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**IMPLANTATION**

The term "implantation" is used to describe process of attachment and invasion of the uterus endometrium by the blastocyst (conceptus) and then the maternal circulation to form the placental. In humans, this process begins at the end of week 1, with most successful human pregnancies the conceptus implants 8 to 10 days after ovulation, and early pregnancy loss increases with later implantation. The implantation process continues through the second week of development. An implantation of the blastocyst outside this zone means an extra-uterine pregnancy with serious consequences for the person's health. The implantation stages of the blastocyst in the uterine endometrium can be seen as taking place in three phases: apposition, adhesion and the embedding in the endometrium.In humans, implantation is the stage of pregnancy at which the already fertilized egg adheres to the wall of the uterus. At this stage of prenatal development, the conceptus is called a blastocyst. It is by this adhesion that the fetus receives oxygen and nutrients from the mother to be able to grow.

Implantation consists of three stages:

(a) the blastocyst contacts the implantation site of the endometrium (apposition);

(b) trophoblast cells of the blastocyst attach to the receptive endometrial epithelium (adhesion); and

(c) invasive trophoblast cells cross the endometrial epithelial basement membrane and invade the endometrial stroma (invasion).

#### 1) Apposition and adhesion

Implantation begins with apposition of the blastocyst at the uterine epithelium, generally about 2-4 days after the morula enters the uterine cavity. The implantation site in the human uterus is usually in the upper and posterior wall in the midsagittal plane. Implantation is considered a pro-inflammatory reaction in which endometrial vascular permeability is markedly increased at the attachment site, mediated by Cyclooxyrgenase (Cox)-derived prostaglandins.

During apposition process, the blastocyst differentiates into an inner cell mass (embryo) and trophectoderm (placenta). Stromal cells surrounding the implanting blastocyst differentiate into a specialized cell type called decidual cells, via a process known as decidualization

Cell adhesion of the blastocyst trophectoderm and endometrial luminal epithelial cells of the uterus is mediated by cell adhesion molecules, including integrins, cadherins, selectins, and immunoglobulins. Cell adhesion molecules are expressed on the surface of invasive trophoblast, and these molecules interact with ligands expressed by the extra-cellular matrix of the decidua in a temporal and spatial way

#### 2) Invasion

The process of implantation allows fetal trophoblast cells to invade and migrate into the maternal decidua. By this time, the trophoblasts at the implantation site have formed masses of cytotrophoblasts and syncytiotrophoblasts. Eventually, trophoblast cells destroy the wall of the maternal spiral arteries, converting them from muscular vessels into flaccid sinusoidal sacs lined with endovascular trophoblast. The aim of invasion is to reconstruct the maternal spiral arteries, which will maintain a high blood flow between the fetus and the mother, replacing small, high-resistance vessels with large, low-resistance vessels. During early pregnancy, fetal trophoblast cells invade the uterus and penetrate the basement membrane, a property that is characteristic of malignant cells.

Various hormones and molecules involved in embryo implantation. They are produced not only in a competent embryo but also in the epithelial and stromal compartments of the uterus. A complex dialogue between a receptive uterus and a competent blastocyst is continued during the implantation period. Many infertility problems have been overcome by a variety of assisted reproductive techniques. But, embryo implantation still remains a major limiting step in the success of In Vitro Fertilization and Embryo Transfer (IVF- ET). Complete understanding of the molecular pathway of implantation will definitely improve the diagnosis and treatment of infertility. Sensitive and non-invasive methods to detect the embryo quality and endometrial receptivity will help to combat infertility which arises from defective implantation and decidualization.