PIPADOR REVISION

MRCOG Part 1 Revision Notes

The Nervous System

EMBRYOLOGY • LECTURE 76

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG Part 1 Revision Notes

Lecture 76: The Nervous System

Embryology • Visual revision edition

COLOUR CODE USED THROUGHOUT THESE NOTES

NEURAL TUBE / CNS	NEURAL CREST / PNS	BRAIN	DEFECTS	MENINGES / MISC

LEARNING OBJECTIVES — tick off as you go

- ☐ Describe neurulation, neuropore closure and secondary neurulation.
- ☐ Know the brain vesicles, spinal cord organisation and where the cord ends.
- ☐ Classify neural tube defects and other brain malformations.
- ☐ List neural crest derivatives, myelination timing, eye and ear origins.
- ☐ Apply to screening, folic acid, antiepileptics, fetal surgery and neonatal cooling.

1 Neurulation

IN ONE LINE: *CNS = neuroectoderm (neural tube). PNS, autonomic ganglia and much more = neural crest. Tube closes from day 22; neuropores shut by day ~25 (cranial) and ~27–28 (caudal).*

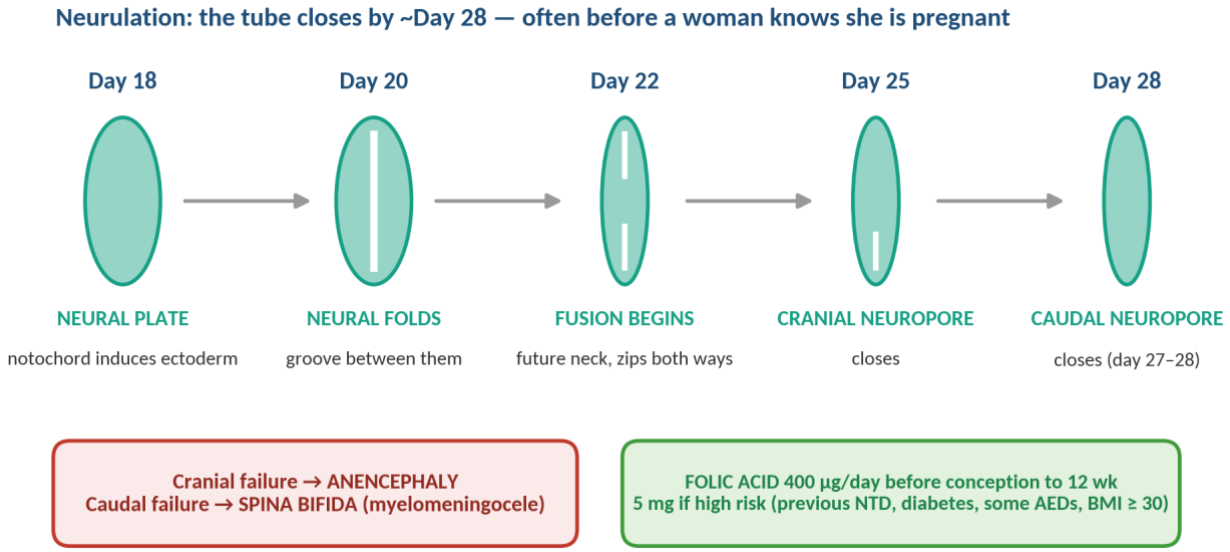


Figure 1. Neurulation timeline (from Lecture 46).

- **Neural plate (day ~18)** forms where the notochord's **BMP inhibitors** (noggin, chordin, follistatin) act; **SHH** from notochord/floor plate later patterns the **ventral** tube (motor side) — it doesn't induce the plate.
- Folds fuse first at the future neck and zip both ways. The lowest (sacral) cord forms by **secondary neurulation** (canalisation of a solid cord).

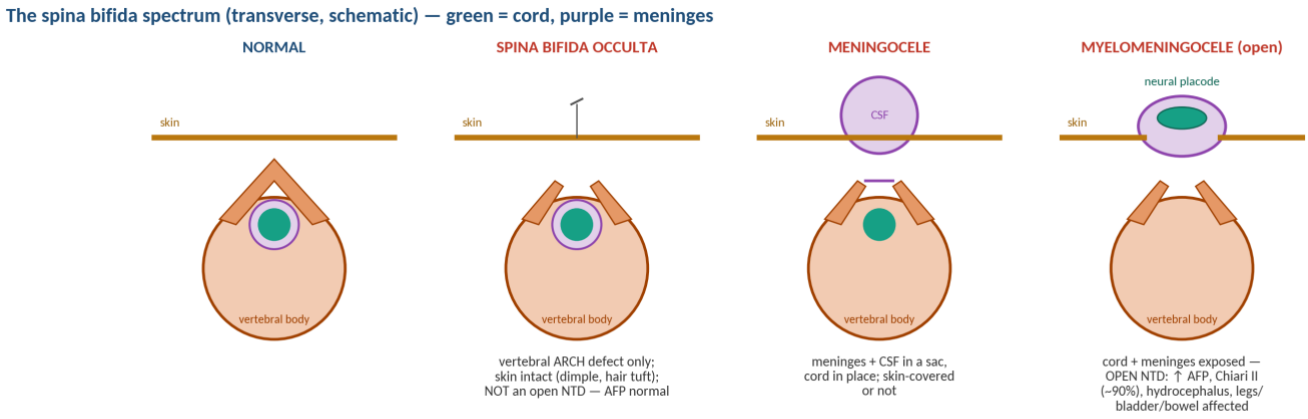


Figure 2. The spina bifida spectrum.

Defect	Key points
Anencephaly	Cranial neuropore fails; no vault/forebrain; lethal; detectable at 11–14 weeks
Myelomeningocele	Caudal neuropore fails; open; ↑ AFP; Chiari II ~90%, hydrocephalus
Encephalocele	Skull defect (usually occipital) with meninges ± brain (Meckel–Gruber)
Craniorachischisis / iniencephaly	Rare, severe, lethal
Prevention	Folic acid 400 µg pre-conception to 12 weeks; 5 mg if previous NTD or family history, BMI ≥ 30, diabetes, antiepileptics, sickle cell/thalassaemia — cuts NTDs ~70%

2 Brain Vesicles and Spinal Cord

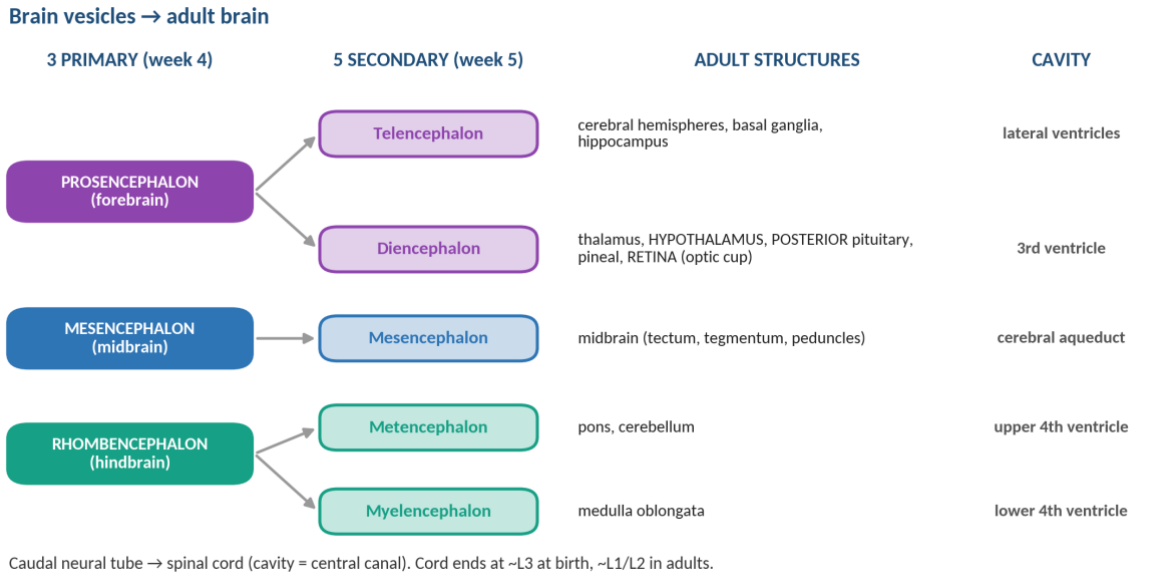


Figure 3. 3 → 5 vesicles (from Lecture 47).

MNEMONIC / MEMORY HOOK

'Pro-Mes-Rhomb → Tel-Di-Mes-Met-Myel' — 3 primary (week 4) → 5 secondary (week 5).

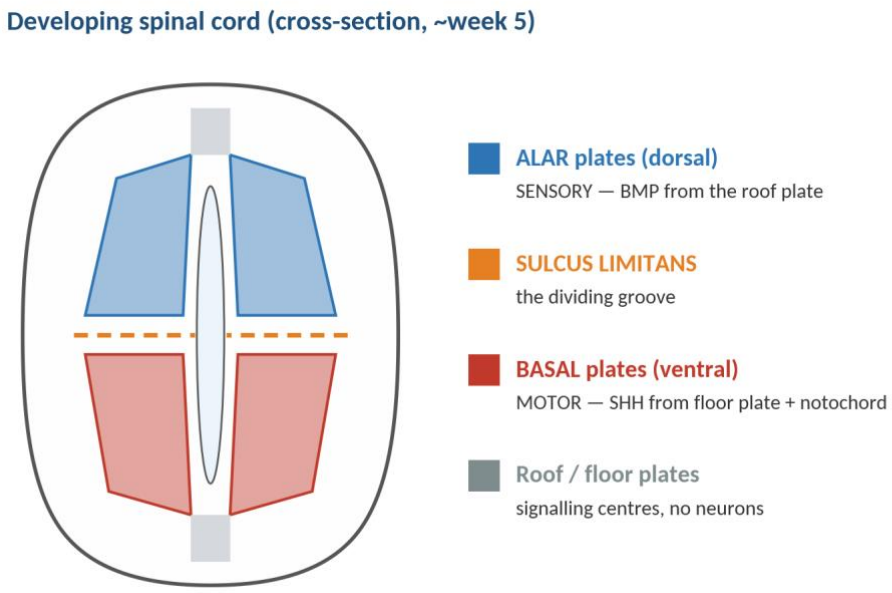


Figure 4. Alar (sensory) vs basal (motor) plates (from Lecture 47).

- Three layers: **ventricular** (proliferating → ependyma), **mantle** (neurons → grey matter), **marginal** (axons → white matter).

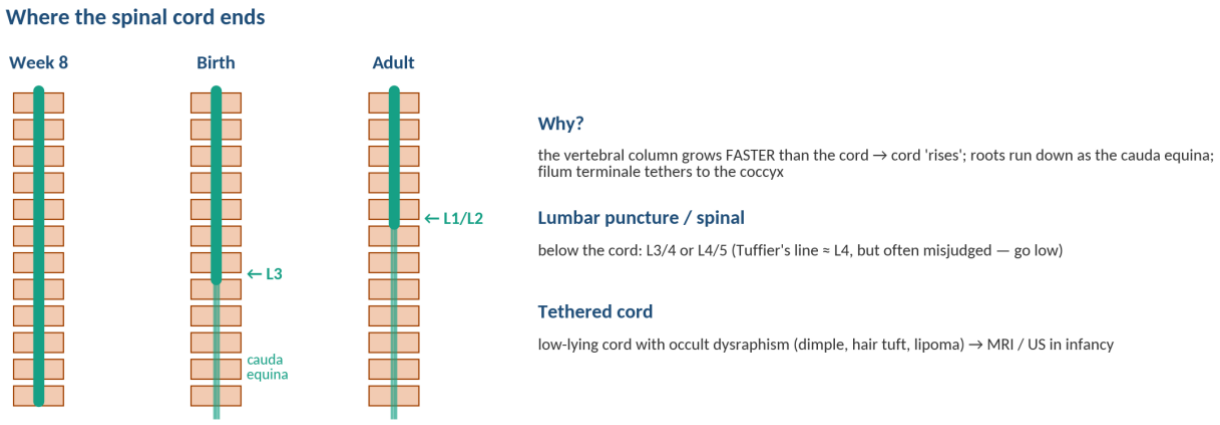


Figure 5. The cord 'rises'.

3 Brain Development and Malformations

- Cortex: neurons born in the ventricular zone migrate along **radial glia** — **inside-out** (first-born deepest); migration largely complete by ~24–26 weeks. Cerebellum from the alar plates of the metencephalon (rhombic lips); matures into the 2nd year.

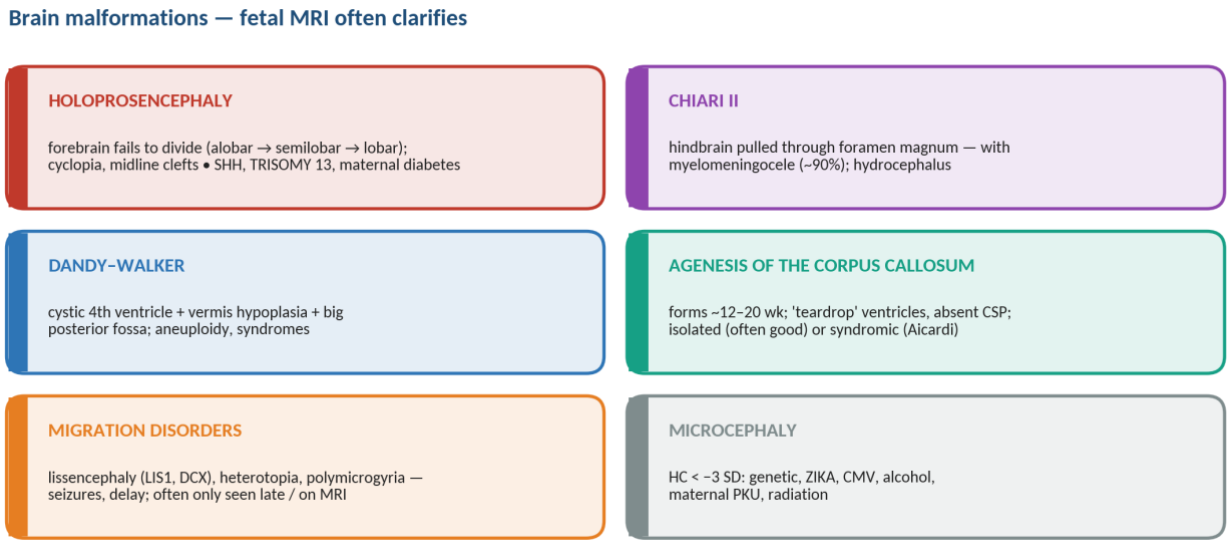


Figure 6. Key brain malformations.

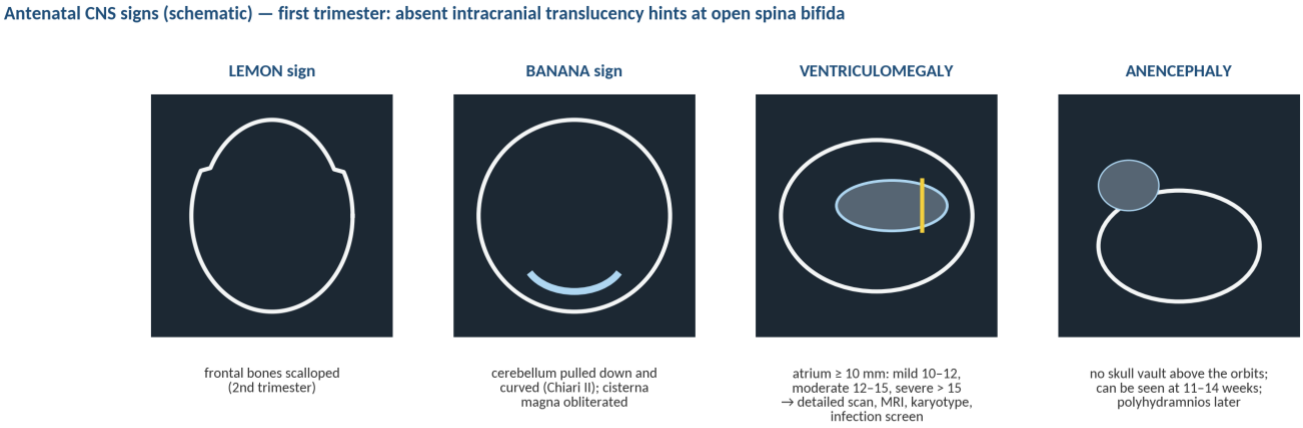


Figure 7. Antenatal CNS signs.

4 Neural Crest, Myelin and Senses

Topic	Key points
Neural crest → PNS	Dorsal root + most cranial ganglia, autonomic ganglia, enteric nervous system, Schwann cells, adrenal medulla, melanocytes (Lecture 50). Disorders: Hirschsprung, NF1, Waardenburg, familial dysautonomia
Myelination	CNS by oligodendrocytes (neuroectoderm); PNS by Schwann cells (crest). Starts mid-gestation (spinal cord), brain mostly from the 3rd trimester; continues into adolescence
Eye	Optic vesicle (diencephalon) → retina (both layers) + optic nerve; lens from surface-ectoderm placode; cornea epithelium (ectoderm) + stroma/endothelium (crest). Rubella → cataract
Ear	Otic placode → membranous labyrinth; middle ear from 1st pouch; malleus + incus (arch 1), stapes (arch 2); external ear from 1st cleft + hillocks. Deafness: CMV (commonest infectious), GJB2

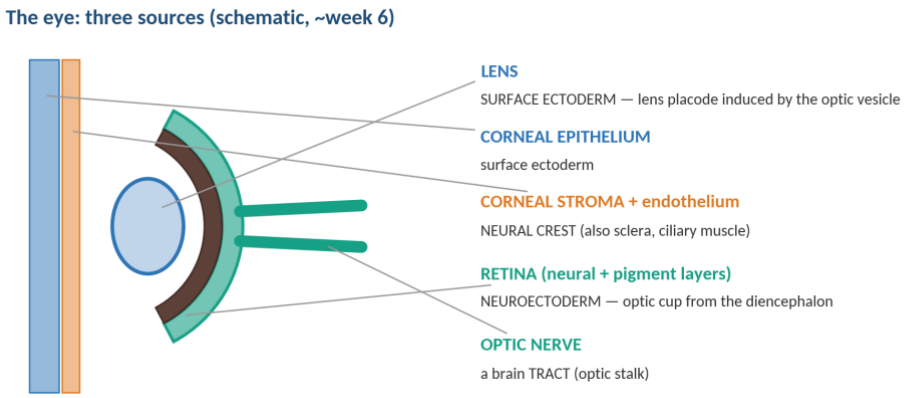


Figure 8. Three origins of the eye (from Lecture 47).

5 Clinical Correlates

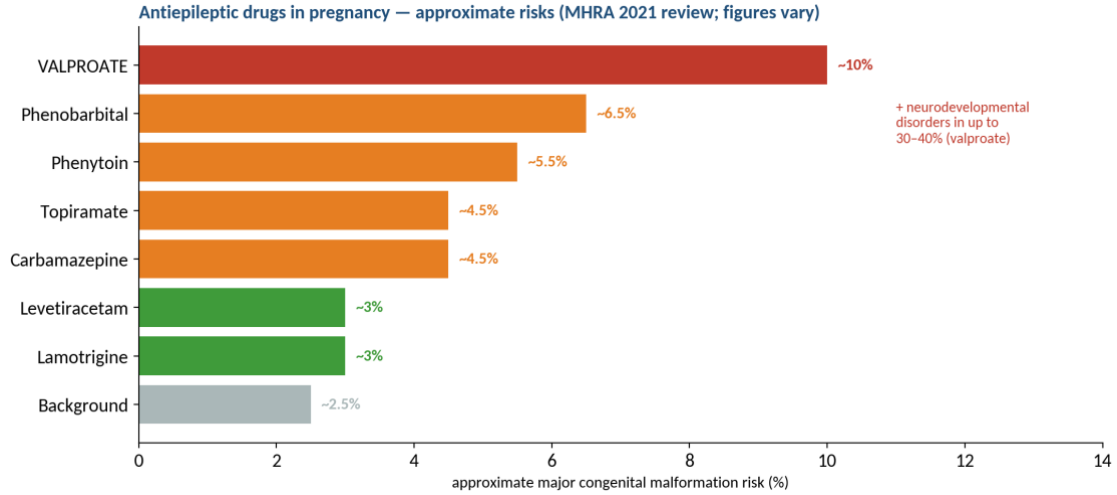


Figure 9. Antiepileptics and malformation risk.

ANTIEPILEPTICS

- **Valproate**: ~10% major malformations (NTD 1–2%) + neurodevelopmental problems in up to 30–40% — **MHRA Pregnancy Prevention Programme**; avoid in women who could conceive unless no alternative
- Lamotrigine / levetiracetam: lowest known risk
- Pre-pregnancy review + 5 mg folic acid; don't stop drugs suddenly

FETAL SURGERY (MOMS)

- Open repair of myelomeningocele before 26 weeks: **less shunting**, less hindbrain herniation, better motor function
- Costs: **preterm birth**, uterine thinning/dehiscence → caesarean in this and later pregnancies
- Specialist centres; strict criteria; fetoscopic repair emerging

SCREENING

- Anomaly scan: lemon/banana signs, ventriculomegaly, open spine
- 11–14 wk: anencephaly; **absent intracranial translucency** → open spina bifida
- ↑ maternal AFP in open NTDs (scan now the main tool)
- Fetal MRI for complex CNS findings

NEONATAL HIE

- **Therapeutic hypothermia** 33–34 °C for 72 h
- ≥ 36 weeks, moderate–severe HIE, start **within 6 hours**
- ↓ death and disability

★ **PEARL**

Open spina bifida → ↑ AFP + lemon + banana + Chiari II; occulta → normal AFP.

Valproate = the teratogen to remember — malformations AND neurodevelopment.

6 MRCOG Exam Pearls — Last-Minute Page

Numbers to know

Day 18 Neural plate	**Day 25 / 27–28** Cranial / caudal neuropore	**L3 → L1/2** Cord end: birth → adult	**~90%** MMC with Chiari II
≥ 10 mm Ventriculomegaly	**~70%** NTDs prevented by folate	**~10%** Valproate malformations	**< 26 wk** MOMS repair

HIGH-YIELD CHECKLIST

- ☐ Plate by BMP inhibition; SHH = ventral patterning.
- ☐ Neuropores: cranial day 25, caudal day 27–28; secondary neurulation for sacral cord.
- ☐ Open NTDs ↑ AFP; occulta is an arch defect.
- ☐ 3 → 5 vesicles and adult derivatives.
- ☐ Alar sensory, basal motor; cord ends L3 at birth, L1/2 adult.
- ☐ Holoprosencephaly (SHH, T13, diabetes); Dandy–Walker; ACC; Chiari II.
- ☐ Ventriculomegaly ≥ 10 mm (severe > 15).
- ☐ Crest → PNS, Schwann, adrenal medulla; oligodendrocytes in CNS.
- ☐ Folate 400 µg / 5 mg; valproate PPP.
- ☐ MOMS benefits vs preterm birth; cooling within 6 h.

Self-assessment — cover the right-hand column

Question	Answer
What induces the neural plate?	BMP inhibition (noggin, chordin, follistatin)
When does the caudal neuropore close?	Day ~27–28
Five secondary brain vesicles?	Telencephalon, diencephalon, mesencephalon, metencephalon, myelencephalon
Which plate forms motor neurons?	Basal plate
Where does the cord end in a newborn?	~L3
Two scan signs of open spina bifida?	Lemon sign, banana sign
Malformation linked with trisomy 13 and SHH?	Holoprosencephaly
Who myelinates the CNS?	Oligodendrocytes
Main benefit of the MOMS trial?	Fewer shunts, better motor outcome
Cooling for HIE — start by when?	Within 6 hours of birth

7 References

- Adzick NS et al. A randomized trial of prenatal versus postnatal repair of myelomeningocele (MOMS). N Engl J Med 2011.
- MHRA. Valproate use by women and girls — Pregnancy Prevention Programme; antiepileptic drugs in pregnancy safety review. 2021.
- RCOG Green-top Guideline No. 68. Epilepsy in Pregnancy. 2016.