Chapter - 32
Fertilization in Human

The union of haploid male (sperm) gametes and female (ovum) gametes and fusion of pronuclei of both gametes is called fertilization. Fertilization results in the formation of diploid zygote.

The fusion of pronuclei of gametes is called Karyogamy, while mixing of two sets of chromosomes of two gametes is known as amphimixis. As in other mammals fertilization is internal in female human. Generally it occurs in ampulla of fallopian tube.

Types of Fertilization

The process of fertilization is of two types

1. External fertilization-

In external fertilization male and female gametes are fused outside the body. This fertilization process is carried out in aquatic medium. Mostly, it is found in fishes (*Labeo*), amphibians (Frog) and all Echinoderms (Starfish).

2. Internal fertilization-

In internal fertilization, the fusion of gametes takes place in some part of female genital duct and generally near the ostium. It is found in oviparous (all birds, prototherians), ovoviviparous and viviparous (all marsupials and eutherians) animals.

Artificial insemination

The process of liberation of sperms by male in the body of female for fertilization is called insemination. When sperms are collected artificially, preserved and stored and fertilization is being done by liberating them in female uterus, as needed, this process is known as artificial insemination. This process is used to improve breed in Livestock.

Steps of Fertilization

1. Approach of Sperm to Ovum

During copulation, male ejaculates semen (3-5ml) in vagina near uterine duct in female is called insemination. About 400 million sperms are found in this ejaculation but out of these 100 sperms can reach up to fallopian tube, because many sperms die due to acidity of female genital duct. Several sperms are ingested by phagocytic cells of vaginal epithelium. The sperms swim at the rate of 1-4 mm per minute in seminal fluid. This movement of sperms is due to the uterine contraction process and peristaltic movement of fallopian tube. After some time of entering in female uterus, the sperm became capable for fertilization. The capability of fertilizing an ovum of its own species is known as sperm's capacitation(Fig. 32.1).

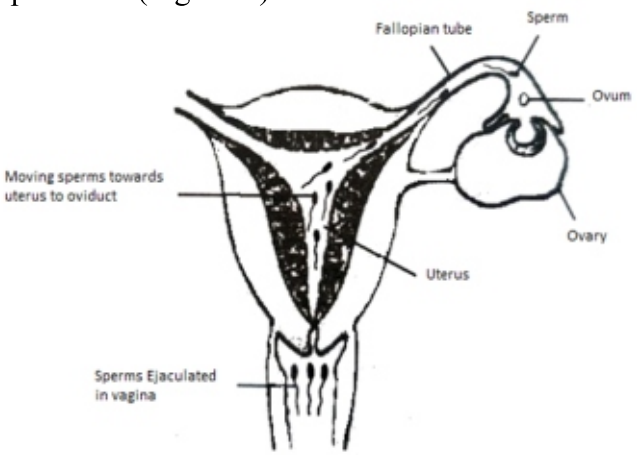

Fig. 32.1 The path of sperms in female reproductive system for fertilization

In this process the physiological maturation of sperm occurs in which due to activity of lysigenous enzyme sperm enters into ovum by penetrating egg membrane. This process takes about 5-6 hours. After this the sperm, fertilizes the ovum.

2. Entry of sperm

The ovum secretes a chemical substance which is called fertilizin. Its surface has sperms affinate sites where specific sperms are attached by its antifertilizin site.By the interaction of fertilizin antifertilizin ovum and sperm are agglutinize together.

Penetration by sperm is a chemical mechanism. In this, acrosome takes part and releases some sperm lysins which make the path for entrance of sperm by dissolving egg membrane. The sperm lysin is an acidic protein having lysigenic enzyme hyaluronidase which dissolves hyaluronic acid polymer present in intercellular spaces. This acid keeps together the granulosa cells of corona radiata. The corona piercing enzyme dissolves corona radiata and acrosin dissolves zona pellucida .

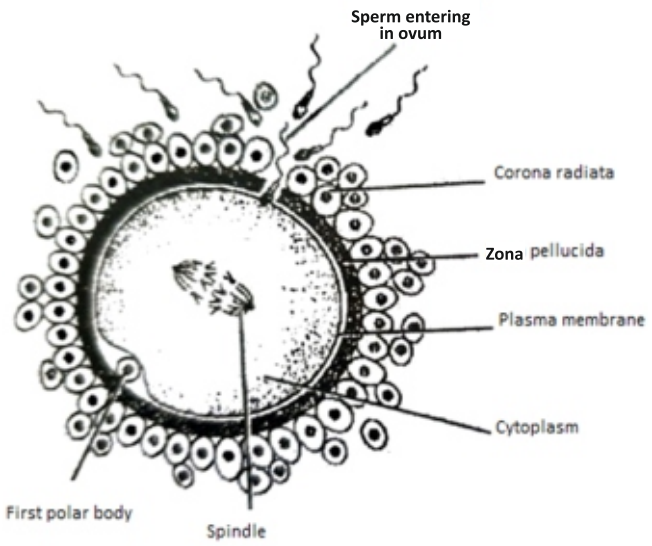

Fig. 32.2 Entery of sperm in an ovum

3. Cortical reaction

Just after entry of sperm cortical reactions takes place to prevent entry of other sperms into ovum. In this reaction the cortical granules present below the plasma lemma of ovum chemical substances are present in between cytoplasm of ovum and vitelline membrane. After entry of sperm into ovum following metabolic activities are induced :-

1. A fertilization cone is formed on the surface of ovum.
2. Vitelline membrane changes into fertilization membrane.
3. Movement is found in cytoplasm.
4. Permeability of plasma membrane increases.
5. The rate of protein synthesis increases.
6. Mitotic division starts.

4. Fusion of pronuclei

Entry of sperm in ovum acts as a stimulation. As a result second maturation division takes place. After entry of sperm in ovum the head and middle piece of sperm rotates by angle, due to which mitochondria and proximal centriole related to middle piece reach forward to head. Centriole carried by sperm is divided into two parts and forms chromosomal spindle in the centre of active cytoplasm. With the formation of second polar body, egg nucleus or female pronuclei becomes prepared to fuse with pronuclei of sperm's head.

After following the sperm penetration path, male pronucleus moves directly to female pronucleus. In several circumstances less change take place in this path of sperm. In such conditions, the part of path of sperm is known as copulation path.

Significance of Fertilization

1. It stimulates the egg for complete maturation.
2. It activates ovum for continuous mitotic division to develop a new organism.
3. It makes the number of chromosomes diploid (in human 46) in zygote by fusion of haploid set of male chromosomes.
4. It makes the egg metabolically more active.
5. It joins the characters of two parents and develops variations. Thus, it also helps in evolution.
6. Sex chromosomes of sperm are X or Y by which it also helps in sex determination.

7. Formation of fertilization membrane takes place after entry of sperm, by which poly spermy is checked.
8. Copulation path determines the axis of division.

Pracice Questions

Multiple choice Questions-

1. Importance of fertilizin antifertilizin process in fertilization is-
   (a) To attract gametes to each other
   (b) Protection of sperms
   (c) Fusion of gametes of same species
   (d) All of above
2. Fertilization is -
   (a) Fusion of male and female pronuclei
   (b) Fusion of two gametes
   (c) Fusion of two gametes of same species
   (d) All of above
3. At the time of fertilization, the part of sperm that comes in contact with ovum is
   (a) Acromion (b) Acromegaly
   (c) Acronia (d) Acrosome
4. The enzyme secreted by acrosome of sperm is
   (a) Hyaluronidase (b) Pepsin
   (c) Carboxylase (d) Dehydrogenase
5. When sperms of human come in contact with vaginal discharge then these acquire capability of fertilization. This process is called.
   (a) Cortical reaction (b) Capacitation
   (c) Acrosome reaction (d) Mating
6. The substance which conserves energy during sperm mobility is-
   (a) Androgamone I (b) Androgamone II
   (c) Gynogamone I (d) Gynogamone II
7. Site of fertilization in female human is
   (a) Vagina (b) Spermatheca
   (c) Uterus (d) Fallopian tubes
8. Gyanogamone is secreted by
   (a) Ovum
   (b) Spermatid
   (c) Graafian follicle cells
   (d) Ovary
9. Sperm moves by
   (a) Tail (b) Head
   (c) Acrosome (d) Middle piece
10. Development of unfertilized egg is called
    (a) Transformation (b) Metamorphosis
    (c) Morphogenesis (d) Parthenogenesis.

Important Questions-

1. Who postulatefertilizin theory in fertilization process?
2. Where is fertilizin present?
3. Which scientist studied acrosome reaction?
4. Define fertilization.
5. What is parthenogenesis?
6. What is amphimixis?
7. What is activation of ovum?
8. What is capacitation process?

Answer Key-

1. (c) 2. (c) 3. (d) 4. (a) 5. (b)
6. (a) 7. (d) 8. (a) 9. (a) 10. (d)