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الأستاذ الدكتور يوسف حسين

أستاذ التشريح وعلم الأجنة - كلية الطب – جامعة الزقازيق – مصر

رئيس قسم التشريح و الأنسجة و الأجنة - كلية الطب - جامعة مؤتة - الأردن

مساعد العميد لشؤون الطلاب والامتحانات - كلية الطب - جامعة مؤتة - الأردن

دكتوراة من جامعة كولونيا المانيا

اليوتيوب Dr. Youssef Hussein Anatomy

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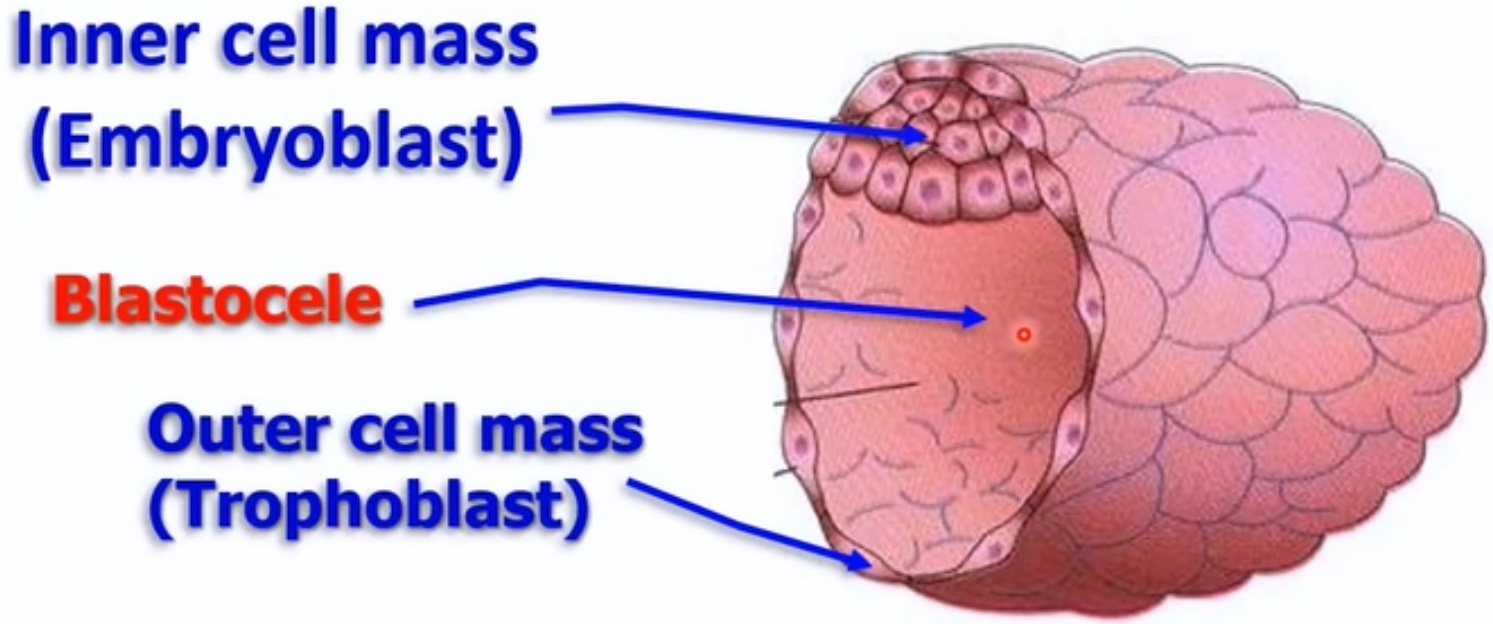
Development of Yolk sac



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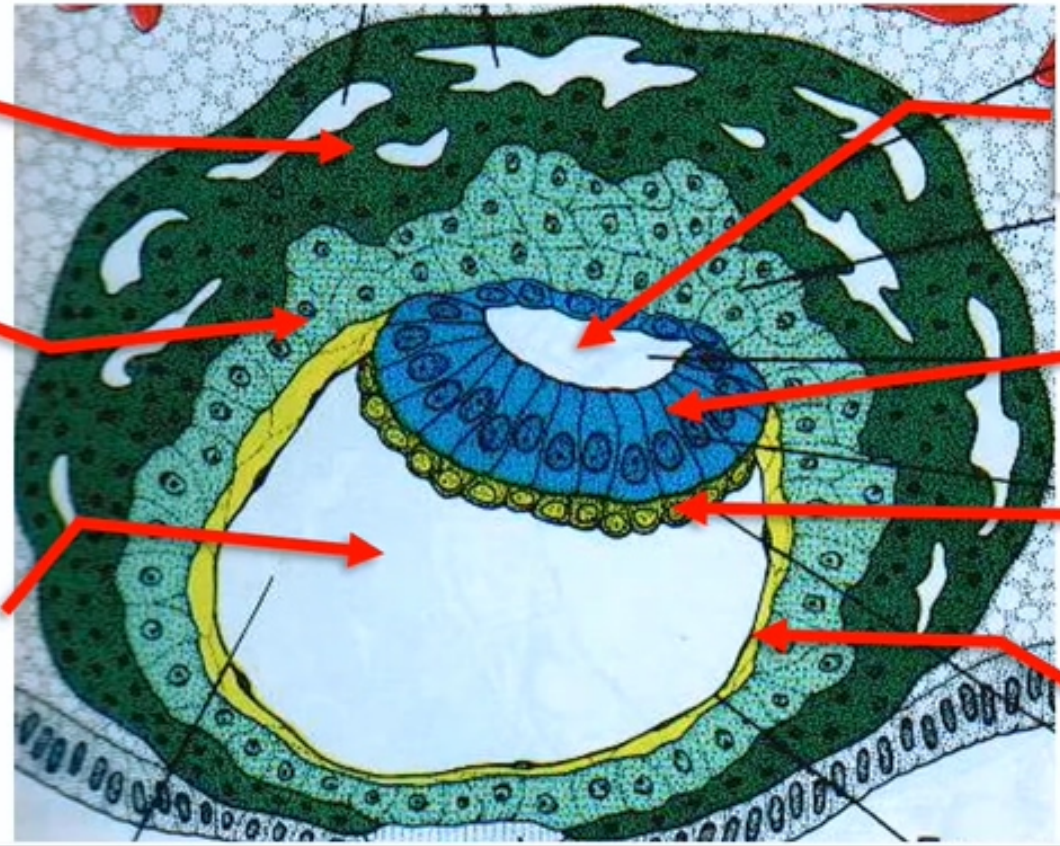
- **Formation of blastocyst**

- The cells of the **morula** rapidly proliferate and forming a large number of cells.
- Fluid collects between the cells and form a single cavity called **blastocele**
- The cystic structure called **blastocyst** at the **5th days** after fertilization.
- The blastocyst is divided by **blastocele** cavity into;

  a- Outer layer of flat cells called **trophoblast** that forms the **placenta**.

  b- Inner cell mass (**embryoblast**). This mass will form the **embryo**.



- **Formation of primitive yolk sac at the 9th day**

- **Blastocele** is lined by a new membrane **exocoelomic (Heuser's) membrane**
- **It** is formed by flattened cells **originate from hypoblast.**
- The cavity is now called **exocoelomic cavity or primitive yolk sac.**

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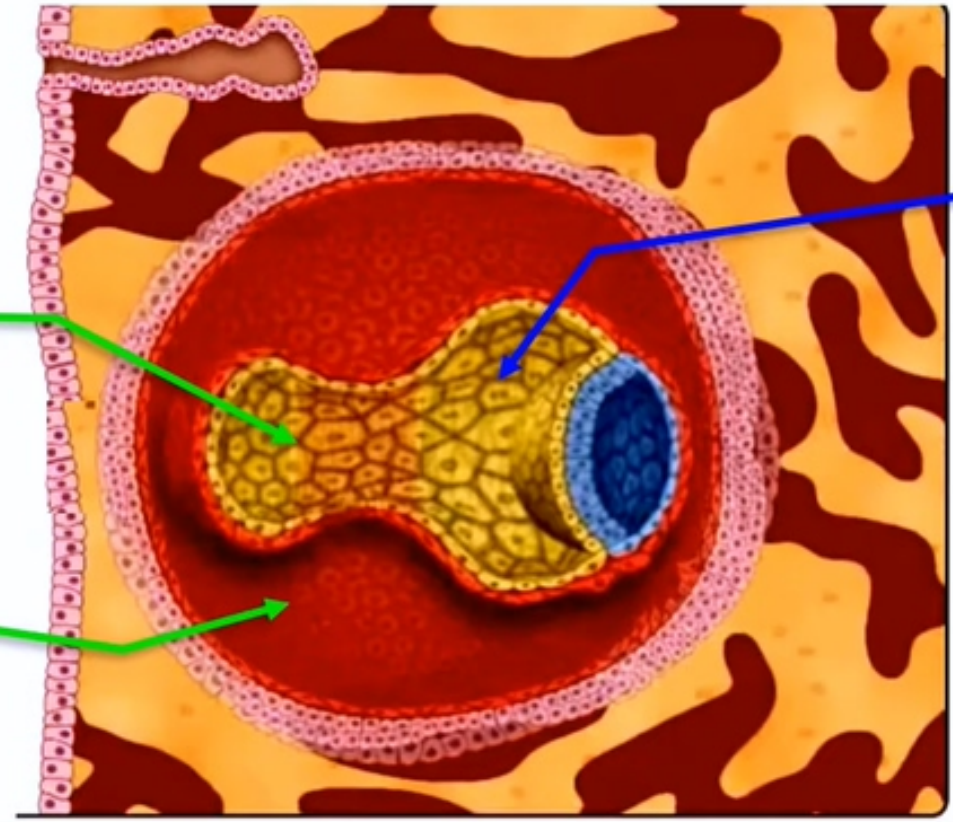
▪ Formation of the secondary yolk sac



- Large portion of primitive yolk sac are pinched off is called Exocoelomic cyst in the extraembryonic coelom.

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▪ Formation of the secondary yolk sac

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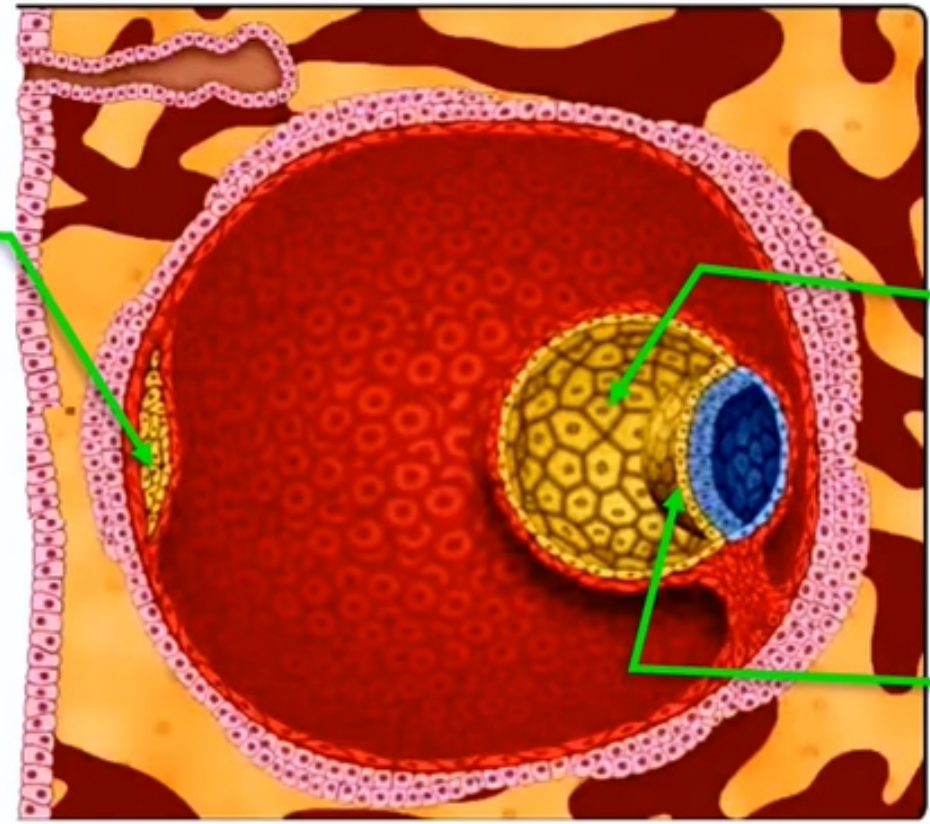

- The **exocoelomic cyst** is separated from **the primitive yolk sac**
- **The endodermal cells from the hypoblast proliferates and migrates to line the Heuser's membrane forming the secondary yolk sac.**

- The 2ry yolk sac is completely lined by endoderm.

▪ Formation of the definitive yolk sac

** After folding of the embryo

- The 2ry yolk sac divides into:

a- Part of the 2ry yolk sac inside the embryo forming the primitive gut.

b- Part remains outside the embryo called the definitive yolk sac.

c- The 2 parts are connected at the umbilical ring by the vitello-intestinal duct (VID) in the connecting stalk.

** Fate of the yolk sac

1) The definitive yolk sac gradually becomes smaller and separated from the body of the embryo.

2) The VID will atrophy and degenerate.

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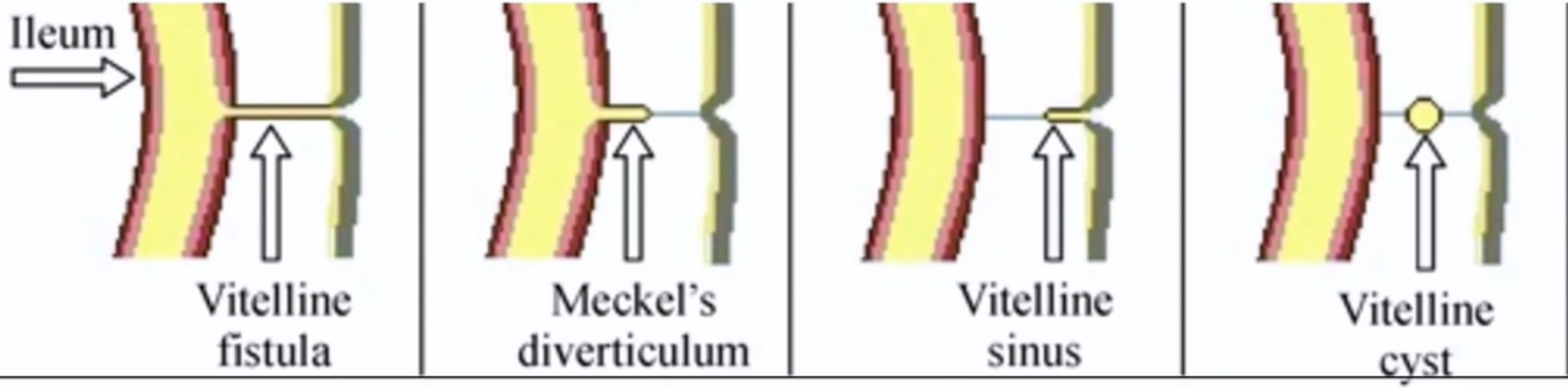
- **Functions of the yolk sac**

1) **Nutrition of the embryo** before the development of the placenta
2) **Formation of the primitive gut except** lower part of the anal canal
3) **Hemopoiesis: formation of embryonic blood cell via blood islands near the sac**
4) **Formation of the primordial germ cells** (spermatogonia or oogonia) **from the wall of the yolk sac and migrate to the developing gonads (testes or Ovary) during the fourth week,**



** Congenital anomalies of Vitellointestnial duct:

i) Vitelline fistula (patent VID): persistence of the duct leading to discharge of the intestinal contents through the umbilicus.

ii) Meckel's diverticulum, persistence of the proximal end of the duct.

iii) Vitelline sinus: persistence of distal end of the duct leading to discharge mucus from the umbilicus.

iv) Viteline cyst: persistence of the middle part of the duct.

v) Fibrous band, The duct completely fibrosed and persistence leading to Volvulus and intestinal obstruction.

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Development of Umbilical cord

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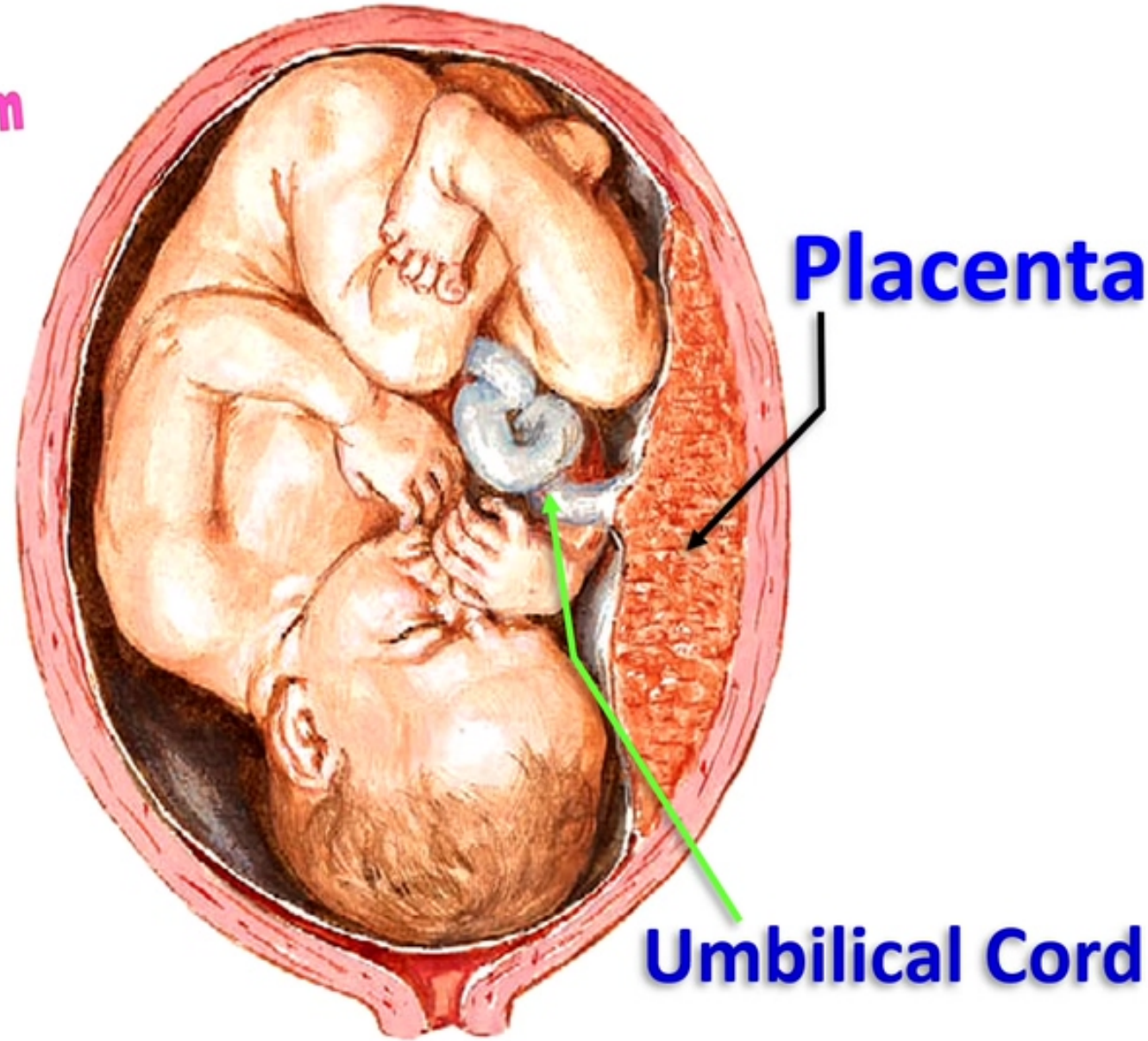
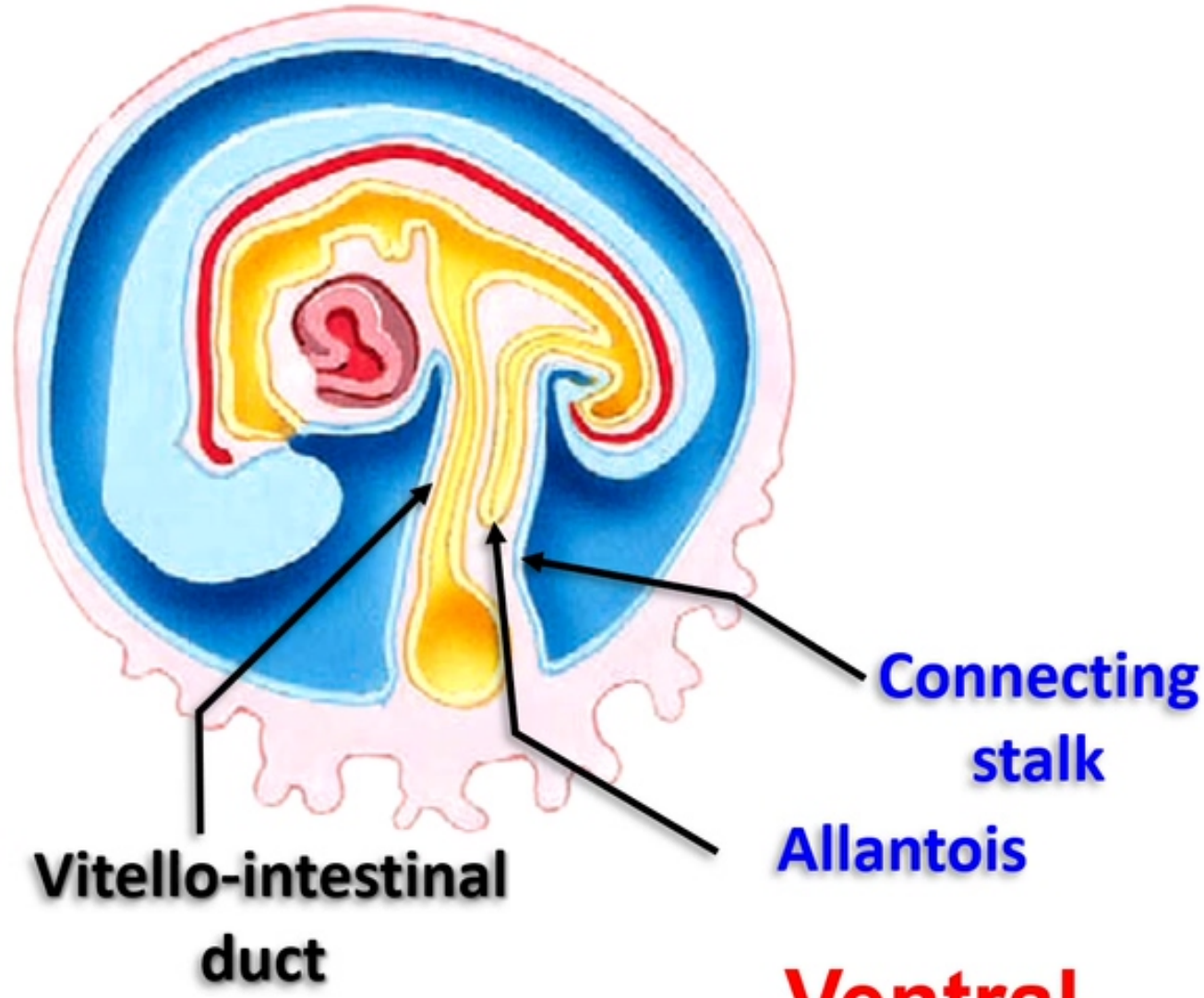
- It is a cord-like structure connects the placenta (fetal surface) with the umbilicus of the fetus



** Formation of the primitive umbilical cord

- As the results of the tail folding, The connecting stalk (Future umbilical cord) becomes ventral to embryo and containing Allantois and Vitellointestinal duct



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** Formation of the primitive umbilical cord

1- Vitello-intestinal duct (VID) between gut and definitive yolk sac and surrounded by 2 vitelline arteries and 2 vitelline veins.

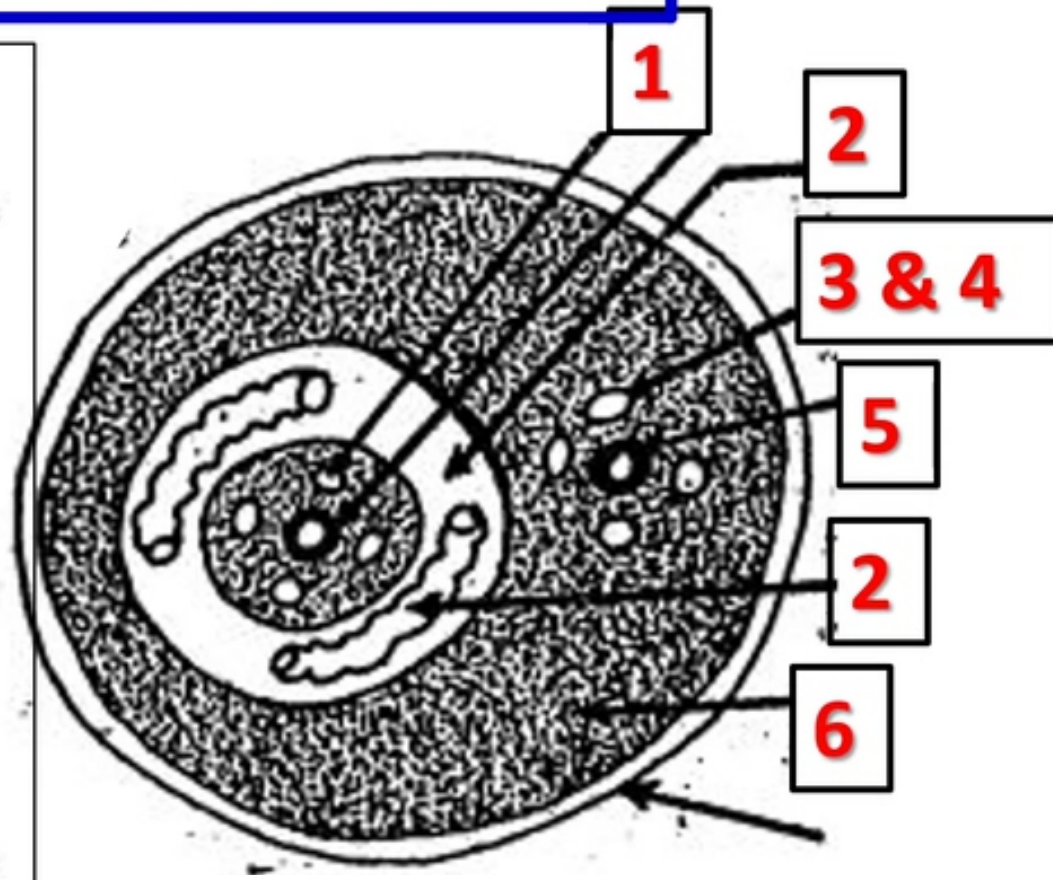
2- Loops of intestine (physiological hernia) in the extra-embryonic coelom.

3- 2 umbilical arteries carry **non-oxygenated** blood from the fetus to the mother.

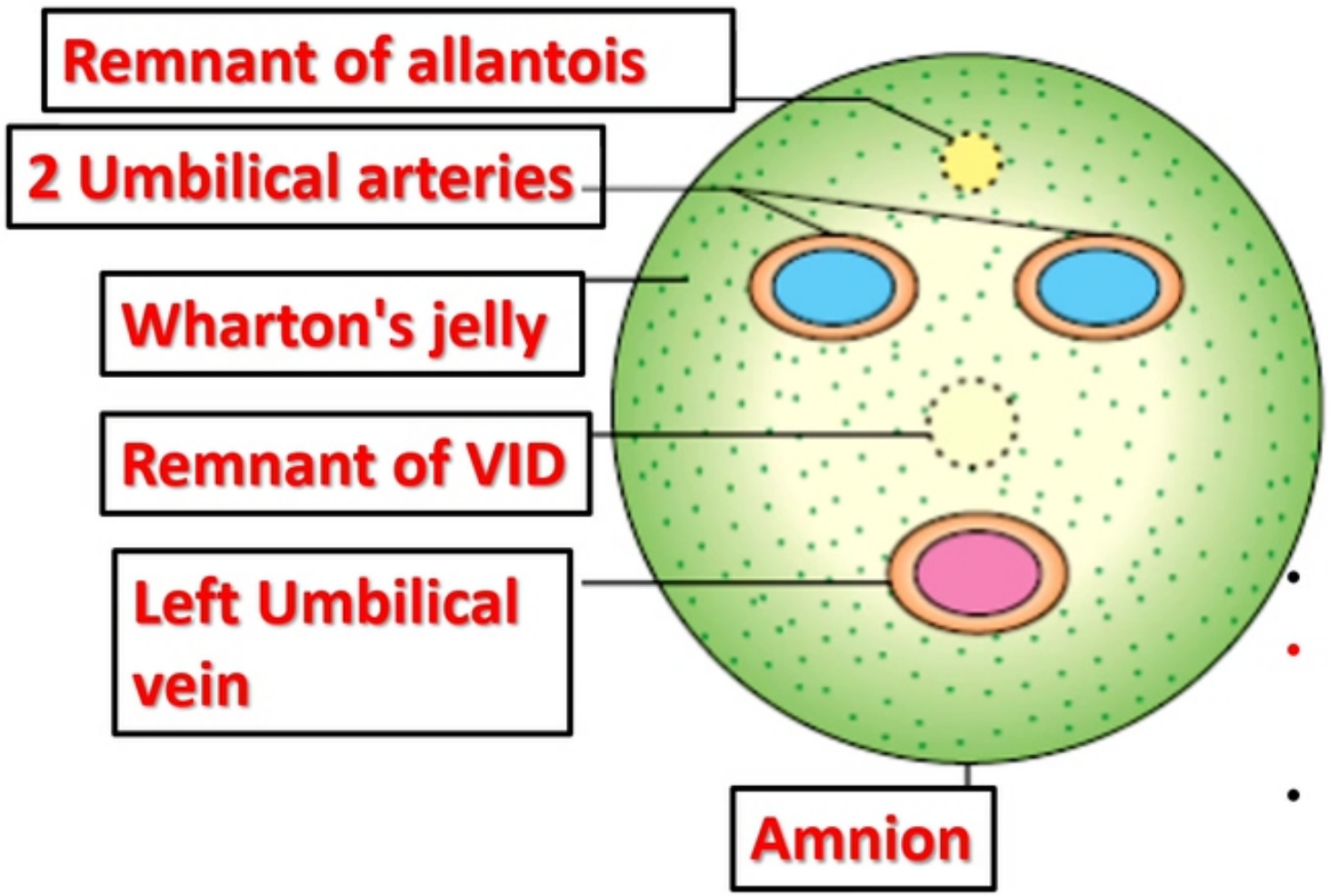
4- 2 umbilical veins carry **oxygenated** blood to the fetus.

5- Allantois (urachus) small diverticulum from cloaca and extends into the connecting stalk.
- It connects the apex of the urinary bladder with the umbilicus.

6- Extra-embryonic mesoderm.



Definitive of Umbilical Cord



- **2 umbilical arteries** (Right & Left).
- **Left umbilical vein**.
- These structures are embedded in a jelly like material called **Wharton's jelly**.
- It is covered by **amniotic membrane**.

- **Right umbilical vein** is obliterated.
- **VID and vitelline vessels** obliterated and degenerated.
- **Allantois** is obliterated and forms median umbilical ligament of the urinary bladder.
- **Loops of intestine** return to abdominal cavity.
- **Extra-embryonic coelom** is closed.

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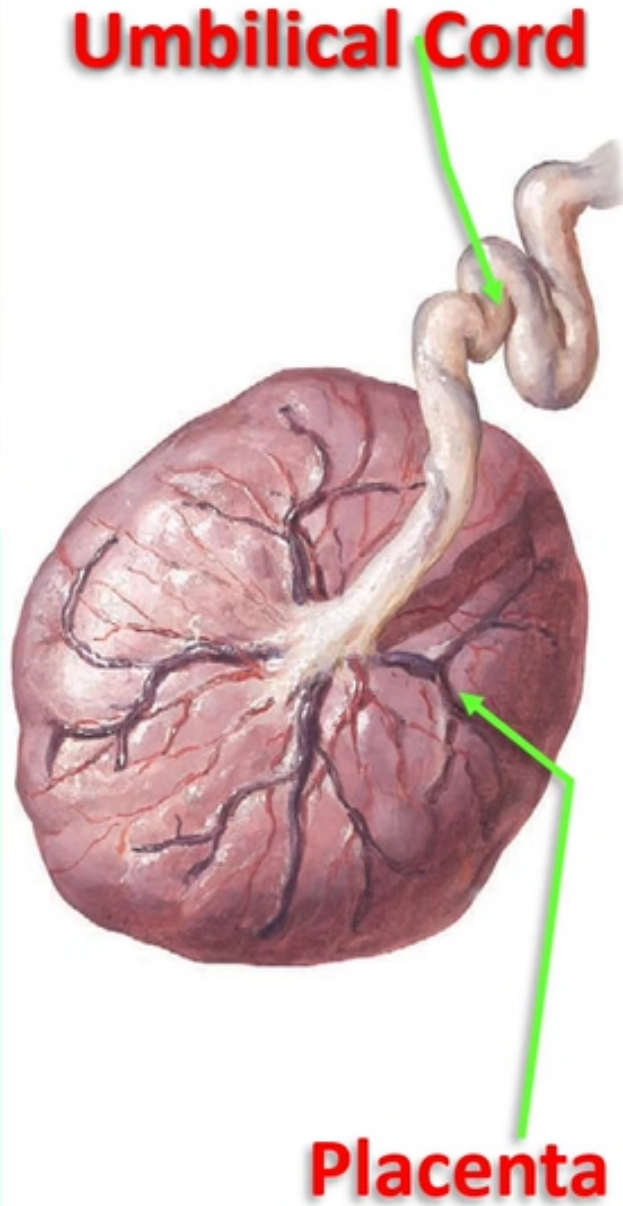
- The umbilical cord has natural twists (false knotting) because umbilical vein is longer than umbilical arteries
- At Full-term Length: 50–55 cm.
  Breadth: 1–2 cm

- Changes of umbilical cord after labor
- Left umbilical vein is obliterated and forms ligamentum teres of the liver.
- 2 umbilical arteries are obliterated and form 2 medial umbilical ligaments of the urinary bladder.
- Allantois is obliterated and forms median umbilical ligament of the urinary bladder
- VID is obliterated and degenerated



- **Congenital anomalies of the umbilical cord**

1) Very long cord: more than one meter.

- It may surround the neck of the fetus leading to death.
- It may turn around limb of the fetus leading to its atrophy.
- Cord prolapse: it prolapse in the vagina during child birth

2) Very short cord: less than 30 cm.

- It limits the movement of the fetus.
- It leads to early separation of the placenta leading to bleeding.

3) Congenital umbilical hernia: failure of reduction of the intestine.

4) True Knotting of the cord: leading to interfere with the blood supply of the fetus.

5) Double or triple cord.

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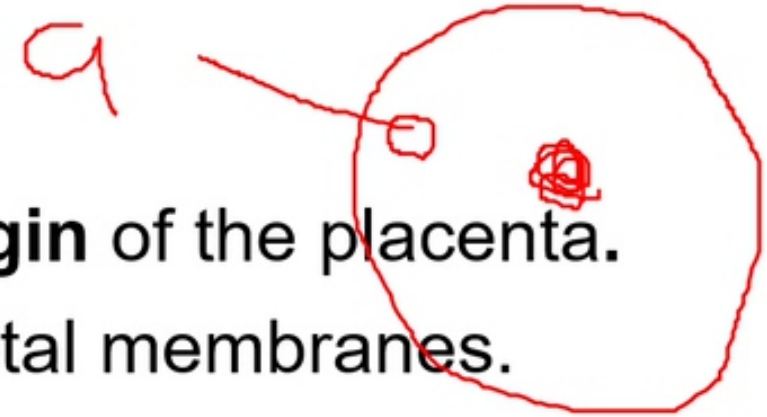

6) Anomalies in the attachment of the cord:

a- Battledore هامشية **placenta,** attached to the **margin** of the placenta.

b- Velamentous غلافي **placenta,** attached to the fetal membranes.

7) Anomalies in the allantois (urachus):

a- Urachal fistula: persistent of the urachus. It leads to discharge of urine from the umbilicus of the fetus.

b Urachal cyst: persistence of the **middle** part.

c- Urachal sinus: persistence of the **distal** end.

7) Anomalies in the vitellointestinal duct (SEE yolk sac)

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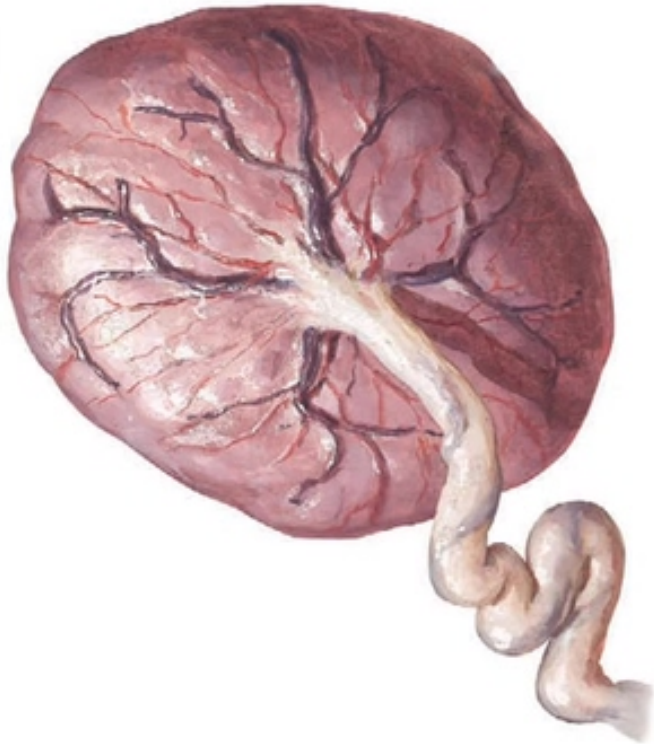

Development of Placenta

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- **Development of decidua (Maternal part)**

- a- The endometrium becomes thicker and more vascular.
- b- Its glands become highly tortuous and filled with secretions.
- c- It contains decidual cells characteristic of pregnancy.

- **Parts of decidua**

- **Decidua basalis**: deep to the embryo (between blastocyst and myometrium). It forms the fetal part of placenta.
- **Decidua capsularis**: covers the blastocyst, later on disappear.
- **Decidua parietalis**: the rest of endometrium that lines uterine cavity, later on disappear.

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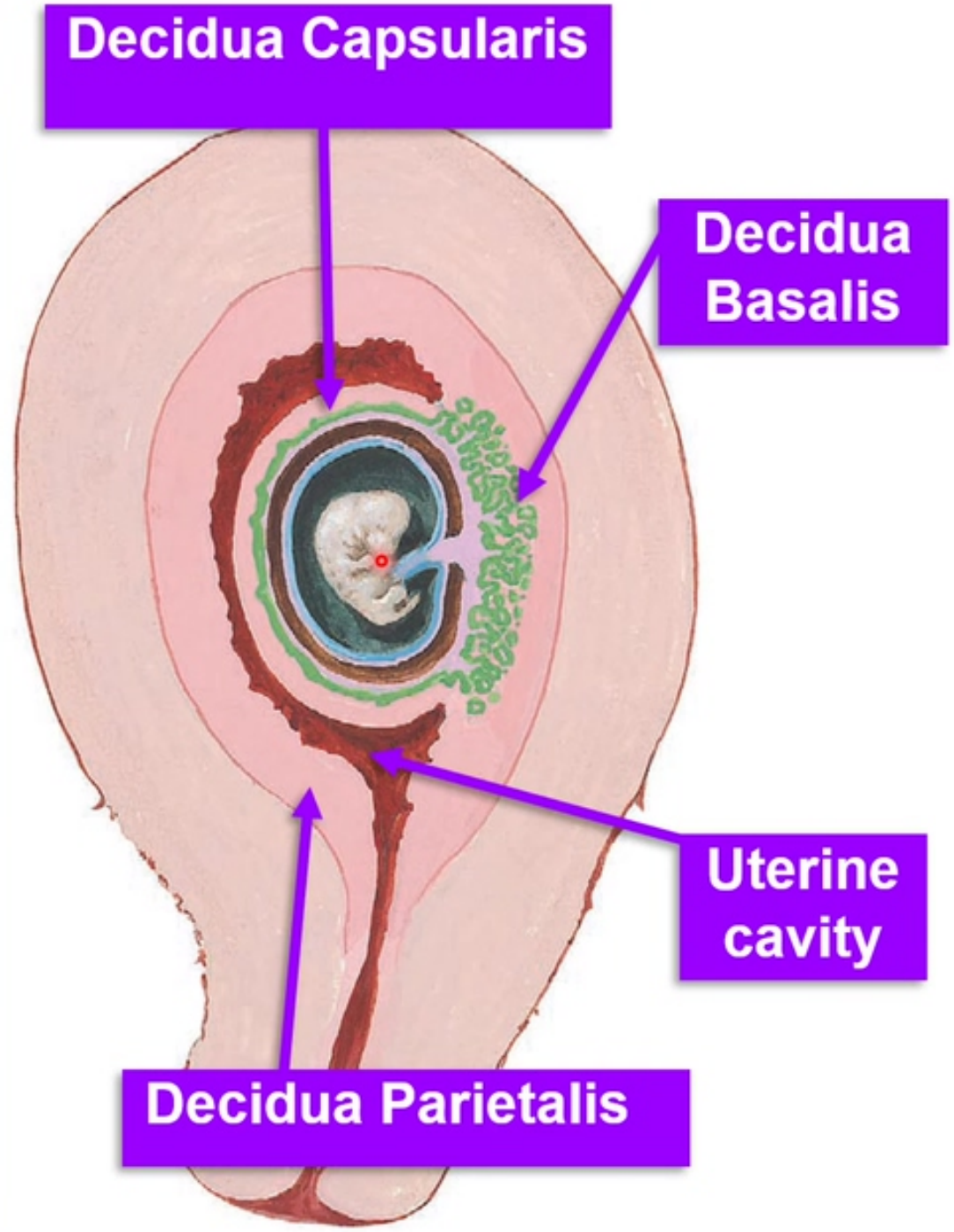

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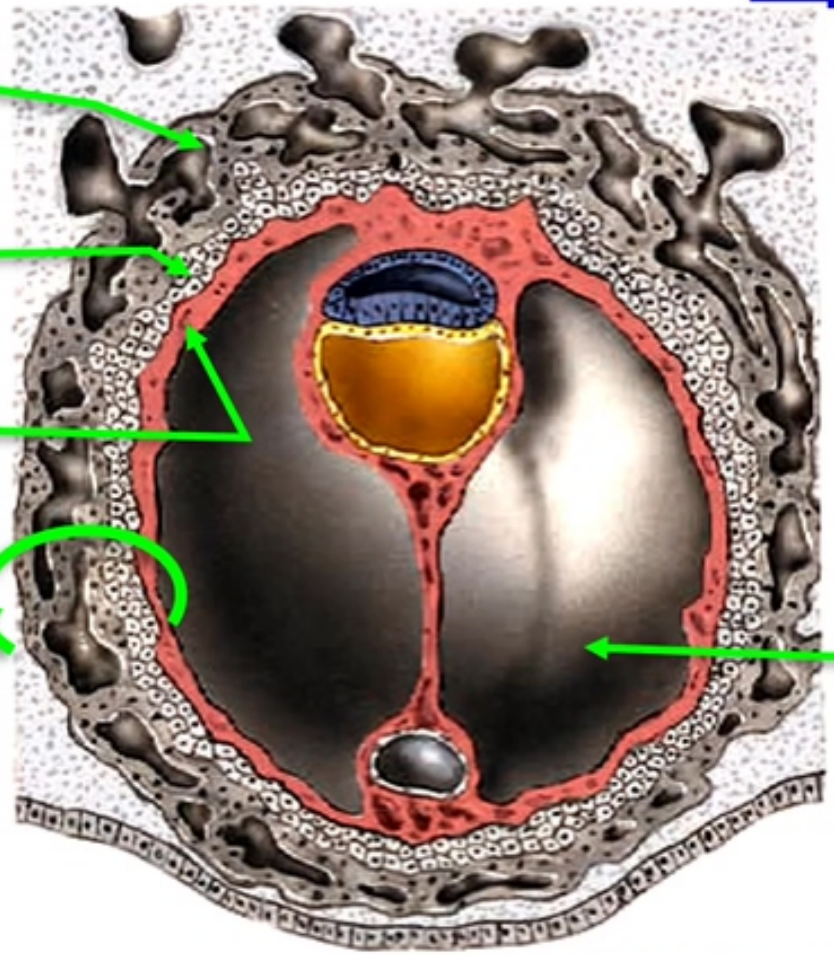
Development of Chorionic Villi

Chorionic Vesicle



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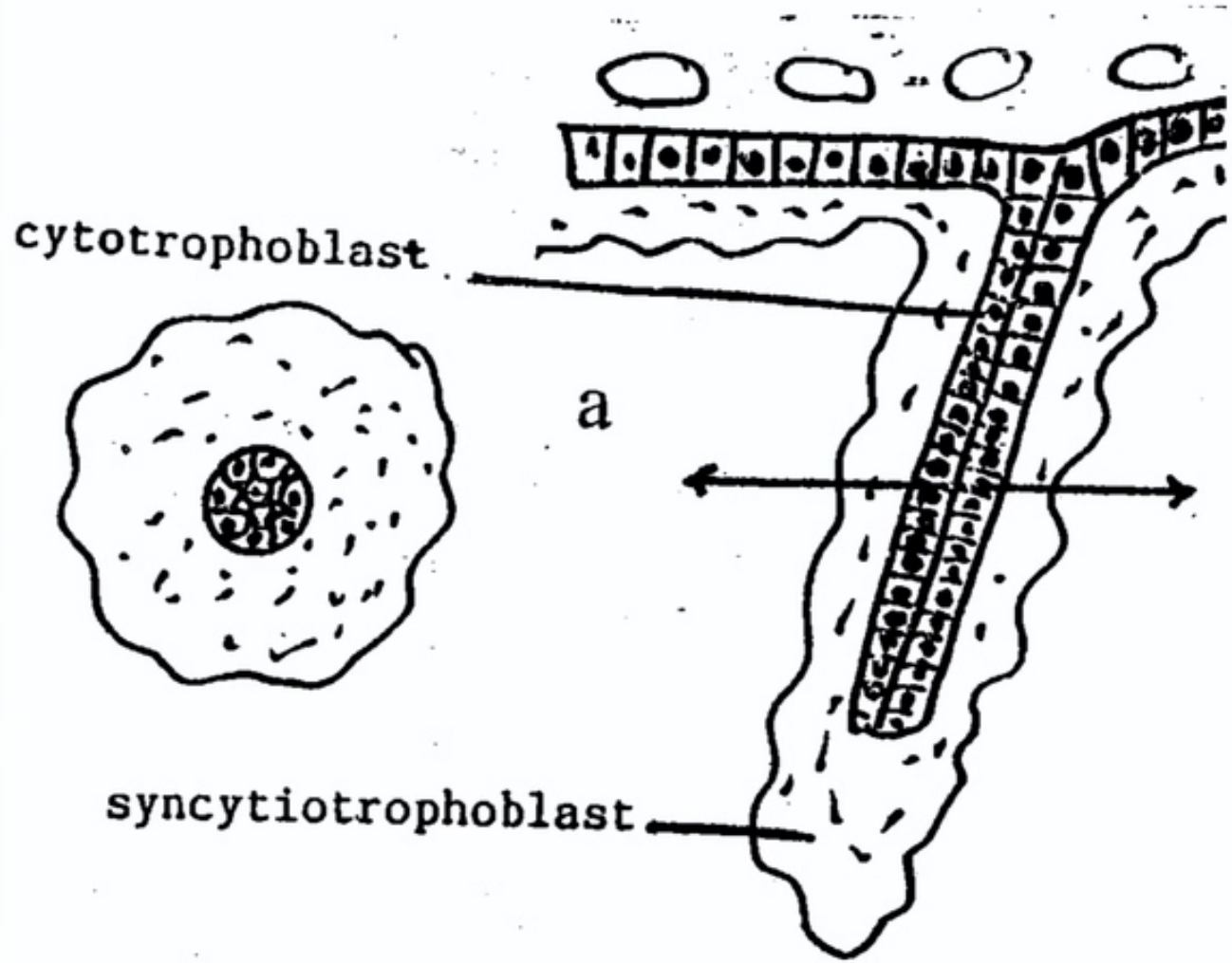
- By the end of 2nd week, The blastocyst is called chorionic vesicle having large cavity called chorionic cavity
- The Chorion (wall) is formed by three layers: 1) Syncytiotrophoblast.

2) Cytotrophoblast. 3) Somatic layer of extraembryonic mesoderm.

- **Primary chorionic villi :**

- The syncytiotrophoblasts form finger-like projections.
- The cytotrophoblasts migrate into center of the projections.
- The villi are separated from each other by spaces called lacunae filled with maternal blood due to erosion of the uterine vessels by syncytiotrophoblast.

Primary chorionic villi



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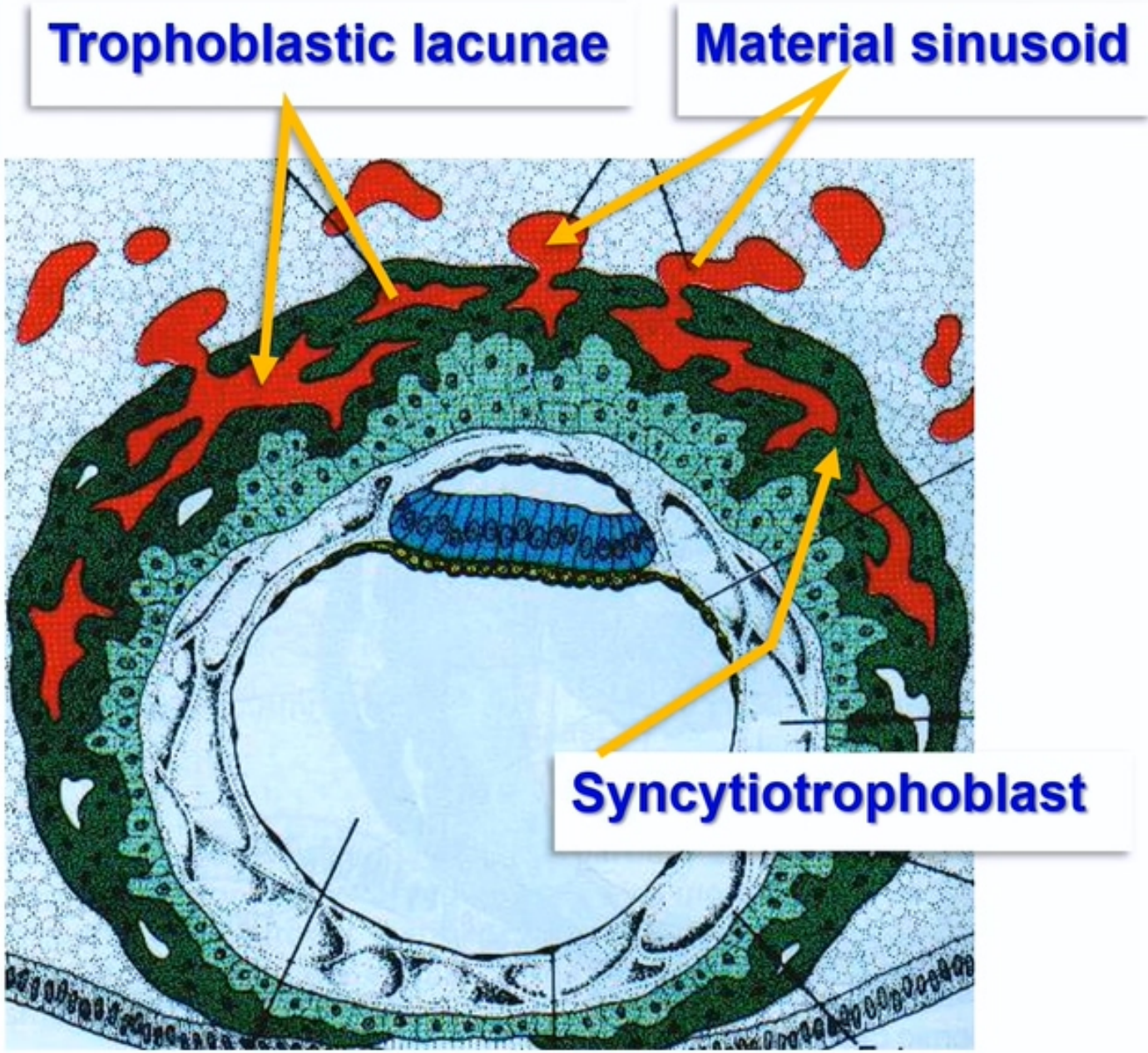
- **Trophoblastic lacunae** appeared in syncytiotrophoblast at embryonic pole of the disc
- The syncytiotrophoblast cells **penetrate** (phagocytosis) deeper into maternal endometrium and **invade its capillaries**
- The lacunae become **filled with maternal blood**
- So, maternal blood begins to flow through **lacunar system** of trophoblast and this is called **uteroplacental circulation.**



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Secondary chorionic villi

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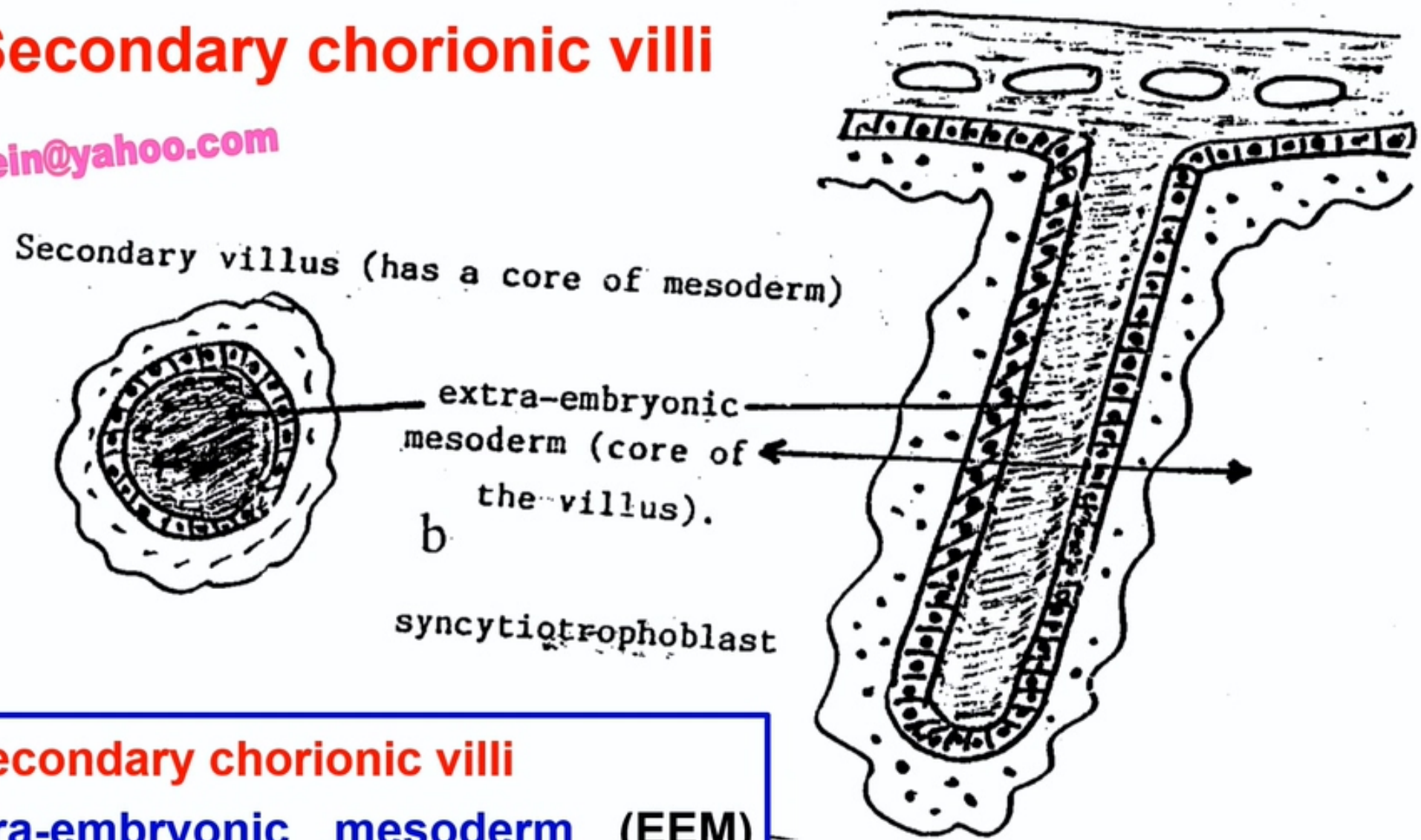
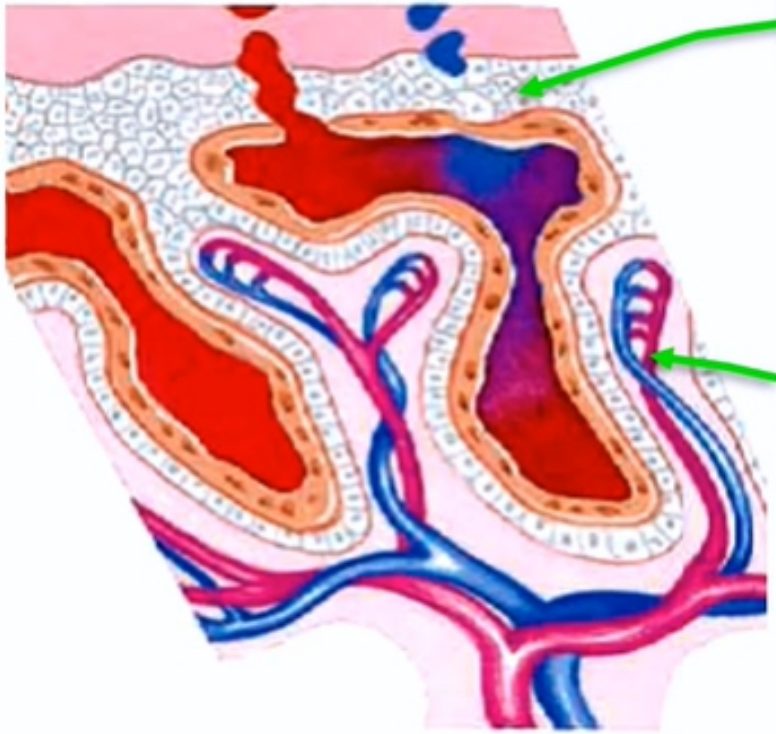


- **Secondary chorionic villi**

- The extra-embryonic mesoderm (EEM) proliferates and migrates into the center of the cytotrophoblastic cells.

Tertiary chorionic villi



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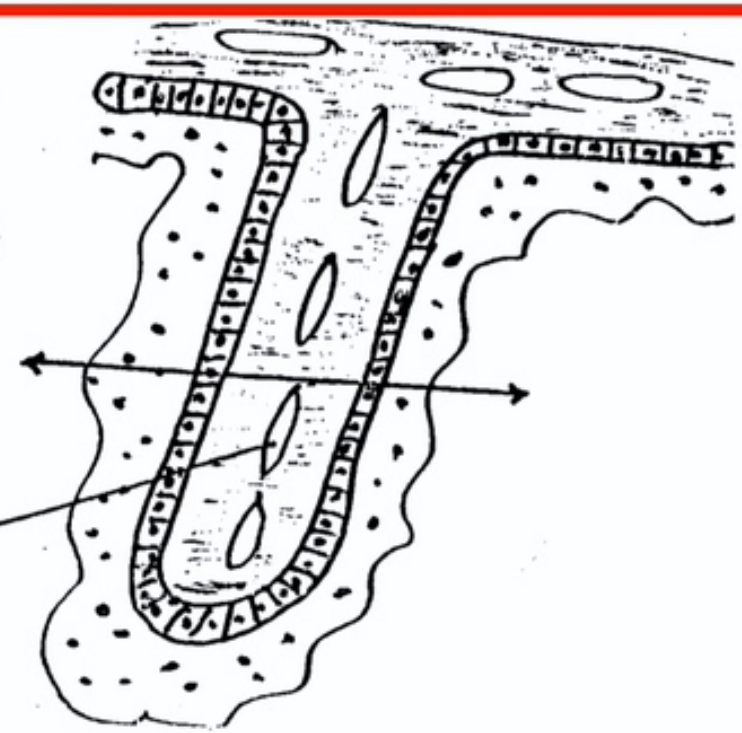


- **Tertiary chorionic villi**

- The cells of the **extra-embryonic mesoderm** give rise to fetal **blood vessels.**

  N.B: The cytotrophoblast cells of the apical region pierce the syncytiotrophoblast cells to meet and fuse with the adjacent one forming **cytotrophoblastic shell** to prevent further erosion of the endometrium by the syncytiotrophoblast and fixes all the villi in the decidua (**Anchoring villi**) .

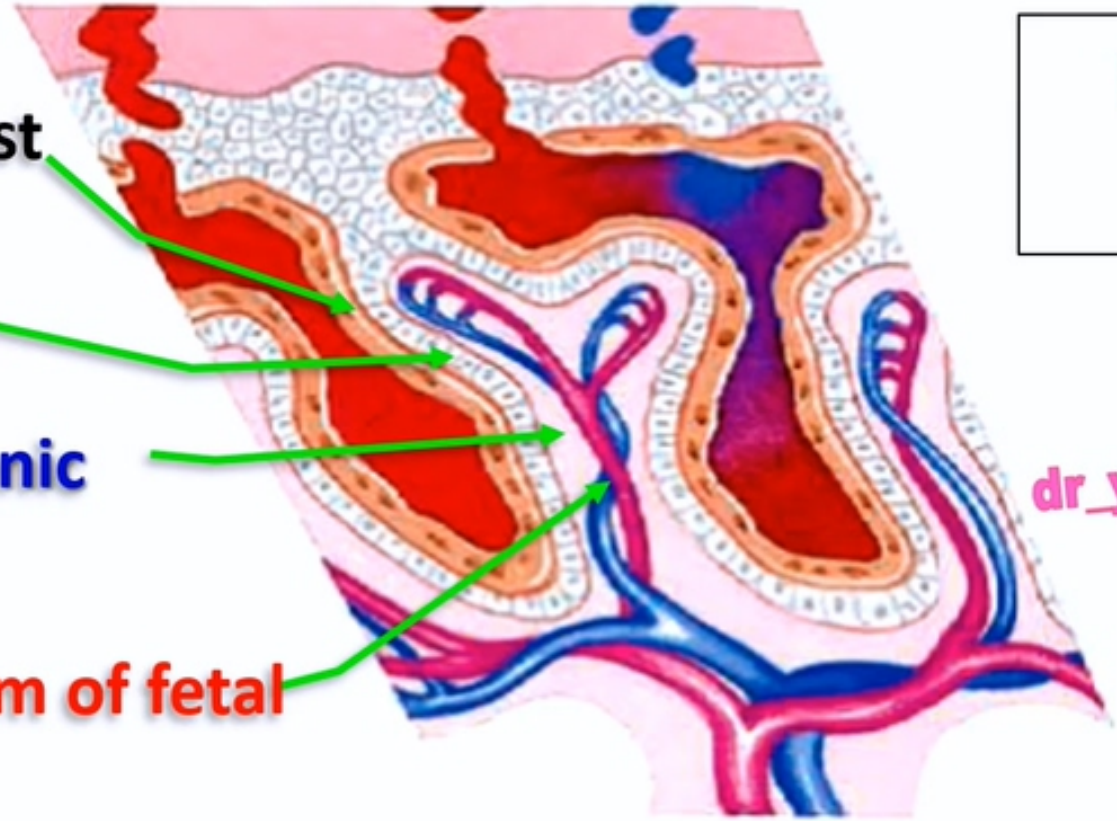
Placental barrier (Membrane)

1- Syncytiotrophoblast

2- Cytotrophoblast

3- Extraembryonic mesoderm

4- Endothelium of fetal blood vessles



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- In early pregnancy, the placental membrane is made up of four layers, its thickness is about 25 micron
- After the 3rd month, the nutritional demands increase so the placental membrane becomes thin to increase the efficiency of transport of nutrients, its thickness is about 1-2 micron. It is made of two layers syncytiotrophoblast and endothelium of the fetal blood vessels

** **Development of decidual septa:**

- The **decidua basalis** forms many **septa** that protrude into the **intervillous spaces** aiming to increase the surface area of the decidua.
- These septa divide the placenta into 15-20 lobes called **cotyledons** الفلقات.

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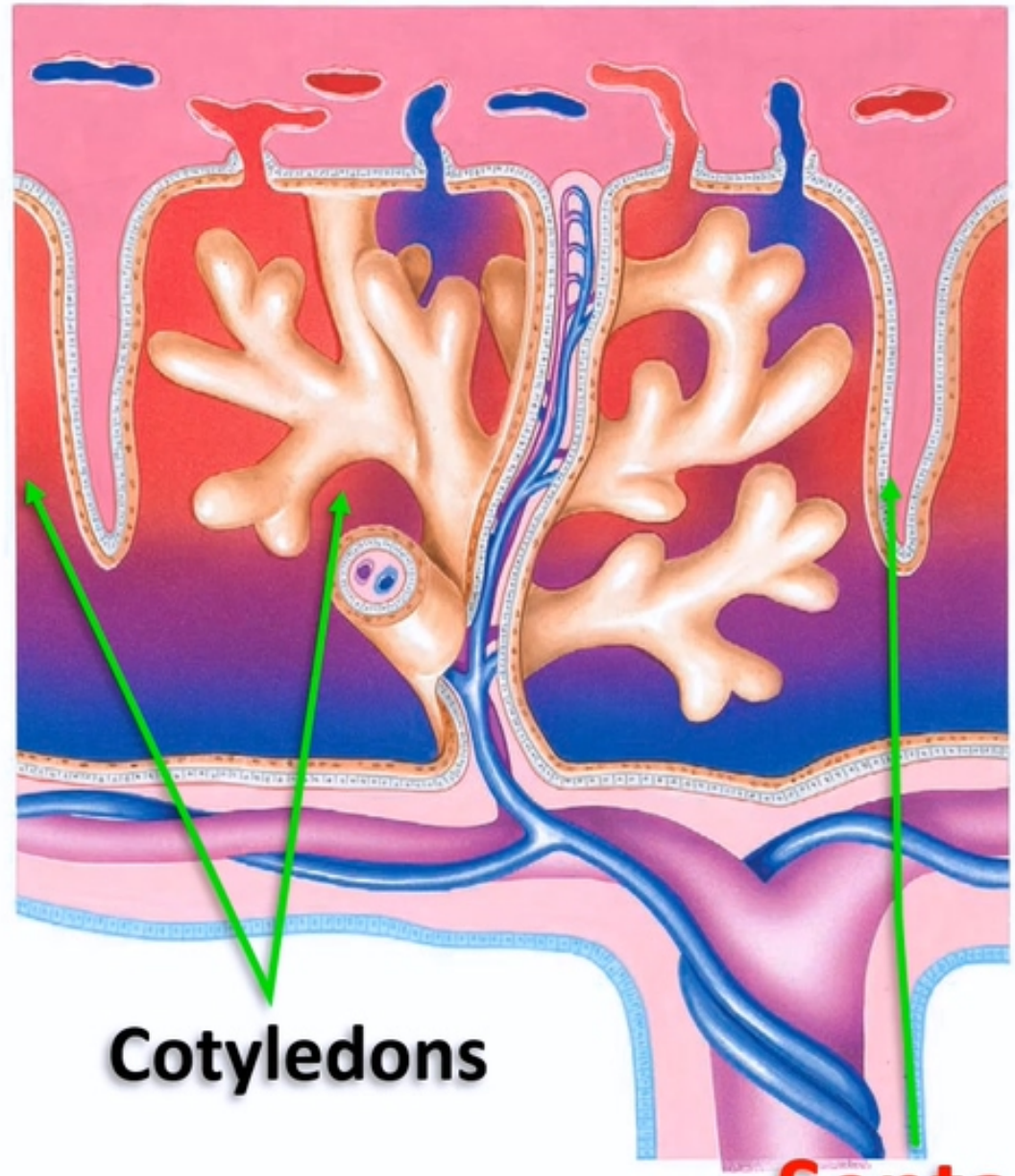
Lobulation of Placenta

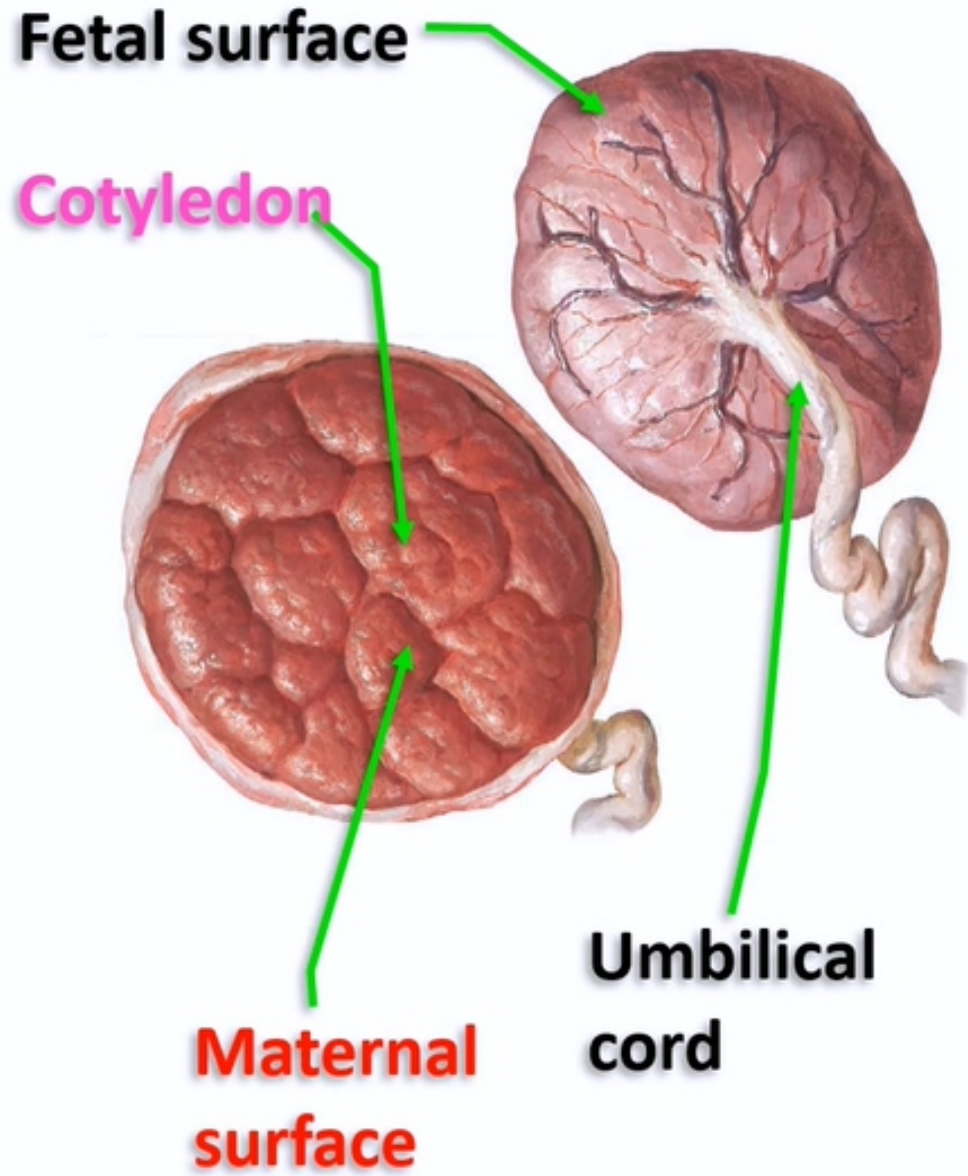


Morphology (Gross features)

- **Shape**; disc shaped.
- **Diameter**; about 15-20 cm.
- **Weight**: about 500 at birth.
- **Thickness**; its center about 3 cm and its margins about 1 cm
- **Surfaces**

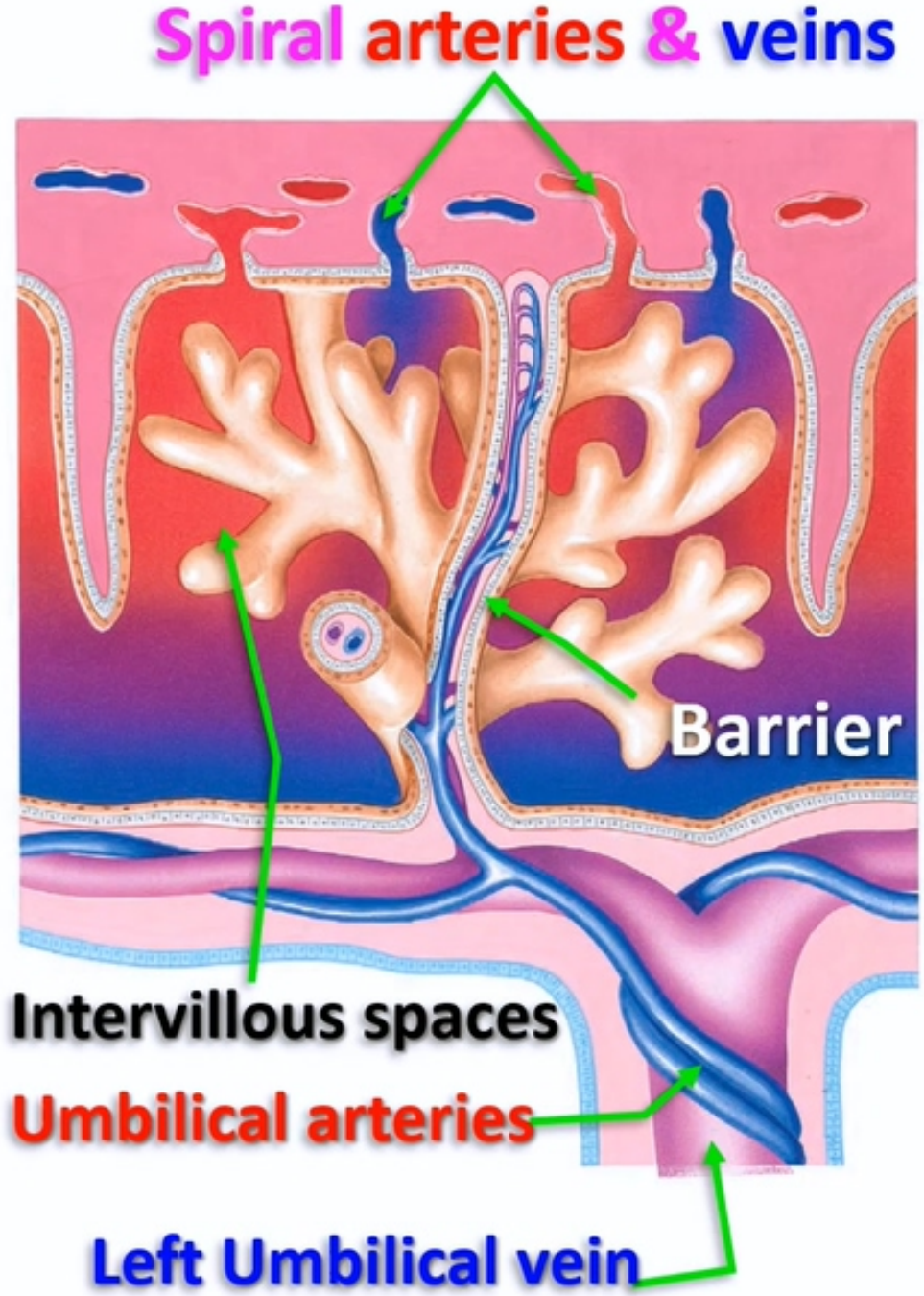
A- maternal: Rough. It is segmented into 15-20 lobes (cotyledons). الفلقات

B- Fetal: Smooth and covered by amniotic membrane. The umbilical cord attached to the center of the fetal surafce.



• Placental circulation:

- The fetal non oxygenated blood reaches to the placenta by **2 umbilical arteries** → where gas exchange occurs with the maternal blood in the **intervillous spaces through spiral arteries and veins of the** decidua basalis.
- Exchange between the 2 blood streams occurred across the **placental barrier**.
- The oxygenated blood returns to the fetus by **left umbilical vein**.



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