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DEPARTMENT: BIOMEDICAL ENGINEERING

ASSIGNMENT QUESTION 1

Discuss the factors facilitating the movement of sperm in the female reproductive tract

ANSWER

1. Vaginal Insemination

At the time of ejaculation, the complex process of sperm transport through the female reproductive tract. During coitus (sexual intercourse), 1.5 to 5.0ml of semen containing between 200 and 500 million sperm is deposited at the posterior vaginal fornix, leaving the external cervical os partially submerged in this pool of fluid.

At this point, some sperm may be passively taken up by the cervix in a process described as ***"rapid transport"*** otherwise, sperm undergo **"delayed transport**".

Within about 1 minute after coitus, the ejaculate undergoes coagulation. This coagulum temporarily restricts movement of sperm out of the seminal clot, thus preventing their passage into the cervical mucus and ascension up the female reproductive tract. Over the next 20 to 30 minutes, however, a seminal-fluid proteolytic enzyme produced by the prostate gland gradually liquefies the clot. At this point, motile sperm may then enter the cervical mucus, leaving behind the seminal plasma. Although there are reports of motile sperm persisting within the vagina for up to 12 hours after ejaculation, 11 motility of most vaginal sperm is diminished within about 30 minutes, and after 2 hours almost all sperm motility in the vagina has been lost.

2. Rapid Sperm Transport

Within seconds after ejaculation, sperm may begin to undergo the process of rapid sperm transport. This type of sperm movement is thought to be principally passive, and comes from coordinated vaginal, cervical, and uterine contractions. Although these contractions are of short duration, they are

believed to be the primary force responsible for the rapid progression of sperm to the upper female reproductive tract (the oviduct).

3. The Cervix

The cervix performs various essential functions in the movement of the sperm.

- It provides a receptive environment for sperm entry close to the time of ovulation.
- It prevents the access of sperm, microorganisms, and particulate matter to the upper reproductive tract and thus, the peritoneal cavity
- It aids the filtering of the spermatozoa and removal of seminal plasma
- It prevents sperm phagocytosis by white blood cells within the female reproductive tract
- It provides a biochemical environment sufficient for sperm storage, capacitation and migration

The structure of the human cervix facilitates performance of these stated functions. Finally, cervical pH is alkaline, with a peak pH during the periovulatory period or follicular phase. This environment is much more hospitable to spermatozoa than the acidic pH of the vagina.

4. Cervical Mucus

Cervical mucus is continuously secreted through exocytosis by the nonciliated epithelial cells that line the cervical canal. This biomaterial serves many important functions, including exclusion of seminal plasma, exclusion of morphologically abnormal sperm, and support of viable sperm for subsequent migration to the uterus and oviduct.

Sperm movement through the cervical mucus is primarily through the interstitial spaces between the mucin micelles, and the sperm's progression depends on the size of these spaces. The size of the interstices is usually smaller than the size of the sperm heads; thus, sperm must push their way through the mucus as they proceed through the lower female genital tract.

Spermatozoa may retain their fertilizing capacity in human cervical mucus for up to 48 hours and their motility for as long as 120 hours. From their temporary storage location within the cervical crypts, sperm can be released gradually over time, thus enhancing the probability of fertilization.

5. Sperm Transport Through the Uterus

Not much is known about sperm transport within the endometrial cavity. Sperm motility does not appear to be the only force directing the sperm toward the oviducts, because inert particles deposited within the uterus are transported to the Fallopian tubes. Uterine muscular contractions likely play a role in this process.

6. Fallopian Tube

A mature Fallopian tube, which is about 9 to 11 cm long, consists of five distinct segments: the fimbria, infundibulum, ampulla, isthmus, and intramural segment. The epithelial lining of the tube is composed of four cell types: ciliated, secretory, intercalary (peg), and undifferentiated cells.

Sperm movement through the Fallopian tube relies on a combination of forces: intrinsic sperm motility, tubular muscular contraction, and fluid flow. Tubal fluid production is maximal at the time of ovulation, and this fluid sustains the sperm before fertilization. Tubal fluid may also facilitate both sperm capacitation and acrosomal reaction.

Although the uterotubal junction does not act as a barrier to inert particles, it may serve as an additional functional barrier to sperm with abnormal morphology or motility. The amount of sperm that reach the oviduct is many orders of magnitude lower than the total number of sperm in the ejaculate. Although tens of millions to hundreds of millions of sperm are deposited in the vagina at the time of ejaculation, anatomic studies have shown that typically only hundreds of sperm are present in the oviduct at various post coital time points.