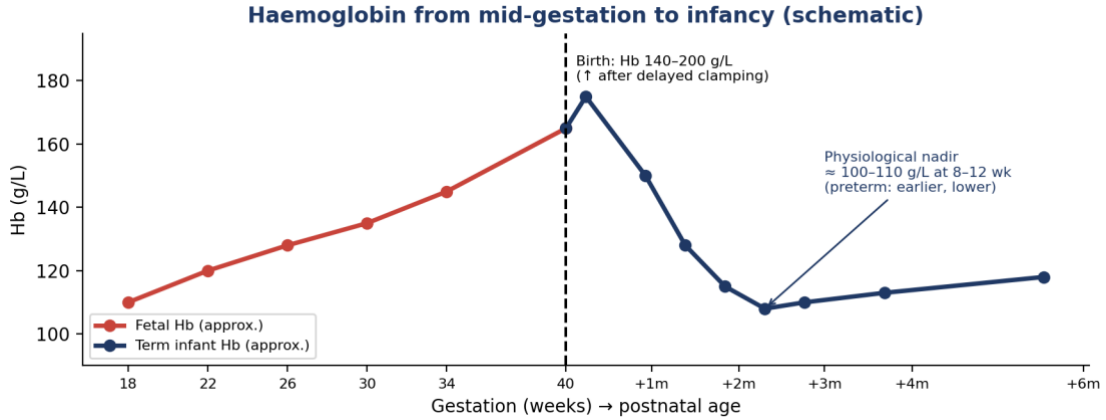


Figure 136.3 — Haemoglobin from mid-gestation through early infancy

Index	Fetus (mid-gestation)	Term neonate	Comment
Hb (g/L)	≈ 110–120 (18–20 wk)	140–200 (mean ≈ 170)	Rises with gestation (fetal EPO; does not cross placenta)
MCV (fL)	≈ 130	≈ 100–120	Macrocytic; falls with gestation
Nucleated RBCs / reticulocytes	High	Reticulocytes 3–7%	↑↑ in hypoxia, haemolysis, FGR

Index	Fetus (mid-gestation)	Term neonate	Comment
Red cell lifespan	—	60–90 days (preterm 35–50)	↑ bilirubin load
Platelets (× 10^9/L)	≥ 150 from ≈ 18 wk	150–450	Adult range from mid-gestation
WCC (× 10^9/L)	Low	10–26 (day 1)	Neutrophilia after birth stress
Blood volume	≈ 110–120 mL/kg (fetoplacental)	≈ 80–90 mL/kg	Delayed cord clamping adds ≈ 20–30 mL/kg

- **Physiological anaemia of infancy**: after birth, PaO_2 rises → **EPO falls** → erythropoiesis stops; with short red cell survival and growth, Hb reaches a nadir of ≈ **100–110 g/L at 8–12 weeks** (preterm: earlier and lower, ≈ 70–90 g/L — **anaemia of prematurity**).
- **Neonatal physiological jaundice** (day 2–3): ↑ red cell mass and shorter lifespan, **immature UGT1A1**, ↑ enterohepatic circulation. Jaundice in the **first 24 hours** is pathological (haemolysis — HDFN, G6PD, spherocytosis) (NICE CG98).
- **Polycythaemia** (venous Hct > 0.65): FGR/chronic hypoxia, maternal diabetes, recipient twin (TTTS), delayed cord clamping, smoking → hyperviscosity, hypoglycaemia, jaundice.

136.4 Fetal anaemia

Cause	Mechanism	Notes
Red cell alloimmunisation (HDFN)	Maternal IgG (anti-D, anti-c, anti-K) haemolyses fetal cells; anti-K also suppresses erythropoiesis	Lecture 129 — titres, referral thresholds, anti-D prophylaxis
Parvovirus B19	Infects erythroid progenitors via P antigen → aplastic crisis (+ myocarditis)	Risk highest < 20 wk; most resolve; IUT if severe; ≈ 3–4 weeks after maternal infection
Fetomaternal haemorrhage	Fetal blood into maternal circulation	↓ fetal movements, sinusoidal CTG; Kleihauer
α-thalassaemia major	No functional α-chains	Hydrops; preventable by carrier screening
Monochorionic twins	TTTS / TAPS (anaemia–polycythaemia sequence)	MCA PSV discordance
Others	Vasa praevia bleeding, Diamond–Blackfan, pyruvate kinase/G6PD deficiency	—

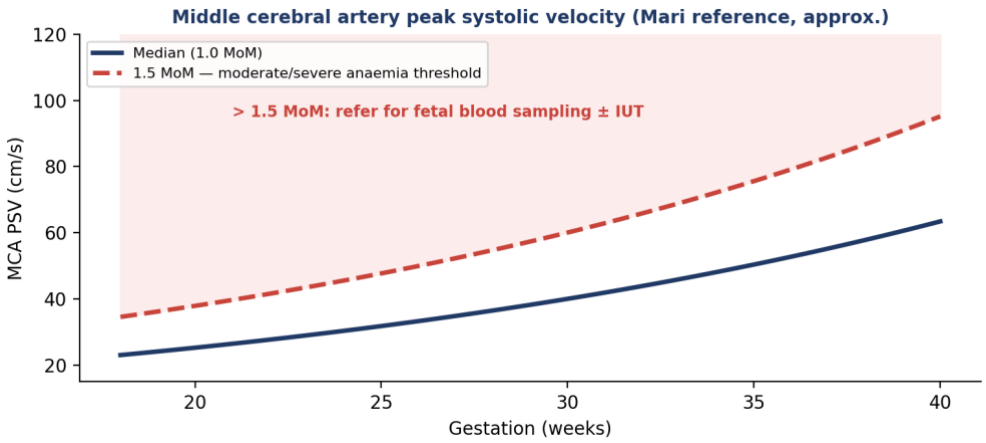


Figure 136.4 — MCA peak systolic velocity screening for fetal anaemia

Fetal anaemia → ↓ viscosity, ↑ cardiac output ▶ **↑ MCA PSV** (> 1.5 MoM) ▶ Hydrops if Hb ↓ ≈ > 70 g/L below mean (high-output failure, hypoalbuminaemia) ▶ **Fetal blood sampling** → intravascular IUT (umbilical vein) ▶ IUT blood: O RhD-neg, K-neg, CMV-neg, irradiated, Hct 0.70–0.85

136.5 Fetal and neonatal platelets

Feature	Neonatal alloimmune thrombocytopenia (NAIT / FNAIT)	Maternal ITP
Antibody against	Fetal paternal platelet antigen (HPA-1a in ≈ 80% of Caucasian cases; also HPA-5b)	Platelet glycoproteins on maternal and fetal platelets
Maternal platelets	Normal	Low
First pregnancy affected?	Yes (≈ 50%) — unlike Rh disease	—
Fetal risk	Severe thrombocytopenia; intracranial haemorrhage in utero (from ≈ 20 wk)	≈ 10% neonatal count < 50; ICH rare; nadir days 2–5
Management	Subsequent pregnancies: maternal IVIg ± steroids; HPA-compatible platelets at birth	Treat mother if count low; neonatal count at birth and daily; avoid traumatic delivery

136.6 Fetal and neonatal coagulation

≈ 30–50%
Vitamin K-dependent factors (II, VII, IX, X)

Do not cross placenta
Coagulation factors (synthesised by fetal liver)

Low AT, PC, PS
Balanced system; fibrinogen ≈ adult

Poor placental transfer
Vitamin K; breast milk low in vitamin K

Vitamin K deficiency bleeding (VKDB)	Timing	Risk factors
Early	< 24 hours	Maternal enzyme-inducing antiepileptics (phenytoin, carbamazepine, phenobarbital), warfarin, rifampicin
Classic	Days 2–7	Inadequate intake; exclusively breastfed
Late	2–12 weeks	Breastfed infants without prophylaxis; cholestasis/malabsorption — high rate of intracranial haemorrhage

Prevention: **vitamin K 1 mg IM at birth** (single dose; oral regimens need repeated doses). Neonates with haemophilia may bleed at birth (ICH, cephalhaematoma) — the reason to avoid ventouse, rotational forceps, fetal scalp electrodes and fetal blood sampling in at-risk male fetuses.

136.7 Must-know summary

■ **EXAM TIP**

- Order of haematopoiesis: **yolk sac (3 wk) → liver (6 wk; main site mid-gestation) → bone marrow (dominant 3rd trimester)**.
- HbF = **$\alpha_2\gamma_2$**, 60–80% at birth; β-chain disorders appear at 3–6 months; Hb Bart's (γ_4) causes hydrops.
- Fetal anaemia: screen with **MCA PSV > 1.5 MoM**; parvovirus targets erythroid progenitors (P antigen).
- **NAIT** (anti-HPA-1a) affects first pregnancies and causes in utero ICH; maternal platelets normal.
- Vitamin K-dependent factors are low at birth → **vitamin K 1 mg IM**; early VKDB with maternal enzyme-inducing drugs.

■ **MNEMONIC / MEMORY AID**

'Young Liver Makes Blood': Yolk sac → Liver → Marrow (Bone). **Hydrops in α-thal — 'Bart's has no α'** (γ_4).