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SECOND WEEK OF DEVELOPMENT

A brief summary of first week events leading to the second week

At the end of the first week, the fertilized ovum, called a zygote, becomes a blastocyst. This occurs through a series of divisions (cleavage) of its embryonic cells, it becomes a morula, then acquires a blastocystic cavity to become a blastocyst. The blastocystic cavity divides the cells in the blastocyst into two layers.

- Inner cell mass called embryoblast
- Outer cell mass called trophoblast

After the blastocyst gets implanted in the endometrial epithelium of the uterus, the trophoblast proliferates to form an inner layer of cytotrophoblast and an outer layer of syncytiotrophoblast. Further events continue in the second week.

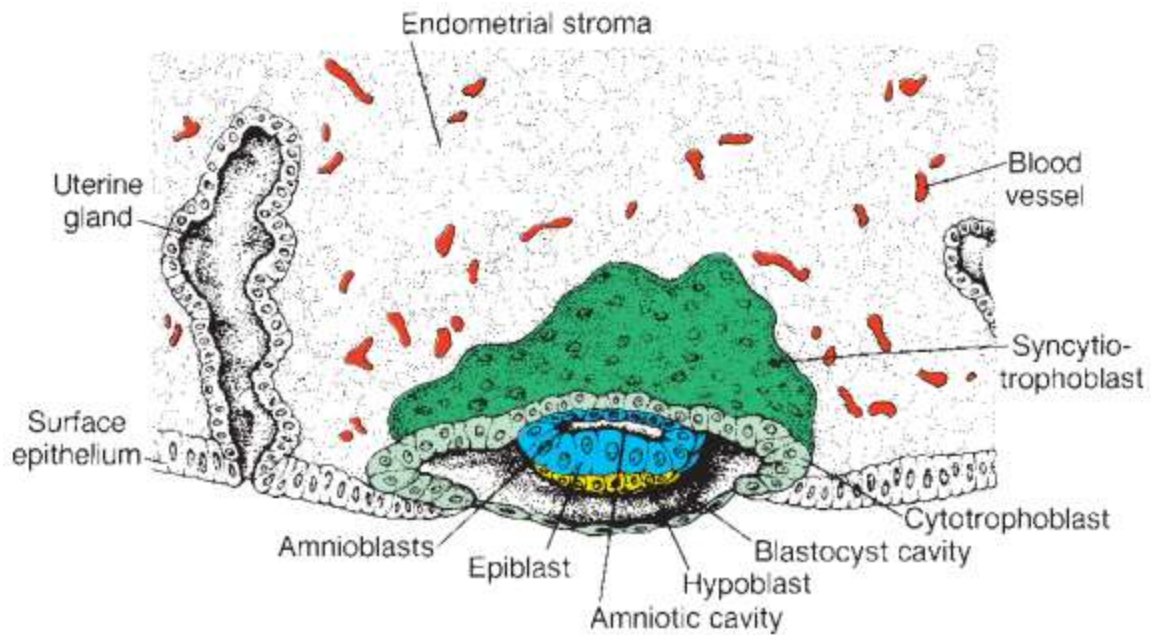
Now the second week in details:

The second week of development comprises three major events namely

1. Completion of implantation of the blastocyst
2. Formation of bilaminar embryonic disc (epiblast and hypoblast)
3. Formation of extraembryonic structures (amniotic cavity, amnion, yolk sac, connecting stalk, and chorionic sac)

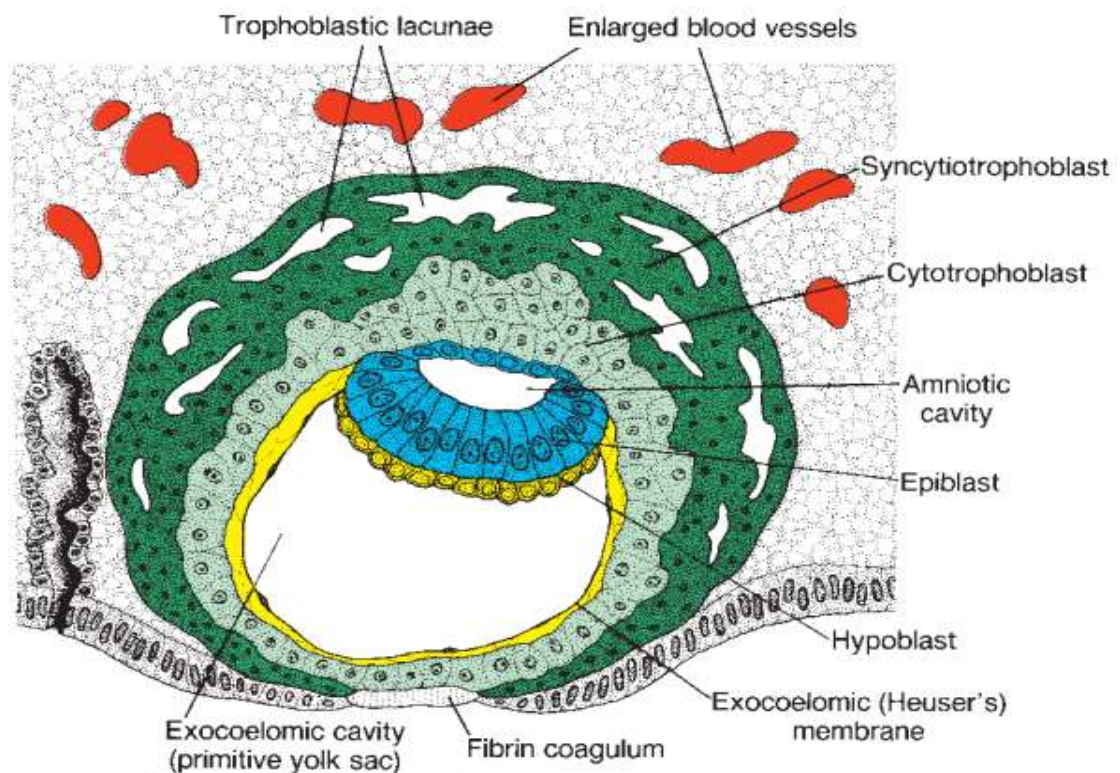
On The 8th Day

- The blastocyst is partially (slowly) embedded in the endometrium. The syncytiotrophoblast continues invading the endometrium and eroding endometrial blood vessels and glands.
- More cells in the cytotrophoblast divide and migrate into the syncytiotrophoblast, where they fuse and lose their cell membranes. The cells of the embryoblast also differentiate into 2 layers: the hypoblast layer, made up of small cuboidal cells,
- the epiblast layer which is made up of high columnar cells
- The hypoblast layer is closer to the blastocystic cavity. The epiblast layer is above the hypoblast layer.
- The hypoblast and epiblast layers together form a flat ovoid shaped disc called the bilaminar embryonic disc
- At the same time, a small cavity appears within the epiblast which enlarges to form the amniotic cavity. Hence epiblast cells adjacent to the cytotrophoblast are called amnioblasts. Amnioblasts together with the rest of the epiblast, line the amniotic cavity.



On The 9th Day

- The blastocyst is now more deeply embedded in the endometrium, and the penetration defect caused by its implantation in the surface epithelium is closed by a coagulum called fibrin
- Large vacuoles appear at the region of the trophoblast and they fuse to form larger lacunae. This phase of trophoblast development is known as the lacunar stage
- The cells of the hypoblast adjacent to the cytotrophoblast form a thin membrane called the exocoelomic membrane. This membrane lines the inner surface of the cytotrophoblast
- The exocoelomic membrane together with the hypoblast forms the lining of the exocoelomic cavity, or primitive yolk sac or primary umbilical vesicle.



On The 11th – 12th Day

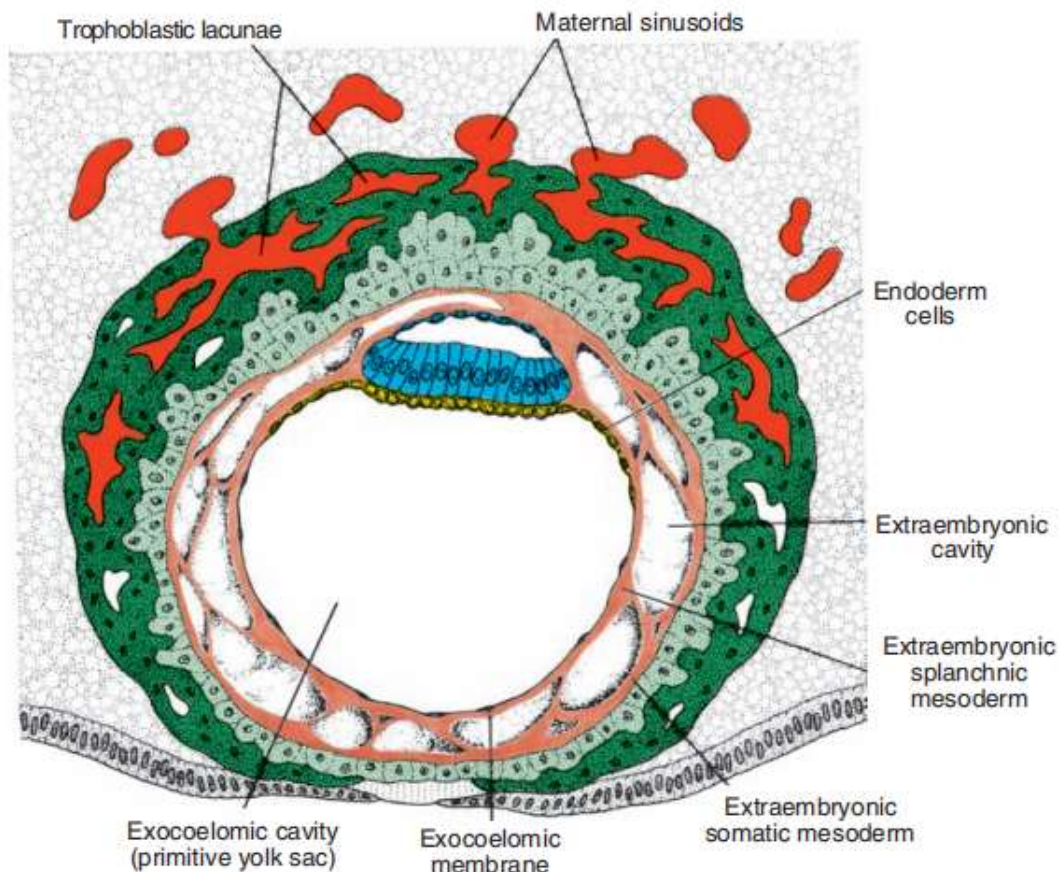
- The blastocyst is now completely embedded in the endometrium, and the surface epithelium almost entirely covers the original defect in the uterine wall.
- The cells of the syncytiotrophoblast penetrate deeper into the stroma (tissue) and erode the endothelial lining of the endometrial capillaries, rupturing them. These ruptured endometrial capillaries are called sinusoids

The lacunae then begin to communicate with the sinusoids, and maternal blood enters the lacunar system. The communication of the capillaries with the lacunae establishes the primordial uteroplacental circulation, making oxygen and nutritive substances available to the embryo from maternal circulation.

- Yolk sac cells appear between the inner surface of the cytotrophoblast and the outer surface of the exocoelomic cavity. These cells form a fine, loose connective tissue called the extraembryonic mesoderm

Soon, large cavities develop in the extraembryonic mesoderm, and when they coalesce, they form a new space known as the extraembryonic cavity or extraembryonic coelom

- The extraembryonic mesoderm lining the cytotrophoblast and amnion is called the extraembryonic somatic mesoderm. This extraembryonic somatic mesoderm also forms the connecting stalk
 - The lining covering the yolk sac is known as the extraembryonic splanchnic mesoderm
- As the conceptus implants, the endometrial connective tissue cells undergo a transformation, called decidual reaction
- This reaction causes the cells of the endometrium swell because of the accumulation of glycogen and lipid in their cytoplasm, and they are known as decidual cells. The primary function of the decidual reaction is to provide nutrition for the early embryo and an immunologically privileged site for the conceptus

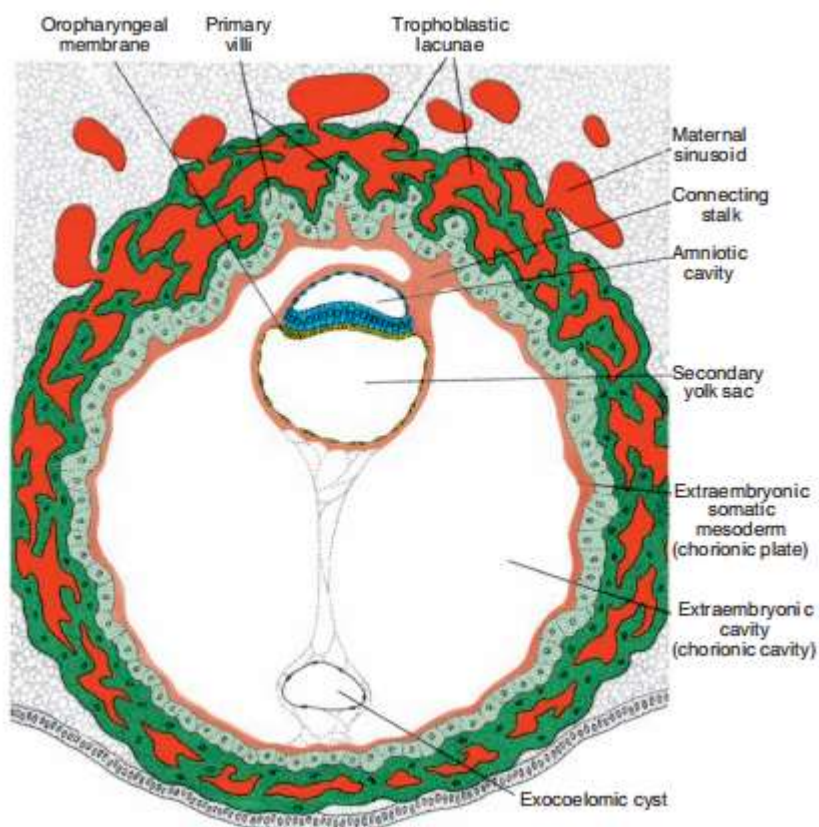


On The 13th Day

- Now, the surface defect in the endometrium has been completely covered by the surface epithelium. Bleeding may occur at the implantation site as a result of increased blood flow into the lacunar spaces.
- Cells of the cytotrophoblast proliferate and penetrate into the syncytiotrophoblast, forming cellular columns surrounded by syncytium. Cellular columns with the syncytial covering are known as primary villi.
- The primary yolk sac becomes reduced in size and is known as the secondary yolk sac. This new cavity is known as the secondary yolk sac or definitive yolk sac or the secondary umbilical vesicle. 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 to form exocoelomic cysts. Exocoelomic cysts are often found in the extraembryonic cavity or chorionic cavity or extraembryonic coelom. Meanwhile, the extraembryonic coelom expands and forms a large cavity called 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 connecting stalk becomes the umbilical cord



CLINICAL CORRELATES DURING SECOND WEEK OF DEVELOPMENT

1. Human Chorionic Gonadotrophin (HCG)

The syncytiotrophoblast produces a hormone called the human chorionic gonadotrophin (HCG), which enters the maternal blood via lacunae. HCG maintains the hormonal activity of the corpus luteum in the ovary during pregnancy by keeping the corpus luteum secreting estrogens and progesterone

HCG can be detected in maternal blood or urine as early as day 10 of pregnancy and is the basis for pregnancy tests. Enough HCG is produced by the syncytiotrophoblast at the end of the second week to give a positive pregnancy test, even though the woman is probably unaware that she is pregnant

2. Extrauterine Implantation

This is when blastocysts may implant outside the uterus. These implantations result in ectopic pregnancies. A large number of them occur in the uterine tubes, most often in the ampulla and isthmus