PIPADOR REVISION

MRCOG Part 1 Revision Notes

Circulatory Changes at Birth

EMBRYOLOGY • LECTURE 72

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG Part 1 Revision Notes

Lecture 72: Circulatory Changes at Birth

Embryology • Visual revision edition

COLOUR CODE USED THROUGHOUT THESE NOTES

DUCTUS VENOSUS	FORAMEN OVALE	DUCTUS ARTERIOSUS	PULMONARY	SYSTEMIC

LEARNING OBJECTIVES — tick off as you go

- ☐ Recap the fetal circulation and its three shunts.
- ☐ Explain what the first breath and cord clamping do to resistances and pressures.
- ☐ Describe how and when each shunt closes, and the adult remnants.
- ☐ Recognise failed transition: PPHN, PDA, PFO, duct-dependent CHD.
- ☐ Apply to cord clamping, newborn resuscitation targets, screening and maternal drugs.

1 Fetal Circulation Recap

IN ONE LINE: *Fetus = PARALLEL circuits with placental gas exchange. Newborn = SERIAL circuits with lung gas exchange. The switch happens in minutes.*

The fetal circulation — three shunts (schematic)

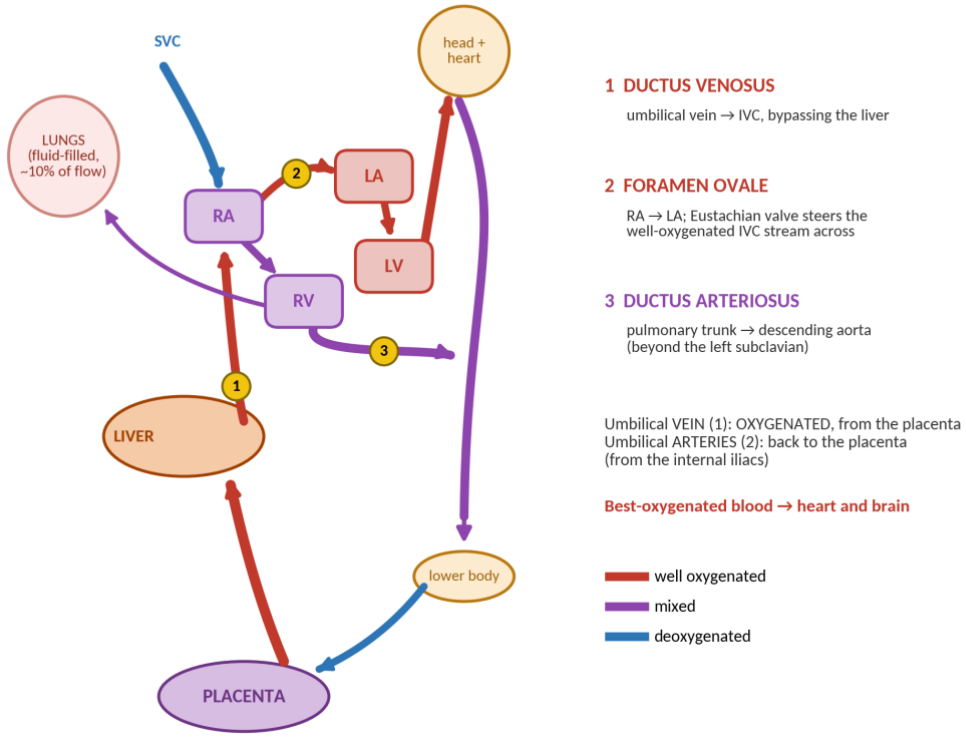


Figure 1. Fetal circulation (from Lecture 35).

Shunt	Connects	Job in the fetus
Ductus venosus	Umbilical vein → IVC	Bypasses the liver

Shunt	Connects	Job in the fetus
Foramen ovale	RA → LA	Sends the best-oxygenated blood to LV → heart + brain
Ductus arteriosus	Pulmonary trunk → aorta (beyond left subclavian)	Bypasses the high-resistance lungs

- Umbilical vein PO_2 ~30 mmHg; **RV dominant** (~55–60% of combined output); lungs get ~10%; **PVR high, SVR low** (placenta).

2 The Transition

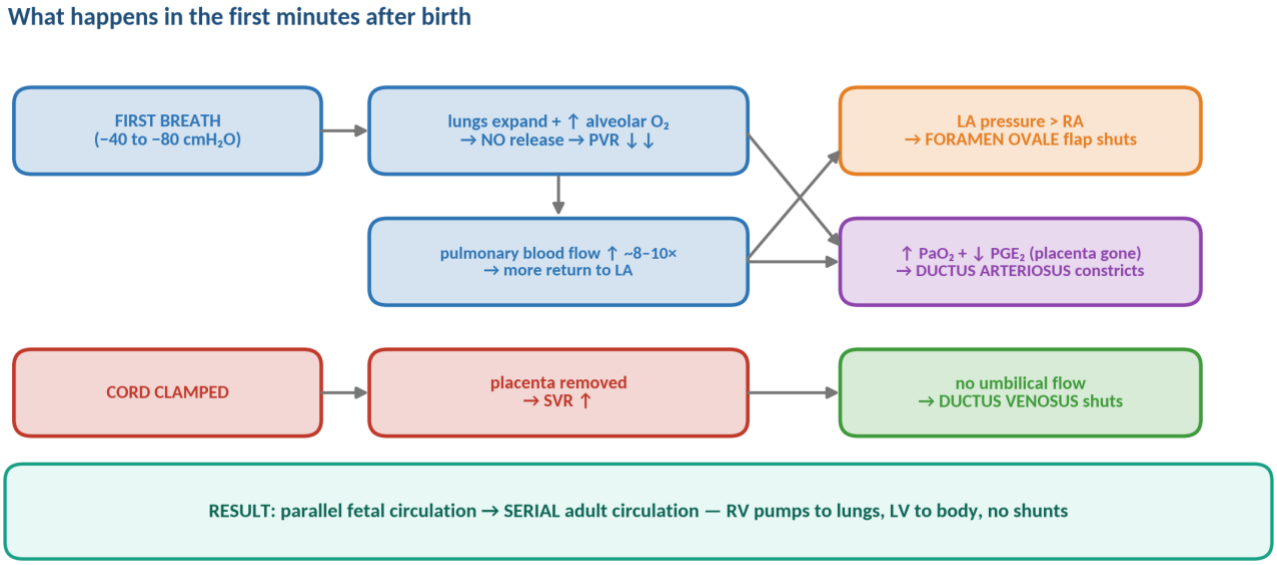


Figure 2. Two triggers, three closures.

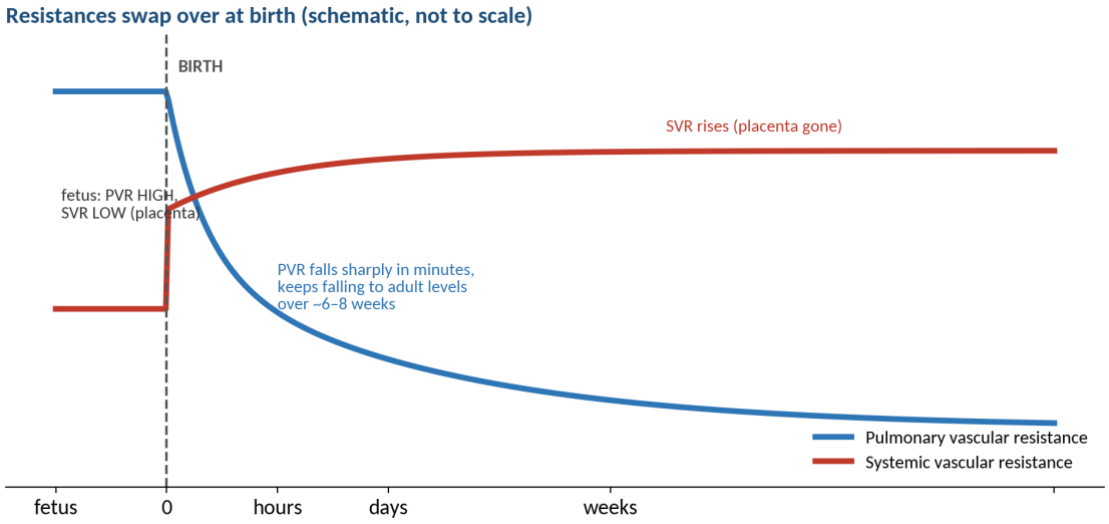


Figure 3. PVR falls, SVR rises.

MNEMONIC / MEMORY HOOK

'Breathe to open the lungs, Clamp to close the placenta' — breath ↓ PVR, clamp ↑ SVR → LA pressure beats RA → foramen ovale shuts; O_2 ↑ + PGE_2 ↓ → ductus shuts.

3 Closure and Remnants

When each shunt closes (log-like time axis, approximate)

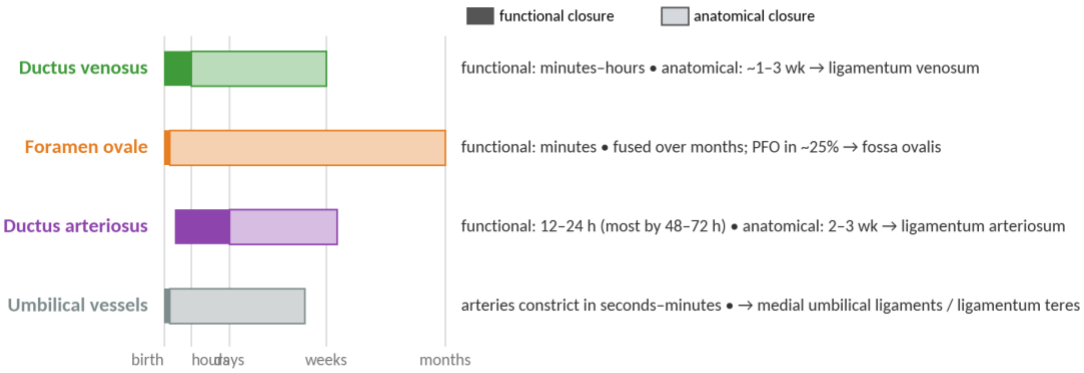


Figure 4. Closure timings.

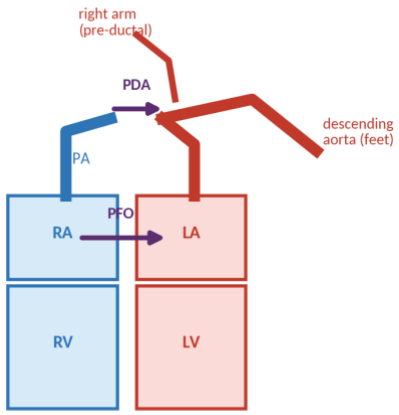
Fetal structures and their adult remnants

Umbilical VEIN (left)	LIGAMENTUM TERES	free edge of the falciform ligament
Ductus VENOSUS	LIGAMENTUM VENOSUM	fissure between caudate + left lobes of the liver
Foramen OVALE	FOSSA OVALIS	interatrial septum (PFO in ~25%)
Ductus ARTERIOSUS	LIGAMENTUM ARTERIOSUM	PA → aortic arch; left recurrent laryngeal hooks round it
Umbilical ARTERIES (distal)	MEDIAL umbilical ligaments	proximal parts → superior vesical arteries
Urachus (allantois)	MEDIAN umbilical ligament	bladder apex → umbilicus

Figure 5. Adult remnants.

4 When Transition Fails

When transition fails — persistent pulmonary hypertension of the newborn



PPHN

PVR stays HIGH → R→L through PDA + PFO → severe hypoxaemia

Clue

pre-ductal (right hand) SpO_2 HIGHER than post-ductal (foot)

Causes

meconium aspiration, sepsis, CDH, asphyxia, lung hypoplasia, idiopathic; ↑ after late SSRIs (small absolute risk)

Treat

oxygen, ventilation ± surfactant, INHALED NITRIC OXIDE, sildenafil/milrinone, ECMO

Figure 6. PPHN.

Problem	Key points
PDA	Common in preterms (esp. < 30 weeks) — immature muscle, more PGE_2; also rubella, altitude, hypoxia. Bounding pulses, wide pulse pressure, continuous murmur, heart failure. Ibuprofen / indomethacin / paracetamol; catheter or surgical closure if needed
PFO	~25% of adults; usually silent. Paradoxical embolism (cryptogenic stroke), decompression illness, platypnoea–orthodeoxia; device closure in selected patients
Duct-dependent CHD	Systemic (HLHS, critical coarctation, interrupted arch), pulmonary (pulmonary atresia, severe tetralogy, tricuspid atresia), mixing (TGA) → collapse/cyanosis as the duct closes (days 1–14) → PGE1 at once
Preterm lungs	Surfactant deficiency keeps PVR high — surfactant, ventilation, iNO if PPHN

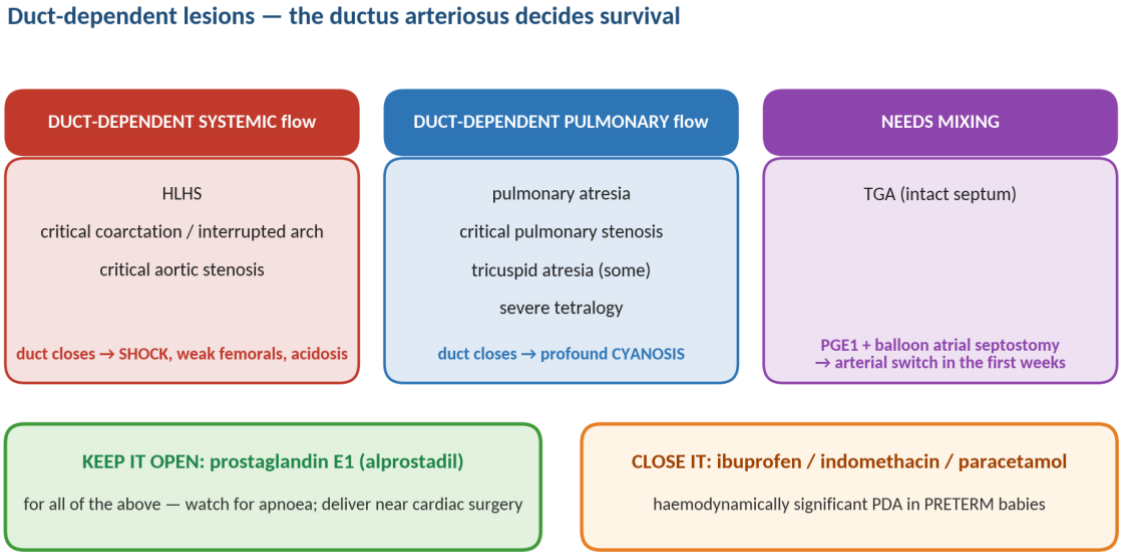


Figure 7. Duct-dependent lesions (from Lecture 71).

5 Practical Points

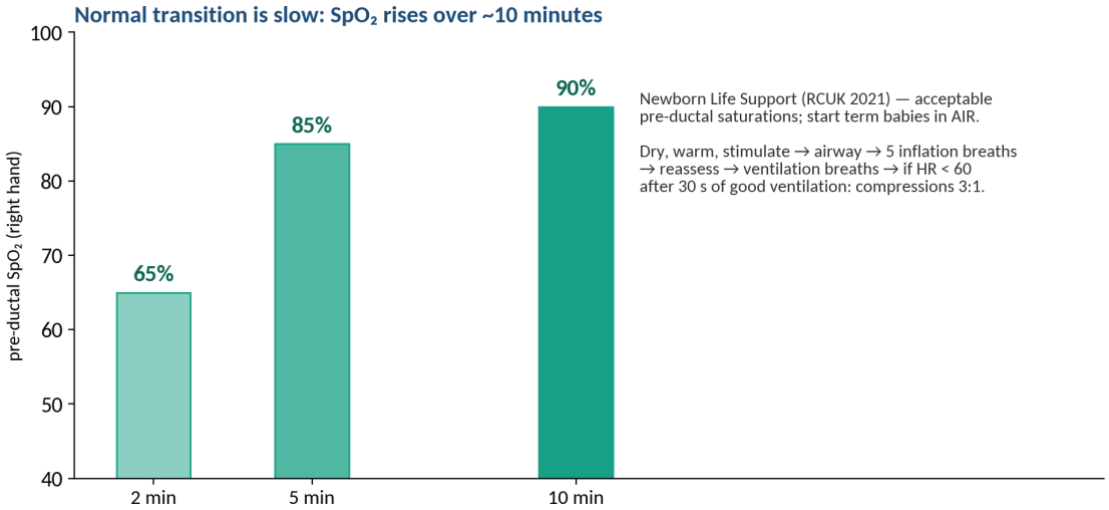


Figure 8. Newborn SpO_2 targets.

DEFERRED CORD CLAMPING

- Wait **at least 60 seconds** in babies not needing immediate resuscitation (NICE / RCUK; WHO 1–3 minutes)
- ~80–100 mL placental transfusion → better iron stores, smoother transition
- **Preterm**: less IVH, fewer transfusions, lower mortality
- Breathing before clamping helps keep the transition smooth

MATERNAL DRUGS

- **NSAIDs**: avoid from ~20 weeks (fetal kidneys → oligohydramnios) and especially in the 3rd trimester (**ductal constriction** → fetal pulmonary hypertension)
- **Indomethacin tocolysis**: short courses only, not after ~32 weeks
- Late-pregnancy SSRIs: small rise in PPHN risk

NEWBORN PULSE OXIMETRY

- Right hand (pre-ductal) + foot (post-ductal)
- Commonly pass ≥ 95% with ≤ 3% difference; protocols vary
- Finds critical CHD before the duct closes

CRITICAL COARCTATION

- Collapse when the duct closes (typically days 3–14)
- Weak/absent femorals, arm–leg BP difference
- **Restart PGE1 immediately**

★ PEARL

Pre-ductal SpO_2 > post-ductal = R→L flow through the duct — PPHN or a duct-dependent systemic lesion.
Ductus venosus → ligamentum VENOSUM; umbilical vein → ligamentum TERES — don't swap them.

6 MRCOG Exam Pearls — Last-Minute Page

Numbers to know

~30 mmHg Umbilical vein PO_2	**~55–60%** Fetal output from RV	**~8–10×** Lung flow rise at birth	**12–24 h** Duct functionally shut
2–3 wk Duct anatomically shut	**~25%** Adult PFO	**≥ 60 s** Deferred cord clamping	**65/85/90%** SpO_2 at 2/5/10 min

HIGH-YIELD CHECKLIST

- ☐ Three shunts: DV, FO, DA; RV dominant; PVR high, SVR low.
- ☐ First breath → PVR ↓ (stretch + O_2 + NO); clamping → SVR ↑.
- ☐ LA > RA → foramen ovale shuts (minutes).
- ☐ ↑ PaO_2 + ↓ PGE_2 → duct shuts (12–24 h; anatomical 2–3 weeks).
- ☐ Remnants: lig. teres, lig. venosum, fossa ovalis, lig. arteriosum, medial + median umbilical ligaments.
- ☐ PPHN: R→L at duct + PFO; pre > post-ductal SpO_2; iNO, ECMO.
- ☐ Preterm PDA → close; duct-dependent CHD → PGE1.
- ☐ Deferred clamping ≥ 60 s; preterm benefits.
- ☐ NLS SpO_2 65/85/90% at 2/5/10 min; air for term babies.
- ☐ NSAIDs late pregnancy → ductal constriction.

Self-assessment — cover the right-hand column

Question	Answer
What closes the foramen ovale after birth?	LA pressure rising above RA pressure
Two triggers for ductal closure?	Rising PaO_2 and falling PGE_2
Adult remnant of the ductus arteriosus?	Ligamentum arteriosum
Adult remnant of the left umbilical vein?	Ligamentum teres
Remnant of the distal umbilical arteries?	Medial umbilical ligaments
Pulse-oximetry clue to PPHN?	Pre-ductal SpO_2 higher than post-ductal
Key treatment for PPHN?	Inhaled nitric oxide (ECMO if severe)
Drug to keep a duct open?	Prostaglandin E1
Acceptable SpO_2 at 5 minutes (RCUK)?	85%
Why avoid NSAIDs late in pregnancy?	Ductal constriction → fetal pulmonary hypertension

7 References

- Resuscitation Council UK. Newborn Life Support guidelines. 2021.
- NICE NG235. Intrapartum care. 2023 (cord clamping).
- Sadler TW. Langman's Medical Embryology. 14th ed. 2019.