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MATRIC NUMBER : 18/MHS01/073

COLLEGE : MEDICINE AND HEALTH
SCIENCES

DEPARTMENT : MEDICINE AND SURGERY

LEVEL: 200LEVEL

COURSE: GENERAL EMBRYOLOGY

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DATE: 5-05-2020

GENERAL EMBRYOLOGY ASSIGNMENT:

DISCUSS THE SECOND WEEK OF HUMAN DEVELOPMENT

The second week of development is concerned with the process of implantation and the differentiation of the blastocyst into early embryonic and placenta forming structures . The second week of development is referred to as the week of twos because the trophoblast differentiates into cytotrophoblast and syncytiotrophoblast and the embryoblast , extra-embryonic mesoderm also divides into two distinct layers known as somatic and splanchnic . Additionally there are two cavities that develop within the embryonic unit at this time as well. As implantation of the blastocyst occurs, morphological changes in the embryo last produce a bilaminar embryonic disc composed of epiblast and hypoblast. The embryonic disc gives rise to the germ layers that form all the tissues and organs of the embryo. Extra embryonic structures forming the second week are the amniotic cavity , amnion ,umbilical vesicles connecting stalk , and chorionic sac.

During the second week of development, with the embryo implanted in the uterus, cells within the blastocyst start to organize into layers. Some grow to form the extra-embryonic membranes needed to support and protect the growing embryo: the amnion, the yolk sac, the allantois, and the chorion.

The following events take place during the 2nd week of development :

- Completion of the implantation of the blastocyst
- Formation of bilaminar embryonic disc (epiblast and hypoblast)
- Formation of extra embryonic structures (amniotic cavity , amnion ,umbilical vesicles (yolk sac),connecting stalk and chorionic sac)

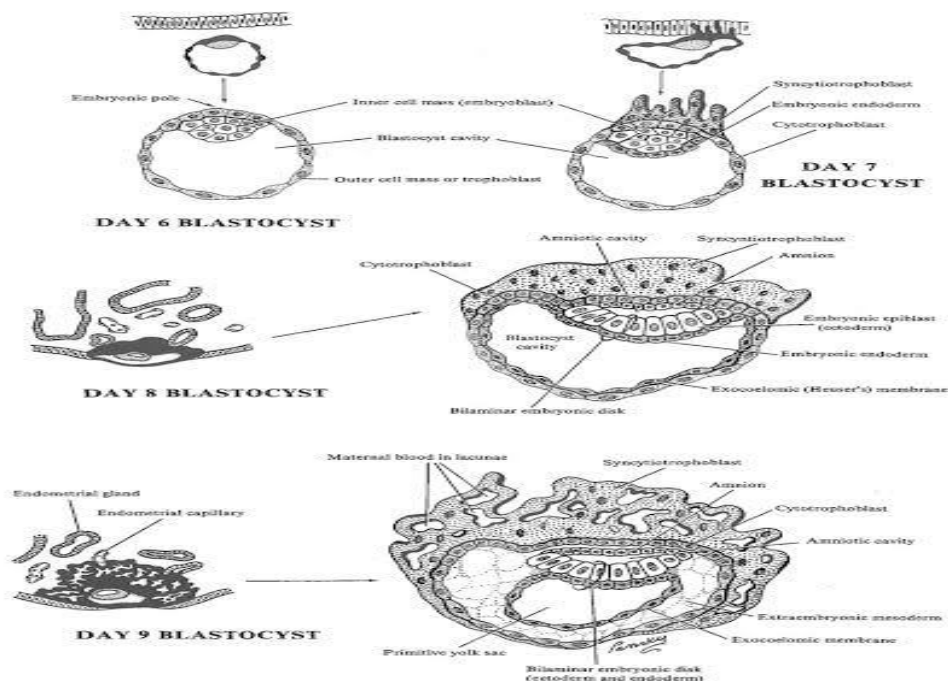
Day 8

At day 8 of embryonic development , the blastocyst is partially embedded in the endometrial stroma. In the area of the embryoblast, the trophoblast differentiates into an inner layer of mononucleated cells called cytotrophoblast and an outer multi nucleated zone without distinct cell boundaries called Syncytiotrophoblast. The syncytiotrophoblast will continue its invasion of the endometrium thereby eroding endometrial blood vessels and endometrial glands.

More cells in the cytotrophoblast divide due to their mitotic figures and migrate into the syncytiotrophoblast where they fuse and lose their individual cell membranes . The embryoblast will differentiate into two distinct layers :

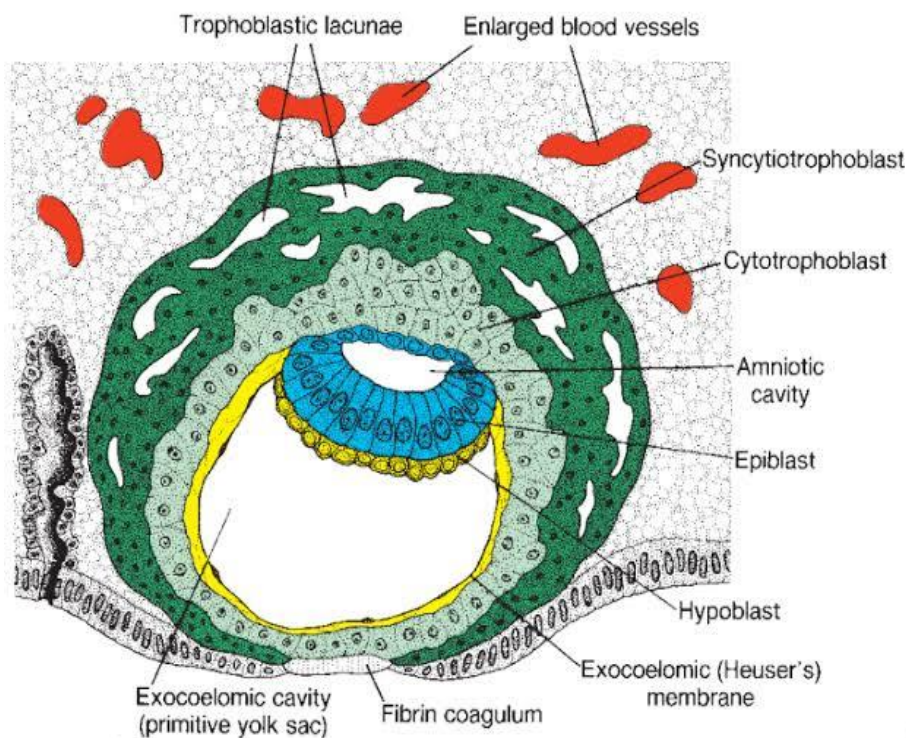
- The hypoblast layer made up of small cuboidal cells and it is adjacent to the blastocystic cavity.
- The epiblast later made up of high columnar cells and it is adjacent to the amniotic cavity .

The hypoblast and epiblast layer together form a flat ovoid shaped disc called the **bilaminar embryonic disc** . At the same time ,a small cavity appears within the epiblast which enlarges to form the amniotic cavity . Epiblast cells adjacent to the cytotrophoblast are called **amnioblasts**. Amnioblasts together with the rest of epiblast line the Amniotic cavity. The endometrium adjacent to the implantation site is edematous and highly vascular.



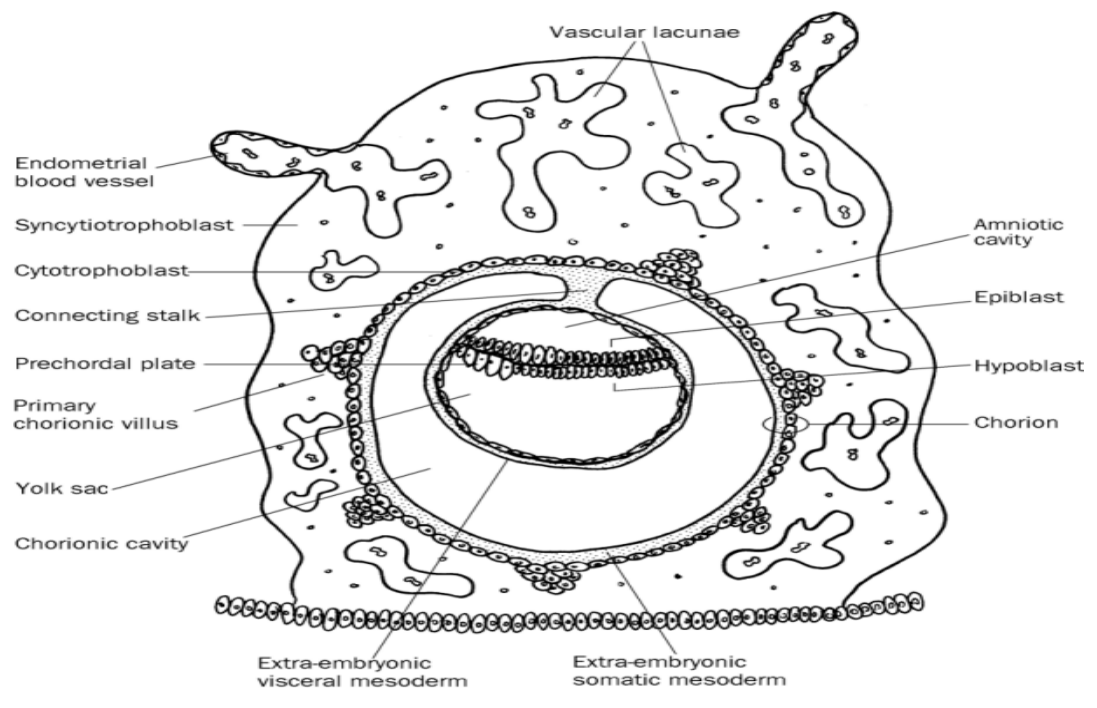
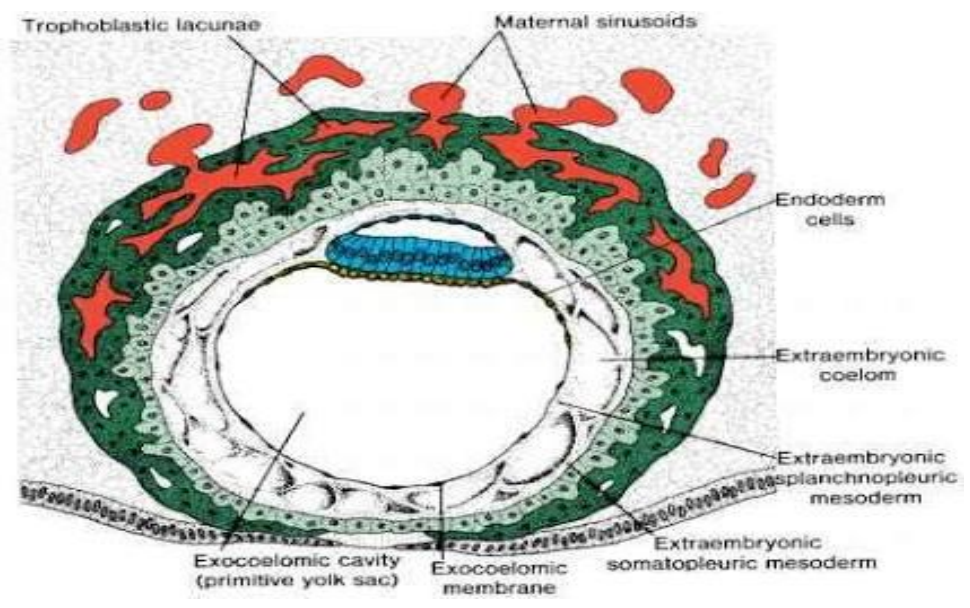
DAY 9

The blastocyst is more deeply embedded in the endometrial stroma and the penetration defect in the surface epithelium is closed by a coagulum called **fibrin**. The trophoblast shows considerable progress in development particularly in the embryonic pole where vacuoles appear in the syncytium. These vacuoles found in the region of the trophoblast fuse to form larger lacunae. This phase of Trophoblast development is known as the **lacunar stage**. The cells of the hypoblast adjacent to the cytotrophoblast form a thin membrane called exocoelomic(Heuser's membrane) that lines the inner surface of the cytotrophoblast. The exocoelomic (Heuser's membrane) together with the hypoblast forms the lining of the **exocoelomic cavity or primary yolk sac or primary umbilical vesicles**.



DAY 11-12

The blastocyst is completely embedded in the endometrial stroma and the surface epithelium almost entirely covers the original defect in the uterine wall. The blastocyst produces a slight protrusion into the lumen of the uterus. Cells of the syncytiotrophoblast penetrate deeper into the stroma (tissue) and erode the endothelial lining of the endometrial capillaries. These ruptured endothelial capillaries are called **sinusoids**. The lacunae communicate with the sinusoids and maternal blood enters the lacunar system. The communication of the eroded endometrial capillaries with the lacunae establishes **primordial uteroplacental circulation**. When maternal blood flows into the lacunae, oxygen and nutritive substances are available to the embryo. Cells appear between the inner surface of the cytotrophoblast and the outer surface of the exocoelomic cavity. These cells which are derived from yolk sac cells form a fine, loose connective tissue called the **extra embryonic mesoderm**. Large cavities develop within the extra embryonic mesoderm forming new space called **extra embryonic cavity or chorionic cavity or extra embryonic coelom** that surrounds the primitive yolk sac and amniotic cavity except where the germ disc is connected to the trophoblast by the connecting stalk (which develops into the umbilical cord). The extra embryonic mesoderm lining the cytotrophoblast and amnion is called the **extra embryonic somatic mesoderm (also forms the connecting stalk)**. The lining covering the yolk sac is known as the **extra embryonic splanchnic mesoderm**. Growth of the bilaminar disc is relatively slow compared with that of the trophoblast; consequently the disc remains very small (0.1-0.2mm). The endometrial connective tissue cells undergo a reaction as the conceptus implants and is known as **Decidual reaction** that provides nutrition for the early embryo and immunologically privileged site for conceptus. During this transformation, the cells of the endometrium swell because of its accumulation of glycogen and lipid in their cytoplasm and this forms the **decidual cells**.



Clinical correlate:

➤ Abnormal implantation :

The syncytiotrophoblast produces a hormone called the human chorionic gonadotropin (HCG) which enters the maternal blood via lacunae and keeps the corpus luteum secreting estrogens and progesterone. Human chorionic gonadotropin maintains hormonal activity of the corpus luteum in the ovary during pregnancy and can be detected on day 10 of pregnancy and is the basis of pregnancy tests. Enough human chorionic gonadotropin is produced by the syncytiotrophoblast at the end of second week to give a positive pregnancy test, even though the woman is unaware that she is pregnant. Because 50% of the implanting embryo's genome is derived from the father, it is a foreign body that potentially should be rejected from the maternal system. Recent evidence suggests a combination of factors protects the conceptus, including production of immunosuppressive cytokines and proteins and the expression of an unusual histocompatibility complex class 1B molecule (HLA-G) that blocks the recognition of the conceptus as a foreign tissue.



- **Extra uterine implantation** : Blastocysts may implant outside the uterus and these implantations result in ectopic pregnancies. However, 95%-98% of ectopic pregnancies occur in the uterine tube mainly in the ampulla and isthmus.
- **Choriocarcinoma** . : A malignant tumor arising from trophoblastic cells that may occur following a normal pregnancy, abortion, or a hydatidiform mole. Trophoblast develops and forms placental membranes, although little or no embryonic tissue is present. Such a condition is known as

hydatidiform moles. Genetic analysis of hydatidiform moles indicates that although male and female pronuclei may be genetically equivalent, they may be different functionally. This evidence is derived from the fact that most white cells of moles are diploid, their entire genome is paternal. Thus, most moles may arise from the fertilization of an oocyte lacking a nucleus followed by duplication of the chromosomes to restore the haploid number. These results may suggest that paternal genes regulate most of the development of the trophoblast, since in moles the tissue differentiates even in the absence of a female pronucleus.

Choriocarcinoma is a fast-growing cancer that occurs in a woman's uterus (womb). The abnormal cells start in the tissue that would normally become the placenta. This is the organ that develops during pregnancy to feed the fetus. Choriocarcinoma is a type of gestational trophoblastic disease.