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Medicine and Health Science

Medicine and Surgery

200 Level

18/MHS01/085

Development

Question: Discuss the second week of development

Embryogenesis is the process by which the embryo forms and develops. In mammals, the term refers chiefly to early stages of prenatal development, whereas the terms fetus and fetal development describe later stages. It is characterized by the processes of cell division and cellular differentiation of the embryo that occurs during the early stages of development.

Week 2 is about the implantation process and blastocyst differentiation. Note that all cells produced from the initial fertilization event are defined as the "conceptus" and will include cells with both embryonic and extraembryonic futures. In the conceptus, this is a period of blastocyst "hatching" rapid blastocyst differentiation into extraembryonic and embryonic tissues and proliferation. In placental animals, this is the first physical interaction between the conceptus and the maternal uterine wall with adplantation and the commencement of implantation.

The implanting conceptus releases a hormone (human Chorionic Gonadotropin or hCG) that initiates maternal hormonal changes, stopping the menstrual cycle. Detection of hCG in maternal urine or blood is also the basis of many modern pregnancy tests. (hCG) Placental hormone initially secreted by cells (syncitiotrophoblasts) from the implanting conceptus during week two, supporting the ovarian corpus luteum, which in turn supports the endometrial lining and therefore maintains pregnancy. Hormone can be detected in maternal blood and urine and is the basis of many pregnancy tests. Hormone also stimulates the onset of fetal gonadal steroidogenesis; high levels are teratogenic to fetal gonadal tissues. Other potential cellular sources can include: hyper glycosylated hCG produced by cytotrophoblast cells, free beta-subunit made by multiple primary nontrophoblastic malignancies, and pituitary hCG made by the gonadotropin cells of the anterior pituitary.

The second week of development takes from the 8^{th} day to 13^{th} day. During this period of the development many events a lot of events takes place; Implantation; Differentiation of the trophoblast; Establishment of utroplacental circulation; Differentiation of the embryoblast; Appearance of 2 cavities.

- Implantation: is the process of embedding of fertilized ovum in the endometrium of the uterus (the posterior and anterior walls of the uterus near the fundus). Implantation at the eighth day of development, the blastocyst is partially embedded in the endometrial stroma. By the day 9 The blastocyst is more deeply embedded in the endometrium, and the penetration defect in the surface epithelium is closed by a fibrin coagulum. By the 11th to 12th day of development, 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 now produces a slight protrusion into the

lumen of the uterus. By the 13th day of development, the surface defect in the endometrium has usually healed.

- The decidua reaction: After implantation the cells of the endometrium become polyhedral and loaded with glycogen and lipids; intercellular spaces are filled with extravasate, and the tissue is edematous. These changes, known as the decidua reaction. Decidua is the endometrium of the uterus after implantation, it is divided into 3 parts; decidua basalis: is the part of the endometrium between the blastocyst and muscle wall of the uterus, Decidua capsularis: is the part of the endometrium between the blastocyst and the cavity of the uterus, Decidua paritalis: is the rest of the endometrium which linning the wall of the uterus.
- Differentiation of the trophoblast: At the eighth day of development: the trophoblast has differentiated into two layers;(1) an inner layer of mononucleotide cells, the cytotrophoblast. (2) an outer multinucleated zone without distinct cell boundaries, the syncytiotrophoblast. By the day 9, the trophoblast shows considerable progress in development, particularly at the embryonic pole, where vacuoles appear in the syncytium. When these vacuoles fuse, they form large lacunae, and this phase of trophoblast development is thus known as the lacunar stage.
- Establishment of utroplacental circulation: By the 11th to 12th day of development, the trophoblast is characterized by lacunar spaces in the syncytium that form an intercommunicating network. This network is particularly evident at the embryonic pole; at the abembryonic pole, the trophoblast still consists mainly of cytotrophoblastic cells. Concurrently, cells of the syncytiotrophoblast penetrate deeper into the stroma and erode the endothelial lining of the maternal capillaries. These capillaries, which are congested and dilatedare known as sinusoids. The syncytial lacunae become continuous with the sinusoids, and maternal blood enters the lacunar system. As the trophoblast continues to erode more and more sinusoids, maternal blood begins to flow through the trophoblastic system, establishing the uteroplacental circulation.
- Formation of primary villi: By the 13th day of development, the trophoblast is characterized by villous structures. Cells of the cytotrophoblast proliferate locally and penetrate into the syncytiotrophoblast, forming cellular columns surrounded by syncytium. Cellular columns with the syncytial covering are known as primary villi

- Differentiation of embryoblast: At the eighth day of development, cells of the inner cell mass or embryoblast also differentiate into two layers; (1) the hypoblast layer a layer of small cuboidal cells adjacent to the blastocyst cavity (2) the epiblast layer a layer of high columnar cells adjacent to the amniotic cavity. Together, the layers form a flat disc.
- Formation of 2 cavities: By the day 8 a small cavity appears within the epiblast. This cavity enlarges to become the amniotic cavity. Epiblast cells adjacent to the cytotrophoblast are called amnioblasts; together with the rest of the epiblast, they line the amniotic cavity. By the day 9 At the abembryonic pole, meanwhile, flattened cells probably originating from the hypoblast form a thin membrane, the exocoelomic (Heuser's) membrane that lines the inner surface of the cytotrophoblast. This membrane, together with the hypoblast, forms the lining of the exocoelomic cavity, or primitive yolk sac.
- Formation of extraembryonic (coelom (chorionic cavity): By the 11th to 12th day of development, a new population of cells appears between the inner surface of the cytotrophoblast and the outer surface of the exocoelomic cavity. These cells, derived from yolk sac cells, form a fine, loose connective tissue, the extraembryonic mesoderm, which eventually fills all of the space between the trophoblast externally and the amnion and exocoelomic membrane internally. Soon, large cavities develop in the extraembryonic mesoderm, and when these become confluent, they form a new space known as the extraembryonic coelom, or chorionic cavity. This space surrounds the primitive yolk sac and amniotic cavity, except where the germ disc is connected to the trophoblast by the connecting stalk.
- The extraembryonic mesoderm lining the cytotrophoblast and amnion is called the extraembryonic somatopleuric mesoderm; the lining covering the yolk sac is known as the extraembryonic splanchnopleuric mesoderm. Meanwhile, the extraembryonic coelom expands and forms a large cavity, the chorionic cavity. The extraembryonic mesoderm lining the inside of the cytotrophoblast is then known as the chorionic plate. The only place where extraembryonic mesoderm traverses the chorionic cavity is in the connecting stalk. With development of blood vessels, the stalk becomes the umbilical cord.
- Formation of the secondary yolk sac or definitive yolk sac: By the 13th day of development, the hypoblast produces additional cells that migrate along

the inside of the exocoelomic membrane. These cells proliferate and gradually form a new cavity within the exocoelomic cavity. This new cavity is known as the secondary yolk sac or definitive yolk sac. This yolk sac is much smaller than the original exocoelomic cavity, or primitive yolk sac. During its formation, large portions of the exocoelomic cavity are pinched off. These portions are represented by exocoelomic cysts, which are often found in the extraembryonic coelom or chorionic cavity.