PIPADOR REVISION

MRCOG Part 1 Revision Notes

The Respiratory System

EMBRYOLOGY • LECTURE 75

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG Part 1 Revision Notes

Lecture 75: The Respiratory System

Embryology • Visual revision edition

COLOUR CODE USED THROUGHOUT THESE NOTES

ENDODERM / AIRWAY	MESODERM	SURFACTANT / TYPE II	DISEASE	TREATMENT

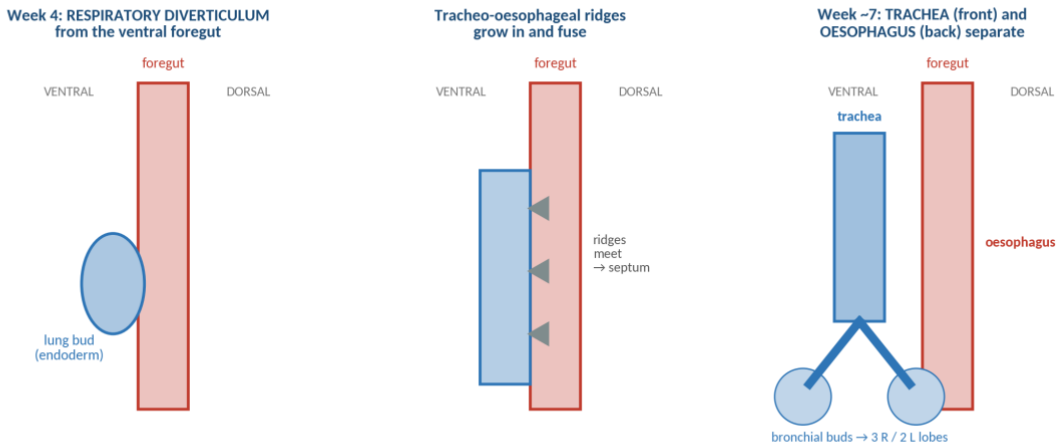
LEARNING OBJECTIVES — tick off as you go

- ☐ Describe the respiratory diverticulum and tracheo-oesophageal septum.
- ☐ Name the five stages of lung development and their timing.
- ☐ Explain pneumocytes, surfactant and what speeds or slows maturation.
- ☐ Apply antenatal steroids, magnesium and the causes of pulmonary hypoplasia.
- ☐ Recognise congenital lung lesions and newborn breathing disorders.

1 The Respiratory Diverticulum

IN ONE LINE: *Week 4: a bud from the ventral foregut. Endoderm lines the airway; splanchnic mesoderm builds everything around it.*

The respiratory diverticulum (side view, schematic)



Endoderm → epithelium of larynx, trachea, bronchi, alveoli • Splanchnic mesoderm → cartilage, smooth muscle, connective tissue, vessels • Failure → OA / TOF

Figure 1. Lung bud and septation.

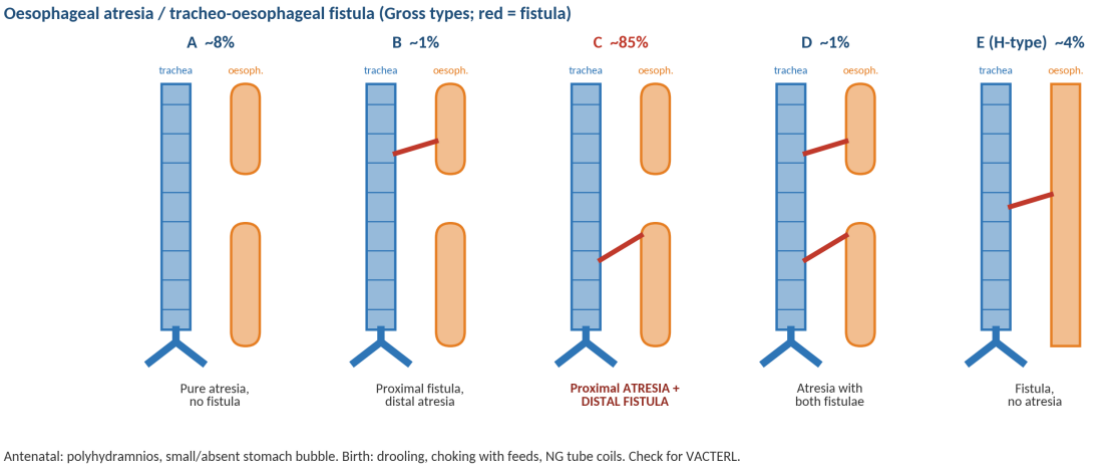


Figure 2. OA/TOF types (from Lecture 49).

2 Five Stages

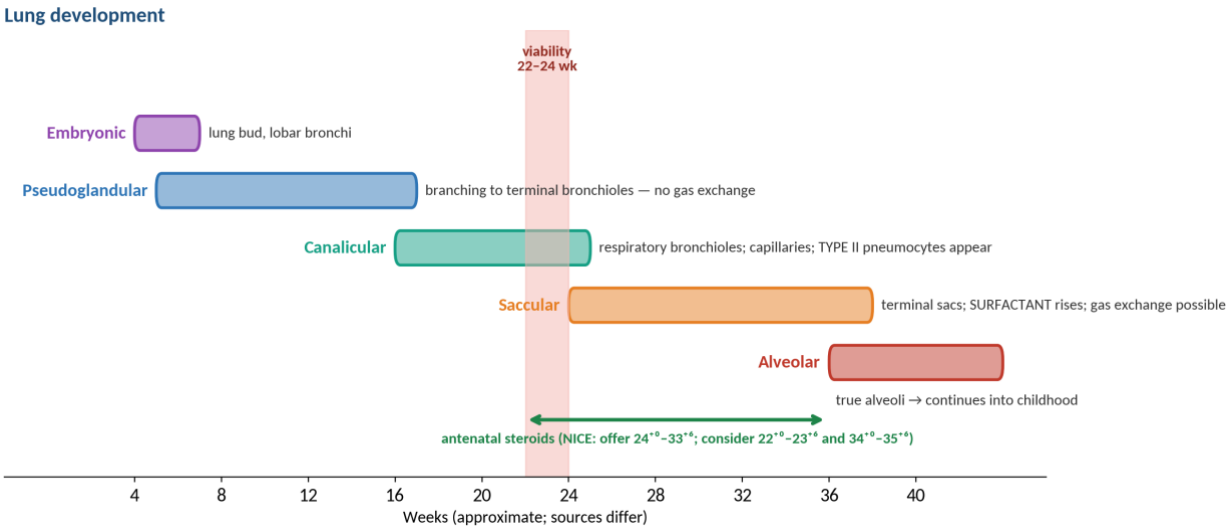


Figure 3. Lung development stages (from Lecture 53).

Stage	Approx. weeks	Key events
Embryonic	4–7	Lung bud; lobar bronchi (3 R, 2 L); septation
Pseudoglandular	5–17	Branching to terminal bronchioles — no gas exchange (CDH and oligohydramnios hit here and later)
Canalicular	16–26	Respiratory bronchioles, capillaries close up, type II cells + first surfactant — survival possible from ~22–24 weeks
Saccular	24–38	Terminal sacs, thin barrier, surfactant rises
Alveolar	36 weeks → childhood	True alveoli; ~20–50 million at birth → ~300 million+ in the adult

MNEMONIC / MEMORY HOOK

'Every Pig Can Swim Alone' — Embryonic, Pseudoglandular, Canalicular, Saccular, Alveolar.

3 Pneumocytes and Surfactant

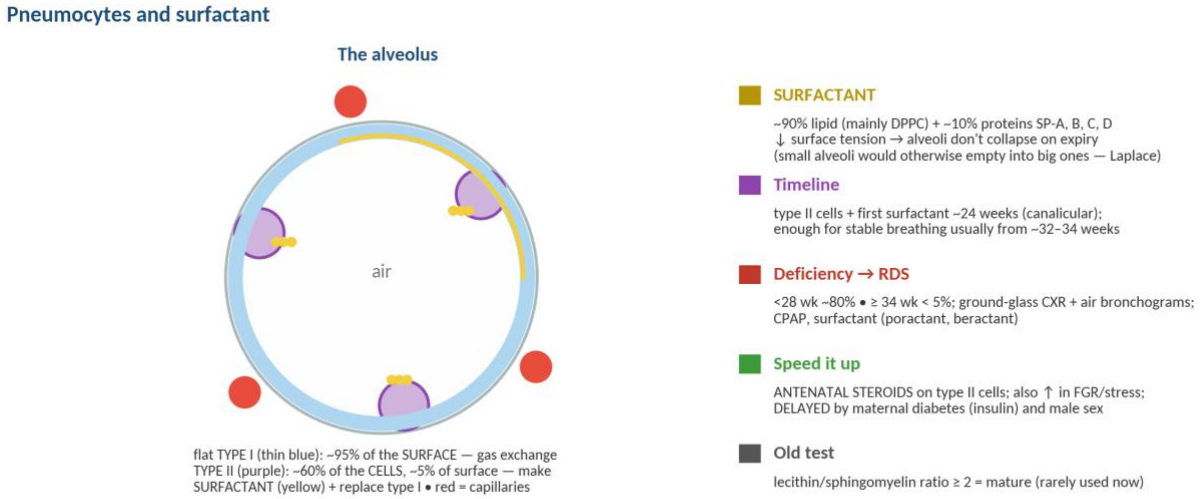


Figure 4. Alveolus and surfactant.

- Other cells: **club (Clara) cells** — bronchiolar progenitors that secrete protective proteins (not surfactant precursors); ciliated and goblet cells; neuroendocrine cells.

4 Steroids, Magnesium and Hypoplasia

ANTENATAL CORTICOSTEROIDS (NICE NG25, 2022)

- Betamethasone 12 mg IM × 2, 24 h apart (or dexamethasone)
- **Offer 24^{+0}–33^{+6}; consider 22^{+0}–23^{+6}** and **34^{+0}–35^{+6}**
- ↓ RDS, IVH, NEC, death; best 24 h–7 days after
- Repeat courses not routine; planned CS < 39 weeks — discuss benefits vs harms (e.g. neonatal hypoglycaemia)

MAGNESIUM SULFATE

- Neuroprotection (↓ cerebral palsy)
- **Offer 24^{+0}–29^{+6}, consider 30^{+0}–33^{+6}** when birth is expected within 24 h
- In-utero transfer to the right level of neonatal unit

PULMONARY HYPOPLASIA

- Lung fluid + breathing movements stretch the lungs — they need room and liquor
- **Oligohydramnios** (renal agenesis, PPROM before ~24 weeks), **CDH**, small chest (skeletal dysplasia), pleural effusions, absent breathing movements

MATERNAL FACTORS

- **ACE inhibitors/ARBs** (2nd–3rd trimester) → oligohydramnios → hypoplasia
- **NSAIDs** → oligohydramnios, ductal constriction
- **Smoking** → smaller airways, more SIDS
- **Diabetes** → delayed surfactant (fetal insulin)

5 Congenital Lesions

Congenital lung and airway lesions

CPAM (formerly CCAM)	cystic/solid lung tissue that CONNECTS to the airway; normal pulmonary blood supply; macro- vs microcystic; CPAM volume ratio (CVR) > 1.6 → hydrops risk; microcystic + hydrops → maternal steroids; macrocystic → shunt; many shrink
SEQUESTRATION	lung tissue with NO airway connection + SYSTEMIC artery (usually from the AORTA) — the feeding vessel on Doppler is the clue; extralobar (own pleura, more often antenatal) vs intralobar; hybrid lesions occur
BRONCHOGENIC CYST	abnormal budding of the foregut/airway — usually mediastinal; may compress airway
CDH	abdominal organs in the chest → pulmonary hypoplasia; O/E LHR + liver position; FETO (Lecture 73)
CHOANAL ATRESIA	bilateral = neonatal distress; CYCLICAL CYANOSIS relieved by CRYING (babies nose-breathe); NG tube won't pass via the nose; oral airway first; CHARGE

Large lesions with mediastinal shift / hydrops: fetal medicine centre; EXIT procedure rarely. Postnatal CT; excision if symptomatic (infection, rare malignancy).

Figure 5. Lung and airway lesions.

EXAM HOOK

CPAM connects to the airway with normal pulmonary supply; sequestration does NOT connect and has a SYSTEMIC (aortic) artery. Doppler of the feeding vessel tells them apart.

6 Newborn Breathing Problems

Newborn breathing problems — compared

Condition	Who	Why	Key features / treatment
RDS	PRETERM, diabetic mother, male	surfactant deficiency	grunting in hours; ground-glass CXR; CPAP, surfactant; prevent with steroids
TTN	term/late preterm, pre-labour CAESAREAN	slow lung-fluid clearance	tachypnoea, settles in 24–72 h; supportive
MAS	post-dates, fetal distress	meconium: blockage, pneumonitis, surfactant inactivation	patchy CXR, air leak, PPHN; no routine suction at birth (NLS)
PPHN	MAS, CDH, sepsis, asphyxia	PVR fails to fall	pre > post-ductal SpO_2; iNO, sildenafil, ECMO
Congenital pneumonia	GBS, prolonged ROM, chorioamnionitis	infection	antibiotics (NICE NG195); maternal intrapartum antibiotics prevent early GBS
BPD (chronic lung disease)	extreme preterm	ventilation, O_2, inflammation	O_2 need at 36 weeks corrected; caffeine, gentle ventilation, selective steroids

Figure 6. RDS, TTN, MAS, PPHN, pneumonia, BPD.

★ PEARL

Surfactant appears ~24 weeks, is usually sufficient by ~34 weeks — steroids hurry it up, maternal diabetes slows it down.

TTN = caesarean before labour; RDS = preterm; MAS = post-dates and distress.

7 MRCOG Exam Pearls — Last-Minute Page

Numbers to know

Week 4 Lung bud	**Week 7** TO septum	**~24 wk** Type II cells + surfactant	**~34 wk** Usually enough surfactant
24^{+0}–33^{+6} Offer steroids	**24^{+0}–29^{+6}** Offer $MgSO_4$	**~80% / < 5%** RDS < 28 / ≥ 34 wk	**36 wk** BPD defined (corrected)

HIGH-YIELD CHECKLIST

- ☐ Lung bud week 4 from ventral foregut; TO septum by week 7 → OA/TOF.
- ☐ Endoderm = epithelium; splanchnic mesoderm = cartilage, muscle, vessels.
- ☐ Five stages: E, P, C, S, A — gas exchange possible from canalicular (~22–24 wk).
- ☐ Type I = surface; type II = surfactant + stem cells.
- ☐ Surfactant: DPPC + SP-A–D; ↓ surface tension.
- ☐ Steroids 24^{+0}–33^{+6} (consider 22–23^{+6}, 34–35^{+6}); $MgSO_4$ 24^{+0}–29^{+6} (consider to 33^{+6}).
- ☐ Hypoplasia: oligohydramnios, CDH, small chest.
- ☐ CPAM vs sequestration (systemic artery).
- ☐ Choanal atresia: cyanosis relieved by crying; CHARGE.
- ☐ RDS, TTN, MAS, PPHN, BPD — who and why.

Self-assessment — cover the right-hand column

Question	Answer
Germ layer of the airway epithelium?	Endoderm
When does the tracheo-oesophageal septum form?	By week 7
Stage in which gas exchange first becomes possible?	Canalicular
Which cells make surfactant?	Type II pneumocytes
Main phospholipid of surfactant?	Dipalmitoylphosphatidylcholine (DPPC)
NICE steroid 'offer' window?	24^{+0}–33^{+6} weeks
Maternal condition that delays surfactant?	Diabetes
Blood supply of a sequestration?	Systemic artery, usually from the aorta
Classic clue to bilateral choanal atresia?	Cyanosis relieved by crying
Definition of BPD?	Oxygen requirement at 36 weeks corrected age

8 References

- NICE NG25. Preterm labour and birth. 2015 (updated 2022).
- Resuscitation Council UK. Newborn Life Support. 2021.
- Sadler TW. Langman's Medical Embryology. 14th ed. 2019.