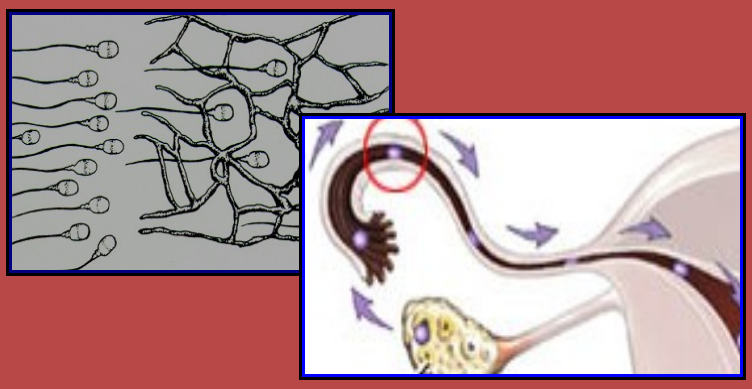
GAMETE TRANSPORT



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Transportation of oocyte and spermatozoa :

Gamete transport is an essential part of the successful fertilization. The **oocyte** moves down the oviduct after ovulation while **spermatozoa** moves from the vagina or cervix up the uterine horn and oviduct to the ***ampullary-isthmic*** junction, where fertilization occurs. The spermatozoa transports through different physiologic and biochemical characteristics containing various luminal fluids such as testicular, epididymal, seminal plasma, vaginal, cervical mucus, uterine, oviductal and peritoneal fluids. Physiochemical and immunologic factors in the vagina and cervix at the time of insemination play an important role in sperm servival and transport into the uterus and oviduct. Semen is deposited at different sites of the genital organ by different species at the time of copulation. These are :

Man, Rabbit, Monkey, cattle and sheep : vagina

Horse, dog, pig and rodents : Uterus

Stages of sperm transport :

There are three stages of sperm transport recognized in the cervix, uterus and oviduct. These are :

Short rapid sperm transport

Colonization of reservoirs

Slow, prolonged release

Short rapid sperm transport :

Both dead and motile sperms reach the oviduct within 2 to 10 minutes from site of deposition of semen ejaculation due to increased contractile activity of the myometrium and mesosulpinx during courtship and coitus besides sperm motility. Release of oxytocin after stimulation of sensory nerves near the cervix during copulation and prostaglndins from the semen could be involved in stimulating these contractions. These uncapacitated sperms are not involved in fertilization and likely pass through the oviduct into the peritoneal cavity.

The rapid phase of sperm transport is followed by a slow and sustained transport of sperm to the oviduct.

Colonization of reservoirs :

Most sperms are trapped in the mucosal folds of the cervical crypts through the micelles of the cervical mucus while the sperm transport from vagina. The spermatozoa may leave the cervix by means of their own motility or be passively transported by cervical and uterine contractions. In species such as pig and dog, in which ejaculation occurs in the uterine horns, sperm reservoirs are localized in the uterotubal junction.

Slow release and transport :

After colonization of reservoir sperms are released slowly for prolonged period. This release of sperm from the reservoirs and transport towards site of fertilization occurs due to innate motility of spermatozoa and contractile activity of the myometrium and mesosulpinx.

Mechanism of sperm transport in the female genital tract :

For most of the species cervix is the greatest barrier to transport of spermatozoa. Billions of spermatozoa deposited in the vagina are probably reduced to thousands reaching the uterus. The various role played ***by the cervix*** in sperm transportation are :

* It is receptive to sperm penetration at or near ovulation and inhibits migration at other phases of the cycle.

*It act as sperm reservoir.

*It protects spermatozoa from the hostile environment of the vagina and from phagocytosis.

*It provides energy requirement to the spermatozoa.

*It participates in the capacitation of spermatozoa.

Cervical mucus that accumulate in the vaginal pool may contain endometrial, oviductal, follicular and peritoneal fluids as well as leukocytes and cellular debris from uterine, cervical and vaginal epithelia.

The contractile activity of the ***vagina and myometrium*** plays a major role in the transport of spermatozoa into and through uterus. Presence of spermatozoa in the uterus induces endometrial leukocytic response, which enhances phagocytosis of excessive numbers of both living and dead spermatozoa. The uptake of spermatozoa by phagocytes is known as **spermophagy**.

The pattern and rate of sperm transport through the oviduct are controlled by :

* Peristalsis and antiperistalsis of oviductal musculature.

* Complex contractions of the oviductal mucosal folds and the mesosulpinx.

* Fluid currents and countercurrents created by ciliary action.

* Opening and closing of intramural portion.

The pattern and amplitude of contractions vary in different segments of the oviduct assisting in sperm transportation, such as :

In the isthmus : peristaltic and antiperistaltic contractions are segmental, vigorous and almost continuous.

In the ampulla : strong peristaltic waves move in the segmental fashion toward the mid portion of the oviduct.

Ovarian hormones also affect on sperm transport in the female genital tract through influencing on :

* The structure, ultrastructure and secretory activity of the cervical, uterine and oviductal epithelia.
* Contractile activity of the uterotubal musculature.
* Quantitative and qualitative characteristics of cervical mucus and uterine and oviductal secretions.

Mechanism of egg transport in the oviduct :

Transportation of egg through the oviduct is controlled by ***four primary factors***. These are :

* The frequency, force and programming of contraction of oviductal musculature and related ligaments which is influenced by endocrine, pharmacologic and neural mechanisms.
* The direction and rate of currents and countercurrents of luminal fluids influenced by the rate and direction of the beat of kiocilia lining the mucosal folds.
* The secretory activity of nonciliated cells in the oviductal epithelium regulated by oestrogen-progesterone ratio.
* The hydrodynamics rheologic properties of luminal fluids at the time of transit of ova.

Oestrogens cause retention of oocyte in the oviduct, whereas progesterone hastens transport. Epinephrine also hasten transport besides the oestrogen-progesterone ratio. The transit of ova through the oviduct is also regulated by 'locking' and 'unlocking' system besides the above mentioned four primary factors to pas the ova specially in the isthmus in a slow deliberate fashion. This ***'locking' and 'unlocking'*** of ova is influenced by various physiologic and pharmacologic mechanisms. These are :

* Mechanical blocking
* Myogenic blocking from
    a) Sustained contraction of circular musculature of the isthmus.
    b) Contractions regulated by cryogenic pacemakers which are somehow coupled in time and space so that they do not propel ova predominantly to the uterus.
    c) Local or general relaxation of muscle so that no motive force exists to propel the ova toward the uterus.
* Neurogenic blocking controls one of the foregoing myogenic mechanisms that affect :
    a) Sustained release of einephrine onto circular muscle cells that respond by contractions increased intracellular Ca++
* Hormonal blocking which acts on a myogenic and neurogenic mechanism :

a) The amount and function of intracellular organelles that control Ca++ binding and release
b) The predominance of alpha and beta adrenergic receptors in oviductal muscle.

The oocyte passes through the ampulla to the ampullary-isthmic junction rapidly, then remains at that point for 2 to 3 days before moving down the isthmus to the uterus.

Transport time of ova in the oviduct in different species :

Species	Time in oviduct (hours)
Cattle	90
Sheep	72
Horse	98
Pig	50
Cat	148
Dog	168
Monkey, rhesus	96
Opossum	24
Woman	48-72

Fertile life of sperm and egg :

Species	Fertile life (hours)	
	Sperm	Ovum
Cattle	30-48	20-24
Horse	72-120	6-8
Man	28-48	6-24
Rabbit	30-36	6-8
Sheep	30-48	16-24
Swine	24-72	8-10

Suggested reading :

* Reproduction in Farm Animals. E.S.E. Hafez.

* Applied Animal Reproduction. H.J. Bearden & J.W. Fuquay.