TRANSPORT OF OVUM

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Egg fertilization involves a complex sequence of events that starts with the release of a mature egg from the follicle, continues with the appearance of the two pronuclei after sperm entry, and is completed with the first mitotic division.

Egg transport refers to the movement of the oocyte from the moment of expulsion from the ovarian follicle to entry into the distal segment of the fallopian tube before fertilization takes place. Once fertilized in the ampullary segment of the fallopian tube, the embryo spends about 5 days traveling into the remaining anatomical oviductal districts and arrives into the uterine cavity at the blastocyst stage. For purposes of clarity and accuracy, the term "egg transport" covers post-ovulation and pre-fertilization stages (i.e. the haploid life span of the ovulated oocyte). A subsequent section provides details concerning transport of the fertilized diploid oocyte (i.e. zygote) and pre-implantation embryo.

The anatomy and physiology of the fallopian tube play an important role in egg transport and fertilization. The fallopian tube is a muscular tube with an average length of about 11–12 cm and is composed of four regions. The most distal portion is called the infundibulum, it is approximately 1 cm in length, and it includes the finger-like fimbria. The epithelial lining of the fimbria is densely ciliated and highly convoluted. This structure, along with the muscle-controlled movements of the fimbria, is thought to be important for capture of the cumulus-oocyte complex. The next portion of the oviduct is called the ampulla. This segment averages 5–8 cm in length. It is within this highly ciliated portion of the oviduct that fertilization and early embryo development occur. The ampulla is most often also the site for ectopic implantation (ectopic pregnancy). The next region, approximately 2–3 cm in length, is the isthmus. Like the ampulla, it too is ciliated yet less densely so. The isthmus is thought to regulate sperm and embryo transport. The last segment of the fallopian tube is called the intramural segment; it is the link between the isthmus of the oviduct and uterine cavity.[1]

The ciliated and non-ciliated cells of the fallopian tube undergo cyclic changes with the menstrual cycle similar to those occurring in the endometrium. Further, each portion of the fallopian tube appears to be preferentially regulated by hormones that cause a distinct regionalization of activities depending on the day in the female reproductive cycle.[2] At the time of ovulation, the oocyte is surrounded by a mass of specialized granulosa cells called the cumulus oophorus. Together, the oocyte and granulosa cells are called the cumulus-oocyte complex (COC). The innermost cell layers of the cumulus immediately overlying the zona pellucida of the oocyte are called the coronal cells. After cumulus maturation, the same cells are called the corona radiata because of their "sunburst" appearance. These cells have processes that extend through the acellular glycoprotein matrix of the zona to contact the oocyte plasma membrane for a rich metabolic exchange of nutrients via the so-called transzonal projections. The cumulus of the mature COC is sticky and is thought to facilitate the adherence of the COC to the surface of the fimbriae once it is expelled from the follicle at ovulation.

The exact mechanism by which the COC is picked up and gains entry into the fallopian tube lumen is unknown. One possibility is that the fimbriated end of the ipsilateral fallopian tube sweeps over the ovary, picks up the COC, and draws it into the tubular lumen by muscular control. Paradoxically, women have become pregnant who were missing the fallopian tube on the side where ovulation occurred. Also, oocytes placed in the peritoneal cavity have been picked up by the fallopian tube and resulted in intrauterine pregnancies.[4] This evidence suggests that other forces help to facilitate oocyte pickup. Another possibility is that the rhythmic and unidirectional beating of cilia on the fimbriae – where the cilia have adhesive sites – and in the ampullary and isthmic regions of the fallopian tube, draw the COC into the lumen of the fallopian tube. However, this cannot be the sole mechanism by which the COC is picked up and transported through the fallopian tube because women with immotile cilia syndrome, otherwise known as Kartagener's syndrome, are often fertile. Another possibility is that muscular contractions of the fallopian tube create negative pressure that helps to aspirate the COC from the surface of the ovary into the lumen. However, capping and suturing of the fimbriated end in women has failed to prevent pregnancy.[5] More recently, researchers have reported that the uterus and fallopian tube appear to act as a peristaltic pump. The pumping frequency increases on the ipsilateral side, in the direction where ovulation will occur, and as the follicular diameter increases.[3] A novel alternative to the aforementioned mechanisms for COC pickup is one involving mucus strand connections between fimbria and ovary that act as a tether between the two structures to facilitate fimbrial capture of the COC.[5] The entire process of pickup and deposition of the COC into the lumen takes between 2 and 3 minutes after ovulation. Therefore, it would seem that at least several mechanisms are involved with COC pickup, the most important of which are ciliary beating, sweeping of the ovarian surface by the fimbria, and peristaltic pumping of the female tract.