FERTILIZATION (25/07/2011)

Major 4 steps the sperm and ovum follow during their interaction are -

① The chemoattraction of sperm to the egg by the soluble substances secreted by the egg.

② The exocytosis of acrosomal vesicle to release the acrosomal enzymes. (in humans)

③ The binding of sperm to the extra-cellular envelope of the oocyte i.e. vitelline membrane or zona pellucida.

④ Passage of the sperm through the extracellular envelope. Fusion of sperm & egg membranes.

Sperm activation attraction by ovum from distance - Species specific sperm attraction has been documented in various species like molluscs, echinoderms & urochordates.

In many species sperms are attracted by chemotaxis.

NOTE: In humans, after ovulation temperature rises. This guards sperm attraction towards ovum → temperature gradient.

Miller demonstrated, the egg of species not only secretes a chemotactic substance or a molecule but it also regulates the timing of release. Thus oocyte controls not only the type of sperm they attract best also the time at which they should attract them. The mechanism of chemotaxis also differs among species and the chemotactic molecules are strictly different structurally ~~different~~ among very closely related species.

It is rather a highly specialized set of tissue that actively regulates the transport of sperm & finally the ovum (cell after ovulation).

→ Capacitation is the change which is membrane bound. It provides motility.

→ Both the ♂ & ♀ gamete use a combination of small scale of biochemical interaction and large scale of physical propulsion to get to the oviduct.

NOTE: ① Theoretically all sperms produced by spermatogenesis are ♂ gametes but practically only fertilizable sperms are ♂ gametes.

② Capacitation controls sperm. Sperm which are not over capacitated will not undergo acrosome rkn.

③ Capacitation is a natural membranal change which is occuring on providing ambience's stimulus.

Translocation of sperm & ovum:-

Mammalian oocyte just released from ovary is surrounded by matrix containing cumulus cells. If this matrix is experimentally removed or altered, the fimbriae of oviduct will'nt pick up the oocyte - cumulus complex. Once it is picked up a combination of ciliary beating & muscle contraction, transport the oocyte - cumulus complex to the appropriate posn for fertilization in oviduct.

Cumulus oophorus + corona radiata = CUMULUS

↓

Provide 2°/3° protection to

Translocation of sperm from vagina → oviduct involves several processes and that work at different times & places. Sperm motility i.e. flagellar action is probably a minor factor in getting the sperm in to the oviduct although motility is req. for mouse sperm to travel to the cervical mucus.

- Sperms are found in oviduct of hamster, cow, mouse & human within 30 min of sperm deposition in vagina. This is too short a time in which a sperm can achieve. This indicates involvement of muscular activity of the ~~uterus~~ uterus.

Capacitation :—

Newly ejaculated sperm are unable to undergo fertilization or even acrosome reaction until they reside (stay) sometime in ♀ rep tract —

- The set of physiological changes by which sperm become competent to fertilized ovum is ~~is~~ called capacitation. Sperm that aren't capacitated are held up in the cumulus matrix which are prevented to reach the zona pellucida surface
- Capacitation can also be accomplished in vitro by incubating the sperm in a tissue culture med. or a simple culture med. containing Ca^{+2}, bicarbonate and serum albumin or cultured in fluid taken out from the oviduct
- In human, fertilizing sperm can take as long as 6 days to finish the journey for fertilization.
- In 1995, the process of capacitation has been

described as a transient event - and the sperms are given a relatively brief window during which they can successfully fertilize the egg.

- The sperms which reaches the ampulla within 6 hours by speedy movement after intercourse to the site of fertilization are unable to fertilize the ovum. As sperm reach the ampulla, they must acquire the competence and in this speedy movement, sperm doesn't acquire sufficient competence and passes through oviduct and released in peritoneum.

NOTE : ∫ movement of sperm → Sperm don't move straightway but in zig zag fashion making shape of ∫

- Competence means they have to loose the motility and they stay around for a long time. Oviduct releases these competent sperms from isthmus at interval when it co-incide with the ovulation.