



# Advancements of Ovarian Follicle in Biotechnology and Biological Aspects

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## DESCRIPTION

Ovarian follicle growth and development need a coordinated series of actions that cause morphological and functional changes within the follicle, which then result in cell differentiation and egg formation. The shift between the preantral and early antral follicle stages occur when the follicle begins to expand or atresize and gonadotropin dependency is achieved. During this time, interactions between oocytes and granulosa cells strictly control follicular growth. Normal folliculogenesis requires a group of early-expressed genes. Theca cells are recruited from cortical stromal cells by granulosa cell factors. Thecal factors inhibit granulosa cell death and enhance granulosa cell growth. Interactions between cells and the extracellular matrix have an impact on how growth factors are produced in various follicular compartments (oocyte, granulosa, and theca cells). Many autocrine and paracrine substances play a role in follicular growth and differentiation; they are active even during ovulation, reducing gap junction communication and promoting the proliferation of theca cells. Additionally, figuring out what influences follicular development from the preantral stage to the tiny antral stage may be crucial for developing assisted reproductive procedures.

The production of intrafollicular estradiol, which is essential for follicular function, as well as the expression of key genes crucial for thecal, granulosa, and cumulus cell differentiation, function, and survival in the three largest follicles growing during follicular waves, have recently been shown to be significantly altered by the naturally high variation in follicle numbers during follicular waves. The follicle is an ovarian structure that serves two primary purposes: producing hormones and developing fertile oocytes. These tasks are performed by antral follicles, which have separate basal laminae and an inner wall made of granulosa cells. This particular extracellular matrix controls the granulosa cells' ability to proliferate and differentiate while separating the epithelium layer from the connective tissue.

Mammalian oocytes grow and attain ovulatory maturity within the follicles. The oocyte is a component of a follicle, which is made up of pregranulosa or granulosa cells. Between three and six

weeks after conception, the embryo begins to develop its ovary. During this time, a variety of cellular processes occur, including the massive colonisation of the ovary with mesonephric cells, which are thought to be one of the precursors of the follicle cells, migration of the primordial germ cells into the genital ridge, gonadal sex differentiation, mitosis, and apoptosis of the germ cells. In domestic animals and primates, follicular development and atresia already start during foetal life.

The development of germ cells occurs in a number of stages. The yolk sac is where Primordial Germ Cells (PGCs) are produced; the vaginal ridge is where PGCs migrate; The PGCs colonise the gonads; they differentiate into oogonia; they proliferate in the oogonial tissue; the meiotic process begins; and they are arrested at the diplotene stage of the meiotic prophase.

The oocyte is currently thought to be crucial to follicular organisation throughout the events leading to ovulation. It is believed that the oocyte regulates the growth of granulosa cells and, eventually, their differentiation into cells that secrete hormones and proteins. Granulosa cells, on the other hand, are crucial for oocyte development, differentiation, meiosis, cytoplasmic maturation, and the regulation of transcriptional activity inside the oocyte. The oocyte secretes substances that prevent granulosa cells from promoting oocyte growth after it reaches a particular size threshold. This suggests that the oocyte indirectly controls both its own growth and the growth of the follicle in addition to the former. Each cell compartment in the follicle expresses growth factors and produces hormones in response to chemical interactions between cells and the extracellular matrix (oocytes, granulosa, and theca cells). The interactions also strengthen the distinct roles played by the follicle's germinal and somatic lines and help to coordinate the processes of oogenesis and folliculogenesis.

The characteristics of this interface are thought to be of fundamental significance for controlling oocyte development, maturation, and follicular luteinization. Therefore, the dynamic alterations at the connections between the oocyte and granulosa cells directly affect the release of autocrine and paracrine substances. Retraction of transzonal projections as a result of the

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reconfiguration of microtubule architecture in response to stimulation of granulosa cells by FSH may modulate both the factors released by the oocytes and the granulosa cells. Proteins and hormones play a role in the autocrine and paracrine processes that affect follicle development and differentiation. Although Neurotrophins (NTs) are known to play a role in the development of the primordial follicles, as evidenced by the presence of 4 of the 5 NTs, the exact mechanisms by which they do so are still not entirely understood. The central and peripheral nervous systems' neurons depend on this group of Neuronal Growth Factors (NGFs) to survive and differentiate. NGFs demonstrate a strong affinity for the ovarian tissue as well, promoting differentiation and growth of the mesenchymal primordial

follicles and granulosa cells as well as the manufacture of FSH receptors. These nonneuronal tissues include those of the immunological and cardiovascular systems. Their activity is still present during ovulation, increasing prostaglandin E2 (PGE2) release, decreasing gap junction communication, and stimulating the proliferation of theca cells. In contrast to mice, bovine and swine animals gain their ability to go through meiosis more gradually after antrum development. When compared to larger ones, bovine follicles fewer than 2 mm in diameter mature at a slower rate and are more susceptible to abnormal fertilization. Similar to this, when oocytes were acquired from follicles smaller than 6 mm, blastocyst in vitro development was reduced.