Embryology

Foundation Block

Lecture4 [FETAL MEMBRANES]

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Fetal membranes

DEFINITION	• It is the membranes that surrounding embryo (the structures connected to the embryo which disappear after formation of placenta)
COMPONENTS	• 1 – Umbilical cord • 2 – Yolk Sac • 5- Amniotic Fluid 3- Allantois 4 - Amnion
FUNCTIONS	• 1- PROTECTION • 2-NUTRITION • 3- RESPIRATION 4- EXCERTION 5- SYNTHESIS OF HORMONS

1) Umbilical cord

1-It is a soft tortuous (not straight) cord.
2-Measuring (30-90) cm in length, (1-2) cm in diameter.
3-Between the ventral aspect of the embryo & the placenta (chorion).
4-It has a smooth surface due to amnion surrounding it.

structure of Umbilical cord

connecting stalk	yolk stalk
allantois & umbilical vessels (2 arteris & 1vein),they all embeded in Wharton's jelly(extra embryonic mesoderm)	-A narrow , elongated duct which connects gut to yolk sac. - It contains Vitellin Vessels. - later on , it is obliterated and the vitelline vessels disappear.

Normal attachment of Umbilical Cord

It is attached to a point near the center of the fetal surface of the placenta

Anomalies of Umbilical Cord:

abnormal attachment

A- Battledore placenta

The UC is attached to the margins of the placenta

Not dangerous

B- Velamentous insertion of the cord

The UC attached to the amnion away from placenta

It is dangerous to the fetus due to liability of rupture of its blood vessels

Knots of umbilical cord

A-False knot

Normally the UC looks tortuous due to twisting of umbilical vessels (umbilical vessels are longer than the cord), these knots are normal and <u>do not cause any harm to the fetus</u>

B-True knot

Are rare (1%) of pregnancy.

Very dangerous because they may cause obstruction to blood flow in umbilical vessels , leading to fetal death (from anoxia)

Abnormalities in length

A-Very long cord

It is dangerous; it may prolapse or coil around the fetus.

Prolapsed cord is compressed during labor causing fetal hypoxia(↓ O_2)or anoxia ($Ø_2$)

If the deficiency of O_2 last for more than 5 min. mental retardation might happen to the baby

B-Very short cord

It is dangerous; it may cause premature separation of placenta, or the cord its self may rupture

2) Yolk Sac: -

- Its presence is essential for the transfer of nutrients to the embryo during 2nd & 3rd weeks, when the uteroplacental circulation is not established.
- It does not contain any yolk

#Its development passes through three stages:

PRIMARY → SECONDARY → DEFINITIVE

1.Primary Yolk Sac :

- Appears in the Blastocyst stage at **10-days**.
- it lies ventral to the embryonic plate.
- Its roof :hypoblast (primary endoderm),
- Its wall :exocoelomic membrane, (lines the inner surface of the cytotrophoblast).

PRIMARY → SECONDARY → DEFINITIVE

2.Secondary Yolk Sac:

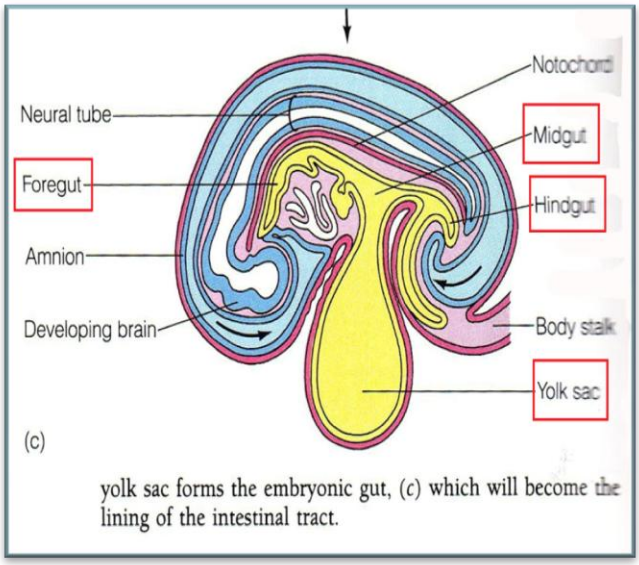
- Appears in the chorionic vesicle stage
- Its roof :hypoblast .
- Its wall :exocoelomic membrane + inner layer (splanchnic layer) of the extraembryonic mesoderm.

PRIMARY SECONDARY DEFINITIVE

3.Definitive Yolk Sac

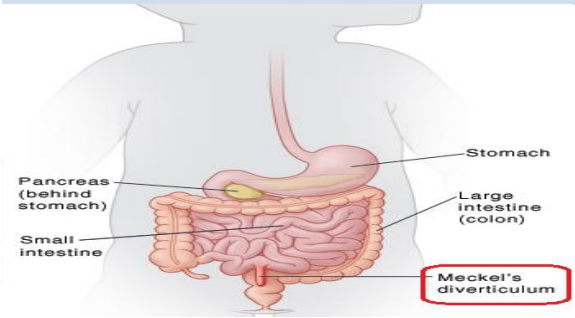
- Part of Yolk Sac is enclosed within the embryo to form the Gut (Foregut, Midgut & Hindgut).
- The remainder of Yolk Sac that remains outside the embryo becomes the **Definitive Yolk Sac**
- The midgut is temporarily connected to Definitive Yolk Sac by a narrow duct Vitello-intestinal duct (Yolk stalk),

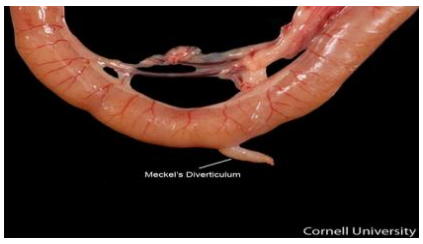
Which is incorporated inside the umbilical cord



#YOLK SAC function & fate

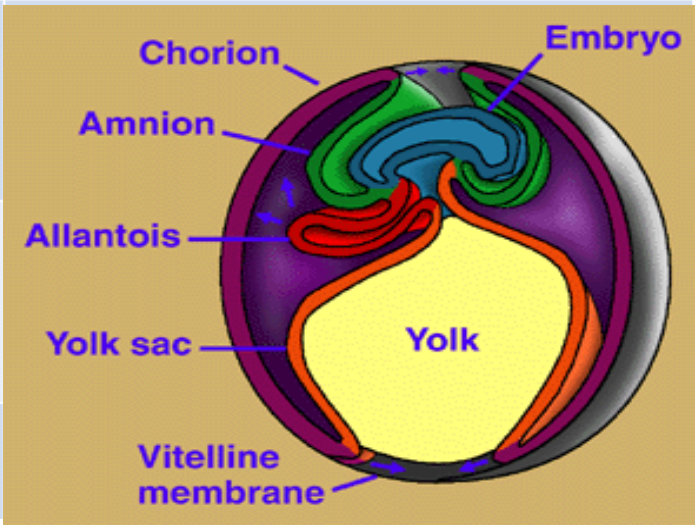
Its Function	Its fate
At 3rd week : A) Blood formation. until hemopoietic activity begins in the liver during 6th week.	YolkStalk: detached from midgut by the end of 6th week. In (2%) of adults, its proximal intra-abdominal part persists as **Ileal diverticulum** (Meckel's Diverticulum).
B) Primordial germ cells differentiate into germ cells (spermatogonia or oogonia).	At week (10): small definitive yolk sac lies between amniotic & chorionic sacs.
At 4th week : endoderm of yolk sac is incorporated into the embryo as the primitive gut and gives rise to the epithelium of the Respiratory &Digestive tracts.	At week (20): definitive yolk sac atrophies and becomes a very small cyst. (Because the placenta starts to appear) and in some cases it may persists.

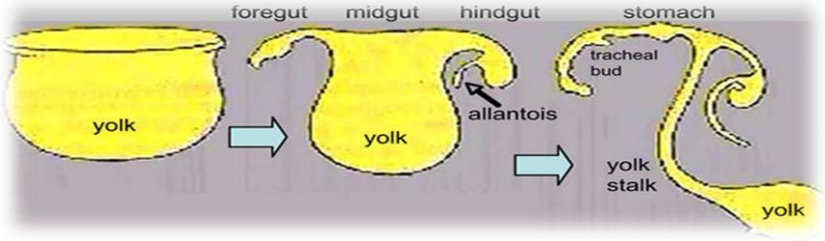


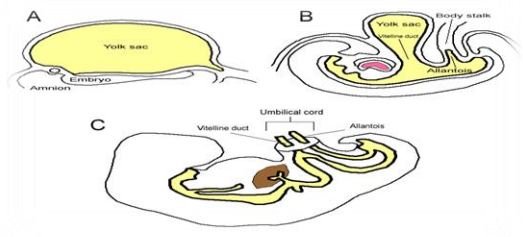


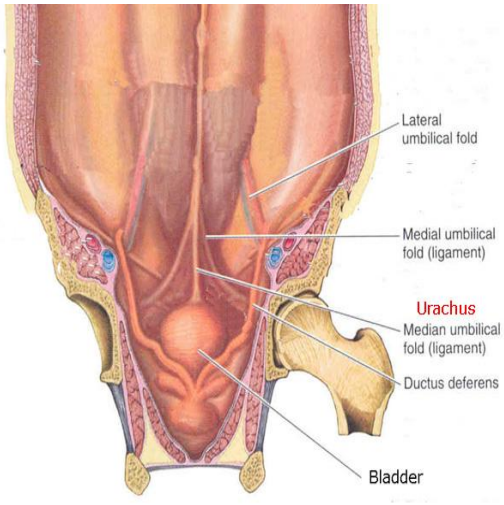
3) Allantois:

A membranous sac that develops from the posterior part of the alimentary canal in the embryos of mammals and is important in the formation of the umbilical cord and placenta.

Its formation	Its function
At 3rd week (day 16) Appears as a diverticulum from caudal wall of yolk sac that extends into the connecting stalk.	**Blood formation** during 3rd – 5th weeks
At 2nd month Its extra- embryonic part degenerates.	**Its blood vessels** persist as the **umbilical vein & arteries**
At 3rd month Its intra-embryonic part extends from urinary bladder " UB " to umbilical cord as a thick tube 'Urachus'	
After birth the Urachus is obliterated and fibrosed to form Median Umbilical Ligament.	
Fibrosed: to form fibrous tissue	







هو غشاء نحيل وشفاف مليء بالسائل الكثيف يغطي الـ embryo

4) AMINION

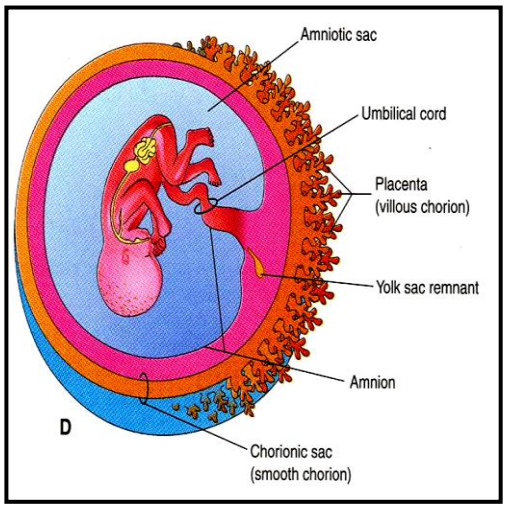
it's a thin , transparent and tough fluid filled , membranous sac surrounding the embryo .

Amnion

AT FIRST	STAGE OF CHORIONIC VESICLE	AFTER FOLDING
It is seen as a small cavity lying **Dorsal** to the embryonic plate.	The amnion becomes separated from the chorion by **Chorionic Cavity** (extra embryonic coelom)	The amnion expands greatly and becomes on the **ventral surface** of the embryo . - As a result of expansion of the amnion , the extra embryonic coelom is gradually obliterated and amnion forms the epithelial covering of umbilical cord .

5) Amniotic fluid

- It is a watery fluid inside the amniotic cavity (sac).
- It has a major role in fetal growth & development
- It increases slowly, to become (700-1000) ml by full term (37) weeks.



#Composition:

- 99% of amniotic fluid is water
- It contains un-dissolved material of desquamated fetal epithelial cells + organic + inorganic salts

#As pregnancy advances, Composition of amniotic fluid changes as fetal excreta (meconium = fetal feces/& urine) are added

Sources of amniotic fluid

Fetal

1 – Skin

2 – Fetal Respiratory track and Mostly by Excreting Urine (at beginning of 11th week)

Maternal

1 - Diffusion across amino-chorionic membrane at the dcidua parietalis .

2 – Diffusion across chorionic plate from the maternal blood in the intervillous spaces of the placenta .

Later .. it is derived from Fetal source

FUNCTIONS OF AMNIOTIC FLUID

- **Provides symmetrical external growth of the embryo**
- **Acts as a barrier to infection (it is an aseptic medium)**
- **Permits normal fetal lung development**
- **Prevents adherence of embryo to amnion**
- **Protects embryo against external injuries**
- **Keeps the fetal body temperature constant**
- **Allows the embryo to move freely, aiding muscular development in the limbs**
- **Permits studies on fetal enzymes, hormones and diagnosis of fetal sex and chromosomal abnormalities**
- **Maintain homeostasis of fluids & electrolytes**

Circulation & Fate of amniotic fluid:

Most of fluid: is swallowed by fetus, and absorbed into fetal respiratory and digestive tracts, where it is metabolised

Part of fluid: passes through placental membrane into maternal blood capillaries in intervillus space

Other part of fluid: is excreted by fetal kidneys and returned to the amniotic sac through the fetal urinary tract.

#Anomalies of Volume of Amniotic fluid

Oligohydramnios	Polyhydramnios (Hydramnios)
The volume is less than half liters .	The volume is more than 2 liters . It is diagnosed by Ultrasonography.
Causes : 1 – Placental insufficiency with low placental blood flow . 2 – Preterm rupture of amino chorionic membrane occurs in 10% of pregnancies . 3 – Renal Agenesis (failure of kidney development) 4 – Obstructive Uropathy (urinary tract obstruction) lead to absence of fetal urine (the main source) Complications : Fetal abnormalities (pulmonary , hypoplasia , facial and limb defects)	**Causes :** 1 - Fetal (1 – 20%) Esophageal atresia 2 – Maternal (2-20%) Defects in maternal circulation . 3– Idiopathic (3-60%) It may be associated with severe anomalies of the CNS

* Amniotic fluid remains constant & in balance *

#Summary

- **Umbilical cord** = (connecting stalk + yolk sac) . attached to a point near the centre of the fetal surface of the placenta.

- **Anomalies of umbilical cord** = (abnormal attachment, abnormalities in length, knots of umbilical cord)

- **Yolk sac** = transfer of nutrients to the embryo during 2nd & 3rd weeks. (three stages : primary yolk sac, secondary yolk sac, definitive yolk sac)

- **Allantois** = diverticulum from yolk sac extends into the connecting stalk.

- **Amnion** = membranous sac surrounding the embryo.

- **Amniotic fluid** = It is a watery fluid inside the amniotic cavity (sac). (maternal source & fetal source

#Simple MCQ's question:

The pathway between the ventral aspect of the embryo and the placenta is:

Amnion
Umbilical Cord
Allantois
None of the above

The length of the Umbilical Cord is (in cm):

(10-100)
(20-60)
(30-90)
(50-120)

The usual number of blood vessels that supply the umbilical Cord is:

2 Arteries, 1 Vein
1 Artery, 2 Veins
2 Arteries, 3 Veins
3 Arteries, 2 Veins

The umbilical vessels are embedded in:

Yolk Sac
Wharton's jelly
Yolk stalk
Allantois

The structure that contains Vitelline Vessels is:

Connecting Stalk
Wharton's jelly
Yolk stalk
Amniotic Cavity

The battledore Placenta is considered as a/an:

Abnormal length
Knots of umbilical
Normal attachment
attachment Abnormal

(True or false) The normal Umbilical Cord has no knots at all, and the presence of them is always dangerous for the fetus (F)

The maximum time the baby's brain survives without oxygen is:

5 Minutes
2 Minutes
3 Minutes
7 Minutes

the yolk sac transfer the nutrients to the embryo during:
1st – 2ed weeks
2ed – 3ed weeks
1st – 3ed weeks
2ed – 4th weeks

all the following are stages of the development of the yolk sac except :
Primary yolk sac
Secondary yolk sac
Tertiary yolk sac
Definitive yolk sac

the primary yolk sac appears at:
5-days
10-days
15-days
20-days

At : endoderm of yolk sac is incorporated into the embryo as the primitive gut.
4th week.
5th week.
6th week.
second week.

Fate of Yolk Sac at week (10): small definitive yolk sac lies in the chorionic cavity
between amniotic & chorionic sacs
between amniotic
between chorionic sacs
cyst.

Allantois at 2nd month: Its extra-embryonic part
Degenerates
Repaid
not change
separate

Blood formation during
3rd -5th weeks
4rd -5th weeks
5rd -6th weeks
5rd -8th weeks

Amnion after Folding: the amnion expands greatly and is becomes on the ventral surface of the embryo.
True
False

.....of amniotic fluid is water
50%
99%
88%
66%

Fetal source :
Skin
Fetal Respiratory tract & Mostly by Excreting Urine
Skin, Fetal Respiratory tract & Mostly by Excreting Urine
Heart

Polyhydramnios (Hydramnios):The volume is more than 2 liters
True
False

YOUTUBE VIDEOS CAN HELP :

OVERVIWE + YOLK SAC :
https://www.youtube.com/watch?v=vQynoadGZaQ
UMBILICAL CORD TRANSPORTING OXYGEN :
https://www.youtube.com/watch?v=zvNPw7m74HE
FETAL CIRCULATION :
https://www.youtube.com/watch?v=ErpEEOdq_1k

Good luck ☺