

Ovulation in domestic females

Ovaries(single is ovary) : are paired organs that serve both a gametogenic and endocrine Function . This dual role is complementary and necessary for successful reproduction . Mammalian ovary is covered by single layer of cuboidal or columnar cells called the **germinal epithelium** . This layer covers the entire ovary except in the mare where is limited to ovulation fossa .

Beneath the germinal epithelium is the **tunica albuginea** and then the **cortex** , where the large mass of **follicles** are located .

From the morphologic point of view , the ovarian follicles may be classified in three major groups :

- 1- **Primordial follicles** .
- 2- **Growing follicles** .
- 3- **Graafian follicles** .

1- Primordial (primary) follicles :these follicles consist of an oocyte surrounded by a single layer of epithelial , flattened granulose cells with irregularly shaped nuclei , theca cells are not present at this stage of folliculogenesis . These follicles lack a distinct vasculature .

The ovary of heifer may contains as many as 150.000 of these follicles , the number of primordial follicles decreases to as few as 1.000 in cow by 15 to 20 years of age .

2- Growing follicles : Are follicles that have left the resting stage as primordial follicles and have begun growth . But have not yet developed a thecal layer or antrum (cavity) .

A growing follicle is characterized as developing two or more layers of granulose cells surrounding the oocyte . With continued growth , additional layers of granulose cells appear to surrounding the oocyte.

By onset of puberty as many as 200 growing follicles may be present in the ovary of heifer . A zona pellucida surrounding the oocyte may be seen in this stage.

3- Graafian follicles (vesicular follicles) : Are follicles in which an antrum is clearly visible , the graafian follicle protrudes from the surface of the ovary , the oocyte rests in a nest of granulose cells which is called **cumulus oophorus**, oocyte in this stage is surrounded by the **zonapellucida**. zonapellucida is a glycoprotein layer which also surrounded by the inner layer of granulose cells is called **corona radiata**.

Two layers of theca cells ,**theca externa** and **theca interna** are now discernible,and together with granulose cells, form the wall of follicle.

Theca externa formed by myoid- type (muscle) cells and fibrocytes . Is the outermost layer of the follicular wall . These myoid cells containing actin and myocin suggesting a role in follicular contractility. Theca interna is formed by ovarian fibrocytes and stroma cells. the innermost layer of the follicular wall is formed by granulose cells which separated from the theca cells by a well- defined **basal lamina or basement membrane**. The cumulus cells maintain contact with the oocyte , even as the follicular fluid fills the antrum and eccentrically displaces the oocyte . The follicular fluid which is viscous originates from the peripheral plasma by transudation across the follicle basement membrane and accumulates in the antrum .

The capillary bed , confined to the thecal layer , develops around the follicle as the thecal cells are formed . These thecal capillaries increase in size and concentrate in the thecal interna in close proximity to the basement membrane . Blood flow through these capillaries also increase as the follicle matures.

The ovarian follicle as a functional unit:

The ovarian follicle is a structural and functional unit which produces steroid hormones (estrogens) , peptide hormones including inhibins. Other factors such as activin and follistatin. The follicle provides a chemical and physical microenviroment , including lower temperature than the somatic temperature , for the oocyte growth and maturation.

Ovulation process:

Ovulation is defined as the discharge of the egg from the graafian follicle.It involves the breakdown of the wall of the ovarian follicle and the release of its contents including the maturing oocyte .**ovulation process includes these following steps:**

- 1- The granulose cells lose cell to cell contact as the follicle approaches ovulation.
- 2- Hemorrhagic areas developing in the vascular network of the follicular membrane , and there is extravasation of blood into follicular fluid near the time of ovulation.
- 3- The connective tissue of the thecal layers dissociates during the preovulatory period and the outer thecal layers separate during the final preovulatory changes.
- 4- An a vascular stigma or papilla is recognizable as a protrusion on the apical surface of the follicle when ovulation is imminent.
- 5- As the protrusion of the papilla progresses , the layers of the follicular wall , including the adjacent superficial epithelium of the ovary , stretch and thin until the follicular wall breaks and the follicular contents released .
- 6- The contraction of myoid elements in the follicular wall may be a contributing factor to dissociate the thecal tissue at the stigma and to provide the force for the mechanical rupture of the follicular wall.
- 7- Cumulus cells actively secrete glycoproteins , which form a viscous mass enclosing the oocyte and its corona , and after follicular rupture the viscous mass spreads at the ovarian surface to facilitate the pickup of the oocyte by the infundibulum of oviduct.

Role of Luteinizing Hormone(L.H.) in ovulation process:

In the domestic species .exception of the mare , ovulation occurs within 24to 40 hours following the ovulatory surge of L.H .

A mature follicle possesses the appropriate hormone receptors needed to respond to an ovulatory surge of L.H , the theca fibroblasts are in a quiescent phase of activity before the ovulatory surge of L.H. , these fibroblasts secrete a procollagenase which must be activated to collagenase . L.H.stimulation rapidly accelerates steroidogenic activity in the theca interna. the rising levels of steroids particularly estradiol 17Beta serve to transform the fibroblasts from the quiescent to proliferative state. These proliferating fibroblasts produce collagenase which in turn initiates collagenolysis of the follicular wall (**enzymatic decomposition of the collagen content of the follicular wall structure**)resulting in ovulation process.

Corpus Luteum (CL) Development

Following ovulation , there is enough haemorrhage into the follicular cavity especially in the mare and cow, for a blood clot to develop, the blood filled follicle now devoid of the oocyte is commonly referred to as **Corpus Haemorrhagicum** .

This clot of blood serves as a physical framework and a nutrient medium for the rapid proliferation of granulose cells and theca cells , which by differentiating into luteal cells are mainly responsible for the secretion of progesterone and rapid development of the **Corpus Luteum** (pleural **Corpora Lutea**).

The corpus luteum is a temporary endocrine organ , which for most of domestic species acts or functions for only a few days during diestrus in the cycling and non pregnant animals, produces maximal amounts of progesterone .

If a viable embryo (s) is (are) not present in the uterus , the corpus luteum undergoes luteolysis and regresses . Luteal regression is prevented by pregnancy and the corpus luteum is maintained in the animal that becomes pregnant .

Note : The corpus luteum is termed a **Corpus LuteumVerum**(if the animal becomes pregnant) .

The corpus luteum is termed a **Corpus Luteum Spurum** (in the cycling none pregnant animal) .

According to the role of copulation in ovulation , the activity and inactivity of the resulting corpus luteum , and the associated behavioral responses of the female , it's possible to classify species into three general types which are :

1- This type is exemplified by non seasonal breeders such as cow and sow or by seasonal breeders such as mare and ewe in the breeding season . The ovulation is spontaneous , the corpora lutea automatically formed and become functional for a definite period of time. In the absence of pregnancy the corpus luteum regresses and subsequent cycle ensues.

2- The rat and mouse provide an example of this type . In which the ovulation is spontaneous but the corpora lutea are not functional unless the mating occurs .

3- This type is shown in camelidae , rabbit and cat. In these species ovulation does not occur unless the male copulates with the female. Therefore these species are commonly referred to induced ovulators .