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Course: Embryology

Discuss the Second Week of Development

The second week of human development is characterized and would be discussed under three main headings which includes:

- I. Completion of implantation of the blastocyst
- II. Formation of a bilaminar embryonic disc consisting of hypoblast and epiblast.
- III. Formation of extra embryonic structures such as amniotic cavity, chorionic sac, amnion, umbilical vesicle (yolk sac) and connecting stalk.

Day 8

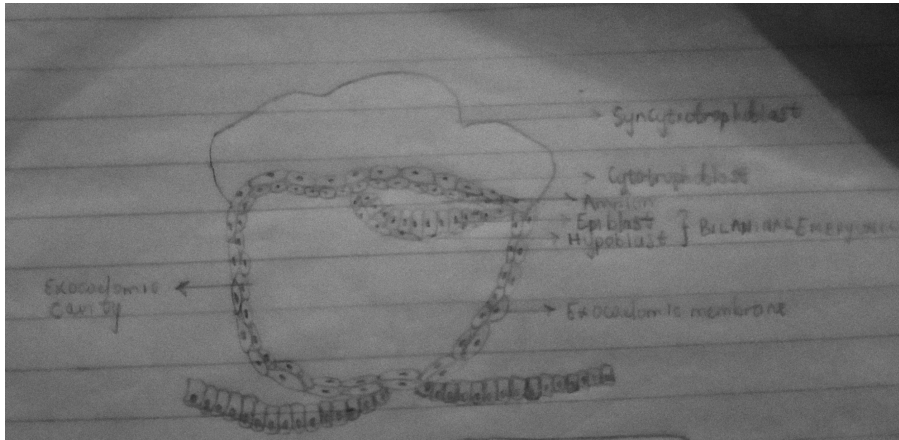
At the beginning of the second week the blastocyst is partially embedded in the endometrium and cells from the cytotrophoblast continue to migrate towards the syncytiotrophoblast where they fuse and lose their membranes. As a result the syncytiotrophoblast continues to erode the endometrium there by eroding endometrial blood vessels and glands.

The cells of the inner mass differentiate into two different types of cells which includes the

- I. Hypoblast: consists of small cuboidal cells that are near the blastocyst cavity.
- II. Epiblast: consist of high columnar cells that are near the amniotic cavity.

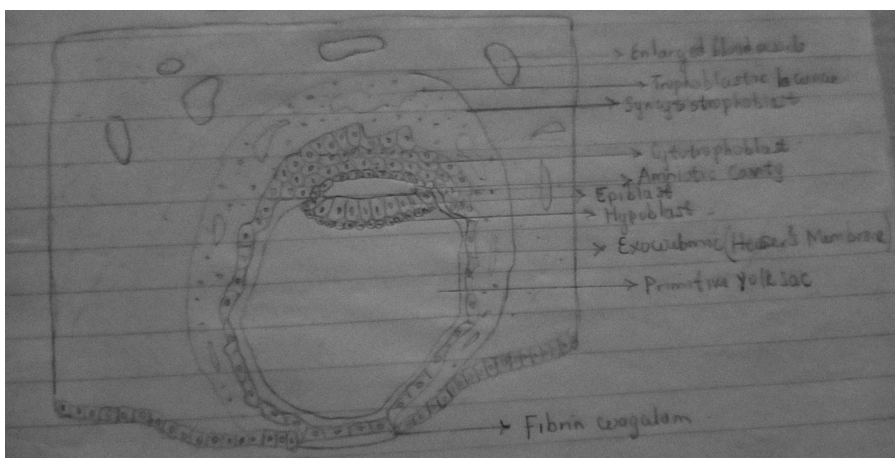
The epiblast and hypoblast layers collectively form an ovoid structure known as the bilaminar embryonic disc.

An amniotic cavity also forms within the epiblast cells and separate epiblast cells from amnioblast cells which lie adjacent to the cytotrophoblast. The endometrium adjacent to the implantation site is also edematous and highly vascularized.



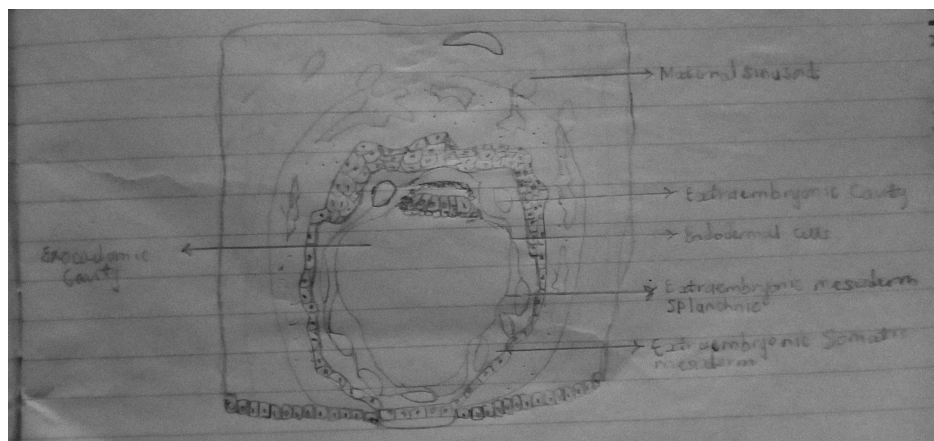
Day 9

On the second day of the second week the blastocyst becomes more deeply embedded in the endometrium and the syncytiotrophoblast continues to erode the endometrium as the cells of the cytotrophoblast continue to proliferate towards the region of syncytiotrophoblast losing their membrane and fusing. The surface defect on the endometrium is also close by a fibrin coagulum. Vacuoles appear in the region of the syncytiotrophoblast and the fuse to form larger lacunae. This stage of trophoblastic development is known as lacunae stage. The cells of hypoblast adjacent the cytotrophoblast now begin to form a thin membrane called the exocoelomic membrane or (Heuser's membrane). This membrane along with the cytotrophoblast forms the lining of the exocoelomic cavity or primary umbilical vesicle or primitive yolk sac.



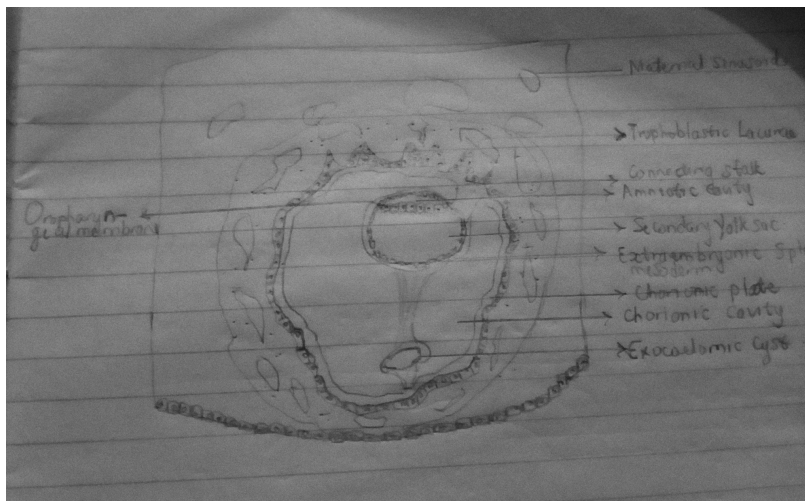
Day 11-12

Here, the blastocyst is completely embedded in endometrium and surface epithelium almost entirely covers the surface defect in uterine wall. The blastocyst now produces a slight protrusion in the lumen of the uterus. The cells of the syncytiotrophoblast continue to erode the stroma of the endometrium rupturing the endothelial lining of endometrial capillaries in the process. These ruptured capillaries are known as sinusoids. The lacunae then start to communicate with the sinusoids and maternal blood begin to enter sinusoids and this establishes the primordial uteroplacenta circulation. Nutrients from maternal blood diffuse into the blastocyst while CO₂ and other waste diffuse out through the lacunae. A new population of cells begin to appear between the inner surface of cytotrophoblast and outer surface of exocoelomic membrane, these cells derived from the yolk sac form a layer of loose connective tissue called the extra embryonic mesoderm. Large spaces begin to form within the extra embryonic mesoderm and when these spaces become confluent, they fuse and give rise to a space called extra embryonic cavity or chorionic cavity or extra embryonic coelom. The space surrounds primitive yolk sac and amniotic cavity everywhere except where germ disc attaches to trophoblast by connecting stalk which later forms the umbilical cord. Extra embryonic mesoderm lining the cytotrophoblast and amniotic cavity is known as extra embryonic somatic mesoderm and it also forms connecting while the extra embryonic mesoderm lining the yolk sac is known as extra embryonic splanchnic mesoderm. As the conceptus is implanting the endometrial connective undergo a transformation known as decidual reaction as the connective tissue cells of endometrium swell as a result of the accumulation of lipid and glycogen in their cytoplasm and are known as decidual cells. The primary aim of decidual cells is to provide nutrition for early embryo and provide an immunologically improved site for the conceptus.



Day 13

On this day, the surface defect on endometrium has been completely covered by surface epithelium and occasional bleeding occurs at implantation site. Cells of cytotrophoblast proliferate locally into syncytiotrophoblast forming cellular columns surrounded by syncytium. Cellular columns with syncytial coverings are known as primary villi. The primary yolk sac also becomes reduced in size and forms the secondary yolk sac or secondary umbilical vesicle or definitive yolk sac and in humans it contains no yolk but it is important in the transfer of nutrients from mother to offspring. The secondary yolk sac is much smaller than primary yolk sac due to the fact that part of the primary yolk sac was pinched off to form exocoelomic cysts which are found within the extra embryonic cavity. While meanwhile the extra embryonic cavity expands to form the chorionic cavity. The extra embryonic mesoderm lining the cytotrophoblast now becomes known as chorionic plate. The only place where extra embryonic mesoderm transverses the chorionic cavity is the connecting stalk which with the development of blood vessels forms the umbilical cord.



It's important to note that the syncytiotrophoblast produces a hormone called the human chorionic gonadotropin (hCG) which enters maternal blood via the lacunae and keeps corpus luteum secreting progesterone and estrogen. Thus hCG maintains the hormonal activity of the corpus luteum in the ovary. The hCG can also be detected as early as the 10th day of development and it forms the basis of most pregnancy tests and it still gives a result at the end of the second week even when the woman is unaware she's pregnant.

Also, blastocysts may implant outside the uterus resulting in extra uterine pregnancies or ectopic pregnancies. 95% to 98% of these pregnancies occur in the uterine tubes mainly the ampulla and isthmus.