**MATRIC NO: 18/MHS01/160**

**NAME: FASIPE BLESSING OLUWAFUNKE**

**COURSE CODE: ANA 206**

**ASSIGNMENT**

**WRITE NOTES ON THE FOLLOWING**

1. **DEVELOPMENT OF THE LUNGS**:

Development of the respiratory system begins early in the fetus. It is a complex process that includes many structures, most of which arise from the endoderm. Towards the end of development, the fetus can be observed making breathing movements. Until birth, however, the mother provides all of the oxygen to the fetus as well as removes all of the fetal carbon dioxide via the placenta.

Development of the lung can be divided into two phases, **lung growth (structural development)**

**and lung maturation (functional development)**. Lung growth can be influenced by a host of physical factors. Lung maturation and the achievement of functionality is primarily a biochemical process and is under the control of a number of different hormones. Lung growth proceeds through gestation.

There is progressive **branching of the airways** and finally development of alveolar spaces capable of gas exchange in the last trimester. The surfactant system, composed of phospholipids that decrease surface tension within the alveoli and prevent alveolar collapse during exhalation, develops in the last trimester, and reaches maturity by approximately **36 weeks**. Lung growth continues after birth alveolar number continues to increase. The end result of the development of the lung is an organ with a tremendously large surface area that is approximately **50-100 m2**, capable of exchanging oxygen and carbon dioxide across a very thin membrane.

**PHASES OF LUNG DEVELOPMEN**T

There are five phases of structural lung development that occur at progressive times during

Gestation:

1. **THE EMBRYONIC STAGE** is apparent in the **3 week old embryo**. The lung bud develops from the foregut and in communication with it. Separation of the two lung buds comes about with fusion of the esophagotracheal ridges to form the esophagotracheal septum.

When the embryo is **5 weeks old**, two primary lung buds are identifiable. The lung buds go on to form their first subdivisions, with 3 lobar buds developing in the right lung bud and 2 lobar buds developing in the left. These are the forerunners of the right upper, middle and lower lobes and the left upper and lower lobes.

Development progresses in the 8 week old embryo as the lobar buds subdivide and form the bronchopulmonary segments. Lung buds are lined by **endodermally derived epithelium** which differentiates into **respiratory epithelium** that lines airways and **specialized epithelium** that lines the alveoli. The innervation of the lungs is derived from ectoderm, while the mesoderm is the origin of pulmonary blood vessels, smooth muscle, cartilage and other connective tissue.

1. **THE PSEUDOGLANDULAR STAGE**: Takes place between the 7th and 16th week of embryonic development. Conducting airways are formed by progressive branching.

Endodermal lung buds undergo branching only if they are exposed to **bronchial mesoderm**.

The rate and extent of branching appear directly proportional to amount of mesenchyme present. All bronchial airways are formed by **16 weeks**. After this time, further growth occurs by elongation and widening of existing airways.

During this stage, the first differentiation of lung epithelium occurs. By 13 weeks cilia appear in the proximal airways. Mesenchyme is necessary for this **epithelial differentiation** to occur and there is a transition from formation of **bronchial epithelial cells** (ciliated columnar and goblet cells) to alveolar type II cells. Conversely, the differentiation of lung mesenchyme requires the presence of lung epithelium.

1. **THE CANALICULAR STAG**E:

Takes place between the **16th and 25th week.** At this time the gas exchanging portion of the lung is formed and vascularized. There is a decrease of **interstitial tissue** and growth of the capillary network. By 20 weeks there is differentiation of the **type I pneumocyte**. The type I pneumocyte is the primary structural cell of the alveolus, and gas exchange will occur across these very thin, membrane-like cells. Capillaries begin to grow in absolutely close proximity to the distal surface of the alveolar cells (if the potential alveolar space is considered proximal). At about the same time, there is the appearance of lamellar bodies, also called inclusion bodies, in **type II alveolar cells**. The lamellar body is the site of surfactant storage, prior to its release into the alveolar space.

1. **SACCULAR STAGE/ TERMINAL SAC**:

It encompasses the period from 26 weeks until term. During this stage, there is a **decrease in interstitial tissue,** and a thinning of the airspace (alveolar) walls.

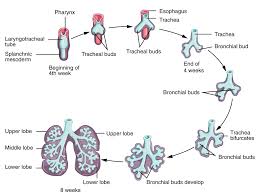
As this stage progresses, there are recognizable Type I and Type II cells. The lamellar bodies of the Type II cells are the site of storage of surfactant, which is rich in phosphatidylinositol (vs. phosphatidyl choline and phosphatidyl glycerol in late gestation lungs), and is necessary for alveolar stability. The stability of the lung at birth correlates with the number of lamellar bodies present. In the absence of surfactant, the lung can maintain alveoli in an open state for only a very short time.

At birth, the air-containing space, later to become the alveolus, has been called a **“primitive saccule**”. There are approximately 20x106 saccules at birth.

1. **POSTNATAL OR ALVEOLAR STAGE**: While these saccules are lined by mature Type I cells, the shape or geometry of the saccules does not achieve “adult” configuration until approximately 5 weeks after birth.

The functioning alveolus is connected to an alveolar duct, is lined with Type I cells, which are in intimate contact to pulmonary capillaries, contain surfactant produced by Type II cells and have pores (**pores of Kohn**) connecting them to adjacent alveoli. The interstitial capillaries are exposed to two alveoli simultaneously. The air/blood interface consists of the Type I cell, a very thin basement membrane and the pulmonary capillary endothelium. At functional maturity, there are approximately **300x106 alveoli** in the lung. This number of alveoli appears to be achieved by the age of 8 .

The development of the pulmonary arterial system follows a similar progression to that of the developing airways. Development of, and branching of the pulmonary artery mirrors bronchial branching, and later mirrors alveolar development.



There are a number of physical influences on lung growth. Proper development of the lung is dependent on the presence of both lung liquid and **amniotic fluid**. The lung liquid is secreted by pulmonary epithelium. The volume of lung fluid is maintained by the activity of the upper airway which acts as a gatekeeper by controlling the resistance to efflux of fluid out of the lung and trachea during non-breathing periods, and by diaphragmatic movement associated with fetal breathing movements.

The larynx is the major site of regulation of efflux and therefore of lung liquid volume. During fetal breathing movements, when the upper airway resistance is decreased, diaphragmatic movements help to maintain lung liquid volume. The experimental drainage of lung liquid leads to **pulmonary hypoplasia**.

1. **ROTATION OF THE STOMACH AND FORMATION OF OMENTAL BURSA**

**What is the Stomach?**

The stomach is the most dilated part of the digestive system, lying between the [esophagus](https://www.kenhub.com/en/library/anatomy/esophagus) and [duodenum](https://www.kenhub.com/en/library/anatomy/the-duodenum). More precisely, the stomach spans the region between the cardiac and pyloric orifices of the gastrointestinal tract. It is covered and connected to other organs by [peritoneum](https://www.kenhub.com/en/library/anatomy/the-peritoneum).

**Where is the Stomach located?**

The stomach is located inside the abdominal cavity in a small area called the **bed of the stomach**, onto which the stomach lies when the body is in a supine position, or lying face up. It spans several regions of the abdomen, including the **epigastric**, **umbilical**, **left hypochondriac**, and **left flank**regions.

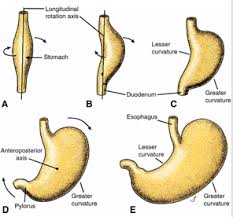
**Rotations of the Stomach**

During the fourth week of gestation, the rudimentary [stomach](https://www.kenhub.com/en/library/anatomy/the-stomach) appears as a fusiform-shaped dilation of the distal foregut. Subsequently, its appearance and position drastically changes; the latter can be better understood by visualizing a longitudinal axis and an antero-posterior axis around which the stomach rotates.

The stomach rotates 90 degrees clockwise around its longitudinal axis, resulting in its left side facing anteriorly and its right side posteriorly. This explains why the left vagus nerve innervates the anterior wall, as it once innervated the left side of the stomach, whereas the **right vagus nerve** innervates the posterior wall, as it once innervated the right side. Concurrent with this rotation, cellular proliferation occurs much faster in the posterior wall of the stomach than in the anterior wall, resulting in the formation of the **greater** and **lesser** **curvatures**, respectively.

The stomach also rotates around its antero-posterior axis, resulting in the caudal end (**pyloric part**) to move upward and to the right and the cranial end (**cardiac part**) slightly downward and to the left. Thus, the stomach assumes its final position, with its pylorus located superiorly to the left and its cardia inferiorly to the right.

The rotational changes of the stomach also alter the position of the mesenteries. Recall that the stomach is attached to the dorsal and ventral walls via the dorsal mesogastrium and the ventral mesentery (a.k.a. mesogastrium), respectively. The rotation of the stomach around the longitudinal axis pulls the dorsal mesogastrium to the left and the ventral mesogastrium to the right: this creates a space behind the stomach known as the **omental bursa** (lesser peritoneal sac).



**FORMATION OF OMENTAL BURSA**

**What is the omental bursa?**

The **omental bursa** or **lesser sac** is a hollow space that is formed by the [greater and lesser omentum](https://www.kenhub.com/en/library/anatomy/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](https://www.kenhub.com/en/library/anatomy/abdomen-and-pelvis) that sits within the [peritoneum](https://www.kenhub.com/en/library/anatomy/the-peritoneum), but outside the lesser sac.

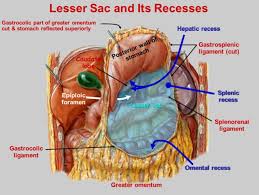
**Formation of omental bursa**

Rotation of the stomach creates the **omental bursa** or **lesser peritoneal sac**.

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](https://www.kenhub.com/en/library/anatomy/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](https://www.kenhub.com/en/library/anatomy/ligaments-of-the-gastrointestinal-tract) . Throughout this entire process, the cavity of the lesser sac is created.

**Congenital anomalies** include duplication cysts and cystic lymphangiomas.



1. **DEVELOPMENT OF OESOPHAGUS**

**What is the Oesophagus (esophagus)**

The esophagus(oesophagus) is a 25 cm long fibromuscular tube extending from the [**pharynx**](https://www.kenhub.com/en/library/anatomy/the-pharynx) (C6 level) to the [**stomach**](https://www.kenhub.com/en/library/anatomy/the-stomach) (T11 level). It consists of muscles that run both longitudinally and circularly, entering into the abdominal cavity via the right crus of the [**diaphragm**](https://www.kenhub.com/en/library/anatomy/diaphragm) at the level of the tenth [**thoracic vertebrae**](https://www.kenhub.com/en/library/anatomy/thoracic-vertebrae).

**DEVELOPMENT OF OESOPHAGUS**

As early as the fourth week of development, the esophagus of the human embryo is merely a sphincter or constricted part of the primitive foregut, situated between the pharynx and stomach.

At this stage, the early embryo consists of three distinct layers, in what is known as a trilaminar disc, connected to the yolk sac. The trilaminar disc is composed of outer ectoderm, middle mesoderm, and an inner layer known as the endoderm.

The layers orient in such a way that the endoderm layer is in contact with the outer ectoderm layer at the poles of the embryo. At the start of the fourth week, folding occurs such that corresponding cranial, caudal, and lateral edges of the disc come together. This folding occurs through the ventral midline, and the layers fuse allowing for internalization of the endoderm layer, such that the embryo takes on a tube within a tube configuration, an inner tube composed of endoderm and an outer tube consisting of ectoderm, and between the two layers, mesoderm. Initially, this inner tube is blind-ended at both poles and is the precursor to the final digestive tract.

 The inner tube itself divides into three anatomical parts, the foregut, midgut, and hindgut. The foregut being the most cranial portion and hindgut the most caudal. The foregut and hindgut delineation is the center component, the midgut, which is continuous with the yolk sac through the vitelline duct. The mechanisms of early folding and tube position have their basis in concentration-dependent signaling which sets up a ventral-dorsal, rostral-caudal, and left-right axis.

These axes are influenced by and contribute, in a reciprocal manner to local endodermal and mesodermal interactions. The component of the foregut that will give rise to the esophagus also will give rise to the trachea and lungs. From the foregut endoderm will arise the esophageal epithelium as well as mucosal glands. The mesodermal layer surrounding the foregut will give rise to the striated muscular and smooth muscle layers of the esophagus.  These processes are associated with numerous signaling molecules.

However, the first step of esophageal organogenesis from the foregut is the differentiation of the foregut cells into the trachea, lung, and esophagus. This process begins with the cellular expression of many genes.

After esophageal specification occurs, several notable changes are visible in the developing embryo. At approximately week 6 of development, the circular and longitudinal muscular layers begin to form, and ganglion cells of the myenteric plexus first present. Moving into week 7, cells of mesodermal origin proliferate into the submucosal layer forming the eventual blood supply to the esophagus. The muscular layers which began in week 6, are completed by the 9th week.

 Rostral-caudally, a distinction occurs in the muscular subtypes found within the esophagus. The cranial third of the esophagus contains mostly striated muscle, the caudal third transitions into mostly smooth muscle, and the middle third being a combination of both muscular subtypes.

 Along with this change in musculature, cranially to caudally, there is hypothesized to be a dual set of innervation of these layers from the enteric nervous system and the vagal nerve, which is a product of branchial arch 6.

Co-innervation of muscle cells is hypothesized to allow for early peristalsis after birth while the nervous system is not fully mature. The process of esophageal innervation occurs throughout the development of the embryo and requires proliferation and migration of neural crest cells which migrate rostrally-caudally through the gut tube starting during the 4th week and ending their migration around the 9th week of development.

Setting the precursor cells for innervation along the entire gut. During the 6th week, when the muscular layers have begun to form, cells of neuronal crest origin migrate inward between the muscular layers eventually giving rise to the submucosal plexus.

 This process which began the neuronal development early in the 4th week continues through a slow maturation process which continues after birth.

At around the 4th month of development, the columnar epithelium of the foregut begins to undergo a transition into a squamous epithelium a process which will continue well into the third trimester.

The **esophagus** may be affected by gastric reflux, cancer, prominent dilated blood vessels called varices that can bleed heavily, tears, constrictions, and disorders of motility. Diseases may cause difficulty swallowing (dysphagia), painful swallowing (odynophagia), chest pain, or cause no symptoms at all.

