

NAME: OJO, IYESANI PRISCILLA

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DEPARTMENT: MEDICINE AND SURGERY

Question: Discuss the second week of embryonic 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.

Human development about day 8 to 9

The embryoblast (inner cell mass) forms the epiblast and hypoblast layers. This early stage of embryo development is referred to as the bilaminar embryo.

The inner cell mass forms an inner layer of larger cells is also called the "embryoblast" is a cluster of cells located and attached on one wall of the outer trophoblast layer. In week 2 this mass will differentiate into two distinct layers the epiblast and hypoblast, also called the bilaminar embryo.

Epiblast

The epiblast layer will form the entire embryo and undergoes gastrulation in week three to form the 3 germ layers. It also forms an epithelial layer lining the amniotic cavity.

Hypoblast

The hypoblast (or primitive endoderm) is a transient epithelial layer facing towards the blastocoel, it is replaced in week three by the gastrulation migrating endoderm cells.

Syncytiotrophoblasts

- secrete proteolytic enzymes, enzymes break down extracellular matrix around cells
- Allow passage of blastocyst into endometrial wall, totally surround the blastocyst
- generate spaces that fill with maternal blood- lacunae
- Secrete Human Chorionic Gonadotropin (hCG), hormone, maintains decidua and corpus luteum. This hormone is diagnostically the basis of pregnancy tests, and is present in maternal.
- Later in development placenta will secrete hCG

Trophoblast

As the blastocyst embeds itself in the endometrium it differentiates into two layers: the cytotrophoblast (inner) and syncytiotrophoblast (outer). The syncytiotrophoblast invades into the maternal endometrium, and in this sense it is more invasive than any tumor tissue. As it comes into contact with blood vessels it creates lacunae, or spaces which fill with maternal blood. These lacunae fuse to form lacunar networks. The maternal blood that flows in and out of these networks exchanges nutrients and waste products with the fetus, forming the basis of a primitive uteroplacental circulation.

Syncytiotrophoblast

The syncytiotrophoblast is acellular and does not expand mitotically. The syncytiotrophoblast produces human chorionic gonadotrophin (hCG), a glycoprotein hormone that stimulates the production of progesterone by the corpus luteum.

Cytotrophoblast

The cytotrophoblast is cellular and expands mitotically into the syncytiotrophoblast to form primary chorionic villi. Cells from these villi can be removed for early genetic testing at some risk to the fetus (chorionic villus sampling).

Embryoblast

After implantation, the inner cell mass subdivides into a bilaminar disc consisting of the hypoblast and epiblast.

Hypoblast

Hypoblast cells migrate along the inner surface of the cytotrophoblast and will form the primary yolk sac. The primary yolk sac becomes reduced in size and is known as the secondary yolk sac. In humans the yolk sac contains no yolk but is important for the transfer of nutrients between the fetus and mother.

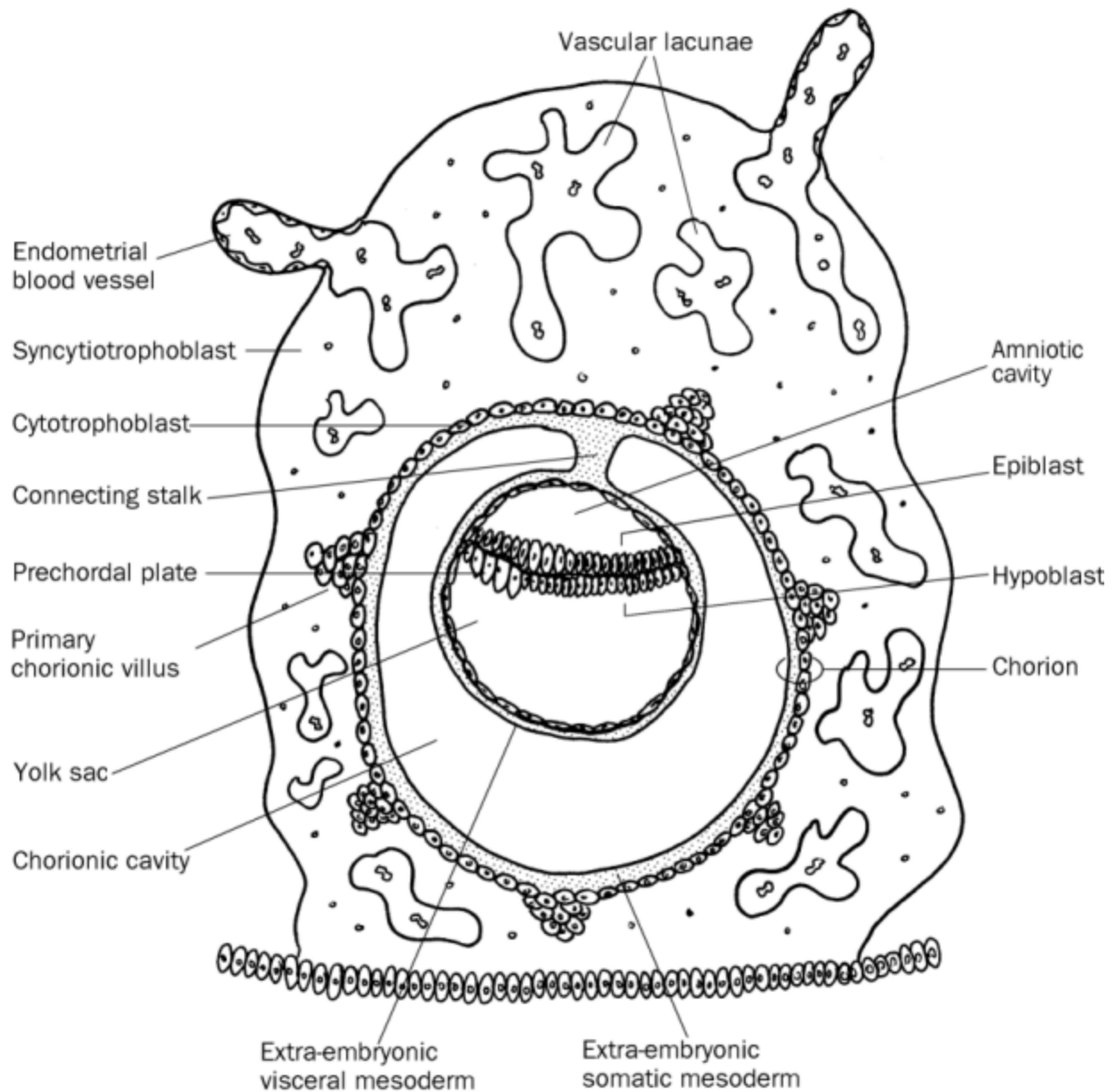
Epiblast

Epiblast cells cavitate to form the amnion, an extra-embryonic epithelial membrane covering the embryo and amniotic cavity. Cells from the epiblast will also eventually form the body of the embryo.

Extra-embryonic mesoderm

Extra-embryonic mesoderm cells migrate between the cytotrophoblast and yolk sac and amnion. Extraembryonic somatic mesoderm lines the cytotrophoblast and covers the amnion. Extraembryonic somatic mesoderm also forms the connecting stalk that is the primordium of the umbilical cord. Extraembryonic visceral mesoderm covers the yolk sac.

At the end of the second week it is possible to distinguish the dorsal (amniotic cavity) from the ventral (yolk sac) side of the embryo.



Clinical Correlations

Early pregnancy testing

hCG produced by the syncytiotrophoblast can be detected in maternal blood or urine as early as **day 10** of pregnancy and is the basis for pregnancy tests.

Hydatidiform mole

A blighted blastocyst leads to death of the embryo, which is followed by hyperplastic proliferation of the trophoblast within the uterine wall.

Choriocarcinoma

A malignant tumor arising from trophoblastic cells that may occur following a normal pregnancy, abortion, or a hydatidiform mole.