HANDBOUT # 6

Fetal Membranes
And
Placenta

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**Fetal membranes and placenta**

The chorion, amnion, yolk sac and allantois develop from the zygote and constitute the fetal membranes that protect the fetus. The placenta allows interchange of substances (e.g. nutrients and gases) between the maternal and fetal blood in addition to other important functions. After delivery, the fetal membranes and placenta are expelled from the uterus as the “afterbirth”.

**Placenta**

The placenta is formed of two parts: The *fetal part* derived from the trophoblast (chorion frondosum) and the *maternal part* derived from the endometrium (decidua basalis). The development of the placenta occurs as follows:

1- It starts in the 2\(^{nd}\) and 3\(^{rd}\) weeks of development by formation of the primary, secondary and tertiary chorionic villi in the wall of trophoblast (see before). At the end of the second month, the tertiary chorionic villi (finger-like projections containing fetal capillaries) become attached to the decidua basalis. Cytotrophoblastic cells extend from these villi through the syncytiotrophoblast until they reach the decidua basalis and form a thin continuous layer called the cytotrophoblastic shell that surround the chorionic sac and anchor it to the decidua basalis.
2- The spaces between the chorionic villi are called the intervillous spaces and are lined by the syncytiotrophoblast and filled by maternal blood. Many extensions (branches) arise from the stem of the chorionic villi and project into the intervillous spaces (villous tree). By the beginning of the fourth month, the placental membrane (barrier) in the branches of the villous tree is reduced to two layers: the syncytiotrophoblast and the endothelial lining of fetal capillaries. This bring the maternal blood very close to fetal blood which allow easy exchange of materials between them (*note that in the stem of chorionic villi, no exchange takes place because the placental barrier is formed of 4 layers: syncytiotrophoblast, cytotrophoblast, extraembryonic somatopleuric mesoderm and endothelial lining of fetal capillaries).
3- The placenta is delineated in its fetal side by the chorionic plate (the base of chorion frondosum) and in its maternal side by the decidual plate (decidua basalis) and the intervillous spaces (lacunae filled with maternal blood) lie between these two plates. From the decidua, incomplete decidual septa (do not reach into chorionic plate) project into these intervillous spaces and divide the placenta into compartments or cotyledons.

4- The placenta enlarge during development and it covers approximately 15 -30% of the internal surface of the uterus. The increase in its thickness is due to the arborization of the existing villi.

Remarks:

- During development, the chorionic villi at the abembryonic pole degenerate then disappear and called chorion leave (smooth). The chorionic villi at the embryonic pole continue to grow and called chorion frondosum (bushy) which forms the fetal part of the placenta.

- Obliteration of uterine cavity: the decidua over the chorion frondosum forms the decidual plate and becomes tightly connected to the chorion and forms the maternal part of the placenta. The decidua over the chorion leave is called decidua capsularis. With growth of the chorionic sac, the decidua capsularis stretches and degenerates and comes into contact and fuses with the decidua parietalis on the endometrial wall of the opposite side. This fusion obliterates the lumen of the uterus.

- Obliteration of chorionic cavity: fusion of the amnion and chorion occurs due to the enlargement of the amniotic sac. This fusion obliterates the chorionic cavity and forms the amniochorionic membrane which ruptures during labor (breaking of water).

- Note that incomplete decidual septa allow the connection between the intervillous spaces with each others and that the lacunar surfaces of these septa are covered by the syncytiotrophoblast.
Q. How the chorionic villi (1\textsuperscript{st}, 2\textsuperscript{nd} and 3\textsuperscript{rd}) are formed?

Q. What is cytotrophoblastic shell?

Q. What is placental barrier (placental membrane)

**Full Term Placenta**

It is discoid in shape with 3 cm thickness, 15-25 cm in diameter and weighs 500-600 gm. It is expelled from the uterus 30 minutes after birth. It has fetal and maternal surfaces which are firmly attached to each other.

A- The fetal surface is smooth and formed of the chorionic plate which is covered by a layer of amniotic membrane. The chorionic vessels are seen under the translucent amniotic membrane converging towards the umbilical cord which is attached to this surface in an eccentric or marginal ways.

B- The maternal surface is rough and is divided into 15-20 bulging areas “cotyledons” which are covered by a layer of decidua basalis. The grooves
between the cotyledons are formed by the decidual septa. Each cotyledon contains 2 or more stem villi and their branches.

Circulation of the placenta
Exchange of substances between fetal and maternal blood occurs in the placenta through the placental membrane (barrier) that cover the branches of the chorionic villi. Normally, no intermingling occurs between fetal and maternal blood.

A- Feto-placental circulation
Two umbilical arteries carry poorly oxygenated blood from the fetus to the placenta. Many chorionic arteries arise from the umbilical arteries and run in the chorionic plate and enter the chorionic villi which end by forming an extensive arteriocapillary-venous system that drain well oxygenated blood into chorionic veins that drain into the umbilical vein to reach the fetus.
B- Materno-placental circulation

Oxygenated maternal blood circulating in the intervillous spaces is poured through approximately 100 endometrial spiral arteries that pierce the decidual plate of the cotyledons. Deoxygenated blood drains back to the maternal venous system through the endometrial veins.

(Note that during the 2nd and 3rd weeks, the maternal blood in the intervillous space is the blood that discharge in the lacunae found in the syncytiotrophoblast layer establishing the utero-placental circulation)

Because the maternal blood in the intervillous spaces is separated from the fetal blood in the chorionic villi by the placental membrane which is a chorionic derivative, the human placenta is considered to be hemochorial type.
Function of the placenta
1- Nutrition, Respiration and Excretion
   • Exchange of metabolic and gaseous products

2- Production of hormones:
   • Estrogen
   • Progesterone
   • Human Chorionic Gonadotropin (HCG)
   • Somatomammotropin (placental lactogen)

3- Protection
   • Prevent passage of certain harmful organism from the mother.
   • Transmission of maternal antibodies

Umbilical cord
The umbilical cord is about 50 cm long. It developed from the connecting stalk. It is the life line of the fetus as it contains blood vessels which connect the fetus with its placenta and is attached to the fetal surface of the placenta. It is formed of two arteries and one vein which are embedded in and surrounded by a mucoid connective tissue known as “Wharton Jelly” to protect the blood vessels. The umbilical arteries carry poorly oxygenated blood while the umbilical vein carries a highly oxygenated blood.