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SECOND WEEK OF DEVELOPMENT

As implantation of the blastocyst occurs, morphologic changes in the embryoblast 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 during the second week are the amniotic cavity, amnion, umbilical vesicle connecting stalk and chorionic sac.

DAY 8

As the blastocyst implants, more trophoblast contacts the endometrium and differentiates into two layers:

1. An inner layer, the cytotrophoblast, that is mitotically active and
2. The synctiotrophoblast, a rapidly expanding, multinucleated mass in which no cell boundaries are discernible.

The blastocyst is partially embedded in the endometrium. The synctiotrophoblast invades the endrometrial connective tissue. Synctiotrophoblastic cells displace endometrial cells at the implantation site. The cytotrophoblast will continue to divide and migrate into the synctiotrophoblast. Cells of the inner cell mass or embryoblast also differentiate into two layers: (1) a layer of small cuboidal cells adjacent to the blastocyst cavity, known as the hypoblast layer, and (2) a layer of high columnar cells adjacent to the amniotic cavity, the epiblast layer. Together, the layers form a flat disc. At the same time, 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. The endometrial stroma adjacent to the implantation site is edematous and highly vascular. The large, tortuous glands secrete abundant glycogen and mucus. The epiblast and hypoblast give rise to the bilaminar germ disc.

DAY 9

The blastocyst is deeply embedded in the endometrium. The surface epithelium is closed by a fibrin coagulant. 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. 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.

DAY 11-12

The blastocyst is completely embedded in the endometrium. The blastocyst now produces a slight protrusion into the lumen of the uterus. 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 embryonic pole, the trophoblast still consists mainly of cytotrophoblastic cells. Cells of the syncytiotrophoblast penetrate deeper into the stroma and erode the endothelial lining of the maternal capillaries. These capillaries, which are congested and dilated, are known as sinusoids. The lacunae become filled with a mixture of maternal blood from the sinusoids and cellular debris from eroded uterine glands. The fluid in the lacunar spaces, embryotroph, passes to the embryonic disc by diffusion and provides nutritive material to the embryo.

The communication of the eroded endometrial capillaries with the lacunae in the synctiotrophoblast establishes the primordial uteroplacental circulation. When maternal blood flows into the lacunar networks, oxygen and nutritive substances pass to the embryo. Oxygenated blood passes into the lacunae from the spiral endometrial arteries, and poorly oxygenated blood is removed from them through the endometrial veins. In the meantime, 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 cavity, 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 somatic mesoderm; the lining covering the yolk sac is

known as the extraembryonic splanchnic mesoderm. Growth of the bilaminar disc is relatively slow compared with that of the trophoblast; consequently, the disc remains very small. Cells of the endometrium, meanwhile, become polyhedral and loaded with glycogen and lipids; intercellular spaces are filled with extravasate, and the tissue is edematous. These changes, known as the decidual reaction, at first are confined to the area immediately surrounding the implantation site but soon occur throughout the endometrium.

DAY 13

By the 13th day of development, the surface defect in the endometrium has usually healed. Occasionally, however, bleeding occurs at the implantation site as a result of increased blood flow into the lacunar spaces. Because this bleeding occurs near the 28th day of the menstrual cycle, it may be confused with normal menstrual bleeding and, therefore, may cause inaccuracy in determining the expected delivery date.

The trophoblast is characterized by villous structures. Cells of the cytotrophoblast proliferate locally and penetrate into the synctiotrophoblast, forming cellular columns surrounded by syncytium. Cellular columns with the synctial covering are known as primary villi. In the meantime, 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. Meanwhile, the extraembryonic mesoderm 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.

CLINICAL CORRELATES

The synctiotrophoblast is responsible for hormone production, including human chorionic gonadotropin(hCG). By the end of this week, quantities of this hormone are sufficient to be detected by radioimmunoassays which serve as the basis for pregnancy testing.

EXTRAUTERINE IMPLANTATION

Blastocysts implantations result in ectopic pregnancies. 95% to 98% of ectopic implantations occur in the uterine tubes, most often in the ampulla and isthmus.