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Beginning of life with the pace of placenta

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Abstract

The placenta is the organ that provides fetal respiration and maintains the metabolic and nutrient exchange between the maternal and fetal circulations. Development & Implantation: The human placenta is discoid, because of its shape; haemochorial, because of direct contact of the chorion with maternal blood and deciduas, because some maternal tissue is shed at parturition. Placenta and its membranes: When the embryo is partially embedded in the decidua, two distinct layers of cell are seen in the trophoblast. The placenta is attached to the uterine wall and establishes connection between the mother and the fetus through the umbilical cord. Placenta at term: The placenta at term is circular and flat disc, have approximately 15 to 20 cm (6 to 8 inches) in diameter and 2.5 cm (1 inch) thick. It presents two surfaces, fetal and maternal, and a peripheral margin.

Cord: The cord is the connecting links between the fetus and the placenta through which the fetal blood flows to and from the placenta; it usually contains one large vein and two smaller arteries. Amniotic fluid: amniotic fluid is pale, straw-colored fluid in which the fetus floats.

Keywords: Placenta, deciduas, haemochorial, trophoblast, Cytotrophoblast, Wharton's jelly, nuchal cord chorion and amnion

Introduction

I. Development & Implantation: The placenta developed by the two sources. The principle component is fetal which develops from the chorion frondosum and the maternal components consist of deciduas basalis [1].

A. Endometrium

i. Preparation of the endometrium for implantation

1. Initial preparation occurs during the proliferation phase of the menstrual cycle
2. The progesterone makes endometrium becomes thick and increases in vascularity to welcome embryo under process of fertilization
3. The endometrial glands become elongated and there is an increase in nutrient, such as glycogen, along with increase in progesterone, and human chorionic gonadotropin (hCG) [1].

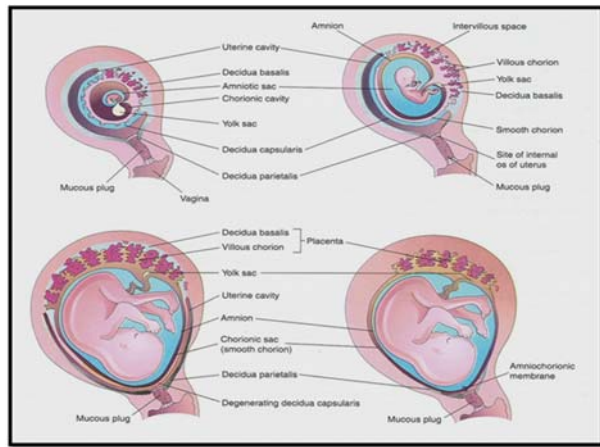
ii. The fertilized egg travels along the fallopian tube toward the uterus

iii. The egg enters the uterine cavity as a blastocyst; it is nourished by the uterine glands, which produce a fluid in the uterine cavity

iv. The trophoblast (outer cell layer of the blastocyst) attaches to the surface of the endometrium [1].

1. Approximately 5 to 6 days after fertilization, the blastocyst adheres to the uterine lining.
2. The site of attachment is usually the upper part of the posterior uterine wall, but it can also be anywhere within the uterine cavity and, occasionally, outside of the uterine cavity.
3. Blastocyst penetrates towards the maternal capillaries by eroding the uterine epithelium [2].
4. The erosion process continues until the blastocyst is completely embedded in the uterine wall
 - a) The blastocyst collapses
 - b) Fibrin and coagulum are released at the site of penetration
 - c) Engulfment of trophoblast by endometrium occurs [1].

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B. Deciduas: the portion of endometrium enveloping the developing fertilized ovum

- i. On approximately the 14 day, the endometrium begins to change at the site of implantation and is then called the deciduas which form in influence of progesterone.
- ii. Implantation causes the adjacent decidual cells to engorge with glycogen and lipids (decidual reaction)
- iii. The swollen decidual cells release their contents during the erosion process to provide nourishment to the embryo.
- iv. The proportion of the deciduas that covers the embryoblast is called the deciduas capsularis
- v. The section below the embryoblast is called the deciduas basalis
 1. This section becomes the maternal portion of the placenta
 2. It contributes to the vascular supply that nourishes the intervillous spaces.
- v. The portion that lines the remainder of the uterine cavity is called parietalis [2].

Placenta and its membranes

When the embryoblast is partially embedded in the deciduas, two distinct layers of cell are seen in the trophoblast.

The inner layer (Cytotrophoblast) is composed of mononucleated cells; it is functional layer because it provides the process of nutrient and waste exchange in early fetal development. It thins out and disappears at approximately 20 to 24 wks [2].

Outer layer (syncytiotrophoblast) consists of the multinucleated cells and is responsible for the erosive ability of the trophoblast.

The Cytotrophoblast and syncytiotrophoblast separates the maternal and fetal circulation; this barrier is referring to as the placental barrier. On approximately the 9th day, spaces (vacuoles) appear in the syncytium. These fuses together to form lacunae. The lacunae eventually develop into an interconnecting system and intervillous spaces are derived from this system [2].

On approximately the 11th day the invading syncytium encounter the congested capillaries of the deciduas. Syncytium enzymes break down the vessels walls, releasing blood into the lacunae. Eventually, the syncytium encounters the larger arteries and veins and establishes a directional flow of blood. Blood enters the lacunae, the embryo experiences rapid growth because of high concentration of nutrient and this growth results in an increases in the distance that nutrient must travels by diffusion to reach the embryo [2].

Chorionic villi develop between the 9th and 25th days. The chorion (trophoblastic cells) is the first placental membrane to form; it encloses the embryo, amnion and yolk sac and grows outward, forming fingerlike projections which take a fine villous appearance, the blood vessels develop within the villi [2].

Initially the chorion covers the whole chorionic surface as the fetus grows, forming a large surface for exchange. The villi develop multiple branches; which contact the deciduas basalis become anchoring villi. The decidual septa form between anchoring villi, which result in 15 to 20 lobes (cotyledons), villi floats free and conduct exchange of gases and nutrient occurs in this vascular system of maternal and developing fetal, this limited in the first trimester of development because the placenta has limited permeability. No further villi formed after the 12 weeks of gestation. The placental growth continues until the 20th week during this it covers the half of the uterine surface after 20 week it only increases in thickness [2].

Placental membrane: It consist of two layers – outer Chorion and inner Amnion.

Chorion: It represents the remnant of chorion leave and ends at the margin of the placenta. It is thicker than amnion, friable and shaggy on both the sides. Internally it is attached to the amnion by loose areolar tissue and remnant of primitive mesenchyme. The term chorion contain no vessel and nerve [3].

Amnion: It is the inner layer of the fetal membranes. Its internal surface is smooth and shiny and is in contact with liquor amnii. The outer surface consists of a layer of connective tissue and is apposed to the similar tissue on the inner aspect of the chorion from which it can be peeled off. The amnion can also be peeled off from the fetal surface of the placenta except at the insertion of the umbilical cord [3].

Placenta at terms

The placenta at term is circular and flat disc, have approximately 15 to 20 cm (6 to 8 inches) in diameter and 2.5 cm (1 inch) thick. It thins off towards the edges and weights approximately one sixth of the baby weight and about 30% of the uterine wall. It presents two surfaces, fetal and maternal, and a peripheral margin [2].

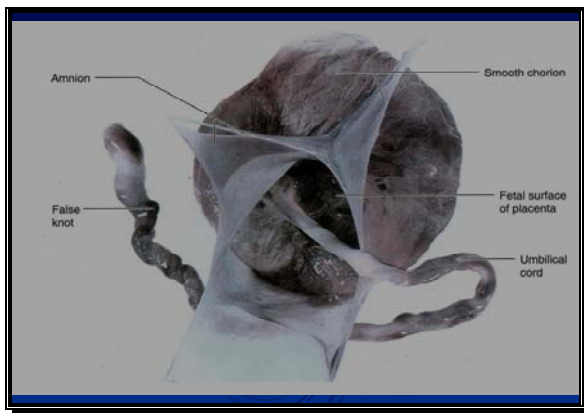
Fetal surface: Develops from the chorionic villi covered by smooth and glistening amnion with the umbilical cord attached at or near its center. Contains branches of umbilical vein and arteries and visible beneath the amnion and radiated from insertion of the cord. At term, about four fifths of the placenta is of fetal origin [3].

Maternal Surface: The maternal surface is rough and spongy it has red and blue color. A thin grayish, some what is the remnant of the deciduas basalis (compact and spongy layer) and has multiple Lobules (15 – 20 cotyledons) which are limited by fissures. Each fissure is occupied by the decidual septum. Numerous small grayish spots are visible. These are due to deposition of calcium in the degenerated areas and are of no clinical significance. The maternal portion of the placenta amounts to less than one fifth of the total placenta [3].

Placental circulation

- a) **Maternal placental circulation:** The oxygenated blood enters the intervillous spaces from the deciduas basalis. The maternal blood pressure directs towards the chorionic villi and the deoxygenated blood leaves the intervillous spaces through openings in the cytotrophoblast and enters the endometrial veins with uterine contraction intervillous spaces, forcing the blood into the uterine veins ^[4].
- b) **Fetal placental circulation:** The deoxygenated blood leaves the fetus through the two umbilical arteries and these two umbilical arteries divided into multiple branches as they enter the chorionic villi. The oxygenated blood returns via venules and veins in the chorionic villi. The veins in the chorionic villi join to form the umbilical vein ^[4].

Cord



Description: The cord is the connecting links between the fetus and the placenta through which the fetal blood flows to and from the placenta; it usually contains one large vein and two smaller arteries. It extends from the fetal umbilical to the fetal surface of the placenta ^[4].

Development

1. Formed from union of the amnion, yolk and connecting stalk or body stalk which is a band of mesoblastic tissues stretching between the embryonic disc and the chorion.
2. **First trimester**
 - a) The body stalk, which attaches the embryo to the yolk sac, contains blood vessels that extend into the chorionic villi
 - b) The blood sac fuses with the embryonic portion of the placenta to provide a circulatory pathway from the chorionic villi to the embryo
 - c) The body stalk elongates and becomes the umbilical cord
 - i. The vessels of the cord contain one large vein and two smaller arteries
 - The umbilical vein contains placental oxygenated blood that returns to the fetus.
 - The arteries carry deoxygenated blood to the placenta.⁵

Structure

- i. **Covering epithelium:** It is lined by single layer of amniotic epithelium but shows stratification like that of fetal epidermis at term.

- ii. **Wharton's jelly:** It consists of elongated cells in a gelatinous fluid formed by mucoid degeneration of the extra embryonic mesodermal cells. It is rich in mucopolysaccharides and has got protective function to the umbilical vessels.
- iii. **Blood vessel:** Initially, there are 4 vessels – 2 arteries and 2 veins. The arteries are derived from the internal iliac arteries of the fetus and carry the venous blood from the fetus to placenta. Of the two vein one disappear by the 4th month, leaving behind one vein, which carries oxygenated blood from the placenta to fetus. The umbilical arteries do not possess an eternal elastic lamina but have got well developed muscular coat ^[4].

Characteristic: At term, the average cord is about 50 cm (22in) long with an usual variation of 30 -100 cm. its diameter average 1.5 cm with variation of 1- 2.5 cm.

3. The cord can appear twisted or spiraled
 - a. Is most likely caused by fetal movement
 - b. A true knot in the cord rarely occurs; when there is a true knot in the cord, the cord is usually longer than normal, allowing the fetus to pass through a loop in the cord.⁴
 - c. So-called false knot are more common
 - i. False knot are caused by the folding of cord vessels
 - ii. False knot are not usually a problem for the developing fetus
4. When the umbilical cord is around the neck of the fetus, it is called nuchal cord.
5. Attachment: the early period, the cord is attached to the ventral surface of the embryo close to the caudal extremity but as the coelom closes and the yolk sac atrophies, the points of the attachment is moved permanently to the center of the abdomen at fourth month of conception ^[4].

Amniotic fluid

Description: amniotic fluid is pale, straw-colored fluid in which the fetus floats.

Development

1. Early pregnancy: Shortly after fertilization, a cleft forms in the morula and the two membranes form around the developing embryo. The outer membrane is the chorion and the inner membrane is the amnion. As the cleft enlarges, it becomes fused with the surrounding amnion, creating the amniotic sac. The sac then fills with colorless fluid. The volume of fluid increases to an average of 50 ml at 12 weeks gestation. The fluid is produced by the amniotic membrane covering the placenta ^[5].

Second trimester to delivery: Fetus modifies the amniotic fluid through the process of swallowing and urinating. The volume can be modifies through the movement of fluid through the fetal respiratory tract ^[5].

2. Volume

There is a wide range of amniotic fluid volume during pregnancy.

The normal approximation of volume:

- At 12 wks, there is approximately 50 ml
- At 20 wks, there is approximately 400 ml
- At 36 to 38 wks, there is approximately 1 lt
- Volume decreases after 38 wks of gestation

3. Composition

- a) Consist of normally approximately 98% water. Is alkaline in reaction
- b) Early pregnancy: similar composition in maternal plasma. It contain lower protein concentration than maternal plasma ^[5].

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