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Editorial

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Avian ovary: a unique dynamic reproductive organ

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Editorial

The ovary is a vital part of reproductive system in female birds. It's a unique organ because of its other varied distinctive adaptations from mammalian ovary. It retains single left ovary and oviduct as functional while the right one is usually rudimentary or absent. The reduced right ovary is probably related to necessity of lightweight body structure for bird's flight. However, "the why" for presence of single ovary is just presumed with examples of some other avian species and still not considerably backed scientifically. For instance, in some other avian species like kiwis (Apteryx), both ovaries are developed, but only the left oviduct is functional as these are flightless ratite birds of New Zealand that evolved from volant predecessors.[1] In ovaries of many avian species especially in migratory birds, seasonal variations are observed in which the size and activity of the ovary can change with the changing seasons.

The ovary in avians is not as compact as the mammalian ovary; however, it is demarcated into a cortex and an ill-defined medulla. The mature bird ovarian cortex and medulla are therefore intermingled, although they can be distinguished specifically in ovaries of actively egg-laying hens. Cells of the ovarian cortex are more basophilic, whereas the medullary cells are eosinophilic. The ovarian medulla mainly consists of elongated, irregularly oriented bands of smooth muscle interspersed with collagenous connective tissue and abundant fibroblast cells. The germinal epithelium on the surface of ovary overlying these follicles is simple cuboidal epithelium which changes to simple squamous mesothelium at the point where small follicles and cortical stroma are no longer present.[2] There is generally increased number of primordial follicles in ovarian hilus region. Birds have acquired an expanded cortex comprising large numbers of young oocytes surrounded by granulosa and steroidogenic cells, and a central medullary region containing largely stromal tissue.[3] These follicles are fluid-filled sacs where the oocytes (egg cells) develop. The sexually mature avian ovary contains several hundreds of white cortical follicles that vary in their diameter ranging from 1-5 mm, some small yellow follicles of 5-8 mm in diameter, and few large yellow pre-ovulatory follicles that are 9-40 mm in diameter. As the follicles mature they grow in size and each follicle can reach a diameter of upto 30 mm, containing a single developing oocyte surrounded by a single layer of granulosa cells with a thick theca interna and externa. Such mature follicles grow and eventually release an ovum (egg) during ovulation. The largest follicle is referred to as the "mature follicle" or "pre-ovulatory follicle" and is released during ovulation. These pre-ovulatory follicles are arranged in a hierarchical order that visibly demarcates the development stage of each follicle. The largest yellow follicle indicates the most mature follicle and the next in line to ovulate. The smallest follicle represents the least mature follicle and the 5th or 6th in line to ovulate. To sustain this hierarchy, a single follicle is selected from the pool of small yellow follicles every day to join the pre-ovulatory follicle hierarchy following the ovulation of the first one. Ovulation can occur daily or at regular intervals, depending on the species and environmental factors. The single ovary in them ovulate one or two oocytes every day, until the species-specific clutch size is reached.[4] An average domestic hen can produce more than 300 eggs every year which is one egg almost every 24 hours, from just one ovary. The regular cycle of egg production, however, can be influenced by numerous factors such as seasonal changes, environmental conditions, and a bird's overall health.

It is generally composed of numerous follicles at various stages of development. The ovaries in birds contain a high number of oocytes which is 480,000 oocytes approximately; present at the time of hatch. Similar to mammals, during the adult stage of the bird, only a few hundred oocytes are selected to reach maturity and ovulate. The process of recruitment from the cluster of white follicles into small yellow follicle group is also a continuous process to maintain the pool of small yellow follicles. The follicular atresia is a common phenomenon that can be observed at any stage of the follicular development. In a hen ovary, the number of viable follicles remaining at the time of sexual maturity is significantly reduced to some 12,000; though, even many of these will ultimately be lost to atresia on an on-going basis. At the beginning of the reproductive season, the ovarian follicular development is followed by atresia and reabsorption of all growing follicles in birds at the termination of breeding. Ovary produces two essential hormones such as estrogen and progesterone that regulate the development of follicle and ovulation. These hormones are produced by the ovary itself and other endocrine glands thereby control the development of follicles and the timing of ovulation.

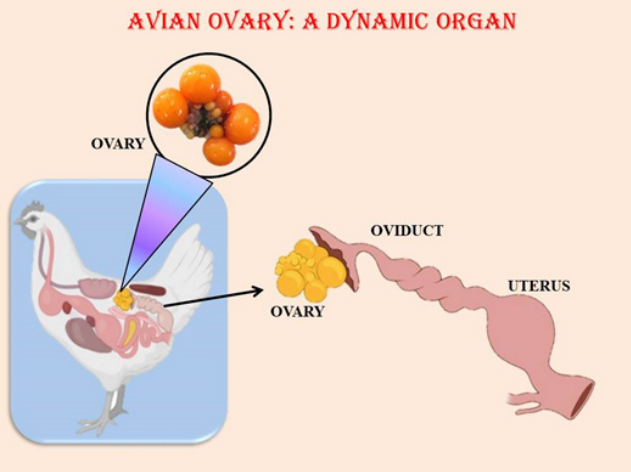

Figure1 Picture showing of ovary, oviduct and uterus and their in-situ localization in Avians.

In avians, the developing oogonia are derived from primordial germ cells (PGCs), which first appear in central region of the embryonic blastoderm.[5] Alike mammals, in birds also there are fixed number of oogonia at birth and their number reduces gradually after sexual maturity. A lot of researcher's attention has been received by oogonial stem cells (OSCs) in mammals which are the cells with regenerative capacity to produce new oocytes and it has been explored to reduce infertility concerns in them. However, they are reported to exist in both young and adult laying avian ovaries by only a few researchers. Scientists have concluded that isolated OSCs have characteristics similar to those of PGCs and embryonic stem cells. The presence of OSCs is more in the ovarian cortex than in other regions of ovary in avian species. These cells have potential of gonadal colonization and subsequent initiation of meiosis to produce oocytes. Furthermore, these OSCs can be located within 'nests' in the ovarian medulla, similar to the germ cell nests observed in other species.[6] Therefore, the identification of functional OSCs inside the adult avian ovaries unlocks novel vistas of prospects for the improvement of egg production, the conservation of endangered avian species thereby maintaining the treasure of genetic diversity as well. It can also further throw light on the basic and applied clinical of aspects of mammalian OSCs and in that way, open a plethora of ideas to work on improving fertility in both mammals and avians.

Acknowledgments

None.

Conflicts of interest

The authors declared that there are no conflicts of interest.

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