

Exercise 4 Mammalian Oogenesis

Transverse section of the cat's ovary will be used for comparison with the frog's ovary. A cursory or LPO view of the ovary will reveal that it is quite different in many aspects from that of the amphibian ovary. Foremost is the absence of the oogonia in the matured ovary since they have been transformed into oocytes and arrested at diplotene stage of meiosis. Thus, the cells that will be observed are either in various stages of growth or undergoing degeneration and a few ova or one matured ovum.

The mammalian oocytes are always associated with concentric layers of cells and together, they constitute the so-called *ovarian follicle*. Other cells are in different stages of natural degeneration called *atresia*. They present various forms and are named accordingly. The most complex, usually the largest and multilayered, is the matured ovum called the *Graafian Follicle*. The detailed structures of the cells are best studied under HPO.

Identify the following parts and cells:

1. Germinal Epithelium – a layer of simple cuboidal epithelium covering the ovary.
2. Tunica Albuginea – thick layer of connective tissue beneath the germinal epithelium.
3. Cortex – outer peripheral region of the ovary containing the smaller oogenic cells.
4. Medulla – inner central region of the ovary where cells are larger and with an abundant stroma.
5. Stroma – region of connective tissues which surround and embed the cells.
Blood vessels and nerves may be seen along with them especially in the medulla.
What cells are predominant in this region?
6. Primordial Follicle – clusters of small rounded cells just beneath the tunica albuginea. They are separated from other clusters of cells by a small amount of stroma. A closer scrutiny under HPO would reveal that it is composed of two cell types, namely:
 - A. Primary Oocyte – large central cell with an eccentric nucleus, i.e., at the periphery and one or two large nucleoli. The cytoplasm is stained lighter than the nucleus.
 - B. Follicular Cells – a single layer of flattened cells around the oocyte. They are spindle shaped and have elongated nuclei. They are also called *Granulosa cells*.
7. Primary Follicle – composed of an enlarged oocyte and a single layer of follicle cells that are cuboidal in shape. They are found between the primordial follicles and other growing follicles. It is also called a unilaminar primary follicle.
8. Secondary Follicle – composed of oocyte and three to five layers of follicle cells.
 - A. Multilaminar Follicle – composed of oocyte and several layers of follicle

cells that proliferate by mitosis. The stratified granulosa cells are *cuboidal* and tightly packed. In some secondary follicles, the boundary between the oocyte and the follicle cells is marked by an amorphous material, basophilic or otherwise called the ***Zona pellucida***. It is a glycoprotein synthesized by the oocyte and the follicle cells.

B. Antral follicle – so-called due to the presence of a small cavity between the cells which coalesce to form a bigger one called the *antrum*. The oocyte at this point starts to be displaced towards the periphery as the cavity enlarges and the granulosa cells reorganize.

9. Graafian Follicle – the matured oocyte surrounded by several layers of follicle cells. It is a highly complex structure composed of :

- A. Oocyte – central cell with large cytoplasm and a nucleus surrounded by cells and the antrum.
- B. Zona Pellucida – a thick layer of glycoprotein *immediately* surrounding the oocyte. It may be stained blue or pink with H and E preparation.
- C. Corona Radiata – 2 to 3 layers of granulosa cells *outer* to zona pellucida. Some of these cells are ovulated together with the oocyte.
- D. Cumulus Oophorus – a small hillock of cells concentrated on the “lower” region of the oocyte.
- E. Antrum – a large cavity containing a fluid, *liquor folliculi*, rich in glycoproteins and steroids secreted by the follicle cells.
- F. Membrana Granulosa – several layers of columnar cells that enclosed the oocyte and the antrum. These cells are tightly packed and beneath them is the basement membrane which appears as a thin ring around the cells.
- G. Theca Interna – two to three layers of small lightly stained cells with prominent nucleoli. They synthesize *androstenedione* which is converted into estrogen by the granulosa cells.
- H. Theca Externa – several layers of elongated fibroblast cells. Both theca interna and externa differentiate from the fibroblasts of the stroma and connective tissue. Together, these two layers constitute the ***theca folliculi***.

10. Atretic Follicle – ovarian follicles in different stages of development that undergo a natural process of cell death called *atresia*. The granulosa cells are detached from the basement membrane, disorganized and the oocyte may be seen free in the antrum.

11. Corpus Luteum or Yellow body – simply a folded Graafian follicle *without* the oocyte. The release of the oocyte and liquor folliculi leads to the collapse of the follicular wall. The layer of cells which make up this body are:

- A. Granulosa Lutein Cells -- derived from membrana granulosa which became bigger and lighter staining.
- B. Theca Lutein cells – theca interna cells which became smaller, fewer and basophilic. They occupy the folds of the walls of the corpus luteum.

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The corpus luteum (CL) is an ephemeral endocrine gland that synthesizes progesterone and estrogen. Active corpus luteum has bigger cells and smaller central cavity while a regressing CL has more abundant fibers than cells.

12. Corpus Albicans or White Bodies – consists of dense connective tissue, mostly collagen, that accounts for its white appearance. The remaining cells are phagocytosed by macrophages.

Label completely the ovary of a cat and the cells in it.

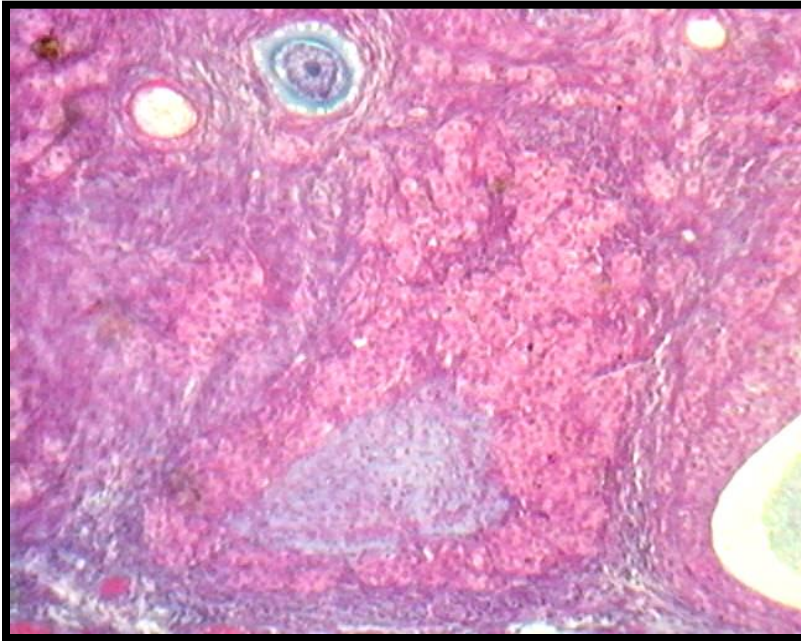


Transverse section of the cat's ovary (LPO)



Enlarged portion of the cat's ovary (HPO)

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Corpus luteum (HPO)

Questions:

1. What is the functional significance of lighter-staining cells (ex. granulosa lutein cells) from those of darker staining- cells (theca lutein cells)?
2. Differentiate a primary from a secondary follicle in terms of its histological appearance.
3. Of what importance is the liquor folliculi to the oocyte?
4. Why are atretic follicles more numerous than the other cells? What are the causes of atresia?

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