

AGE RELATED CHANGES IN THE PARENCHYMA OF ADRENAL GLAND IN KUTTANAD DUCKS (*Anas platyrhynchos domesticus*) DURING POST HATCH PERIOD

Fathima, R., Lucy, K. M., Ashok, N. and Maya, S.

Department of Veterinary Anatomy and Histology,
College of Veterinary and Animal Sciences, Mannuthy - 680 651, Thrissur, Kerala.

Received: 4-06-2014, Accepted: 20-06-2014

ABSTRACT

The post hatch histological changes of the adrenal gland parenchyma was studied using 78 female Kuttanad ducks of different age groups ranging from day-old to 24 weeks. The parenchyma of the gland constituted three components namely, the cortical or interrenal tissue, medullary or chromaffin tissue and venous sinuses. There was no distinct demarcation between cortex and medulla. In day-old ducklings, parenchyma was composed of a homogenous mass of interrenal and chromaffin tissue. Zonation of interrenal tissue into subcapsular and inner zones was not evident in day-old birds. Chromaffin cells possessed spherical centrally placed nuclei and were larger than that of the interrenal cells. From two weeks onwards, the proportion of interrenal and chromaffin tissue increased and adrenal parenchyma was divisible into three indistinct zones viz. the subcapsular zone, inner zone and central zone. The inner zone was about twice thicker than the subcapsular zone in all age groups. The subcapsular zone and inner zone constituted interrenal cells predominantly. Maximum width for the subcapsular zone was recorded at 12 weeks of age ($89.25 \pm 6.63 \mu\text{m}$). Inner zone attained maximum width in adult birds by 24 weeks ($171.50 \pm 10.14 \mu\text{m}$). The central zone was the widest among the three zones consisting of

sparsely distributed, irregularly arranged interrenal cell cords. Chromaffin tissue was found as clumps of basophilic cells embedded in the interrenal tissue.

Keywords: Parenchyma, adrenal gland, post hatch period, Kuttanad ducks

INTRODUCTION

The adrenal gland is one of the most important glands in all the species due to its functional and metabolic significance. Completely adrenalectomized birds will die within 60 hours (Nickel *et al.*, 1977). In mammals the gland is defined into a distinct cortex and medulla. But in birds the whole parenchyma is made of mixed cortical and chromaffin tissue. The cortex and medulla is represented by interrenal tissue and chromaffin tissue, respectively. Various controversies still exist regarding the zonation of interrenal tissue. Anatomy of the adrenal gland has been described by several authors in various species of birds, but the data regarding our native Kuttanad ducks are scanty. In this view, present study was undertaken to explore the structure and developmental pattern of adrenal parenchyma which will help in interpreting the functions of the organ.

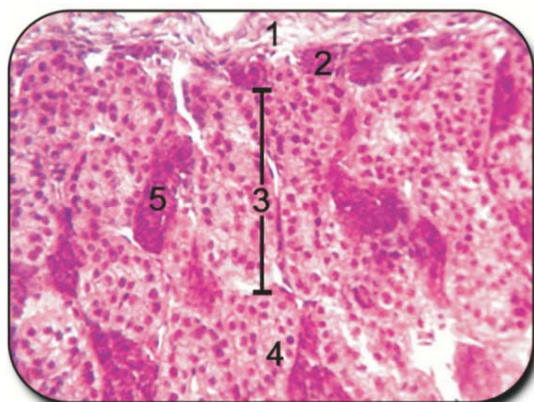
MATERIALS AND METHODS

Post hatch development of adrenal gland in Kuttanad ducks was studied in 78 apparently healthy birds. They were selected randomly from a single hatch and reared at the

University Poultry and Duck Farm, Mannuthy under semi-intensive system of management. The study was carried out in female birds of different age groups, ranging from day-old to 24 weeks. The materials were collected from six birds in each age group at fortnightly intervals up to 24 weeks. The birds were anaesthetized and bled to death. Samples were collected by dissection and were fixed in the fixatives like 10 per cent neutral buffered formalin and Bouin's fluid. After fixation, the materials were processed for paraffin embedding and sections of 5 µm thickness were taken for histological studies. Haematoxylin and Eosin (H&E) staining technique and Gomori's one step trichrome method were carried out for routine histological studies (Luna, 1968).

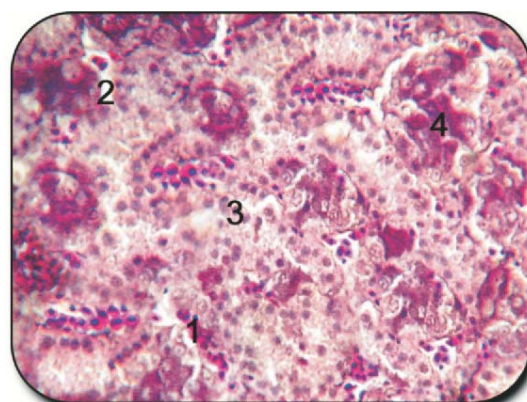
RESULTS AND DISCUSSION

Adrenal gland of the Kuttanad duck was not clearly demarcated into cortex and medulla. The parenchyma of the gland constituted three components namely, the cortical or interrenal tissue, medullary or chromaffin tissue and venous sinuses. In the day-old ducklings, parenchyma was composed of a homogenous mass of inter renal and chromaffin tissue. Similar findings were made in Japanese quail by Basha *et al.* (2009). The interrenal tissue appeared more eosinophilic and



1. Capsule 2. Subcapsular zone 3. Inner zone 4. Interrenal tissue 5. Chromaffin tissue

Fig. 1. C. S. of adrenal gland showing indistinct zonation (2 weeks). H & E X 400



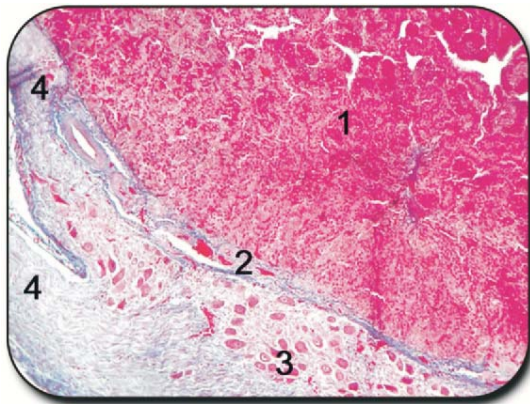
1. Blood capillaries 2. Venous sinuses 3. Interrenal tissue 4. Chromaffin tissue

Fig. 2. C. S. of adrenal gland showing high vascularity of parenchyma (12 weeks). H & E X 400

light stained than the basophilic, darkly stained chromaffin tissue, as reported by Humayun *et al.* (2012) in chicken. The cell boundaries were indistinct at this stage. The basophilic nuclei of interrenal cells were round to oval in shape.

Zonation of interrenal tissue into subcapsular and inner zones was not evident in day-old birds. Similar observations were made by Bhattacharya and Ghosh (1972) in grey quail, parakeet and myna and Basha *et al.* (2004) in quail. Chromaffin tissue formed smaller islets among the interrenal tissue (Fig. 1). Venous sinuses were seen enclosing these islets. Similar details were noted in the adrenal gland of adult chicken by Humayun *et al.* (2012).

From two weeks onwards, the proportion of interrenal and chromaffin tissue increased and adrenal parenchyma was divisible into three indistinct zones *viz.* the subcapsular zone, inner zone and central zone (Fig. 1). The same terminologies were followed by Basha *et al.* (2009) in quail and Tang *et al.* (2009) in ostrich; but Humayun *et al.* (2012) named these zones as subcapsular, peripheral and central zones. The evidence of zonation was also supported in terms of histochemical localization which indicated that there existed a bizonal variation in production and distribution of lipids,



Adrenal gland 2. Capsule 3. Cranial suprarenal ganglion 4. Sympathetic nerves

Fig.3. C.S. of adrenal gland showing close relation with cranial sympathetic ganglia (14 weeks). Gomori's one step trichrome method X100

cholesterol and alkaline phosphatase in subcapsular and inner zones of adrenals of several avian species, as reported by Ghosh (1962). Functional anatomy of the organ also supported the zonation.

Thickness of the subcapsular and inner zones at different ages is presented in table 1. The inner zone was about twice thicker than the subcapsular zone in all age groups. Maximum width for the subcapsular zone was recorded at 12 weeks of age. Another characteristic feature of the adrenal gland in this age group was the high vascularity of the parenchyma (Fig. 2). The inner zone recorded the maximum width at this age. Width of the inner zone increased progressively from $102.50 \pm 1.12 \mu\text{m}$ in two weeks old birds to $159.33 \pm 0.62 \mu\text{m}$ at 12 weeks (Table 1). Similar reports in birds are not available for comparison. However, one possible explanation for this increase in the width of inner zone could be the greater need to regulate water and electrolyte balance during rapid growth period in the species. Inner zone attained maximum width in adult birds (24 weeks). The central zone was the widest among the three zones consisting of sparsely distributed, irregularly arranged interrenal cell

Table. 1 Thickness of adrenal capsule, subcapsular zone and inner zone in Kuttanad ducks at different ages (Mean \pm S.E.)

Age	Thickness of capsule (μm)	Thickness of subcapsular zone (μm)	Thickness of inner zone (μm)
Day-old	14.04 \pm 0.27	No zonation	No zonation
2 weeks	18.08 \pm 0.37	51.33 \pm 0.74	102.50 \pm 1.12
4 weeks	18.96 \pm 0.54	54.92 \pm 1.99	110.25 \pm 1.30
6 weeks	23.04 \pm 2.57	61.83 \pm 2.33	147.17 \pm 3.35
8 weeks	24.50 \pm 2.39	66.50 \pm 1.57	155.67 \pm 1.22
10 weeks	27.75 \pm 1.16	66.83 \pm 4.62	156.67 \pm 0.88
12 weeks	28.42 \pm 0.52	89.25 \pm 6.63	159.33 \pm 0.62
14 weeks	28.50 \pm 0.34	71.17 \pm 3.69	137.67 \pm 7.09
16 weeks	29.50 \pm 0.34	63.00 \pm 3.50	125.42 \pm 3.77
18 weeks	29.50 \pm 0.71	68.25 \pm 3.69	147.00 \pm 2.71
20 weeks	28.00 \pm 0.90	68.83 \pm 1.17	149.50 \pm 3.28
22 weeks	28.17 \pm 0.48	66.50 \pm 5.93	157.50 \pm 1.28
24 weeks	28.17 \pm 0.40	66.83 \pm 2.15	171.50 \pm 10.14

corcords (Fig. 3). The cords consisted of double or multilayered cells arranged in clumps or circular groups. The cell cords of interrenal tissue were not organized to form the stacks, as reported by Prasad (1994) in ducks. Perivascular extracellular spaces between the cell cords were large and irregular forming wide venous sinuses. Chromaffin tissue was found as clumps of basophilic cells embedded in the interrenal tissue. These clumps were irregular in shape with groups of small to large number cells. Prabhavathi *et al.* (2010) reported that the parenchyma of the adrenals of guinea fowl constituted mainly of cortical or interrenal tissue, medullary or chromaffin tissue and vascular sinusoids. Capillaries and sinusoids were present throughout the adrenal gland. The sinusoids were more frequent in the glandular tissue and formed larger venous sinuses in the center of the gland as reported in chicken, by Humayun *et al.* 2012.

REFERENCES

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

Basha, S. H., Vijayaragavan, C. and Ramesh, G.

2004. Light and electron microscopic studies on the interrenal tissue of the adrenal gland in Japanese quail (*Coturnixcoturnix japonica*). *Indian J. Anim. Sci.* **74**: 1021-1023.
- Bhattacharya, T. K. and Ghosh, A. 1972. Cellular modification of interrenal tissue induced by corticoid therapy and stress in three avian species. *Am. J. Anat.* **133**: 483-494.
- Ghosh, A. 1962. A comparative study of the histochemistry of avian adrenals. *Gen. Comp. Endocrinol. Suppl.* **1**: 75-80.
- 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.
- Luna, L. G. 1968. *Manual of Histological Staining Methods of the Armed Forces Institute of Pathology*. Third edition. McGraw-Hill Book Company, New York, 258p.
- Nickel, R., Schummer, A. and Seiferle, E. 1977. *Anatomy of Domestic Birds*. Verlag Paul Parey, Berlin, 202p.
- Prabhavathi, M., Basha, S. H., Venkatesan, S., Leela, V. and Ramesh, G. 2010. Histomorphology of adrenal cortex (inter-renal tissue) in guinea fowl. *Indian J. Anim. Res.* **44**: 297299.
- Prasad, R. V. 1994. Microanatomical studies on the endocrine glands of domestic duck (*Anasboschas domesticus*). Ph.D. Thesis, Tamil Nadu Veterinary and Animal Sciences University, Chennai.
- 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.
-