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TOPIC: IMPLANTATION

The reception-ready phase of the endometrium of the uterus is usually termed the "implantation window" and lasts about 4 days. The implantation window occurs around 6 days after the peak in luteinizing hormone levels. With some disparity between sources, it has been stated to occur from 7 days after ovulation until 9 days after ovulation, or days 6-10 postovulation. On average, it occurs during the 20th to the 23rd day after the last menstrual period.

The implantation window is characterized by changes to the endometrium cells, which aid in the absorption of the uterine fluid. These changes are collectively known as the plasma membrane transformation and bring the blastocyst nearer to the endometrium and immobilize it. During this stage the blastocyst can still be eliminated by being flushed out of the uterus. Scientists have hypothesized that the hormones cause a swelling that fills the flattened out uterine cavity just prior to this stage, which may also help press the blastocyst against the endometrium. The implantation window may also be initiated by other preparations in the endometrium of the uterus, both structurally and in the composition of its secretions.Adaptation of uterus

To enable implantation, the uterus goes through changes in order to be able to receive the conceptus.

Predecidualization

The endometrium increases thickness, becomes vascularized and its glands grow to be tortuous and boosted in their secretions. These changes reach their maximum about 7 days after ovulation.

Furthermore, the surface of the endometrium produces a kind of rounded cells, which cover the whole area toward the uterine cavity. This happens about 9 to 10 days after ovulation. These cells are called decidual cells, which emphasises that the whole layer of them is shed off in every menstruation if no pregnancy occurs, just as leaves of deciduous trees. The uterine glands, on the other hand, decrease in activity and degenerate around 8 to 9 days after ovulation in absence of pregnancy.

The decidual cells originate from the stromal cells that are always present in the

endometrium. However, the decidual cells make up a new layer, the decidua. The rest of the endometrium, in addition, expresses differences between the luminal and the basal sides. The luminal cells form the zona compacta of the endometrium, in contrast to the basalolateral zona spongiosa, which consists of the rather spongy stromal cells.

Decidualization

Decidualization succeeds predecidualization if pregnancy occurs. This is an expansion of it, further developing the uterine glands, the zona compacta and the epithelium of decidual cells lining it. The decidual cells become filled with lipids and glycogen and take the polyhedral shape characteristic for decidual cells.

Trigger

It is likely that the blastocyst itself makes the main contribution to this additional growing and sustaining of the decidua. An indication of this is that decidualization occurs at a higher degree in conception cycles than in nonconception cycles. Furthermore, similar changes are observed when giving stimuli mimicking the natural invasion of the embryo.Parts of decidua

The decidua can be organized into separate sections, although they have the same composition.

Decidua basalis - This is the part of the decidua which is located basalolateral to the embryo after implantation.

Decidua capsularis - Decidua capsularis grows over the embryo on the luminal side, enclosing it into the endometrium. It surrounds the embryo together with decidua basalis.

Decidua parietalis - All other decidua on the uterine surface belongs to decidua parietalis.

Decidua throughout pregnancy

After implantation the decidua remains, at least through the first trimester. However, its most prominent time is during the early stages of pregnancy, during implantation. Its function as a surrounding tissue is replaced by the definitive placenta. However, some elements of the decidualization remain throughout pregnancy.

The compacta and spongiosa layers are still observable beneath the decidua in pregnancy. The glands of the spongiosa layer continue to secrete during the first trimester, when they degenerate. However, before that disappearance, some glands secrete unequally much. This phenomenon of hypersecretion is called the Arias-Stella phenomenon, after the pathologist Javier Arias-Stella.

Pinopodes

Main article: Pinopod

Pinopodes are small, finger-like protrusions from the endometrium. They appear between day 19 and day 21 of gestational age. This corresponds to a fertilization age of approximately five to seven days, which corresponds well with the time of implantation. They only persist for two to three days. The development of them is enhanced by progesterone but inhibited by estrogens.

Function in implantation

Pinopodes endocytose uterine fluid and macromolecules in it. By doing so, the volume of the uterus decreases, taking the walls closer to the embryoblast floating in it. Thus, the period of active pinocytes might also limit the implantation window.Parts of decidua

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Not only the lining of the uterus transforms, but in addition, the secretion from its epithelial glands changes. This change is induced by increased levels of progesterone from the corpus luteum. The target of the secretions is the embryoblast, and has several functions on it.

Nourishment

The embryoblast spends approximately 72 hours[6] in the uterine cavity before implanting. In that time, it cannot receive nourishment directly from the blood of the mother, and must rely on secreted nutrients into the uterine cavity, e.g. iron[6] and fat-soluble vitamins.[6]

Growth and implantation

In addition to nourishment, the endometrium secretes several steroid-dependent proteins,[6] important for growth and implantation. Cholesterol[6] and steroids[6] are also secreted. Implantation is further facilitated by synthesis of matrix substances, adhesion molecules and surface receptors for the matrix substances.

Mechanism

Implantation is initiated when the blastocyst comes into contact with the uterine wall.

Zona hatching

Main article: Zona hatching

To be able to perform implantation, the blastocyst first needs to get rid of its zona pellucida. This process can be called "hatching".

Factors

Lytic factors in the uterine cavity, as well as factors from the blastocyst itself are essential for this process. Mechanisms in the latter are indicated by that the zona pellucida remains intact if an unfertilized egg is placed in the uterus under the same conditions. A substance probably involved is plasmin. Plasminogen, the plasmin precursor, is found in the uterine

cavity, and blastocyst factors contribute to its conversion to active plasmin. This hypothesis is supported by lytic effects in vitro by plasmin. Furthermore, plasmin inhibitors also inhibit the entire zona hatching in rat experiments. Of gestational age. This corresponds to a fertilization age of approximately five to seven days, which corresponds well with the time of implantation. They only persist for two to three days.The development of them is enhanced by progesterone but inhibited by estrogens.

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Adaptation of secretions

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The embryo releases serine proteases which causes the epithelial cell membrane to depolarize and activates the epithelial Na+ channel. This triggers a Ca2+ influx and phosphorylation of CREB. Phosphorylation of CREB upregulates the expression of COX-2, which leads to the release of prostaglandin E2 (PGE2) from epithelial cells. PGE2 acts on the stroma cells activating cAMP-related pathways in stromal cell leading to decidualization.