Spermatogenesis

Spermatogenesis is the basic process of male reproduction, resulting in the production of spermatozoa from the spermatogonia. It is carried out in the seminiferous tubule of the adult testis and comprises three main processes.

1- Initially, undifferentiated spermatogonia undergo a period of mitotic, multiplication, divisions **(spermatocytogenesis),** followed by :
2- Meiotic reduction of the diploid to haploid genome **(meiosis).**
3- Finally, the post meiotic cells undergo the morphological transformation of **spermiogenesis,** resulting in the release of formed spermatozoa into the lumen of the tubule.

- The basement membrane of the seminiferous tubule is surrounded externally by fibroblasts and myoid cells. The blood supply is limited by the basement membrane and does not pass into the tubule itself.
- Within the tubule there are somatic Sertoli cells and the various stages of the seminiferous cell line, which together form the seminiferous epithelium.
- Sertoli cells rest upon the basement membrane, but extend through the entire thickness of the seminiferous epithelium, so that the germinal cells in all stages of spermatogenesis are in contact with the plasmalemma of Sertoli cells.
- Sertoli cells are irregularly cylindrical in shape, with large, variably shaped nuclei situated close to the basement membrane. They multiply during fetal and prepubertal life, with the full complement being present at the time of puberty. Sertoli cells secrete oestrogens, inhibin, and tubule fluid.
- The cells are joined by specialized tight-cell like junctions, so that the seminiferous epithelium is separated into apical and basal compartments by the **blood–testis barrier** formed by these junctions.
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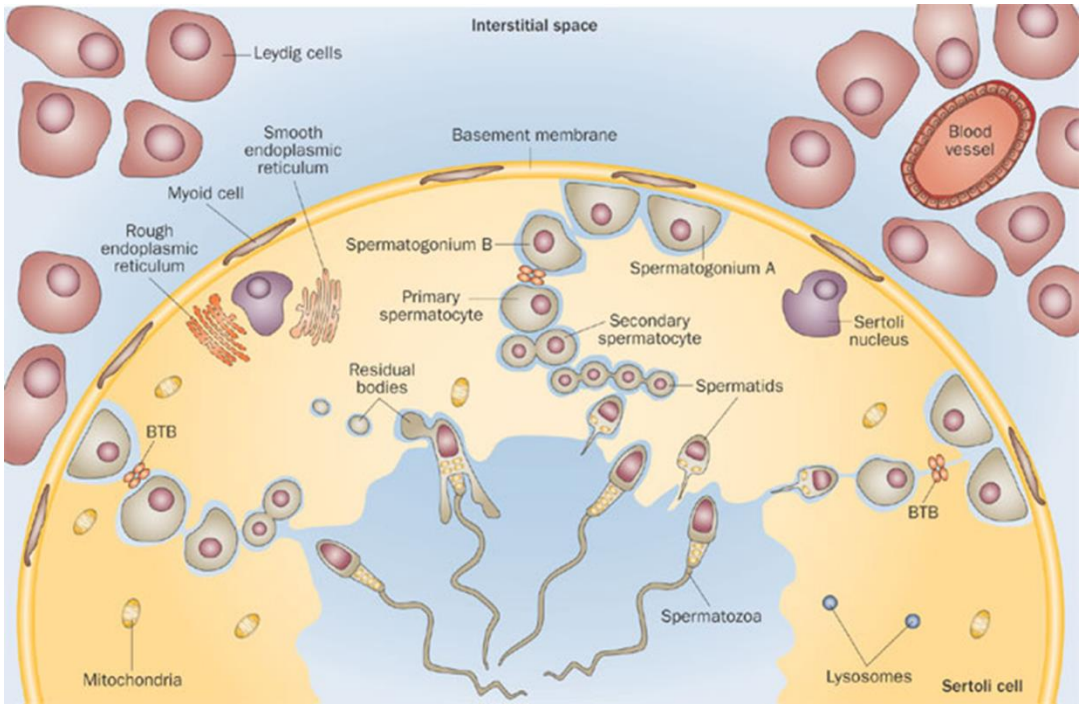


- In the mature animal, spermatogonia are divided into A, intermediate and B classes, with each class further subdivided according to morphology and degree of differentiation. Thus, in the ram, A0, A1, A2, A3, intermediate, B1 and B2 spermatogonia occur.
- **A-series spermatogonia are the least differentiated and form the reservoir of stem cells within the seminiferous tubule. It is likely that stem cells are regenerated by asymmetrical divisions of early A-series spermatogonia; with one daughter cell remaining as an uncommitted stem cell, the other being committed to undergo further mitotic and meiotic divisions.**
- An important part of the proliferation phase is **stem cell renewal.** Some spermatogonia revert back to a more primitive type of spermatogonia thus providing continual replacement (renewal) of stem cells from which new spermatogonia can be derived. The second
- During the first meiotic division, the cells move deeper into the seminiferous epithelium and the tight cell junctions of the Sertoli cells form

beneath the spermatocytes and degenerate above them, so that the cells effectively pass through the blood–testis barrier. Thus, the progeny of the first meiotic division, the secondary spermatocytes, move from the basal to the apical compartment of the seminiferous epithelium and are thereafter separated from the general tissue fluid compartment.

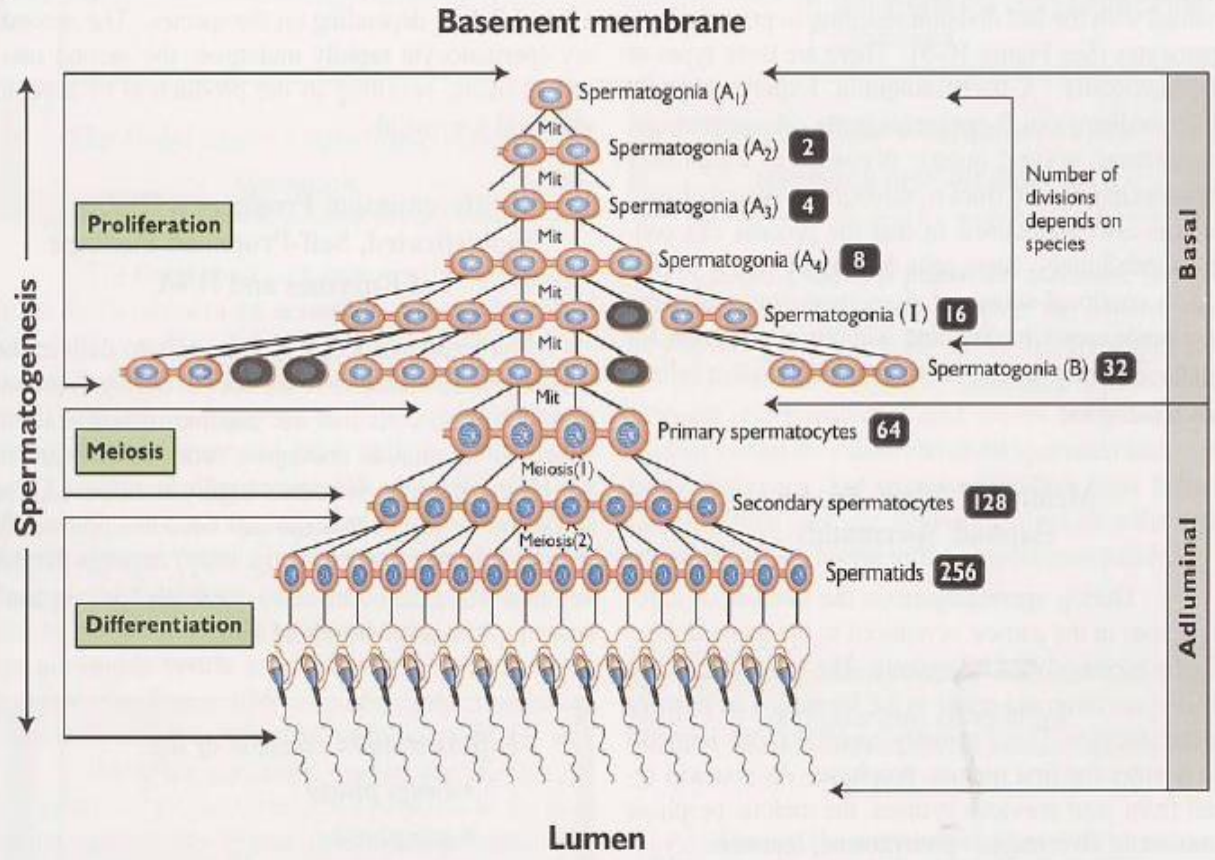
- The second meiotic division produces spermatids, which do not divide further.
- The spermatids there after differentiate into spermatozoa. At the end of meiosis, spermatids are round cells with round nuclei, which have to then undergo the very marked changes in cell function and morphology that occur during **spermiogenesis.**
- After the spermatozoa formed, it will be leaved the seminiferous tubule and become freely inside the lumen, this process called the **spermiation (**The process in which the mature spermatozoa are released from th**e** protective Sertoli cells into the lumen of the seminiferous tubule) .
- The duration of spermatogenesis, i.e. the time between spermatogonial divisions and the release of the spermatozoa, is approximately 60 days in most domestic animals. Epididymal transit takes a further 8–14 days. Thus, the interval between the most sensitive stage of spermatogenesis, meiotic prophase, and ejaculation, is approximately 30 days. Hence, the interval between damage to the testis and the appearance of abnormal spermatozoa in the ejaculate is generally between 30 and 60 days, depending upon the site of damage.

Home work

Explain: During spermatogenesis the primary spermatocyte (diploid genome) undergo to two process of meiosis to produce spermatid with haploid genome.

Figure 10-5. Typical Sequence of Spermatogenesis in Mammals

Spermatogonia (A_1-A_4, I and B) undergo a series of mitotic divisions (Mit) and the last mitotic division gives rise to primary spermatocytes that enter meiosis. This series of mitotic divisions allows for continual proliferation of spermatogonia and replacement of A_1 spermatogonia.



After meiosis, haploid spherical spermatids differentiate into spermatozoa. Meiosis and differentiation take place in the adluminal compartment. Notice that each generation of cells is attached by intercellular cytoplasmic bridges. Thus, each generation divides synchronously in cohorts. Some cells (black) degenerate during the process. Numbers indicate the theoretical number of cells generated by each division.

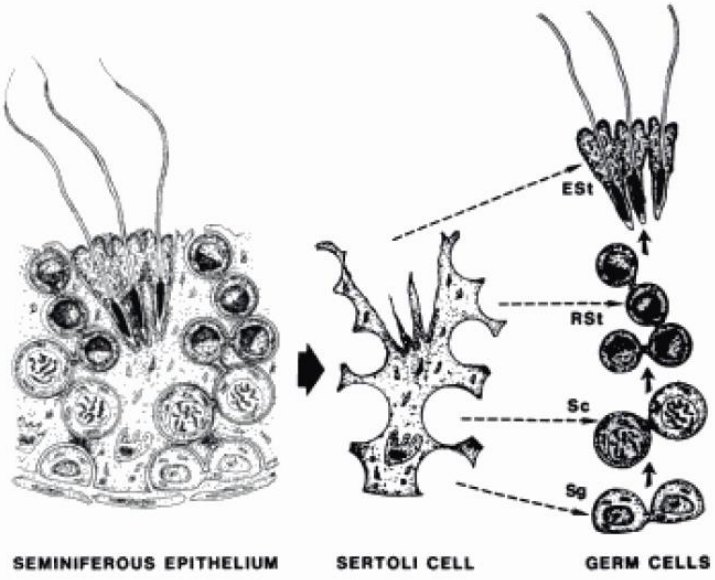


FIGURE 7-4. The seminiferous epithelium showing the complex nature of the association between Sertoli cells and the developing germ cells along with an illustration depicting dissociation of this cellular complex. The developing germ cells occupy intracellular spaces between adjacent Sertoli cells and move from the basement membrane toward the lumen during spermatogenic process. The germ cells begin their developmental process as spermatogonia (*Sg*), become spermatocytes (*Sc*), then round spermatids (*RSt*) and finally elongated spermatids (*ESt*). Schematic dissociation of the seminiferous epithelium shows how the germ cells occupy the expanded intercellular spaces between adjacent Sertoli cells. (Adapted from Fawcett DW. In: Mancini RE, Martini L, eds. Male Fertility and Sterility. New York: Academic Press, 1974.)

- Meiosis
- Sertoli cells
  - Nourish and "clean"
  - Secrete testicular fluid
    - androgens
- Tight junction
  - Blood-testis barrier
  - prevents sperm antigens from the immune