POST HATCH DEVELOPMENT OF CAPSULE, STROMA AND VENOUS SINUSES OF ADRENAL GLAND IN KUTTANAD DUCKS

R. Fathima[1], K. M. Lucy[2], N. Ashok[3] and S. Maya[4]
Department of Veterinary Anatomy and Histology
College of Veterinary and Animal Science
Mannuthy - 680651, Thrissur, Kerala

Received - 16.06.2014
Accepted - 26.09.2014

Abstract

Post hatch developmental changes of capsule and stroma of the adrenal gland in Kuttanad ducks were studied using 78 female birds from day-old to 24 weeks of age. The material was collected from six female birds in each group at fortnightly intervals. After recording the gross features, the glands were fixed and histological studies were conducted. In day-old ducklings, the glands were ensheathed by thin connective tissue capsule made up of collagen, reticular and a few elastic fibres. Numerous blood vessels, non-myelinated nerve bundles and fibroblasts were present in the capsule. Stroma composed of fine connective tissue septa which ramified from the capsule between the cords and islands of parenchymal cells. Large number of venous sinuses extended from the hilus of the gland towards the centre in day-old birds. By two weeks, the capsule became thicker and showed Herbst corpuscles and a small amount of interrenal tissue. Subcapsular venous sinuses and lymphocytes made their first appearance in this age group. At four weeks, smooth muscle cells could be identified in the capsule. By six weeks, size of the venous sinuses greatly reduced with proportionate increase in the parenchymatous tissue. Thickness of the capsule was almost doubled by 12 weeks. By 16 weeks, the parenchymatous tissue greatly expanded and subcapsular venous sinuses almost disappeared. Thickness of the capsule showed highly significant positive correlation with age and body weight.

Keywords: *Post hatch development, capsule, stroma, venous sinuses, Kuttanad ducks*

Adrenal gland is an important endocrine organ performing the vital functions of an organism. It produces multiple hormones and regulates several physiological functions. Birds are unique among vertebrates in having intermingled cortical and medullary tissue in the adrenal gland. The parenchyma of the gland is supported by the stroma which also holds the vessels, nerves, receptors and lymphatic tissue. Although extensive research has been conducted on the adrenal gland of domestic fowl and Japanese quail, information regarding the normal structure and post hatch developmental pattern of the adrenal gland in duck is scanty. Hence present study was undertaken to explore the developmental pattern of the capsule, stroma and venous sinuses of the adrenal gland in Kuttanad ducks.

Part of MVSc thesis submitted to the Kerala Veterinary and Animal Sciences University

1. *District Co-ordinator, Progeny Testing Scheme, National Dairy Plan, Kozhikkode*
2. *Professor*
3. *Professor & Head*
4. *Professor and Head, Department of Veterinary Anatomy and Histology, CVAS, Pookode*

Table 1. Thickness of adrenal capsule at different ages in Kuttanad ducks (Mean ± S.E.)

Age	Thickness of capsule (cm)
Day-old	14.04±0.27
2 weeks	18.08±0.37
4 weeks	18.96±0.54
6 weeks	23.04±2.57
8 weeks	24.50±2.39
10 weeks	27.75±1.16
12 weeks	28.42±0.52
14 weeks	28.50±0.34
16 weeks	29.50±0.34
18 weeks	29.50±0.71
20 weeks	28.00±0.90
22 weeks	28.17±0.48
24 weeks	28.17±0.40

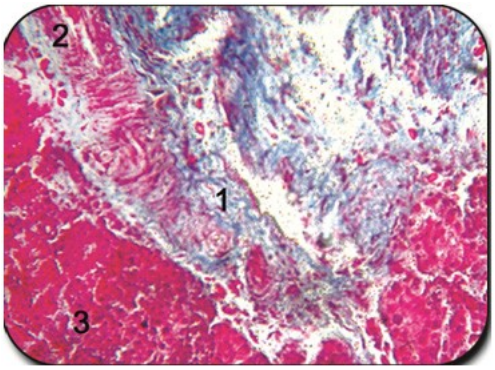

Fig. 1. Capsule with collagen fibres (day old) Gomori's one step trichrome X100

1.Collagen fibres 2. Artery 3. Parenchyma

Materials and Methods

Post hatch development of capsule and stroma of adrenal gland in Kuttanad ducks was studied using 78 female birds from day-old to 24 weeks of age. The birds were selected randomly from a single hatch and reared at the University poultry and duck farm, Mannuthy, under identical feeding and environmental conditions. Birds were divided into 13 age groups. The adrenal gland was collected from six birds at fortnightly intervals. Body weight, morphological features and position of the adrenal gland were recorded. The glands were then carefully dissected out and fixed

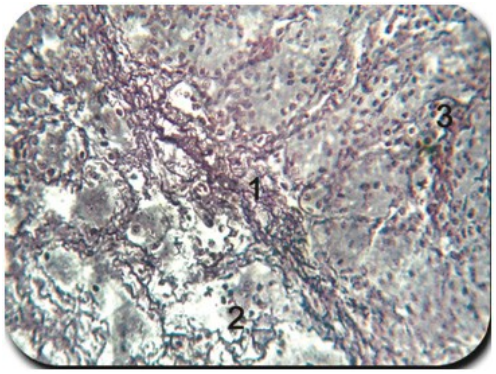

Fig. 2. C S of adrenal gland showing reticular fibres in the capsule (day old). Gridley's method x400

1. Reticular fibres in the capsule 2. Sympathetic Ganglion 3. Parenchyma

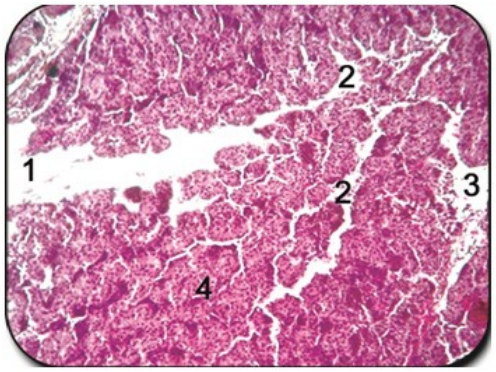

Fig. 3. CS of adrenal gland showing pattern of venous drainage (day-old) H & E X100

1.Hilus 2.Venous sinus 3.Centralvenous sinus 4. Parenchyma

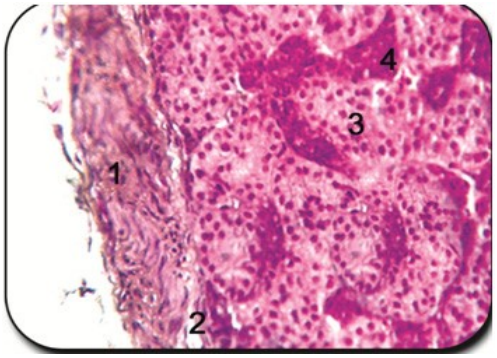

Fig. 4. C S of adrenal gland showing elongated Herbst corpuscle (2 weeks) H & E X400

in fixatives like 10 per cent neutral buffered formalin, Bouin's fluid and Formol-Dichromate at pH 4.0-4.2 (Wood, 1963). After fixation in the appropriate fixatives, the materials were processed for paraffin embedding and sections of 5 mm thickness were taken for histological studies and stained using routine and special methods.

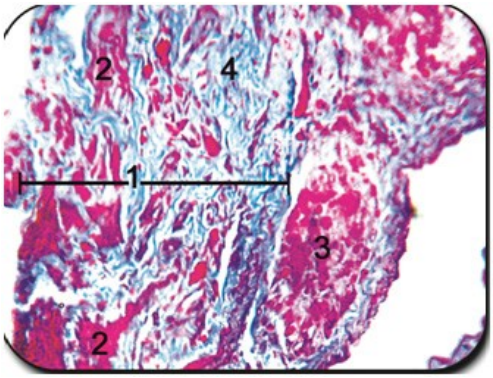

Fig. 5.C S of adrenal gland showing smooth muscle fibre in the capuscle (4 weeks) Gomori's one step trichrome X400
1. Capsule 2.Smooth muscle fibres 3.Ganglion 4. Collagen fibres

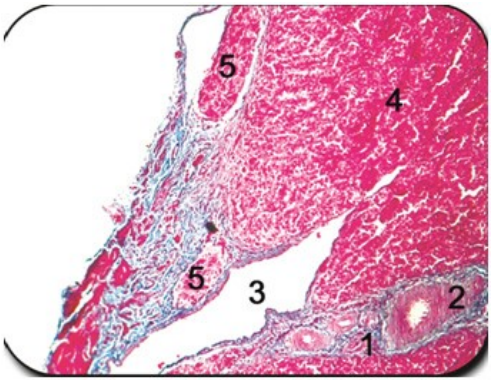

Fig. 6. L S of adrenal gland showing lobulation (4 weeks) Gomori's one step trichrome X100
1. Connective tissue septum 2. Arteries 3.Venous sinus 4. Parenchyma5.Ganglion

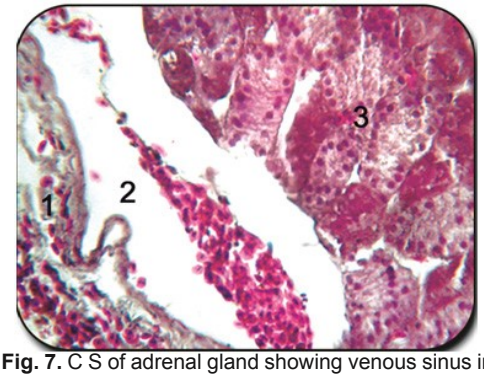

Fig. 7. C S of adrenal gland showing venous sinus in the subcapsular area (8 weeks) H & E X400
1. Capsule 2.Venous sinus 3. Parenchyma

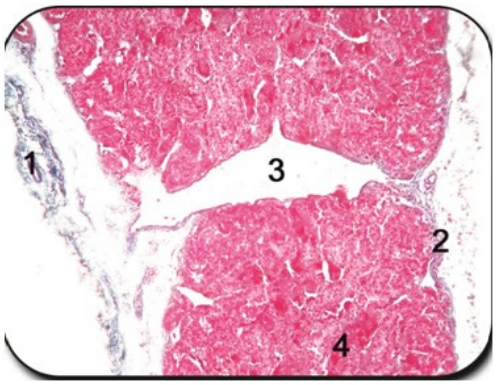

Fig 8. C S of adrenal gland showing venous sinus extending along the entire width of the gland (10 weeks)Gomori's one step trichrome X100
1. Pericapsular sheath 2.Capsule 3. Venous sinus 4.Parenchyma

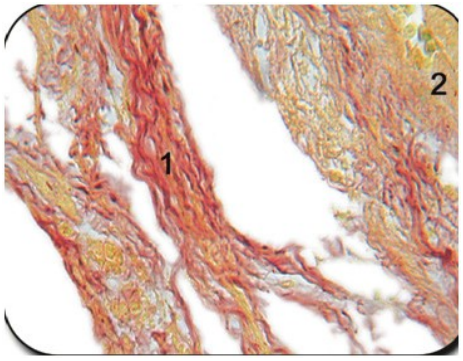

Fig 9. LS of adrenal gland showing bundles of collagen fibres (20 weeks) Van Gieson's method x 400
1.Collagen fibres in capsule 2.Parenchyma

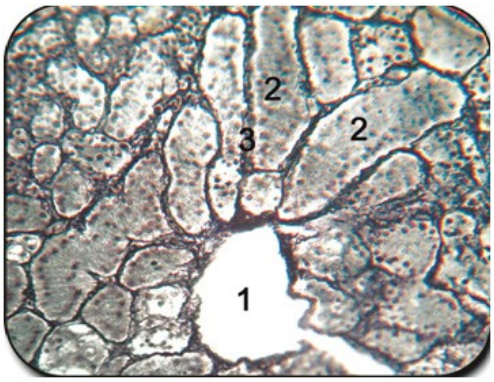

Fig 10. CS of adrenal gland showing reticular fibres in the stroma (24 weeks) Gridley's method X400
1. Venous sinus 2. Interrenal tissue 3. Reticular fibres in stroma

Results and Discussion

In day-old ducklings, the glands were ensheathed by a very thin connective tissue capsule(14.04 ± 0.27 µm) made up of collagen and reticular fibres and a very few elastic fibres (Figs.1 and 2) as observed by Hartman and Albertin (1951), Bacha and Bacha (1990) and Humayun *et al.* (2012) in fowl and Basha *et al.* (2009) in Japanese quail. Micrometrical parameters of the capsule are presented in table 1. Numerous blood vessels including capillaries

and small veins, non-myelinated nerve bundles and fibroblasts were present in the capsule. The capsule showed variable thickness at different areas depending on the structures included in it. An incomplete pericapsular sheath consisting of large nerve trunks, nerve cell bodies, receptors, lymphocytes and chromaffin cells embedded in connective tissue almost covered the capsule as reported in fowl by Hodges (1974).

Stroma of the adrenal gland was composed of fine connective tissue septa which ramified from the capsule between the cords and islands of parenchymal cells. This interparenchymal network contained collagen and fine reticular fibres. Similar findings were reported in fowl by Wells and Wight (1971), in ostrich chicks by Tang *et al.* (2009) and in emu by Rajendranath *et al.* (2012).

Large number of venous sinuses extended from the hilus of the gland towards the centre in day-old ducklings (Fig. 3). Elongated blood sinuses were found in the parenchyma that formed an anastomosing network and finally drained towards the centre of the gland. Similar observations were made by Tang *et al.* (2009) in ostrich chicks. There was a large central venous sinus at this stage.

By two weeks, the capsule became thicker and showed Herbst corpuscles and a small amount of interrenal tissue (Fig. 4). The presence of Herbst corpuscle in the capsule is reported in day-old Japanese quail by Basha *et al.* (2009). Subcapsular venous sinuses and lymphocytes made their first appearance in this age group. The venous sinuses in the peripheral zone were smaller than those in the central zone as reported by Sivaram (1965) in domestic fowl.

At four weeks, smooth muscle cells could be identified in the capsule (Fig. 5). The gland was found to be divided into two unequal parts by a connective tissue septum, which contained a large artery and its smaller divisions which continued into the glandular parenchyma (Fig. 6) as reported by Hodges (1974) in adult fowl. By six weeks, size of the venous sinuses greatly reduced with the proportionate increase in the parenchymatous tissue. About 12 to 13 large venous sinuses were found at this stage, out of which the largest sinus had the dimensions of 192.50 x 87.50 µm (Fig. 7).

At 10 weeks of age, the capsule was thicker (27.75 ± 1.16 µm) with numerous blood vessels and nerves. Adrenal was closely adherent to the ovary and both of them were separated by a very thin capsule as noted by Oglesbee *et al.* (1997). Size of the subcapsular sinuses reduced greatly at this stage. Venous sinuses were not uniformly distributed; instead, they appeared to occupy the peripheral and central regions of the gland. A large venous sinus extended along the entire width of the gland almost dividing the gland into two separate lobes (Fig. 8).

By 12 weeks, thickness of the capsule almost doubled from that of the day-old chicks. Capsule showed many nerve bundles also. The connective tissue trabeculae from the capsule traversed deep into the parenchyma. Hodges (1974) reported that numerous fine septa passed inwards from the capsule between the cords of parenchymal cells in the adrenal gland of fowl. By 16 weeks, as the parenchymatous tissue greatly expanded, the venous sinuses were much reduced in number and size. Subcapsular venous sinuses almost disappeared except at one or two regions. In the parenchyma of the gland, the number of venous sinuses reduced to five to six small channels seen towards the central portion. Subcapsular venous sinuses could not be identified at 18 weeks of age. The arteries supplying the gland divided to form numerous capillaries, which eventually drained into a network of venous sinuses passing inwards into one or more large central sinuses. These sinuses converged to an adrenal vein that transported blood to the caudal vena cava.

In 20 weeks-old birds, the connective tissue stroma became thicker and showed collagen, elastic and reticular fibres (Fig. 9) as reported by Hodges (1974) in fowl. Lymphocytes migrated from the sinusoids into the parenchyma of the gland. At 22 weeks, the pericapsular sheath presented two large Herbst corpuscles measuring 231.00 x 66.50 µm and 196.00 x 59.50 µm, respectively (Fig. 10). At 24 weeks, the gland was divided by connective tissue trabeculae into two parts and each part showed two to three large venous sinuses in the central zone. Stroma showed the typical adult pattern at this stage with fine trabeculae originating from the capsule completely outlining each interrenal cell cords. These were predominantly made up of reticular

fibres. Thickness of the capsule showed highly significant positive correlation with age (r = 0.815) and body weight (r = 0.974).

References

Bacha, W. J. and Bacha, L. M. 1990. *Color Atlas of Veterinary Histology.* (2nd ed.) Lippincott Williams and Wilkins, Philadelphia, 193p.

Basha, S. H., Kannan, T. A. and Ramesh, G. 2009. Age related changes of the adrenal gland in Japanese quail (*Coturnix coturnix japonica*). *Tamilnadu J. Vet. Anim. Sci.* **5**: 198-202.

Hartman, F. A. and Albertin, R. H. 1951. A preliminary study of the avian adrenal. *The Auk.* **68**: 202-209.

Hodges, R. D. 1974. *The Histology of the Fowl.* Academic Press, London. 648p.

Humayun, K. A. K. M., Aoyama, M. and Sugita, S. 2012. Morphological and histological studies on the adrenal gland of the chicken (*Gallus domesticus*). *J. Poult. Sci*. **49**: 39-45.

Oglesbee, B. L., Orosz. S. and Dorrestein, G. M. 1997. The endocrine system. In: *Avian Medicine and Surgery* (Altman, R. B., Clubb, S. L., Dorrestein, G. D. and Quesenberry. K. eds.), W. B. Saunders, Philadelphia, pp. 475-488.

Rajendranath, N., Babu. A. P., Ramayya, P. J., Patki, H. S. and Rao, T. S. C. 2012. Histology of the adrenal gland of emu *(Dromaiusnovae hollandiae*). *Indian Vet. J.* **89**: 56-57.

Sivaram, S. 1965. Structure and development of adrenal gland of *Gallus domesticus*. *Can. J. Zool*. **43**: 1021-1031.

Tang, L. Peng, K.M., Wang, J. X., Luo, H. Q., Cheng, J. Y., Zhang, G. Y., Sun, Y.F., Liu, H. Z. and Song, H. 2009. The morphological study on the adrenal gland of African ostrich chicks. *Tissue Cell.* **41**: 231-238.

Wells, J. W. and Wight, P. A. L. 1971. The adrenal glands. In: *Physiology and Biochemistry of Domestic Fowl.* (Bell, D. J. and Freeman, B.M. (eds.). Vol. III. Academic Press, London, pp. 489-520.

Wood, J. G. 1963. Identification and observations of epinephrine and norepinephrine containing cells in the adrenal medulla. *Am. J. Anat*. **112**: 285-303.

❑