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COURSE TITLE: PHYSIOLOGY

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ASSIGNMEMT TITLE: Male reproductive functions

Questions

Write short note on

- Semen
- Spermatogenesis

SEMEN

Semen is a white or grey fluid that contains sperms. It is the collection of fluids from testes, seminal vesicles, prostate gland and bulbourethral glands. Semen is discharged during sexual act and the process of discharge of semen is called **ejaculation.**

Testes contribute sperms. Prostate secretion gives milky appearance to the semen. Secretions from seminal vesicles and bulbourethral glands provide mucoid consistency to semen.

At the time of ejaculation, human semen is liquid in nature. Immediately, it coagulates and after some time it becomes liquid once again **(secondary liquefaction).**

Fibrinogen secreted from the seminal vesicle is converted into a weak **coagulum** by the clotting enzymes secreted from prostate gland. Coagulum is liquefied after about 30 minutes, as it is lysed by fibrinolysin produced in prostate gland.

When semen is ejaculated, the sperms are nonmotile due to the viscosity of coagulum. When the coagulum dissolves, the sperms become motile.

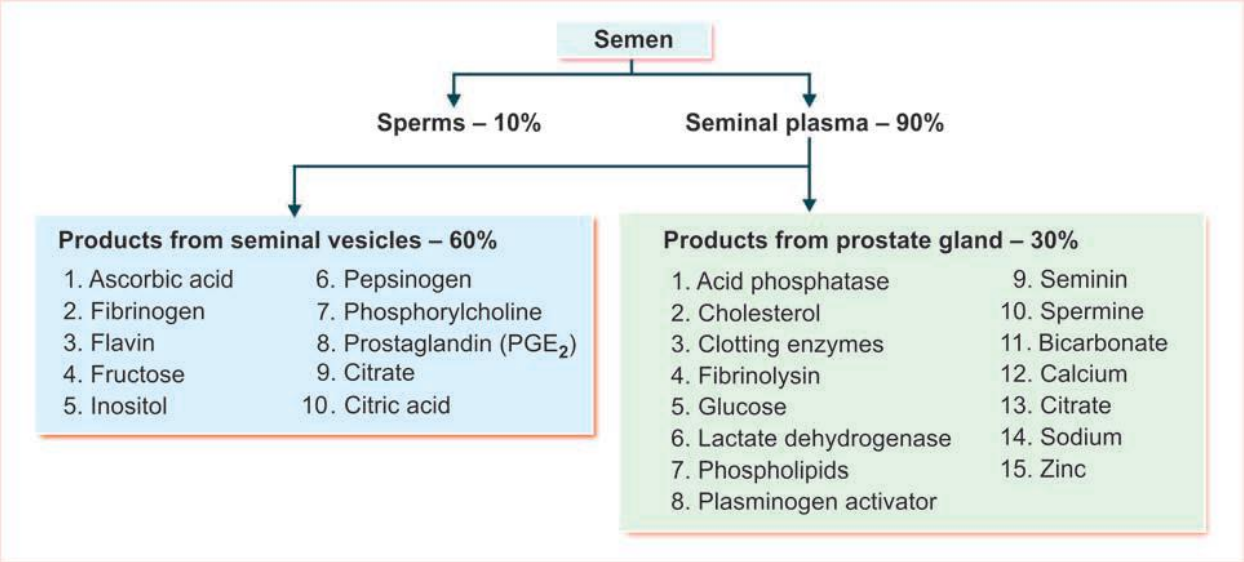
PROPERTIES OF SEMEN

1. Specific gravity: 1.028
2. Volume: 2 mL to 6 mL per ejaculation
3. Reaction: It is alkaline with a pH of 7.5.

Alkalinity is due to the prostate fluid.

COMPOSITION OF SEMEN

Semen contains 10% sperms and 90% of fluid part, which is called **seminal plasma.** Seminal plasma contains the products from seminal vesicle and prostate gland . It also has small amount of secretions from the mucus glands, particularly the bulbourethral glands.



The Sperm is the **male gamete (reproductive cell),** developed in the testis. It is also called **spermatozoon** (plural =spermatozoa). It is necessary for fertilization to occur. Matured sperm is 60 μ long.

Minimum required qualities of semen for fertility are:

1. Volume of semen per ejaculation must be at least 2 mL
2. Sperm count must be at least 20 million/mL
3. Number of sperms in each ejaculation must be at least 40 million

4. 75% of sperms per ejaculation must be alive

5. 50% of sperms must be motile

6. 30% of sperms must have normal shape and structure

7. Sperms with head defect must be less than 35%

8. Sperms with midpiece defect must be less than 20%

9. Sperms with tail defect must be less than 20%.

Total count of sperm is about 100 to 50 million/mL of semen.

Structure of Sperm

Sperm consists of four parts

1. Head

2. Neck

3. Body

4. Tail.

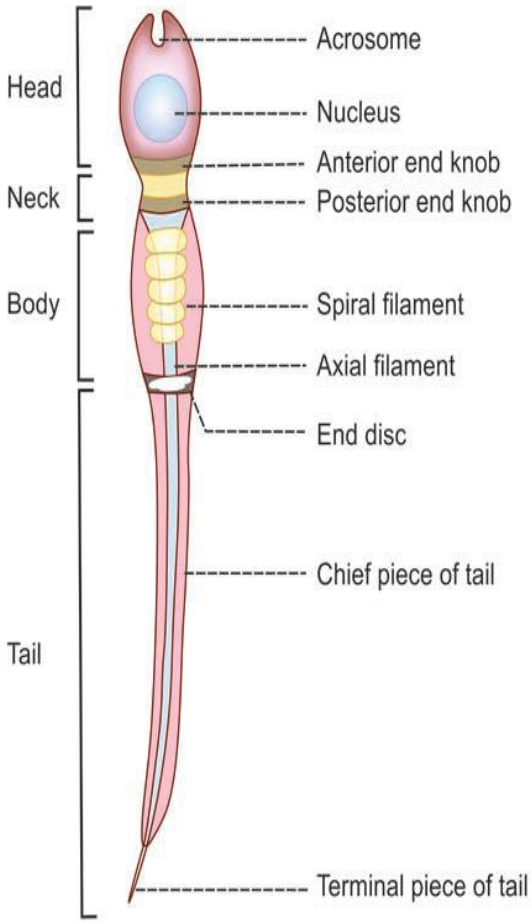
1. *Head*

Head of sperm is oval in shape (in front view), with a length of 3 to 5 μ and width of up to 3 μ. Anterior portion of head is thin. Head is covered by a thin cell membrane and it is formed by a condensed nucleus with a thin cytoplasm.

Anterior two thirds of the head is called **acrosome** or **galea capitis.**

Acrosome is the thick cap like anterior part of sperm head. It develops from Golgi apparatus and it is made up of mucopolysaccharide and acid phosphatase.

Acrosome also contains hyaluronidase and proteolytic enzymes, which are essential for the sperm to fertilize the ovum.



2. *Neck*

Head is connected to the body by a short neck. Its anterior end is formed by thick disk-shaped anterior end knob, which is also called **proximal centriole.** Posterior end is formed by another similar structure known as **posterior end knob.** It gives rise to the **axial filament** of body. Often, the neck and body of sperm are together called **midpiece**

3. *Body*

Body is cylindrical with a length of 5 to 9 μ and the thickness of 1 μ. The body of the sperm consists of a central core called **axial filament,** covered by thin cytoplasmic capsule. Axial filament starts from posterior end knob of the neck. It passes through the body and a perforated disc called **end disk** or **end ring centriole.** Finally, the axial filament reaches the tail as **axial**

thread. In the body, the axial filament is surrounded by a closely wound spiral filament consisting of mitochondria.

4. Tail

Tail of the sperm consists of two segments:

i. *Chief or main piece:* It is enclosed by cytoplasmic capsule and has an axial thread. It is 40 to 50 μ long

ii. *Terminal or end piece:* It has only the axial filament.

- **SPERMATOGENESIS**

  Spermatogenesis is the process by which stem cells develop into mature spermatozoa. The testes are composed of numerous thin, tightly coiled tubules known as the seminiferous tubules; the sperm cells are produced within the walls of the tubules. Within the walls of the tubules, also, are many randomly scattered cells, called Sertoli cells, that function to support and nourish the immature sperm cells by giving them nutrients and blood products. One immature sperm cell takes as long as 74 days to reach final maturation, and during this growth process there are intermittent resting phases.

The seminiferous tubules, in which the sperm are produced, constitute about 90 percent of the testicular. The immature cells (called spermatogonia) are all derived from cells called stem cells in the outer wall of the seminiferous tubules. The stem cells are composed almost entirely of nuclear material. (The nucleus of the cell is the portion containing the chromosomes). A single Sertoli cell extends from the basement membrane to the lumen of the seminiferous tubule although its cytoplasm is difficult to distinguish at the light microscopic level.

They are characterized by the presence of a vesicular, oval, basally positioned nucleus which contains a prominent nucleolus. The nuclear envelope often contains a definite fold. The significance of the very close association of the two types of cells is unknown. Sertoli cells are endocrine cells - they secrete the polypeptide hormone, inhibin. Inhibin acts at the level of the pituitary to reduce the secretion of follicle stimulating hormone.

There are three phases:

(1) Spermatocytogenesis (Mitosis)

(2) Meiosis,

(3) Spermiogenesis.

1. Spermatocytogenesis (also called Mitosis)

Stem cells (Type A spermatogonia) divide mitotically to replace themselves and to produce cells that begin differentiation (Type B spermatogonia). Spermatogonia have spherical or oval nuclei, and rest on the basement membrane.

2. Meiosis: Cells in prophase of the first meiotic division are primary spermatocytes. They are characterized by highly condensed chromosomes giving the nucleus a coarse chromatin pattern and an intermediate position in the seminiferous epithelium. This is a long stage, so many primary spermatocytes can be seen. Primary spermatocytes go through the first meiotic division and become secondary spermatocytes. The cells quickly proceed through this stage and complete the second meiotic division. Because this stage is short there are few secondary spermatocytes to be seen in sections. You are not responsible for identifying secondary spermatocytes in lab. Meiosis is the process by which the diploid number of chromosomes present in spermatogonia (the stem cells) is reduced to the haploid number present in mature spermatozoa. The products of the second meiotic division are called spermatids. They are spherical cells with interphase nuclei, positioned high in the epithelium. Since spermatids go through a metamorphosis into spermatozoa, they occur in early through late stages.

3. Spermiogenesis Is a process of metamorphosis from a round cell with typical organelles to a highly specialized, elongated cell well adapted for traversing the male and female reproductive tracts and achieving fertilization of an egg . No further mitosis or meiosis occurs. During spermiogenesis, the acrosome forms, the flagellar apparatus forms, and most excess cytoplasm (the residual body) is separated and left in the Sertoli cell. Spermatozoa are released into the lumen of the seminiferous tubule. A small amount of excess cytoplasm (the cytoplasmic droplet) is shed later in the epididymis.

Due to the Interaction at all stages of differentiation, the spermatogenic cells are in close contact with Sertoli cells which are thought to provide structural and metabolic support to the developing sperm cells.

The secondary sperm cell still must mature before it can fertilize an egg; maturation entails certain changes in the shape and form of the sperm cell. The nuclear material becomes more condensed and oval in shape; this area develops as the head of the sperm. The head is covered partially by a cap, called the acrosome, which is important in helping the sperm to gain entry into the egg. Attached to the opposite end of the head is the tailpiece. The tail is derived from the secondary sperm cell's cytoplasm. In the mature sperm, it consists of a long, slender bundle of filaments that propel the sperm by their undulating movement. Once the sperm has matured, it is transported through the long seminiferous tubules and stored in the epididymis of the testes until it is ready to leave the male body.