**NAME:** OMODELE MORAYO

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**DEPARTMENT:** ANATOMY

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**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**

**DEVELOPMENT OF THE LUNGS**

The function of the respiratory system can be divided into two parts: the conducting portion and the respiratory portion. The conducting portion conveys, moistens, and warms the air from outside the body as it makes its way to the lungs. The exchange of gas occurs at the respiratory portion.

Structurally, the respiratory system is divided into the upper and lower respiratory tracts/systems. The upper respiratory system consists of the nasal cavity, oral cavity, pharynx and their associated structures.

The lower respiratory system consists of the trachea, bronchi, bronchioles and alveoli. It develops relatively late in the embryo – which can cause problems when babies are born prematurely.

**Initial Development**

The respiratory system is derived from the primitive gut tube – the precursor to the gastrointestinal tract. The gut tube is an endodermal structure which forms when the embryo undergoes lateral folding during the early embryonic period.

At approximately week 4 of development, an outpocketing appears in the proximal part of the primitive gut tube (the foregut) – this is known as the respiratory diverticulum.

Initially, the respiratory diverticulum is continuous with the foregut; but this is not functionally suitable. The formation of a longitudinal ridge known as the tracheoesophageal septum rectifies this to make the two structures compatible with life.

The diverticulum bifurcates into two buds, which become the left and right primary bronchi. The primary bronchi then proliferate to give rise to secondary and tertiary bronchi.



**Ongoing Development**

**Pseudoglandular Stage: Weeks 8-16**

Each bronchopulmonary segment will become a specific portion of the lung, carrying its own tertiary bronchus and branches of the bronchial and pulmonary arteries. During weeks 8-16, the ducts develop within bronchopulmonary segments. Bronchiolar buds branch off from the tertiary bronchi, and begin to proliferate.

At this stage, as there are no alveoli, there is no gas exchange – and so the lungs are unable to oxygenate blood. However, the lungs are a metabolically active, developing tissue, which means they are able to remove large amounts of oxygen from the blood

In order to stop the lungs from starving the body of oxygen, the ductus arteriosus shunts blood from the pulmonary artery directly to the aortic arch. This closes at birth in the vast majority of people.

During this stage, the lungs resemble the development of tubule-acinous glands – hence the name.

**Canalicular Stage: Weeks 16-26**

Throughout the canalicular stage, the respiratory bronchioles develop, budding off from the terminal bronchioles formed within the pseudoglandular stage.

Despite this, there is still no gas exchange membrane, and so the lungs are not yet functional. Therefore, the prognosis for vast majority of babies born during this stage is not high.

**Terminal Sac Stage: Week 26 onwards**

From week 26 onwards, the alveoli develop. Within these alveoli there are two types of cell:

Type I pnuemocytes – basic simple squamous epithelial cells, which comprise 90% of the alveolus.

Type II pnuemocytes – simple cuboidal cells which comprise the remaining 10%, and are responsible for the production of surfactant.

Surfactant is amphipathic, meaning it is able to bind to both hydrophobic and hydrophilic molecules simultaneously. In this case, surfactant binds to water and air within the alveoli. This has the effect of reducing the surface tension. As a result of the reduced surface tension, the alveoli are able to expand to greater volumes at a given pressure.

Simply put, surfactant allows us to expand our lungs with minimal effort.

**ROTATION OF THE STOMAACH AND FORMATION OF THE OMENTAL BURSA**

The omental bursa or lesser sac is a hollow space that is formed by the greater and lesser omentum and its adjacent organs. It communicates with the greater sac via the epiploic foramen of winslow, which is known as the general cavity of the abdomen that sits within the peritoneum, but outside the lesser sac.

This space has well-defined borders which are represented by certain organs or their parts, so they are quite easy to spot and form a mental image of the omental bursa. In addition, like anything in anatomy, the omental bursa doesn't just exist as a standalone and isolated entity, but rather it communicates with several other spaces and recesses found throughout the body.

**Borders**

**Anteriorly** - quadrate lobe of liver, gastrocolic ligament, lesser omentum

**Left** - left kidney, left adrenal gland

**Posteriorly** - pancreas

**Right** - epiploic foramen, lesser omentum, greater sac

Borders

**Communications**

Superior recess, splenic recess, inferior recess, folds and recesses around the cecum and duodeum.

**Communications and connections**

The cavity itself is almost completely closed, save its communication with the greater sac and the entrance through the omental foramen and is filled with a capillary film. The greater part of the omental bursa consists of its superior recess which extends cranially between the esophagus and the inferior vena cava.

The splenic recess extends to the left between the splenic ligaments and the stomach. Finally, the inferior recess of the omental bursa extends caudally between the stomach and the transverse colon. Other anatomical landmarks of note include a varied number of small peritoneal folds, recesses and fossae which seem to accumulate mostly around the cecum and the duodenum.

**Embryology**

During embryonic development, the peritoneum is anchored to the gut in the midline of the abdomen anteriorly, with the dorsal mesentery securing it posteriorly. The mesenteric layers develop in an anterior direction around the upper alimentary canal, carrying the blood supply and creating the ventral mesentery.

Due to the growth of the organs, they gradually become larger and have to shift in order to fit into the abdominal cavity. The stomach rotates 90 degrees, the spleen is displaced to the left and the liver moves to the right. The peritoneum twists with these movements which lead to the formation of the falciform ligament, the lesser omentum and the coronary ligaments of the liver . Throughout this entire process, the cavity of the lesser sac is created.

**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.

The human esophagus has a mucous membrane consisting of a tough stratified squamous epithelium without keratin, a smooth lamina propria, and a muscularis mucosae.The epithelium of the esophagus has a relatively rapid turnover, and serves a protective function against the abrasive effects of food.

In many animals the epithelium contains a layer of keratin, representing a coarser diet. There are two types of glands, with mucus-secreting esophageal glands being found in the submucosa, and esophageal cardiac glands, similar to cardiac glands of the stomach, located in the lamina propria and most frequent in the terminal part of the organ.The mucus from the glands gives a good protection to the lining. The submucosa also contains the submucosal plexus, a network of nerve cells that is part of the enteric nervous system.