PIPADOR REVISION

MRCOG Part 1 Revision Notes

Endoderm Derivatives

EMBRYOLOGY • LECTURE 49

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG Part 1 Revision Notes

Lecture 49: Endoderm Derivatives

Embryology • Visual revision edition

COLOUR CODE USED THROUGHOUT THESE NOTES

FOREGUT	MIDGUT	HINDGUT / CLOACA	PHARYNGEAL POUCHES	GLANDS

LEARNING OBJECTIVES — tick off as you go

- ☐ State the rule: endoderm makes epithelium and gland parenchyma; mesoderm makes the wall.
- ☐ Describe the gut tube, its three regions and their arteries.
- ☐ Name the pharyngeal pouch derivatives and describe thyroid descent.
- ☐ Describe the lung, liver and pancreas buds and the partition of the cloaca.
- ☐ Explain midgut herniation and the pectinate line.
- ☐ Apply to TOF/OA, annular pancreas, biliary atresia, thyroglossal cyst, DiGeorge, Meckel's, abdominal wall defects.

1 The Rule

IN ONE LINE: *Endoderm lines the inside — epithelium and gland parenchyma of the gut, airways, bladder and urethra. The muscle and connective tissue around them are splanchnic mesoderm.*

- Formed at gastrulation (first cells through the streak). **Folding in week 4** pulls the yolk sac in → **primitive gut tube**, still joined to the yolk sac by the **vitelline duct** (normally gone by ~week 7–10).

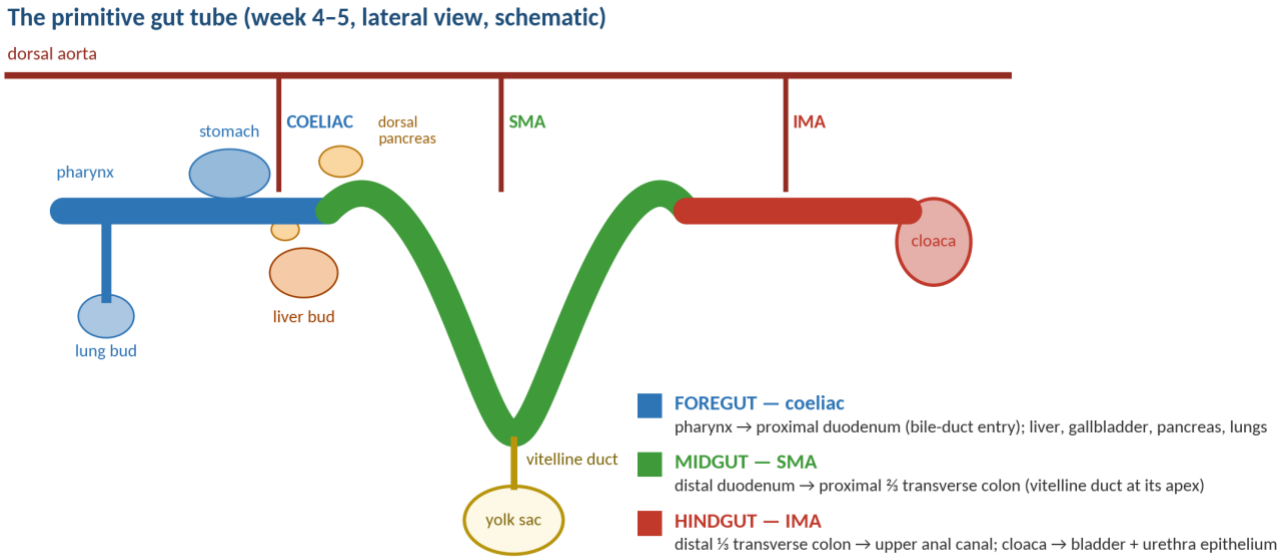


Figure 1. The gut tube and its three arteries.

2 Foregut

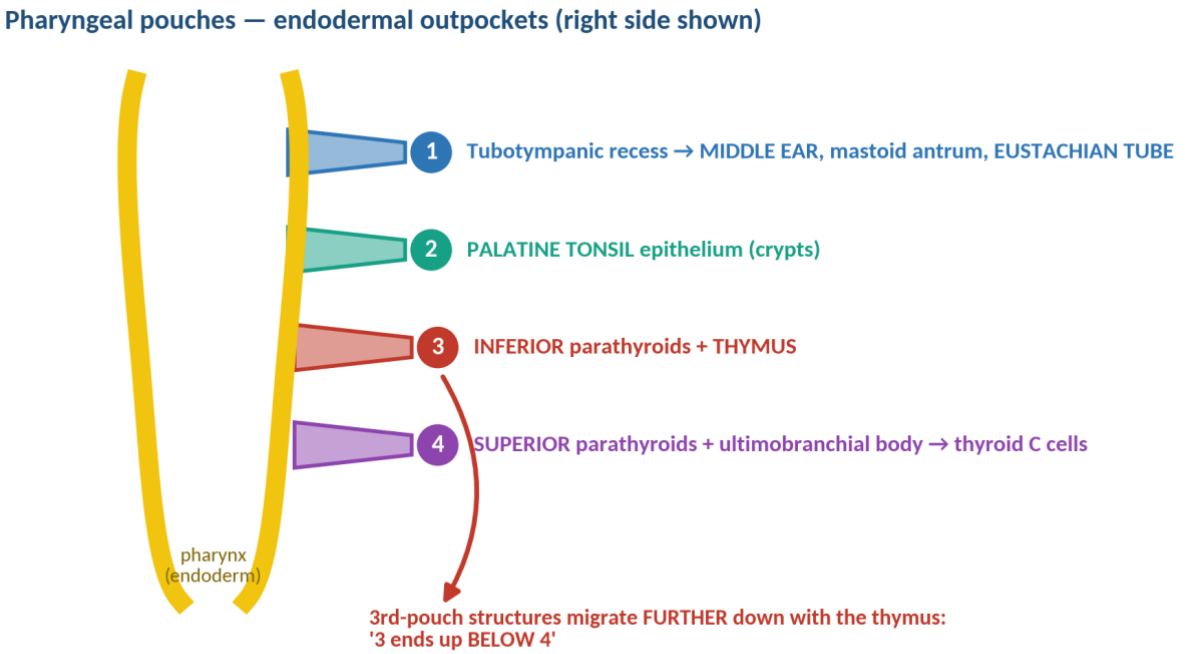


Figure 2. Pharyngeal pouches.

- **Parafollicular C cells** reach the thyroid in the **ultimobranchial body** (4th pouch); classically neural-crest in origin, though recent lineage work suggests endoderm.

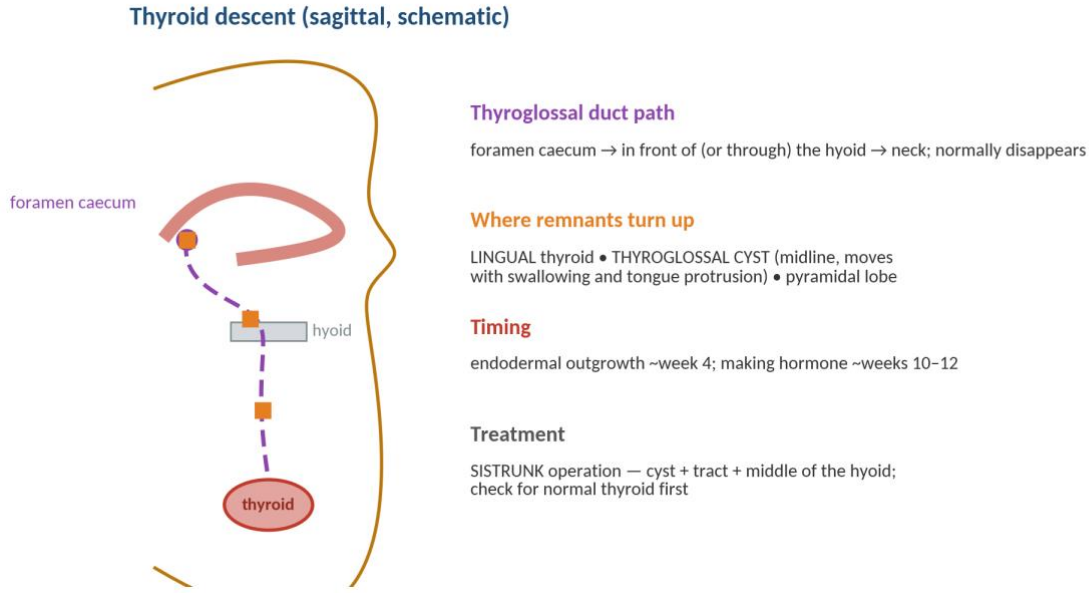


Figure 3. Thyroid descent.

RESPIRATORY BUD (week 4)

- **Laryngotracheal diverticulum** from the ventral foregut
- **Tracheo-oesophageal septum** separates trachea (front) from oesophagus (back)
- Endoderm → epithelium + glands of **larynx**, trachea, bronchi, alveoli; cartilage + muscle from mesoderm / arches

LIVER + GALLBLADDER (week 4)

- **Hepatic diverticulum** from the ventral foregut (future duodenum) into the **septum transversum**
- Cranial part → **hepatocytes**, intrahepatic ducts; caudal part → **gallbladder**, cystic duct
- Septum transversum → liver connective tissue; blood-forming and Kupffer cells arrive from the blood; liver haematopoiesis from ~week 6

STOMACH

- Dilates in week 4; rotates **90° clockwise** (left side → front)
- Hence **left vagus → anterior**, **right vagus → posterior** stomach

PANCREAS — two buds

- **Ventral bud** (with the bile duct) → uncinate + lower head
- **Dorsal bud** → upper head, neck, body, tail
- Ventral bud swings behind the duodenum and fuses
- Endoderm → acini **and** islets

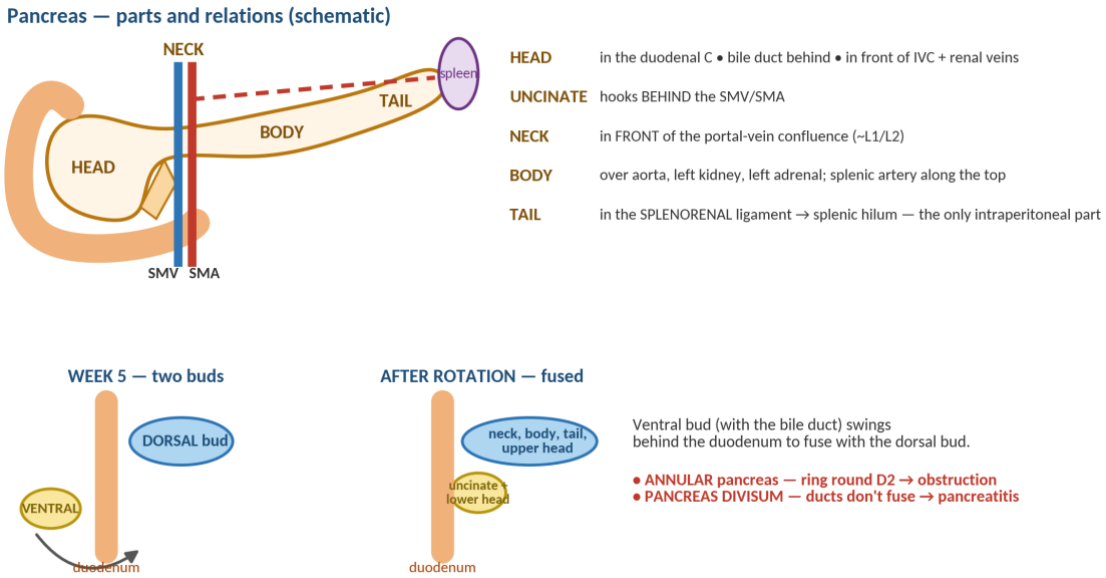


Figure 4. Pancreas parts and buds (from Lecture 30).

3 Midgut

- Distal duodenum → proximal ⅔ of transverse colon (SMA). **Physiological umbilical hernia** from **week 6**, returning by **week 10–12** after a **270° anticlockwise** rotation around the SMA.

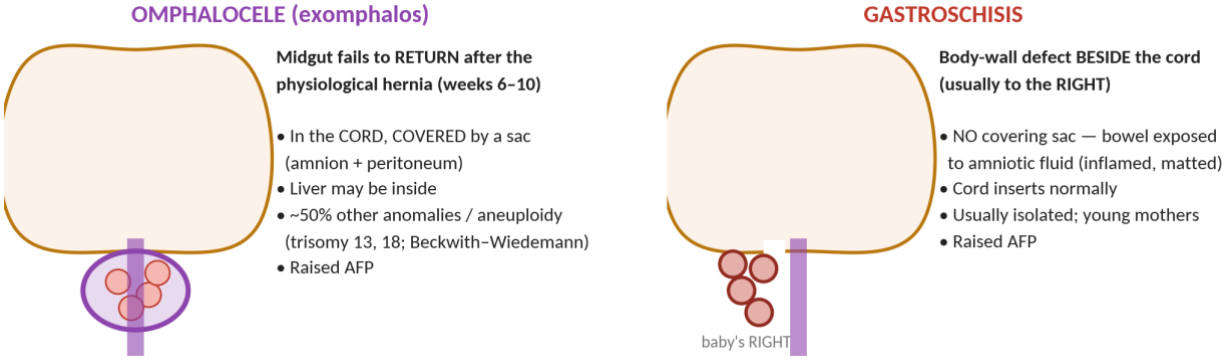


Figure 5. Omphalocele vs gastroschisis.

- Midgut disorders: **malrotation ± volvulus**, **Meckel's diverticulum** (persistent vitelline duct).

> **MNEMONIC / MEMORY HOOK**
>
> **Meckel's 'rule of 2s'**: ~2% of people • ~2 feet from the ileocaecal valve • ~2 inches long • 2 ectopic tissues (gastric, pancreatic) • often presents by age 2.

4 Hindgut and Cloaca

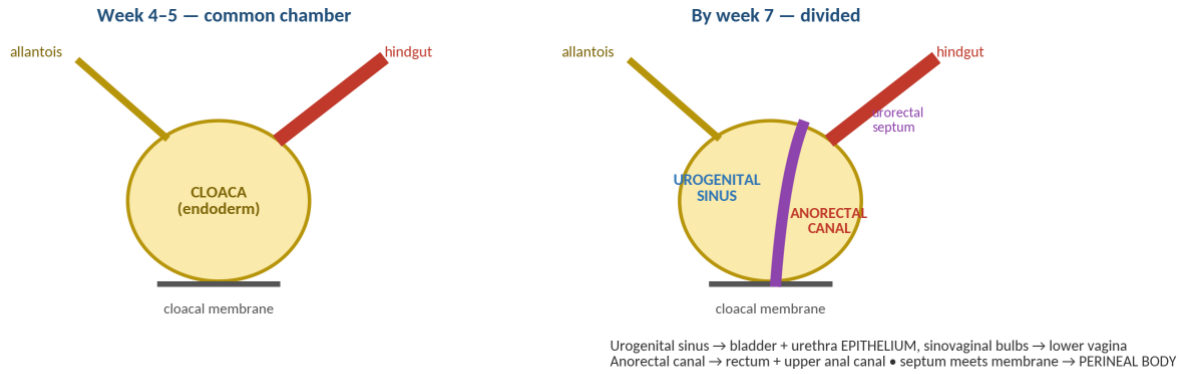


Figure 6. Partition of the cloaca.

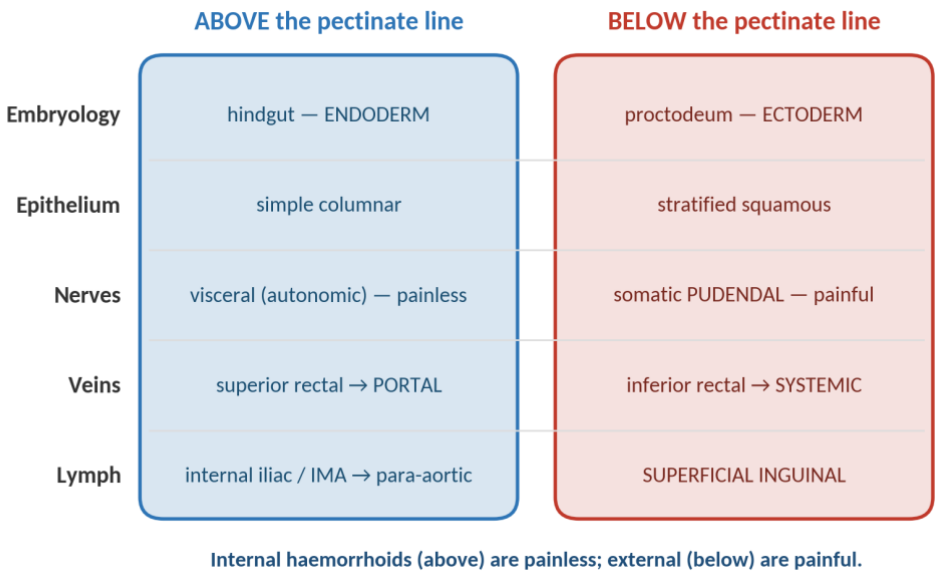


Figure 7. Above vs below the pectinate line (from Lecture 28).

5 Endodermal Derivatives at a Glance

System	Endoderm forms…
Gut epithelium	Pharynx → upper anal canal (not the mouth in front of the oropharyngeal membrane or the anal canal below the pectinate line)
Airway epithelium	Larynx, trachea, bronchi, alveoli
Gland parenchyma	Liver, pancreas (exocrine + endocrine), thyroid follicles, parathyroids, thymus epithelium, submandibular + sublingual glands (parotid is ectoderm)

System	Endoderm forms…
Urogenital epithelium	Bladder, most of the urethra, lower vagina (sinovaginal bulbs); allantois/urachus lining
Head	Tympanic cavity + Eustachian tube (pouch 1); palatine tonsil (pouch 2)

- Signals: **SOX17, FOXA2, HNF** specify endoderm; liver needs **FGF** (cardiac mesoderm) + **BMP** (septum transversum); dorsal pancreas needs **SHH suppressed** (notochord).

6 Clinical Correlates

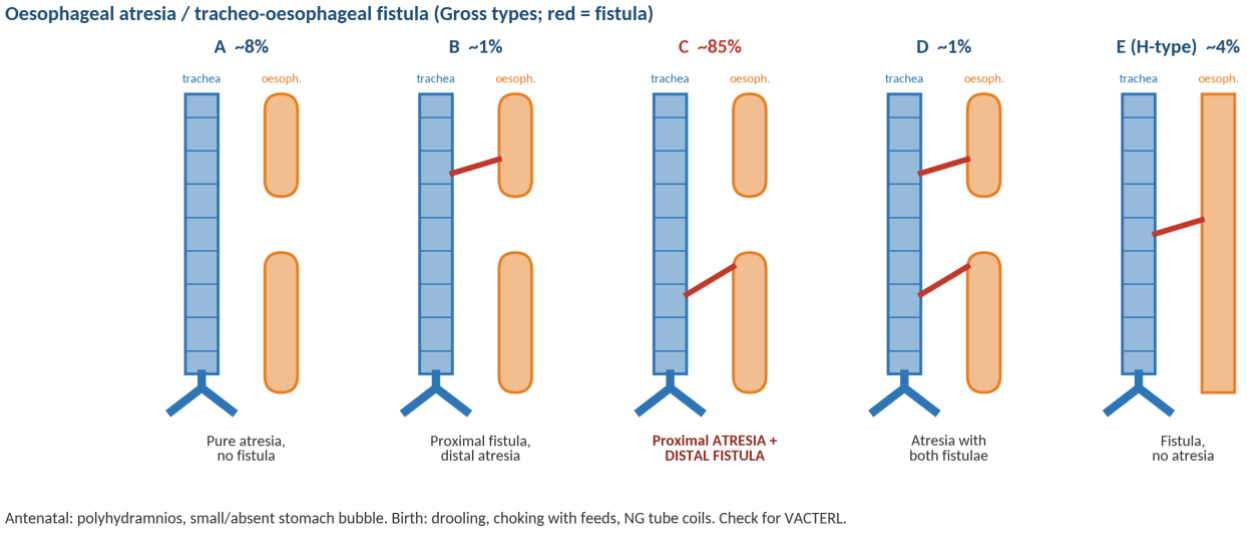


Figure 8. Types of oesophageal atresia / TOF.

Condition	Key points
Annular pancreas	A bifid ventral bud grows both ways round the 2nd part of the duodenum → obstruction, 'double bubble'; linked to Down syndrome. Divisum = ducts fail to fuse
Biliary atresia	Extrahepatic ducts obliterated — prolonged jaundice, pale stools, dark urine; Kasai portoenterostomy (best before ~60 days); many later need a transplant
Thyroglossal cyst	Midline, moves on swallowing and tongue protrusion; Sistrunk operation
DiGeorge (22q11.2)	Pouches 3 + 4: absent thymus + parathyroids → hypocalcaemia, T-cell deficiency, conotruncal heart defects
Diaphragmatic hernia	Pleuroperitoneal membrane (mesoderm) defect → gut in the chest → pulmonary hypoplasia
Hirschsprung	Neural crest fails to reach the distal hindgut → aganglionic segment (endodermal organ, neural-crest defect)
Bladder / cloacal exstrophy	Mesoderm fails to grow between cloacal membrane and ectoderm → open bladder/cloaca on the abdominal wall

★ PEARL

Endoderm = epithelium; splanchnic mesoderm = wall — true for gut, airways and bladder.

Pouch 3 → inferior parathyroid + thymus; pouch 4 → superior parathyroid ('3 ends up below 4').

Commonest TOF (~85%): proximal oesophageal atresia + distal fistula — polyhydramnios antenatally, NG tube coils after birth.

7 MRCOG Exam Pearls — Last-Minute Page

Numbers to know

Week 4 Gut tube; lung + liver buds	**Week 6** Midgut herniates	**Week 10–12** Midgut returns	**270°** Anticlockwise rotation
90° Stomach rotation (clockwise)	**Week 7** Cloaca divided	**~85%** TOF type C	**2%** Meckel's (rule of 2s)

HIGH-YIELD CHECKLIST

- ☐ Endoderm = epithelium + gland parenchyma; mesoderm = muscle + connective tissue.
- ☐ Foregut coeliac • midgut SMA • hindgut IMA — know the boundaries.
- ☐ Pouches: 1 middle ear/Eustachian • 2 tonsil • 3 inferior parathyroid + thymus • 4 superior parathyroid + C cells.
- ☐ Thyroid: foramen caecum → thyroglossal duct → neck; functioning by 10–12 weeks.
- ☐ Lung bud + TO septum → TOF/OA (type C ~85%).
- ☐ Liver bud into septum transversum; pancreas from ventral + dorsal buds.
- ☐ Midgut: herniates wk 6, returns wk 10–12, 270° anticlockwise.
- ☐ Omphalocele covered, in the cord, associated anomalies; gastroschisis uncovered, right of cord, isolated.
- ☐ Urorectal septum divides cloaca by week 7; pectinate line = endoderm/ectoderm boundary.
- ☐ Meckel's rule of 2s; annular pancreas (Down); DiGeorge; biliary atresia (Kasai).

Self-assessment — cover the right-hand column

Question	Answer
Artery of the midgut?	Superior mesenteric artery
Where does the foregut end?	Duodenum at the bile-duct entry
Pouch forming the inferior parathyroids?	Third (with the thymus)
Origin of the thyroid?	Endoderm at the foramen caecum
Commonest form of oesophageal atresia?	Proximal atresia + distal TOF (~85%)
Cause of annular pancreas?	Bifid ventral bud encircling the duodenum
Which abdominal wall defect has a covering sac?	Omphalocele
What divides the cloaca?	Urorectal septum (by week 7)
Which gland is ectodermal, not endodermal?	Parotid
Pectinate line marks which boundary?	Endoderm (above) / ectoderm (below)

8 References

- Sadler TW. Langman's Medical Embryology. 14th ed. 2019.
- Moore KL, Persaud TVN, Torchia MG. The Developing Human. 11th ed. 2020.