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Embryology

Question: Discuss the second week 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 implantaion.

The embryo (the blastula) is out of its rigid zona pellucida and has arrived in the uterus. It can now grow and it implants itself on the side of the embryoblast into the wall of the uterus. Enzymes of the embryo digest the maternal uterus tissue. The embryo invades; it eats into the wall of the uterus. The embryo behaves aggressively. The trophoblast grows fast, so fast that it causes a proliferative tissue with many nuclei and without cell membranes (called syncytiotrophoblast (syn = together, cyto = cell). A layer of 'normal' (cyto)trophoblast cells (= nutritive tissue with cell membranes) remains present between the syncytiotrophoblast and the embryoblast.

In the syncytiotrophoblast gaps arise, called lacunae, through which maternal blood starts to flow. Only one membrane exists between maternal blood and embryonic tissue, and there is just one barrier for the exchange of substances. Embryonic tissue also surrounds capillaries and maternal glands. In this way, the embryo can be supplied with oxygen and nutrients and waste products can be disposed of. However, substances that are bad for the embryo can also get through.

The embryo eats into the maternal tissue. On the other hand, the mother gives room to the embryo in her own tissue. She allows a strange creature to grow in her own body. This is a wonderful process, because strange creatures (which is what the embryo is to the mother because of the fusion of egg and sperm) normally are fought against. A hormone of the embryo (HCG) ensures that the mother accepts the embryo.

On day 10 the embryo is completely inside the maternal tissue and a ball or wad is formed to close the wall of the uterus. Now this wall is completely closed. Around the embryo is the trophoblast, later called chorion (= skin), uterine tissue and the uterine wall.

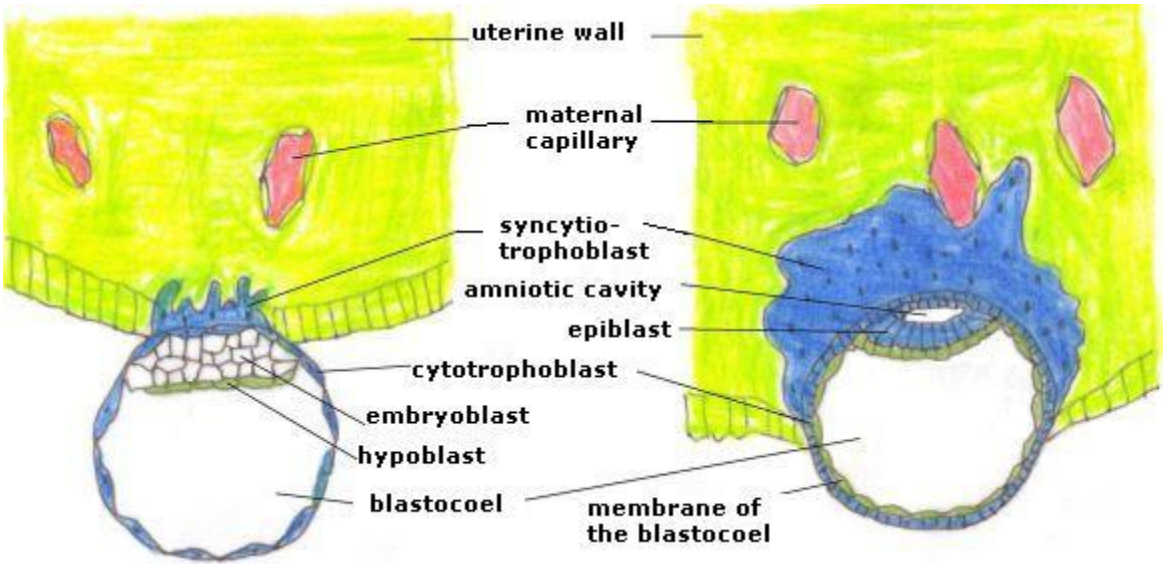

Figure 1. Implantation of the embryo in the uterine wall

Left diagram: on day 7-8. The embryo lies against the uterine wall on the side of the embryoblast. The syncytiotrophoblast expands into the maternal tissue (yellow-green). The hypoblast is ligated from cells of the embryoblast (white).

Right diagram: on day 8-9. The embryo eats further into the uterine wall, the hypoblast (flat cells) has extended all the way down and forms, together with the cytotrophoblast, the membrane of the blastocoele. In the embryoblast the amnion arises. The epiblast (high cells) is located above the hypoblast and the amnion is formed from epiblast and cytotrofoblast cells. The syncytiotrophoblast lies against a maternal blood vessel (capillary).

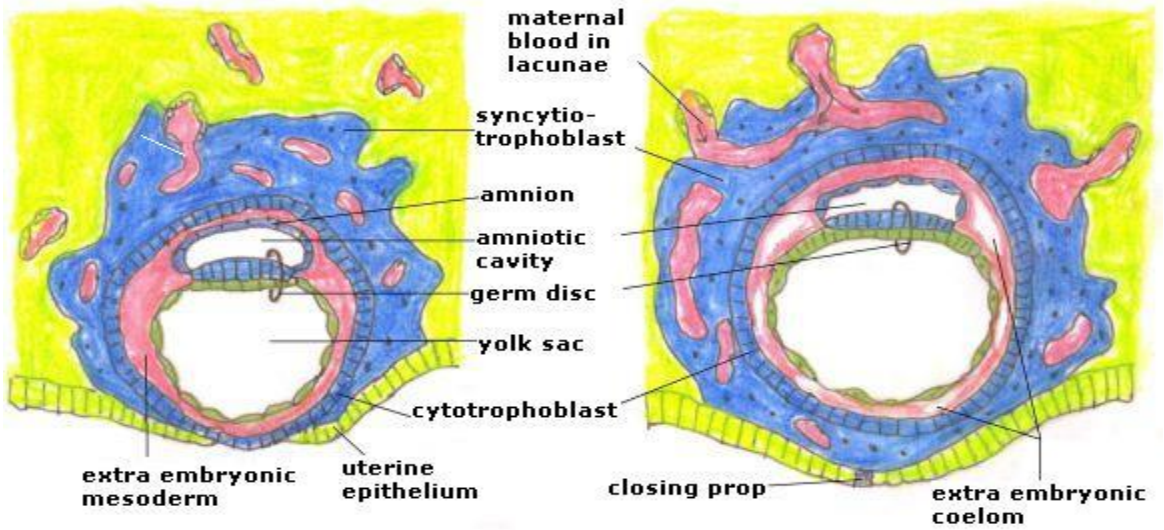

Figure 2. Implantation, continued

Left diagram on day 9: The embryo eats further into the uterine wall. The syncytiotrophoblast proliferates in the maternal tissue and lies around capillaries and makes holes (lacunae) where maternal blood can flow. Maternal blood and tissues remain separated from embryonic tissue. The amniotic cavity develops, by which the two-cells-thick embryonic disc arises. The tissue of the hypoblast covers the blastocoel membrane, now called yolk sac. Between the trophoblast and the membrane of the yolk sac a thick tissue develops: the extra-embryonic mesoderm.

Right diagram on day 12: The embryo is completely enclosed by the tissue of the uterine wall. The syncytiotrophoblast is still rapidly expanding. The extra-embryonic mesoderm is thicker and holes in the extra embryonic coelom are developing.

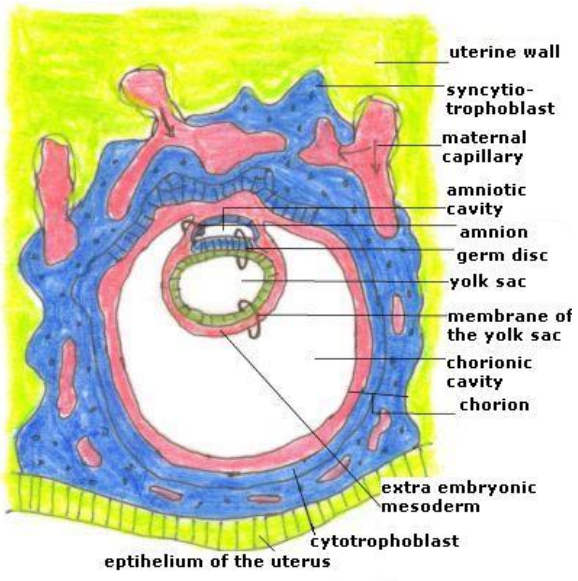

Figure 3. The embryo on day 13 (simplified)

The holes in the extra-embryonic mesoderm have joined together to form the chorionic cavity, its membrane is the chorion. The syncytiotrophoblast is growing all around the embryo, it is thicker on the inside of the uterine tissue than near the epithelium. The embryonic disc is on the backside attached to the chorion. All around the chorion cavity lies the syncytiotrophoblast with the lacunae containing maternal blood. (The primary yolk sac which is now separated from the now called secondary yolk sac has been omitted.)

Development of the embryonic disc

Flat, square cells are ligated from the embryoblast on the side of the blastocoele (Fig. 1 to 4). These cells are called the hypoblast (hypo = under). The hypoblast expands on the inside of the trophoblast, too, and covers it. The blastocoele is now called yolk sac. In the embryoblast a small cavity develops, called the amniotic cavity, its roof is called the amnion (= sheep skin). The cells adjacent to the hypoblast become cylinder - or elongated cube-shaped; these cells form the epiblast (epi = upper).

Through the formation of the yolk sac and the amniotic cavity a round, flat embryonic - or germ disc is formed, existing of two layers (epi- and hypoblast). At the end of the week the prochordale plate (a spot of different shaped cells) develops in the embryonic disc.

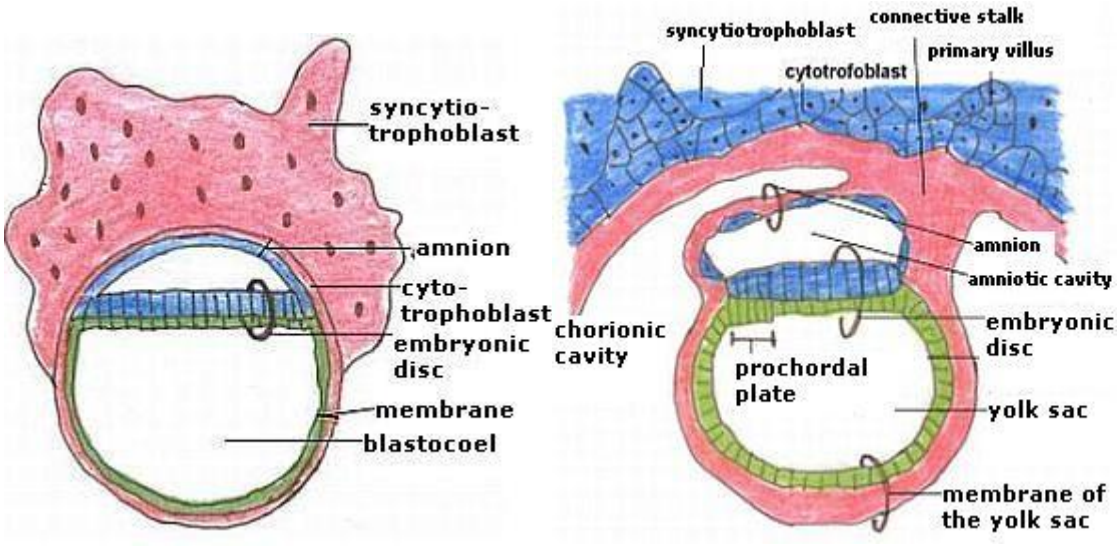

Figure 4. The embryonic disc on day 9 (left) and day 14 (right)

Left diagram: The embryonic disc consists of two cell layers and is round and flat.

Right diagram: at the tail-side the embryo is attached to the chorion and the cyto- and syncytiotrophoblast by the connective stalk. It hangs free in the fluid-filled chorion cavity. The prochordale plate is formed in the embryonic disc at the side where the head will develop. Epiblast cells (up) are high, hypoblast cells (under) are flat.