THE PLACENTA
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Objectives
- Describe the changes which occur in the endometrium during pregnancy
- Discuss the changes which occur in the trophoblast
- Describe the Structure of the Placenta
- Describe Full-term Placenta
- Talk briefly about the functions of the placenta

The placenta is the primary site of nutrient and gas exchange between the mother and fetus. It is a fetomaternal organ that has two components:
- A fetal part that develops from the chorionic sac
- A maternal part that is derived from the endometrium

The Decidua:

It refers to the gravid endometrium, the functional layer of the endometrium in a pregnant woman that separates from the remainder of the uterus after parturition (childbirth).

The three regions of the decidua are named according to their relation to the implantation site:
- The decidua basalis is the part of the decidua deep to the conceptus that forms the maternal part of the placenta.
- The decidua capsularis is the superficial part of the decidua overlying the conceptus.
- The decidua parietalis is all the remaining parts of the decidua

Decidual reaction:
The cellular and vascular changes occurring in the endometrium as the blastocyst implants constitute the decidual reaction.
- Thickness & vascularity of the mucous membrane greatly increased
- Its glands are elongated & tortuous
- Interglandular tissue is also increased and is crowded with decidual cells. These cells swell with accumulation of lipid & glycogen.
  These changes “decidua reaction” at 1st are confined to the area immediately surrounding the implantation site but soon occur throughout the endometrium

Decidual cells:
In response to increasing progesterone levels in the maternal blood, the connective tissue cells of the decidua enlarge to form pale-staining decidual cells. These cells enlarge as glycogen and lipid accumulate in their cytoplasm.
The full significance of decidual cells is not understood, but it has also been suggested that they protect the maternal tissue against uncontrolled invasion by the syncytiotrophoblast and that they may be involved in hormone production. Decidual regions, clearly recognizable during ultrasonography, are important in diagnosing early pregnancy.
**Chorion**

Outer – trophoblast (syncytiotrophoblast and cytotrophoblast)
Inner - somatic mesoderm

**Changes in the Trophoblast**

At the beginning of the second month of development. The trophoblast is characterized by a great number of secondary and tertiary villi, which give it a radial appearance.

At the embryonic pole, villi are numerous and well formed; at the abembryonic pole, they are few in number and poorly developed.

- **Chorion laeve**: is the greater part of the chorion in contact with decidua capsularis and over this portion the villi undergoes atrophy and by the 4th month scarcely a trace of villi is left. This part of the chorion becomes smooth.

- **Chorion frondosum**: is the part of the chorion which is in contact with decidua basalis and the villi over this part increase greatly in size and complexity.

Stem (anchoring) villi extend from the mesoderm of the chorionic plate to the cytotrophoblast shell.

The capillary system developing in the core of the villous stems soon comes in contact with capillaries of the chorionic plate and connecting stalk, thus giving rise to the extraembryonic vascular system.

Maternal blood is delivered to the placenta by **spiral arteries** in the uterus. Erosion of these maternal vessels to release blood into intervillous spaces is accomplished by endovascular invasion by cytotrophoblast cells.

These cells, released from the ends of anchoring villi, invade the terminal ends of spiral arteries, where they replace maternal endothelial cells in the vessels’ walls, creating **hybrid vessels** containing both fetal and maternal cells.

To accomplish this process, cytotrophoblast cells undergo an epithelial to endothelial transition.

**Invasion of the spiral arteries by cytotrophoblast cells** transforms these vessels from small-diameter, high-resistance vessels to larger-diameter, low-resistance vessels that can provide increased quantities of maternal blood to intervillous spaces.

During the following months, numerous small extensions grow out from existing stem villi and extend as free villi into the surrounding lacunar or intervillous spaces.

**Structure of the Placenta**

By the beginning of the fourth month, the placenta has two components:

(a) a fetal portion, formed by the chorion frondosum and
(b) a maternal portion, formed by the decidua basalis

On the fetal side, the placenta is bordered by the **chorionic plate**

On the maternal side, the placenta is bordered the **decidual plate**
**junctional zone**: trophoblast and decidual cells intermingle. This zone is characterized by decidual and syncytial giant cells, is rich in amorphous extracellular material.

By this time, most cytotrophoblast cells have degenerated.

Decidual plate sends a series of septa through the thickness of the placenta and subdivide it into lobules or cotyledons. Since the decidual septa do not reach the chorionic plate, contact between intervillous space in various cotyledons is maintained.

The villi are suspended in the intervillous space and are bathed in maternal blood which is conveyed to the space by uterine arteries and carried away by uterine veins. A branch of umbilical artery enters each villous and ends in a capillary plexus from which blood is drained by a tributary of umbilical vein. As a result of the continuous growth of the fetus and expansion of the uterus, the placenta also enlarges. Throughout pregnancy it covers approximately 15% to 30% of the internal surface of the uterus. The increase in thickness of the placenta results from arborization of existing villi and is not caused by further penetration into maternal tissues.

**Separation of the placenta**

The placenta is torn from the uterine wall and, approximately 30 minutes after birth of the child, is expelled from the uterine cavity.

The expelled placenta is discoid with a diameter of 15 to 25 cm, is approximately 3 cm thick, and weighs about 500 to 600 g.

**The fetal surface of the placenta** *(facing the fetus)*

Has a shiny, smooth surface provided by the amniotic membrane that covers it. A number of large arteries and veins, the chorionic vessels, converge toward the umbilical cord.

The attachment of the umbilical cord is usually eccentric and occasionally even marginal. Rarely, however, does it insert into the chorionic membranes outside the placenta (velamentous insertion).

**Maternal side of the placenta**

Is textured and spongy looking

Is divided by a series of fissures into lobules or cotyledons

The fissures contain the remains of septae which extended between the maternal and fetal portions.

**Placental Changes at the end of Pregnancy**

At the end of pregnancy, a number of changes that occur in the placenta may indicate reduced exchange between the two circulations. These changes include:

(a) an increase in fibrous tissue in the core of the villus,
(b) thickening of basement membranes in fetal capillaries,
(c) obliterator changes in small capillaries of the villi, and
(d) deposition of fibrinoid on the surface of the villi in the junctional zone and in the chorionic plate. Excessive fibrinoid formation frequently causes infarction of an intervillous lake or sometimes of an entire cotyledon. The cotyledon then assumes a whitish appearance.

**Function of the Placenta**
Main functions of the placenta are
(a) exchange of metabolic and gaseous products between maternal and fetal bloodstreams and
(b) production of hormones.

(a) exchange of metabolic and gaseous products between maternal and fetal bloodstreams

exchange of gases—such as oxygen, carbon dioxide, and carbon monoxide—is accomplished by simple diffusion.

Exchange of nutrients and electrolytes, such as amino acids, free fatty acids, carbohydrates, and vitamins, is rapid and increases as pregnancy advances.

Transmission of Maternal Antibodies: Immunological competence begins to develop late in the first trimester, by which time the fetus makes all of the components of complement. Immunoglobulins consist almost entirely of maternal immunoglobulin G (IgG), which begins to be transported from mother to fetus at approximately 14 weeks. In this manner, the fetus gains passive immunity against various infectious diseases. Newborns begin to produce their own IgG, but adult levels are not attained until the age of 3 years

(b) production of hormones

The placenta (syncytiotrophoblast) is classified as an endocrine organ. It produces both protein and steroid hormones
1. human Chorionic Gonadotropin (hCG)
2. estrogen
3. Progestrone
4. human Chorionic Somatomammotropin (hCS)

human Chorionic Gonadotropin (hCG)

Synthesis of this hormone begins before implantation and the presence of hCG in mother’s urine form the basis of pregnancy test. Its main function is to maintain the activity of the maternal corpus luteum
Production of hCG peaks at 8 weeks and then gradually declines

Estrogen
The amount of estrogen secreted increase with time during pregnancy and the maximum point breaches just before labour
The synthesis of estrogen depend on the integrity of foetal adrenals and liver as well as the placenta
Estrogen stimulate uterine growth and development of the mammary glands

Progestrone
Secretion of progestrone increase during pregnancy
The placenta can produce progestrone hormone independently from cholestrol precursors
In early pregnancy, progestrone inhibits the movement of the uterus. Its main function is to maintain the inner layer of the uterus
**human Chorionic Somatomammotropin (hCS)**
   Formly known as human placental lactogen ( hPL )
   Similar to growth hormone
   This protein hormone influencing:
   (1) the preparations of breasts for lactation and
   (2) lipid & CHO metabolism

Thank you
Next Lecture: Umblical cord and Fetal membranes