

* 4th week:

1) proliferation starts from the mesenchyme or mesodermal cells.

2) placode → precursor of organs.

3) stomodeum → anterior of oral cavity separated posteriorly by oropharynx membrane.

* 5th Week e-:

Formation of nasal pits (nostrils) then it dilates deeper making the vestibule (lined by stratified squamous epithelium) ⇒ Nasal pits coming from nasal placodes invagination.

1) medial prominence / lateral prominence / frontal prominence / Maxillary prominence / Mandibular prominence

frontal → frontal bone (forehead) / nasal bridge / fuse with the medial making nasal septum (medial nasal wall)

Maxillary → cheeks / Maxilla / lateral part of upper lip. ⇒ Grow medially compressing the medial wall prominence and fuse with it making cleft that disappears later making philtrum.

Mandibular → Mandible / upper lip.

Medially → fuses with frontal → nasal septum (medial wall of the nose)

Maxillary → philtrum → vertical depression above the upper lip. ⇒ fusion problem makes unilateral or bilateral hernal lip or labial cleft.

Laterally → Ala of the nose + lateral nasal wall

from ectoderm (skin).

* 6th week: nasal cavity formation

1) Nasal pits grows deeper by the development of the mesenchyme and form the conchae/recess/meatuses

2) oronasal membrane separates nasal pits and primitive oral cavity → by primitive choana.

3) oronasal membrane ruptures forming again permanent oral membrane by secondary and primary palates } oral membrane making nasal cavity floor.

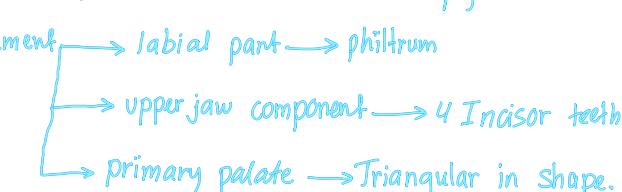
Secondary palate separates oral and nasal cavities and forms the meatuses, recesses and conchae.

* definitive choana lies b/w nasal cavity and pharynx (nasopharynx).

* paranasal sinuses = develop as diverticula of lateral nasal wall (drainage side) as ducts into frontal, ethmoidal, sphenoidal, maxillary; end as sinuses reach their maximum size at puberty.

* primary palate = maxillary develops medially → fusion of medial prominences not just on the surface, but also deeply

Deep fusion of medial + maxillary prominences → Intermaxillary segment



* Secondary palate e-

6th week → outgrowth of palatine shelves from lateral side of maxilla → making the main part of definitive palate.
↳ They descend obliquely downward on each side of the tongue.

7th week → 2 shelves ascend to attain horizontally above the tongue → fuse forming secondary palate
then secondary palate + primary palate (Δ) fuse with the frontonasal

Anteriorly shelves fuse with primary palate (Δ) ⇒ Incisive foramen midline between primary and secondary palates (landmark)

at the same time → frontonasal septum grows down + joins with the cephalic aspect of the newly formed palate (primary + secondary)
2 folds grow posterior to hard palate from edge of the palatine process forming soft palate and the uvula

8th week ⇒ fusion of 2 soft palates

11th week ⇒ fusion of 2 parts of uvula in midline ⇒ x-fuse w/ fine cleft separating the uvula.

* Respiratory system: develops of

1) pharyngeal gut (pharynx) ⇒ from buccopharyngeal membrane (separates between oral + pharynx) → tracheobronchial diverticulum = lung bud (posterior of oral cavity + pharynx).

2) foregut ⇒ located caudal to the pharyngeal tube then extends as far caudally as the liver bud (2nd part of duodenum upper half).

3) midgut ⇒ caudal liver bud → right junction of proximal 2/3 + distal 1/3 of transverse colon.

4) hindgut ⇒ left distal 3rd of transverse colon descending colon, sigmoid colon, rectum and upper 1/2 of anal canal → cloacal membrane.

4th week: diverticulum (lung bud) outgrowth from ventral wall of foregut

* location of the gut and bud determined by → signal (Fibroblast growth factor (FGF)) from the surrounding mesenchyme ⇒ problems lead to anomalies

* epithelium lining larynx, trachea + bronchi → from endodermal origin.

* cartilages + muscles (ie Trachealis) + C.T. → splanchnic mesoderm which surrounds the foregut

* lung bud open communication with the foregut.

* Esophagus → begins short then extends after the formation of the heart pericardium.

* Diverticulum extends caudally → 2 ridges tracheoesophageal ridges separate between them at the same time of tracheoesophageal septum formation → The foregut separates into ventral → trachea + lung bud dorsal → esophagus.

* Larynx inlet (slit like) → connects respiratory + GI tracts.

* Anomalies of Tracheoesophagus →

* Tracheoesophageal fistula (TEF) → Tracheal fistula + esophageal atresia (blind end of the esophagus). ↘
Abnormality in partitioning of esophagus and trachea by tracheoesophageal septum leading to esophageal atresia with or without tracheoesophageal fistula.

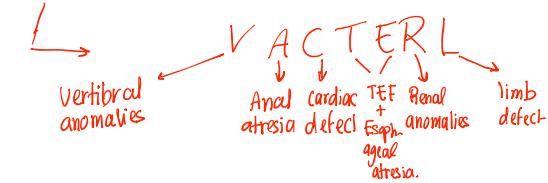
- proximal blind end of esophagus (atresia) making a pouch + lower segment forming a fistula with the trachea ⇒ 90% or 1/3000 ⇒ proximal atresia + distal fistula.
- Double atresia
- H-shape TEF
- proximal fistula + distal atresia
- Double fistula.

* leading to problems → 1) milk drinking swallowing → fill esophagus → regurgitation.

- 2) polyhydramnios → excessive amniotic fluid within amniotic sac since it doesn't pass to stomach + intestine
- 3) gastric content + amniotic fluid fills the trachea through a fistula ⇒ pneumonia or pneumomediastinum

→ air from respiratory tract → digestive tract ⇒ abdomen distended during respiration.

* Anomalies associated with cardiac defects



* Tracheal atresia and stenosis → Uncommon associated with TEF → Web tissue obstruct tracheal air flow → partial / incomplete tracheal atresia.

* Larynx & -

The lining epithelium from endoderm.

Muscles + cartilages → 4th (cricothyroid m.) + 6th (The rest muscles) pharyngeal arches.

* As the mesenchyme proliferate rapidly → The laryngeal orifice changes its shape from sagittal slit into T shape.

laryngeal orifice reaches the thyroid, cricoid and arytenoid cartilages → its characteristics can be recognized.

* At the time of cartilages formation → epithelium proliferate → occlusion of the lumen → recanalization → recanalization forming laryngeal ventricles + saccules binding by fold → false + true vocal cords.

* larynx supplied by vagus n. (10th n.) →
superior laryngeal → Internal laryngeal
External laryngeal → 4th arch (cricothyroid).
recurrent laryngeal → 6th arch arising muscles.

* laryngeal anomalies e.g. laryngeal atresia = congenital high airway obstruction syndrome (CHAOS)

- uncommon → obstruction of the upper airway

- diagnosed by prenatal ultrasound

- results e.g. Enlargement of the lungs or distal atresia → As lungs are trying to compensate.

flattened or inverted diaphragm

Fetal ascites → abdominal cavity filled with fluid.

Hydrops → Accumulation of serous fluid.

* Trachea, bronchi, lungs

- lung bud separates from foregut → making 1] Trachea, 2] bronchial buds (lateral outpocketing)

↳ beginning of 5th week
right main bronchi → then 3 secondary / lobar bronchi
left main bronchi → 2 secondary / lobar bronchi

pericardial peritoneal canal (they're narrow) → pleuropericardial + pleuroperitoneal forming lung's spaces.

* The lungs grow within the pleuropericardial space

pericardial peritoneal canal separated from the peritoneal and pericardial cavities through pleuropericardial + pleuroperitoneal folds → remnant spaces → primitive pleural cavities

* outer lining mesoderm of the lung → visceral pleura.
* inner somatic mesoderm → parietal pleura → space in between pleural cavity.

More divisions:

lobes → dichotomous forming → right 10 segments
↓ → left 8 segments (Apicoposterior + Anteromedial)

17 subdivision prenatal + 6 postnatal (before terminal tree completion) = 23 divisions.

alveoli + alveolar sac + duct → form primordial after birth.

Growth by FGF.

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* lung's Maturation:

* 7th prenatal month:

1] Dividing of terminal bronchiole into smaller canals → canalicular phase (6-26 weeks)

2] Steadily increasing in vascular supply → there's no respiratory membrane (capillaries not in contact) → cells are still cuboidal.

3] Terminal sac period (26 weeks) → Respiration is possible as the cuboidal cells get flattened.

→ primitive alveoli → cells are associated with numerous blood, lymph capillaries. (They get contacted)

→ Cells become squamous

→ 7th month → Respiratory membrane + sufficient no. of capillaries → To guarantee adequate gas exchange so premature infants are able to survive (7 months / 26 weeks after)

Type I cells → surrounding the primitive alveoli → Then cells becomes thinner then invagination of capillaries into alveolar sac.

* 6th month → growing of pneumocyte type II → releasing of surfactants → ↓ surface tension → If → Surfactants causes IRDS = hyaline membrane disease (causing lung collapse = Atelectasis)
↳ At the same time with [mainly increase 2 weeks before birth]

* Breathing movement → Aspiration of amniotic fluid.

↳ Reabsorption of fluids (suctioning can be done for further airway cleaning)

then surfactant → phospholipid thin coat lining the alveoli preventing the air-water (blood) high tension interfering with the first breath.

* Anomalies:

1] ↓ surfactants → ↑ air-water (blood) tension → Alveolar collapse/rupture = Atelectasis ⇒ Respiratory distress syndrome. causes 20% neonatal death.

2] Abnormal bronchial tree division → more common

3] Ectopic = outside the normal site → lobes arising from trachea or esophagus

4] Congenital cyst of the lung → The most important → Multiple small cysts → Honeycomb in radiography → result in lung's chronic infection.
↳ restricted to one or more larger ones. because of poor drainage.

5] Lung hypoplasia → Associated with congenital diaphragmatic hernia → Abnormal compression of abdominal viscera on the lung (more on left side) → result in ↓ lung volume

6] Oligohydramnios → ↓ amniotic fluid → retarding in lung's development (As Amniotic fluid is important for lung development and muscle conditioning) → result in pulmonary hypoplasia.

* fresh healthy lung contain some air → floating in water

* Still born dead babies lungs are firm → sinking in water (as they contain fluid not air)

↳ pulmonary insufficiency because of hypoplastic lung
↳ infants death.