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18/MHS05/010

Physiology

ANA 206

Question

Write notes on the following:

I) Development of the lungs

II) Rotation of the stomach and the formation of the Omental bursa

III) Development of the esophagus

Answers

I) Development of the lungs

The development of the human lungs arise from the [laryngotracheal groove](https://en.wikipedia.org/wiki/Laryngotracheal_groove%22%20%5Co%20%22Laryngotracheal%20groove) and develop to maturity over several weeks in the foetus and for several years following birth.

The [larynx](https://en.wikipedia.org/wiki/Larynx), [trachea](https://en.wikipedia.org/wiki/Trachea), [bronchi](https://en.wikipedia.org/wiki/Bronchus) and lungs that make up the respiratory tract, begin to form during the fourth week of [embryogenesis](https://en.wikipedia.org/wiki/Human_embryogenesis)from the [lung bud](https://en.wikipedia.org/wiki/Lung_bud) which appears ventrally to the caudal portion of the [foregut](https://en.wikipedia.org/wiki/Foregut).



Lungs during development, showing the early branching of the primitive bronchial buds

The respiratory tract has a branching structure, and is also known as the respiratory tree. In the embryo this structure is developed in the process of [branching morphogenesis](https://en.wikipedia.org/wiki/Morphogenesis), and is generated by the repeated splitting of the tip of the branch. In the development of the lungs (as in some other organs) the epithelium forms branching tubes.The lung has a left-right symmetry and each bud known as a [bronchial bud](https://en.wikipedia.org/wiki/Lung_bud) grows out as a tubular epithelium that becomes a bronchus. Each bronchus branches into bronchioles.The branching is a result of the tip of each tube bifurcating. The branching process forms the bronchi, bronchioles, and ultimately the alveoli.The four genes mostly associated with branching morphogenesis in the lung are the [intercellular signalling protein](https://en.wikipedia.org/wiki/Hedgehog_signaling_pathway) – [sonic hedgehog](https://en.wikipedia.org/wiki/Sonic_hedgehog) (SHH), [fibroblast growth factors](https://en.wikipedia.org/wiki/Fibroblast_growth_factor) [FGF10](https://en.wikipedia.org/wiki/FGF10) and FGFR2b, and [bone morphogenetic protein](https://en.wikipedia.org/wiki/Bone_morphogenetic_protein) [BMP4](https://en.wikipedia.org/wiki/Bone_morphogenetic_protein_4). FGF10 is seen to have the most prominent role. FGF10 is a [paracrine signalling](https://en.wikipedia.org/wiki/Paracrine_signalling) molecule needed for epithelial branching, and SHH inhibits FGF10. The development of the alveoli is influenced by a different mechanism whereby continued bifurcation is stopped and the distal tips become dilated to form the alveoli.

At the end of the fourth week the lung bud divides into two, the right and left [primary bronchial buds](https://en.wikipedia.org/wiki/Lung_bud) on each side of the trachea. During the fifth week the right bud branches into three secondary bronchial buds and the left branches into two secondary bronchial buds. These give rise to the lobes of the lungs, three on the right and two on the left. Over the following week, the secondary buds branch into tertiary buds, about ten on each side. From the sixth week to the sixteenth week, the major elements of the lungs appear except the [alveoli](https://en.wikipedia.org/wiki/Pulmonary_alveolus). From week 16 to week 26, the bronchi enlarge and lung tissue becomes highly vascularised. Bronchioles and alveolar ducts also develop. By week 26 the terminal bronchioles have formed which branch into two respiratory bronchioles.During the period covering the 26th week until birth the important [blood–air barrier](https://en.wikipedia.org/wiki/Blood%E2%80%93air_barrier) is established. Specialised [type I alveolar cells](https://en.wikipedia.org/wiki/Alveolar_cells) where [gas exchange](https://en.wikipedia.org/wiki/Gas_exchange) will take place, together with the [type II alveolar cells](https://en.wikipedia.org/wiki/Alveolar_cells) that secrete [pulmonary surfactant](https://en.wikipedia.org/wiki/Pulmonary_surfactant), appear. The surfactant reduces the [surface tension](https://en.wikipedia.org/wiki/Surface_tension) at the air-alveolar surface which allows expansion of the alveolar sacs. The alveolar sacs contain the primitive alveoli that form at the end of the alveolar ducts, and their appearance around the seventh month marks the point at which limited respiration would be possible, and the premature baby could survive.

II) Rotation of the stomach and the formation of the Omental bursa

The greater omentum develops from the [dorsal mesentery](https://en.wikipedia.org/wiki/Dorsal_mesentery) that connects the [stomach](https://en.wikipedia.org/wiki/Stomach) to the posterior abdominal wall. During its development, the stomach undergoes its first 90° rotation along the axis of the embryo, so that posterior structures are moved to the left and structures anterior to the stomach are shifted to the right. As a result, the dorsal mesentery folds over on itself, forming a pouch with its blind end on the left side of the embryo. A second approximately 90° rotation of the stomach, this time in the [frontal plane](https://en.wikipedia.org/wiki/Frontal_plane), moves structures inferior if they were originally to the left of the stomach, and superior if they were originally to the stomach's right. Consequently, the blind-ended sac (also called the [lesser sac](https://en.wikipedia.org/wiki/Lesser_sac)) formed by the dorsal mesentery is brought inferiorly, where it assumes its final position as the greater omentum. It grows to the point that it covers the majority of the small and large intestine.

II) Rotation of the stomach and the formation of the Omental bursa

ROTATION OF THE STOMACH

The "stomach"is located between the esophagus and the small intestine. ... The longitudinal "rotation of the stomach" involves a 90° clockwise "rotation" resulting in the right side of the "stomach" becoming posteriorly oriented and the left side of the "stomach" facing anteriorly.

THE OMENTAL BURSA FORMATION

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III) Development of the esophagus

In early embryogenesis, the esophagus develops from the endodermal primitive gut tube. The ventral part of the embryo abuts the yolk sac. During the second week of embryological development, as the embryo grows, it begins to surround parts of the sac. The enveloped portions form the basis for the adult gastrointestinal tract. The sac is surrounded by a network of vitelline arteries. Over time, these arteries consolidate into the three main arteries that supply the developing gastrointestinal tract: the celiac artery, superior mesenteric artery, and inferior mesenteric artery. The areas supplied by these arteries are used to define the midgut, hindgut and foregut.

The surrounded sac becomes the primitive gut. Sections of this gut begin to differentiate into the organs of the gastrointestinal tract, such as the esophagus, stomach, and intestines. The esophagus develops as part of the foregut tube. The innervation of the esophagus develops from the pharyngeal arches.