

Insight of Process of Oogenesis

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Received: October 05, 2021

Published: October 21, 2021

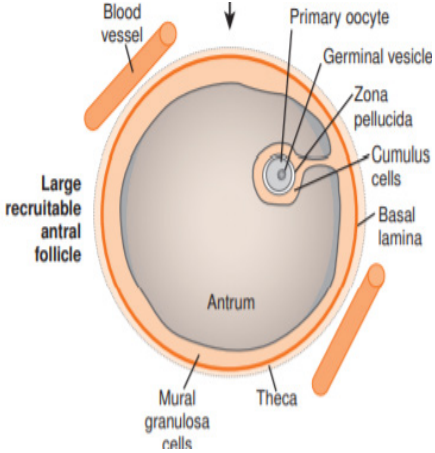
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Growth, development and functions of ovarian follicle

A sound knowledge of oogenesis help us to understand the menstrual cycle. Ovarian follicle is the functional unit of ovary.

Ovary has gametogenic and endocrinal functions. Different stages of follicle is elaborated under the following headings.

Stage of follicle	Growth and structure of follicle	State of gamete	Endocrine function of follicle
Primordial follicle	<p>Approximately 7 million oogonia is present during the midgestational period of the female fetus. Oogonia enter into the process of meiosis to form Primary oocyte</p>	Oogonia enter into the 1 st meiotic division to form primary oocyte which get arrested at the prophase due to lack of cell cycle proteins	Pregranulosa cells of Primordial follicles release paracrine factors, they do not produce ovarian steroid hormones.
Preantral follicle	<p>The first stage of follicular growth involves the pre-antral follicle. Appearance of granulosa cuboidal cells around the oocyte give rise to Primary follicle. Granulosa cell form the multilayer epithelium around the oocyte to form the Secondary follicle. Granulosa cell secrete paracrine factors that induce the stromal cells in the ovarian cortex. Induced stromal cells gets differentiated into Theca cells. Development of theca cells give rise to Preantral follicle. Follicle development is associated with inward movement of follicle from cortex to medulla of the ovary.</p>	Oocyte grow and secrete extracellular matrix glycoproteins ZP ₁ , ZP ₂ , ZP ₃ that form zona pellucida (ZP). Granulosa cells and the oocyte have the cellular extensions to maintain the junctional contact with ZP	Granulosa cell express FSH(Follicle stimulating hormone) receptor and theca cell express LH(Luteinizing hormone) receptor

<p>Antral follicle</p>	<p>Fluid filled space appears between the cells of granulosa epithelium and they coalesce to form Antrum. The size of antrum increases to the diameter of 2 - 5mm. Formation of antrum form two type of granulosa cells.</p> <p>Mural granulosa (Stratum granulosum): Outer wall of follicle Highly steroidogenic Remain in the ovary and gets differentiated into corpus luteum after ovulation</p> <p>Cumulus (Corona radiata): Inner cell surrounding the oocyte Released along with the oocyte during ovulation</p> 	<p>Oocyte grow and synthesize sufficient cell cycle components needed to complete 1stmeiotic division. Meiotic arrest is maintained till the LH surge of menstrual cycle</p>	<p>Theca cell with LH receptor acted upon by LH to produce androgens (Androstenedione and Testosterone). Androgens diffuse into the granulosa cell where Estrogens are produced from androgens in the presence of Aromatase enzyme that gets activated by FSH which act on granulosa cell</p>
<p>Dominant follicle</p>	<p>20 antral follicles in both the ovary of size 2 - 5mm in diameter is recruited and rapidly grows to form the dominant follicle. Only one follicle with large number of FSH receptor become dominant follicle. Dominant follicle will be of size 20mm in diameter with 50 million granulosa cells</p>	<p>Oocyte continue to grow at the slower rate to attain a diameter of 140µm</p>	<p>In addition to the hormones produced by the antral follicle. FSH induces expression of LH receptors on mural granulosa cell. Granulosa cell become responsive to both FSH and LH; thus they will respond to LH surge. FSH induces the expression of Inhibin B in the Granulosa cell</p>

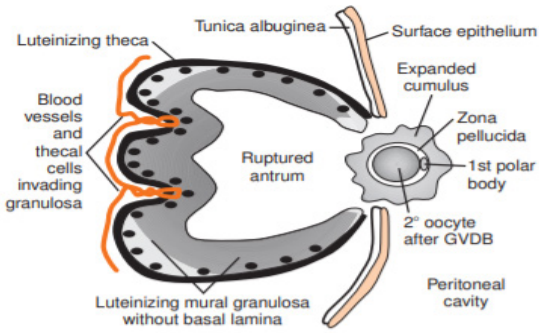

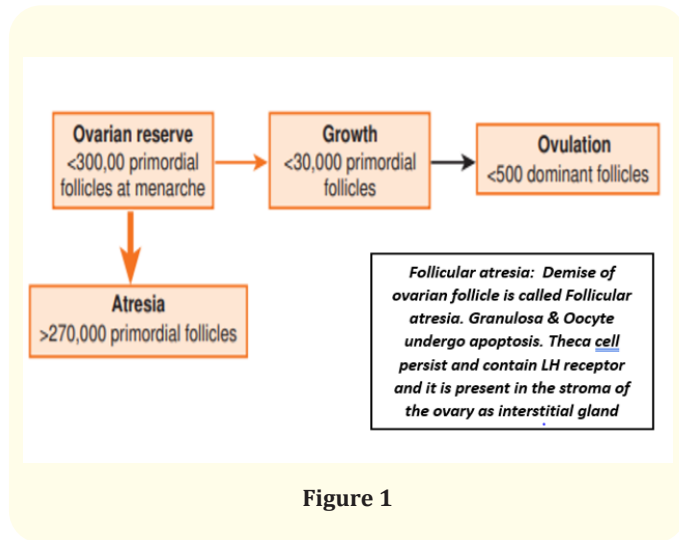
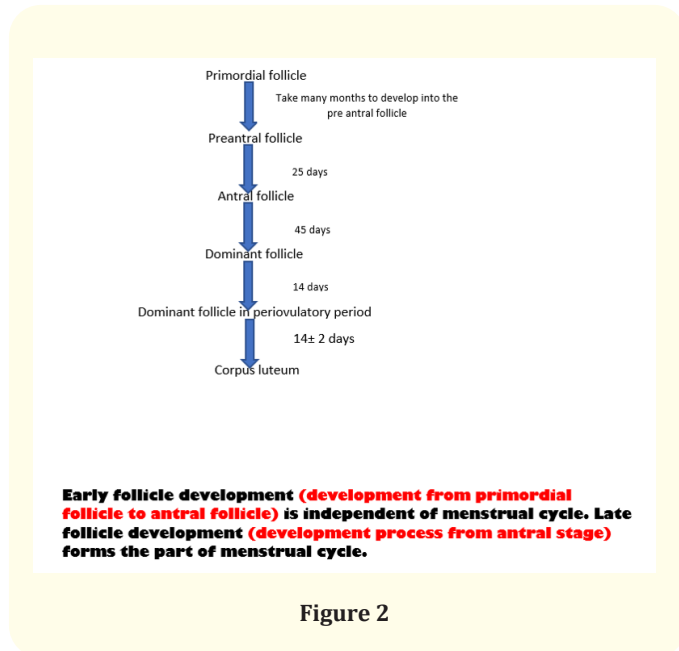
<p>Dominant follicle in periovulatory period (Time from the onset of LH surge to expulsion of cumulus - oocyte complex)</p>	<p>Large preovulatory follicle press against the ovarian surface generating a poorly vascularized bulge on the ovarian wall called stigma.</p> <p>At the time of LH surge inflammatory cytokines and hydrolytic enzymes are produced from the Theca and Granulosa cells which cause breakdown of follicle wall, Tunica albuginea and surface epithelium so that antral cavity become continuous with peritoneal cavity.</p> <p>LH surge also induces oocyte to release TGF (Transforming growth factor). TGF stimulate cumulus cells to secrete hyaluronic acid that cause cumulus expansion so that it can be easily captured and transported</p> <p>Cumulus - oocyte complex gets detached from the granulosa cells and floats freely in the peritoneal cavity</p> <p>Basal lamina of mural granulosa cell degrades. Outer lying theca and blood vessels is pushed into the granulosa cells. The granulosa cells secrete angiogenic factors which will increase the blood supply to corpus luteum that is to be formed after the ovulation.</p> 	<p>Before ovulation primary oocyte becomes competent to complete 1st meiosis to form secondary oocyte and polar body. Secondary oocyte gets arrested at metaphase of 2nd meiotic division until fertilization</p>	<p>Theca and mural granulosa cells express LH receptors. LH act on the granulosa cells to cause differentiation of granulosa cells to corpus luteum. Expression of aromatase enzyme that get activated by FSH is reduced as the granulosa cell is now predominantly acted upon by LH. There is transient reduction in estrogen synthesis as estrogen is reduced the positive feedback mechanisms of estrogen that induce LH surge in the mid menstrual cycle is also lost. LDL and HDL cholesterol that gain access to the granulosa cell to form progesterone as a major hormone</p>
<p>Corpus luteum</p>	<p>After ovulation the antral cavity gets filled with blood from the damaged blood vessels and form corpus haemorrhagicum (CH). The RBC debris of CH is removed by macrophages and is filled with fibroblast and extra cellular matrix (ECM) to create corpus luteum.</p> <p>Corpus luteum is viable throughout the pregnancy if it is rescued by LH-like hormone, human chorionic gonadotropin (HCG), that originates from an implanting embryo.</p> <p>Corpus luteum of menstruation regresses by 14th day after ovulation to form scar-like body called the corpus albicans, which sinks into the medulla of the ovary and is slowly absorbed.</p> 	<p>No gamete</p>	<p>Progesterone production is increased after LH surge and reaches the peak by mid luteal phase of menstrual cycle. Uterus is prepared to receive the developing embryo during this phase.</p> <p>Estrogen production that is transiently reduced after 3 days of LH surge also reaches the peak during mid luteal phase.</p>

Table 1

Fate of ovary reserve in women



Duration of the process of oogenesis



Volume 3 Issue 11 November 2021

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