PIPADOR REVISION

MRCOG Part 1 Revision Notes

Development of the Heart

EMBRYOLOGY • LECTURE 70

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG Part 1 Revision Notes

Lecture 70: Development of the Heart

Embryology • Visual revision edition

COLOUR CODE USED THROUGHOUT THESE NOTES

TRUNCUS / CREST	BULBUS / RIGHT	VENTRICLE / LEFT	ATRIUM	SINUS VENOSUS

LEARNING OBJECTIVES — tick off as you go

- ☐ Describe the heart fields, cardiac neural crest and heart tube.
- ☐ Name the tube regions and their fates; explain looping.
- ☐ Describe atrial, AV, ventricular and outflow-tract septation and their defects.
- ☐ Outline venous development and the fetal circulation.
- ☐ Apply to antenatal cardiac screening, risk factors and recurrence.

1 Origins

IN ONE LINE: *First organ to work: the heart beats from ~Day 22 (5 weeks by LMP). Tube to four chambers by the end of week 8 — CHD affects ~1% of births.*

Source	Contribution
Cardiogenic (splanchnic) mesoderm	Starts cranial to the oropharyngeal membrane; brought into the chest, ventral to the foregut, by head folding
First heart field	Left ventricle, parts of atria
Second heart field	Right ventricle, outflow tract, parts of atria — added at both poles
Cardiac neural crest	Aorticopulmonary septum, great-artery smooth muscle, parts of semilunar valves → defects = conotruncal (truncus, tetralogy, interrupted arch type B), often 22q11.2
Proepicardium	Epicardium and coronary arteries

- **Days 19–21** paired endocardial tubes → **Day ~22** fused tube (endocardium, **cardiac jelly**, myocardium) → beats.

2 Heart Tube and Looping

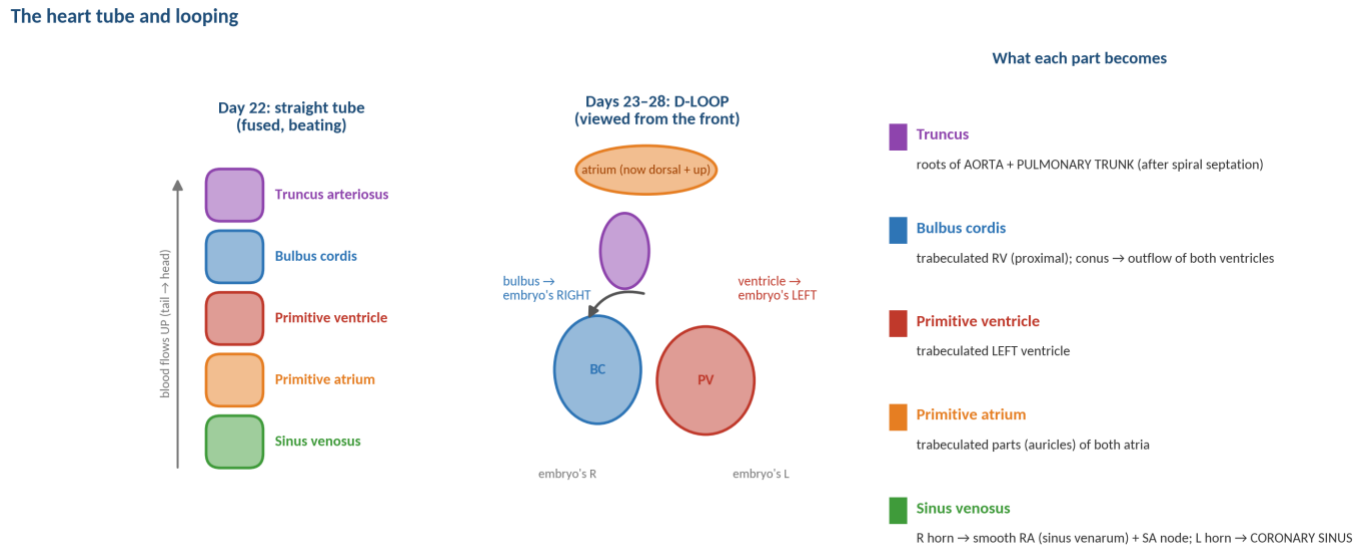


Figure 1. Tube regions, D-loop and fates.

- **D-loop (days 23–28)**: bulbus goes ventral, caudal and to the embryo's **right**; ventricle to the **left**; atria move up and back. **L-loop** → ventricular inversion/dextrocardia; **heterotaxy** from node-cilia defects (Lecture 46).

3 Septation

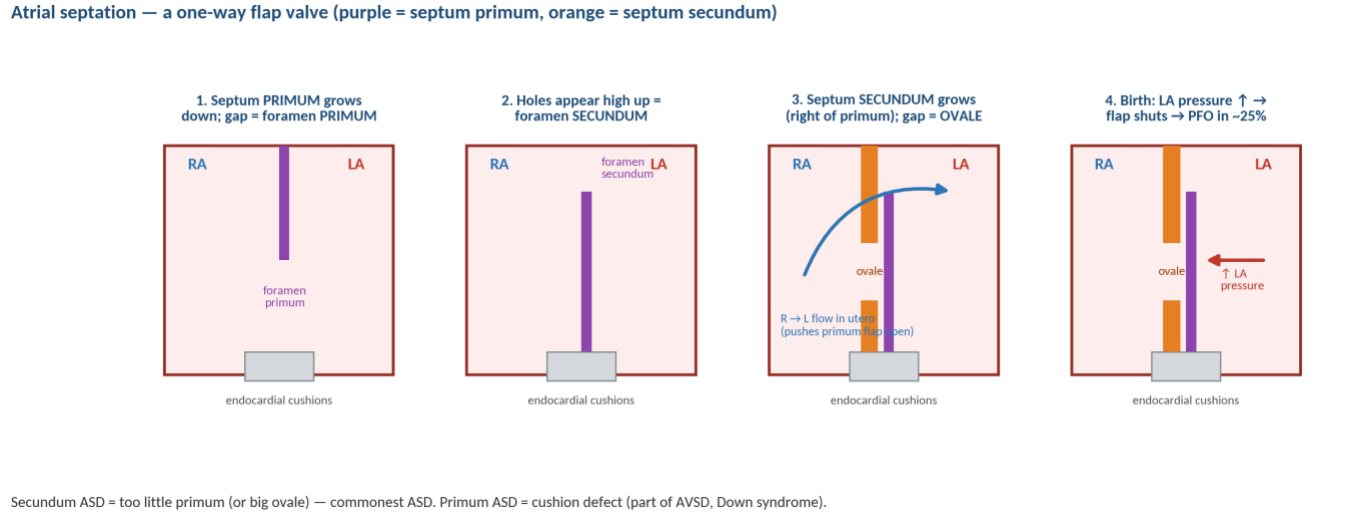


Figure 2. Atrial septation.

Septum	How	Failure
Atrial	Septum primum + secundum; foramen ovale flap	Secundum ASD (commonest); PFO ~25% of adults
AV (cushions)	Superior + inferior endocardial cushions fuse	AVSD — ~40% occur with trisomy 21; primum ASD
Ventricular	Muscular part grows up; membranous part from cushions + conotruncal septum; closed by ~week 7	VSD — commonest CHD; usually perimembranous

Septum	How	Failure
Outflow	Spiral aorticopulmonary septum (neural crest)	Truncus, TGA, tetralogy

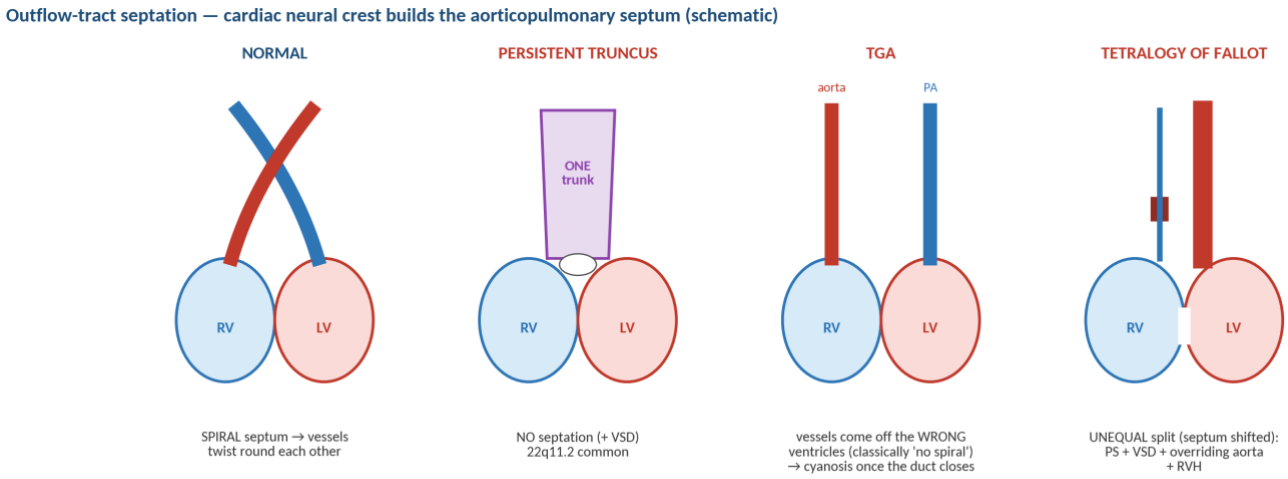


Figure 3. Outflow-tract anomalies.

MNEMONIC / MEMORY HOOK

Tetralogy = 'PROVe' — **P**ulmonary stenosis, **R**V hypertrophy, **O**verriding aorta, **V**SD — all from one shifted septum.

- **Valves**: AV valves from cushions + ventricular myocardium (chordae, papillary muscles); semilunar valves from outflow cushions. **Bicuspid aortic valve** ~1–2% (stenosis, aortopathy; Turner).

4 Veins, Conduction and Coronaries

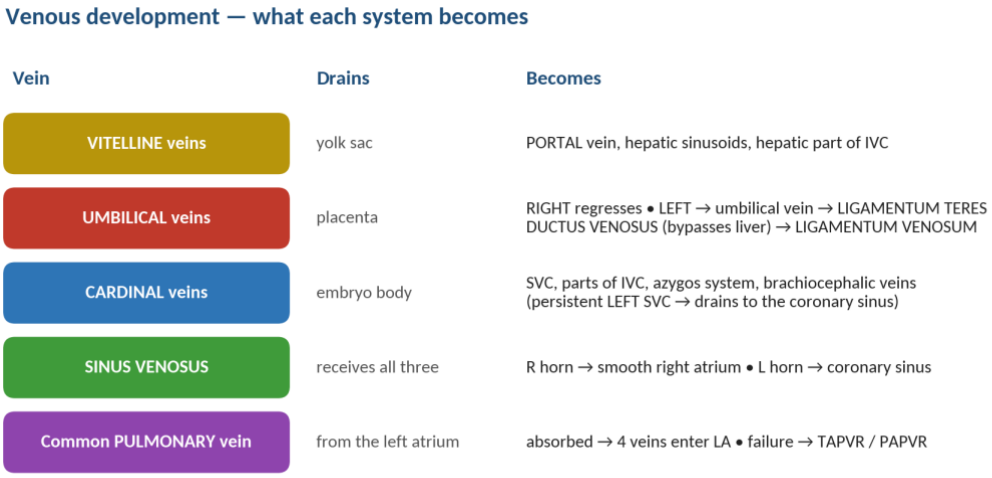


Figure 4. Venous systems and their fates.

- **Conduction**: SA node from the right sinus venosus; AV node from sinus venosus + AV canal; His–Purkinje from ventricular myocardium. **Coronaries** from epicardium-derived cells; anomalous origin (e.g. left main from the right sinus, running between the great arteries) → sudden death in young athletes.

5 Fetal Circulation

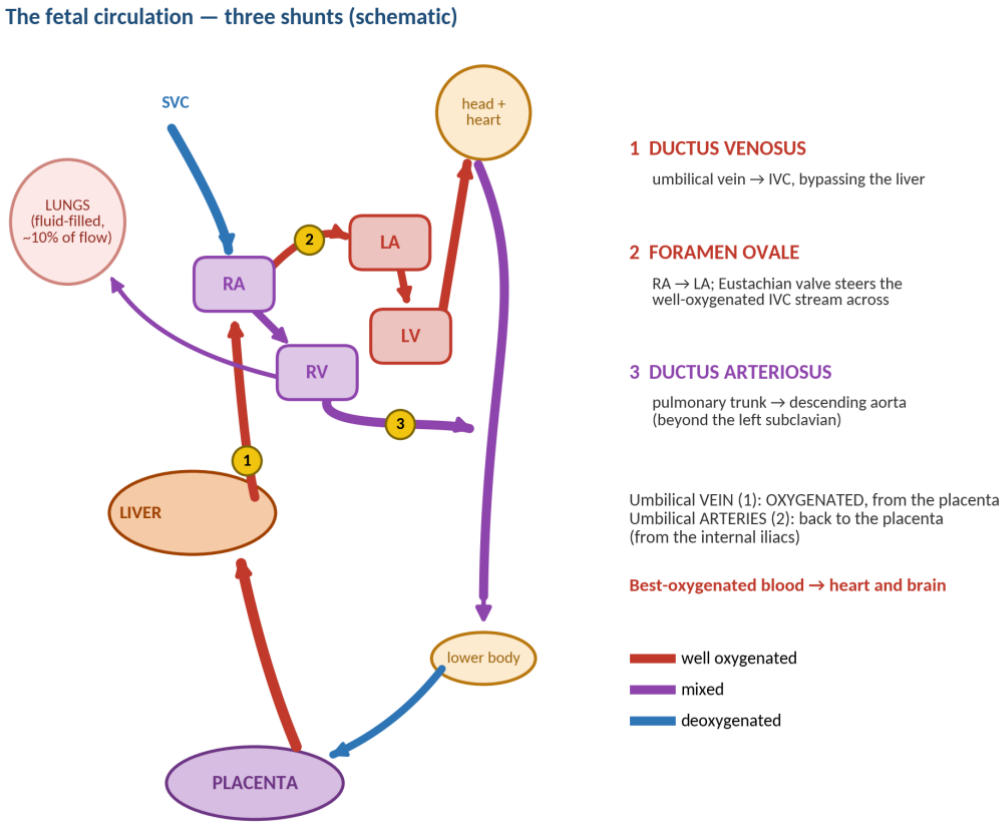


Figure 5. Fetal circulation (from Lecture 35).

- **Three shunts**: ductus venosus (bypasses liver), foramen ovale (RA → LA), ductus arteriosus (PA → aorta). **RV dominant** (~60% of combined output); high pulmonary, low placental resistance. Best-oxygenated blood goes via the foramen ovale to the **heart and brain**.

6 Clinical Correlates

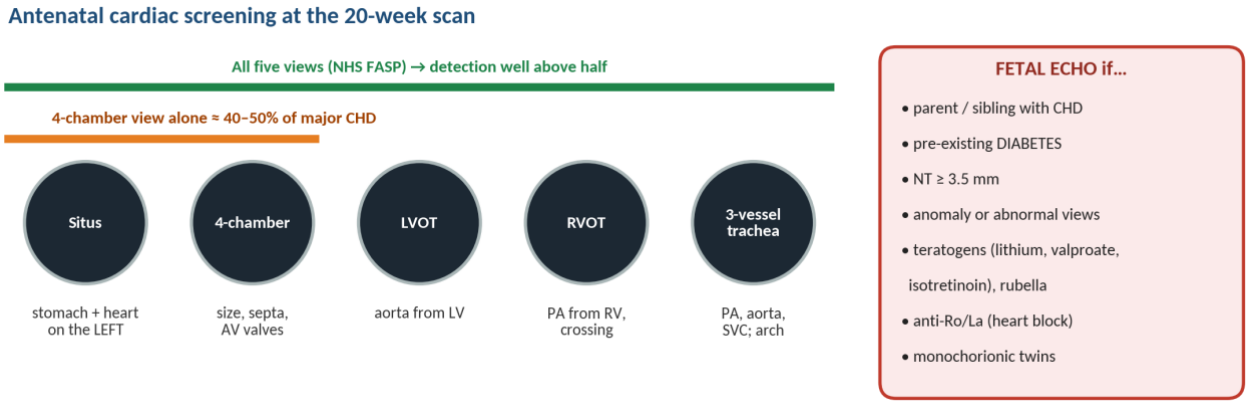


Figure 6. Screening views and fetal echo indications.

RISK FACTORS

- **Pre-existing diabetes** (strongest common maternal factor — HbA1c matters)
- PKU, rubella, alcohol; **lithium** (Ebstein), valproate, isotretinoin
- **Anti-Ro/La** → congenital heart block (not structural)
- Aneuploidy: T21 (AVSD), T18, T13, **22q11.2**, **Turner** (coarctation, bicuspid valve)

RECURRENCE

- One affected sibling ~2–3%; two siblings ~10%
- Affected **mother** higher (~5–10%, more for some lesions) than affected father (~2–3%)
- Offer fetal echo (~18–22 weeks) and genetic review

★ PEARL

Neural crest → conotruncal defects (22q11.2); endocardial cushions → AVSD (T21); septum primum/secundum → ASD/PFO.

Four-chamber view alone misses outflow lesions (TGA, tetralogy) — that's why outflow and 3VT views are part of the 20-week scan.

7 MRCOG Exam Pearls — Last-Minute Page

Numbers to know

Day 22 First heartbeat (5 wk LMP)	**Days 23–28** Looping	**Week 7** VSD closed	**~1%** CHD at birth
~25% Patent foramen ovale	**~40%** AVSDs with T21	**~60%** Fetal output from RV	**NT ≥ 3.5** → fetal echo

HIGH-YIELD CHECKLIST

- ☐ Heart beats Day ~22; four chambers by end of week 8.
- ☐ First heart field → LV; second → RV + outflow; crest → AP septum.
- ☐ Tube: truncus, bulbus, ventricle, atrium, sinus venosus — know fates.
- ☐ D-loop days 23–28.
- ☐ Septum primum + secundum → foramen ovale; PFO ~25%.
- ☐ Cushions → AVSD (T21); membranous VSD commonest CHD.
- ☐ Spiral septum: truncus, TGA, tetralogy (PROVe).
- ☐ Ductus venosus → ligamentum venosum; umbilical vein → ligamentum teres.
- ☐ Three fetal shunts; RV dominant.
- ☐ Pre-existing diabetes, 22q11.2, T21; fetal echo indications.

Self-assessment — cover the right-hand column

Question	Answer
When does the heart first beat?	~Day 22 (≈5 weeks LMP)
Fate of the primitive ventricle?	Trabeculated left ventricle
Fate of the left sinus horn?	Coronary sinus

Question	Answer
What keeps the foramen ovale shut after birth?	Higher LA pressure pushes septum primum against secundum
Defect linked to trisomy 21?	AVSD (endocardial cushion defect)
Which cells build the aorticopulmonary septum?	Cardiac neural crest
Four features of tetralogy?	PS, RVH, overriding aorta, VSD
Adult remnant of the ductus venosus?	Ligamentum venosum
Maternal antibody causing heart block?	Anti-Ro / anti-La
Why add outflow views to the 4-chamber view?	To detect TGA, tetralogy and other outflow lesions

8 References

- Sadler TW. Langman's Medical Embryology. 14th ed. 2019.
- NHS Fetal Anomaly Screening Programme Handbook — fetal cardiac views (current edition).
- NICE NG3. Diabetes in pregnancy. 2015 (updated 2020).