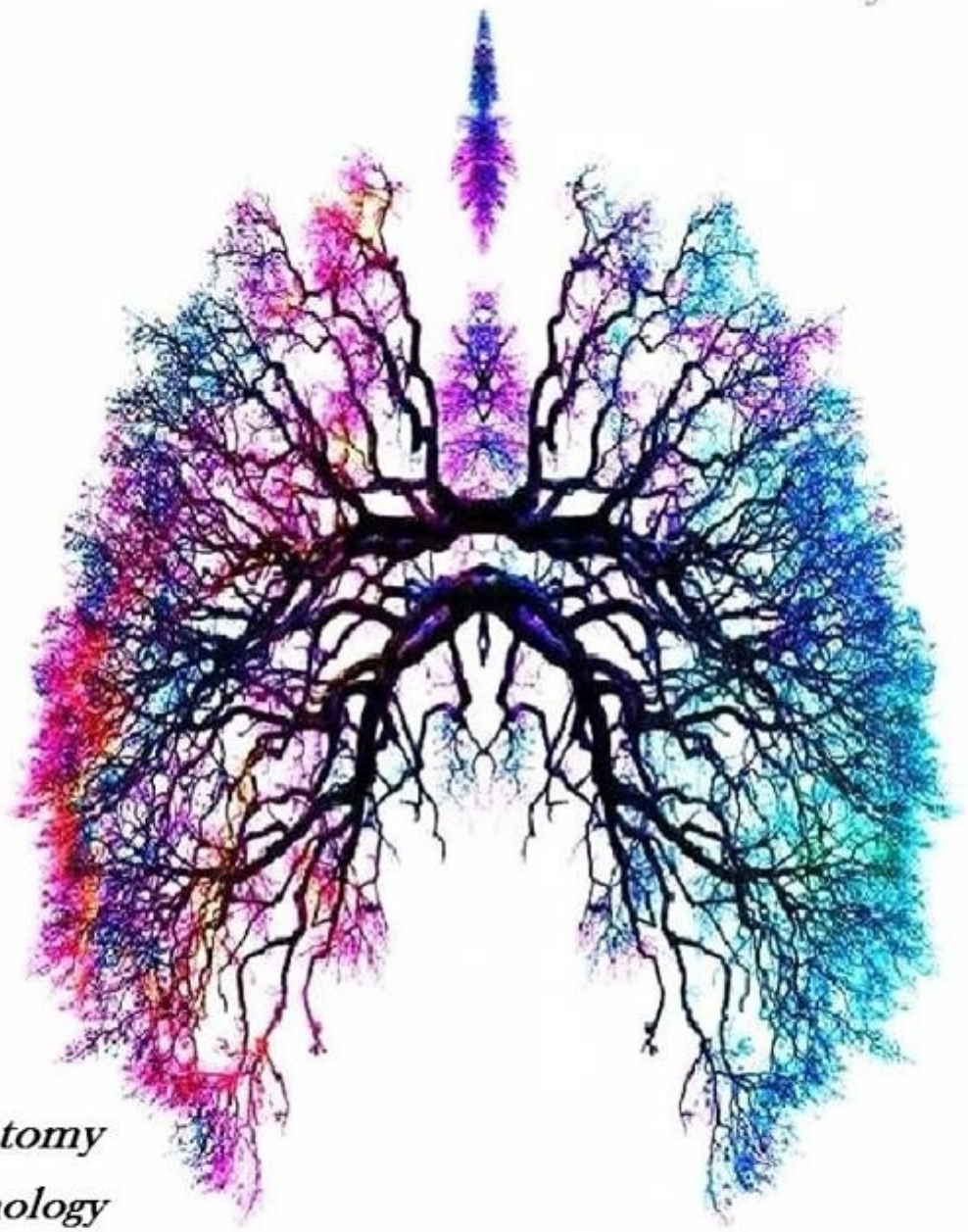
RESPIRATORY SYSTEM

Cover by: Aseil Khatib



- ○ *Anatomy*
- ○ *Pathology*
- ○ *Physiology*
- ○ *Pharmacology*
- ○ *Microbiology*
- ○ *PBL*
- ● **Embryology**

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Lecture # **1**
Done By: **Alaa Farkouh**

Sheet ■
Slide □
Other □

Respiratory System Embryology – 1

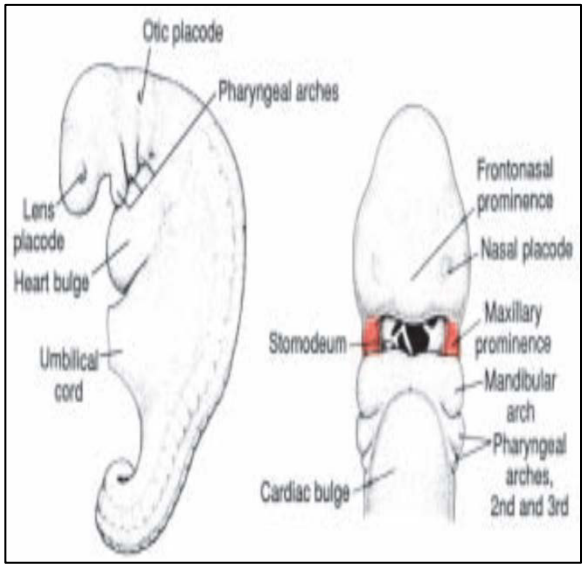
I added little extra information from the slides to clarify a few points. These were not mentioned by the doctor. I will underline them. All figures are from the slides.

(1) Development of the nose and palate:

The nose:

The figure shows an embryo with:

- the maxillary prominence,
- the frontonasal prominence,
- the nasal placodes, where the nostrils (anterior nasal openings) will be formed.

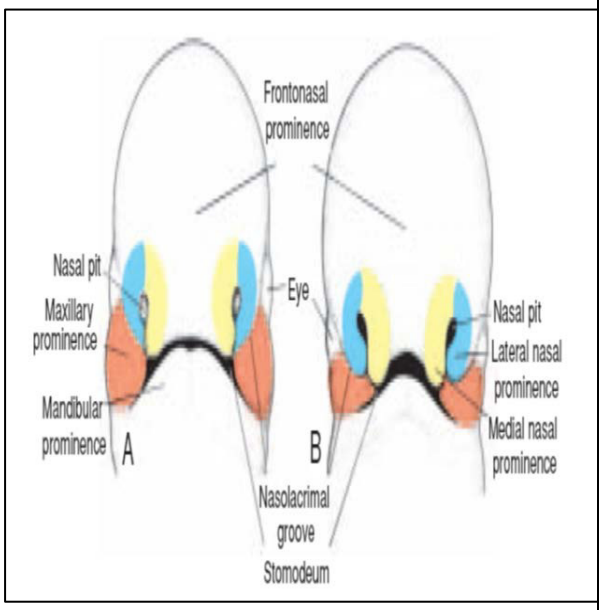


Remember: The nose has a tip, alae, nostrils, vestibule, septum, lateral walls, and choanae (posterior nares).

We are going to see how these form from the following prominences (processes):

- maxillary,
- frontonasal,
- medial nasal,
- lateral nasal.

All of these participate in the formation of the nose.

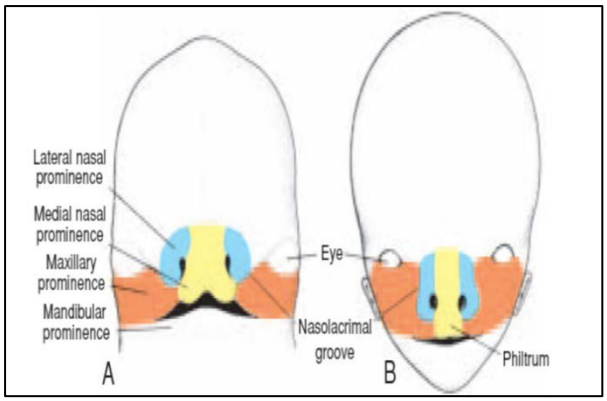


Notice in the figure: nasal pits, maxillary processes (in orange), mandibular processes (below the maxillary), the nasal processes (medial – yellow and lateral – blue).

The nasal pits (openings of the nose) are found between the medial and lateral nasal prominences.

During the fifth week, the nasal placodes invaginate to form nasal pits (nostril). In so doing, they create a ridge of tissue that surrounds each pit and

forms the nasal prominences. The prominences on the outer edge of the pits are the lateral nasal prominences; those on the inner edge are the medial nasal prominences.



During the following 2 weeks, the maxillary prominences continue to increase in size. Notice in the figure the roof of the oral cavity (stomodeum) – in black.

The nose is formed from five facial prominences:

- The frontal prominence (the frontonasal – coming from above down): gives rise to the nasal septum.
- The medial nasal prominences (2 - one on each side): provide the crest and tip of the nose.
- The lateral nasal prominences (2): form the sides (alae).

Olfactory pit forms the nostril and then invaginates to give the vestibule.

Summary: The table shows the structures given by each prominence:

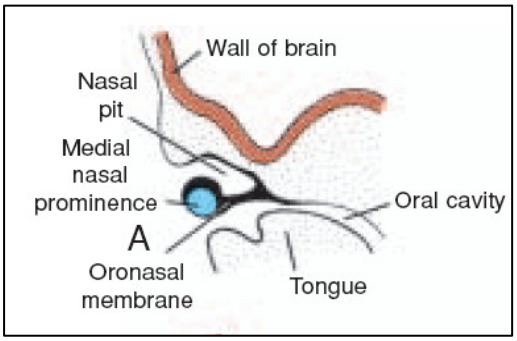
TABLE 15.2 Structures Contributing to Formation of the Face

Prominence	Structures Formed
Frontonasal[a]	Forehead, bridge of nose, medial and lateral nasal prominences
Maxillary	Cheeks, lateral portion of upper lip
Medial nasal	Philtrum of upper lip, crest and tip of nose
Lateral nasal	Alae of nose
Mandibular	Lower lip

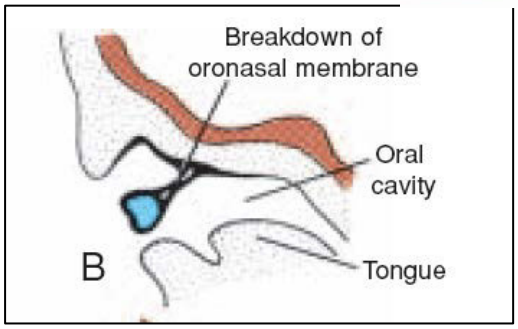
[a] The frontonasal prominence is a single unpaired structure; the other prominences are paired.

Remember: The philtrum is a longitudinal groove on the upper lip.

As for the nasal cavities, there must be invagination towards the underlying mesenchyme of the nose. The nasal pits deepen, first giving the vestibule, then penetration and invagination of the underlying mesenchyme.

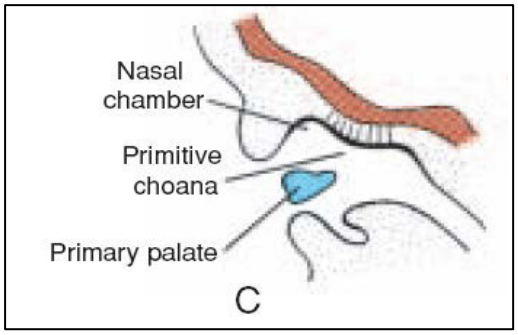


Notice in the figure the oronasal membrane between the oral cavity and the nasal cavity. At first, this membrane **ruptures**, creating a communication between the oral and nasal cavities. This communication remains open until the palate is formed, separating them.



The rupture of the oronasal membrane gives rise to the primitive choanae posteriorly. The primitive choanae lead to the nasopharynx.

At the end, the primary and secondary palates form, separating the two cavities and forming the definitive choanae, leading into the nasopharynx.



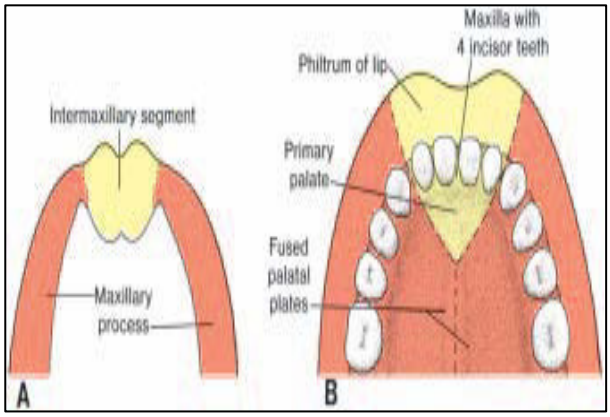
The paranasal sinuses:

They form as **invaginations in the lateral nasal wall** forming ducts. Proliferation of cells and canalization take place. Eventually the canalization (diverticula) reaches one of the skull bones (frontal, ethmoidal, maxillary, and sphenoid) and forms a cavity in it, forming a paranasal sinus.

At the beginning, they have a very small size (rudimentary). Enlargement occurs **after** birth. The maxillary sinuses become large in size at 8 years of age, with development of the facial bones.

The primary palate:

Notice in the figure: the teeth, the primary palate (part of it participates in formation of the philtrum), the secondary palate (fusion at the midline), and the intermaxillary segment.



<u>As a result of medial growth of the maxillary prominences, the two medial nasal prominences merge not only at the surface but also at a deeper level.</u>

The structure formed by the two merged prominences is the **intermaxillary segment**. It is composed of:

(*a*) a labial component, which forms the philtrum of the upper lip;

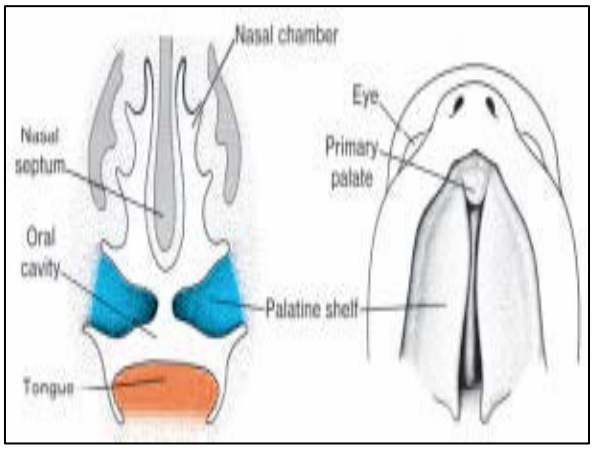
(*b*) an upper jaw component, which carries the four incisor teeth;

(*c*) a palatal component, which forms the **triangular primary palate**.

The intermaxillary segment also participates with the formation of the nasal septum as it reaches the midline.

The secondary palate:

The secondary palate **develops from the maxillary prominences**. Each maxillary prominence grows towards the midline and eventually they fuse together.

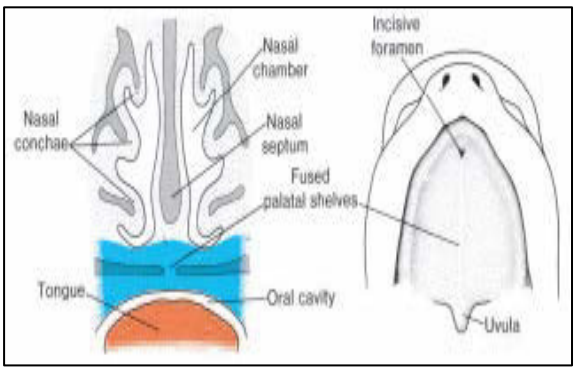


<u>The main part of the definitive (secondary) palate is formed by two shelflike outgrowths from the maxillary prominences.</u>

These outgrowths (palatine shelves) appear in the sixth week of development and are directed obliquely and downwards towards the tongue.

The palatine part of the maxilla is called the secondary palatine.

Fusion occurs between the primary and the secondary palates. As a result of this fusion, the **incisive foramen** is formed.



The hard palate is the result if fusion of primary and secondary palates.

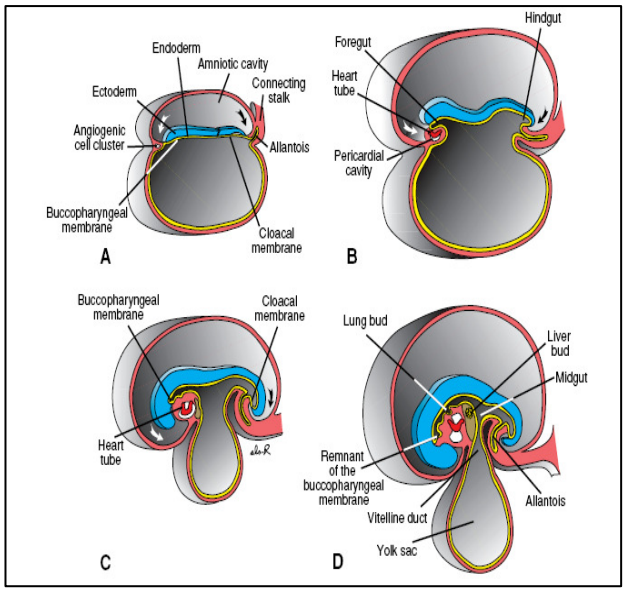
Any defect in fusion will lead to cleft palate and cleft lip. These might be unilateral or bilateral, complete or partial. Nowadays, these are treated surgically, giving good results.

(2) Development of the respiratory system:

The figure shows the embryo with the yolk sac, the mesoderm, the ectoderm, and the gut, which is divided into 4 parts:

- Pharyngeal part.
- Foregut.
- Midgut.
- Hindgut.

The respiratory system begins developing from the **anterior surface of the foregut**.

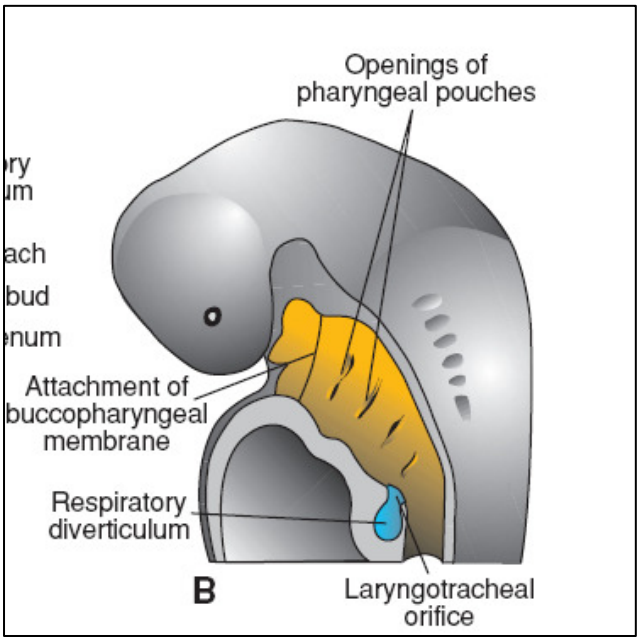


Notice in the figure the respiratory diverticulum, beginning from the anterior wall of the foregut.

The entire respiratory tract begins as a respiratory diverticulum, which forms at **the fourth week of development**.

The respiratory diverticulum is also called the lung bud, because it will give the tracheal bud, then two lung buds.

Notice also in the figure the laryngotracheal orifice, which is slit-like, and the pharyngeal pouches.

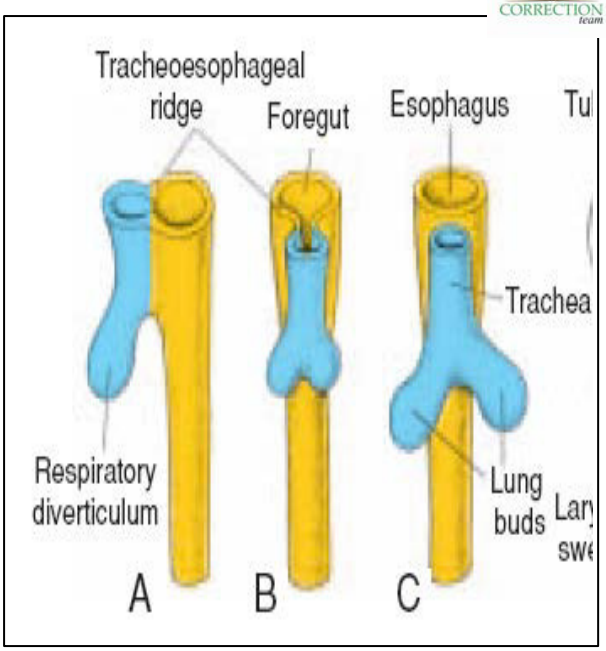


All lining epithelium of the respiratory system is **endodermal** in origin. But, all cartilages, muscles, and connective tissues are **splanchnic mesodermal** in origin.

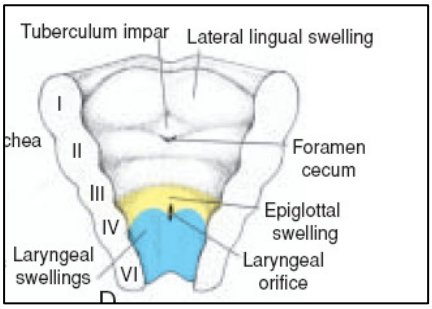
Remember: the mesoderm is two layers – splanchnic and somatic (parietal).

As the respiratory diverticulum forms, the **tracheoesophageal ridges** appear (one on the left and one on the right). These ridges develop internally, until they form a septum (the tracheoesophageal septum), that separates the trachea (anteriorly) from the esophagus (posteriorly).

At the end of the trachea, two lung buds are formed (one on the right and one on the left).

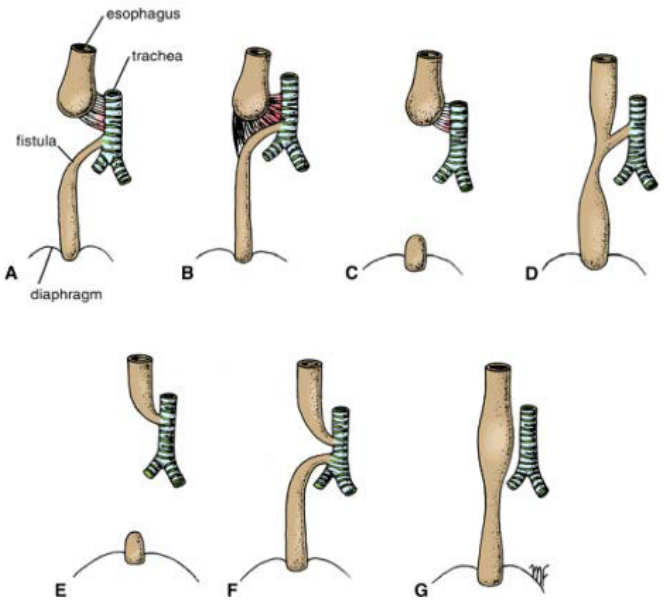


Notice in the figure, the laryngeal orifice, which is slit-like and connects the larynx with the laryngopharynx.

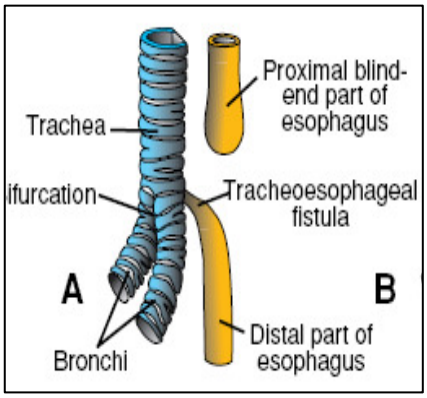


Anomalies of the trachea and esophagus:

<u>Abnormalities in partitioning of the esophagus and trachea by the tracheoesaphageal septum result in esophageal atresia with or without tracheoesaphageal fistulas (TEF).</u> These occur in 1/3000 births.

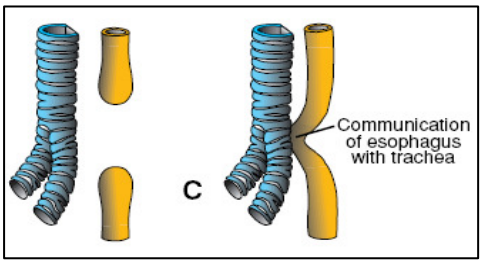


1. Proximal esophageal atresia with distal tracheoesophageal fistula (very common – 90% of anomalies). This predominantly affects male infants.



2. Two-sided atresia without fistula.
3. H-shaped fistula.

These account for 4% of cases. Other types account for 1%.



Other birth defects accompany TEFs. The most important are **cardiac anomalies** (in 33% of cases). Other anomalies include:

- Vertebral anomalies.
- Anal atresia.
- Renal anomalies or agenesis.

Clinical consequences/complications of TEF:

1. Pneumonia: this is mainly due to the fistula; as materials can reach the lung forming infections.
2. Air can reach the stomach, leading to apparent distention of the stomach when the baby cries.
3. Polyhydramnios: excessive amniotic fluid around the baby (the opposite of polyhydramnios is oligohydramnios).

Good Luck