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Research Article

COMPARATIVE HISTOMORPHOLOGICAL STUDY ON THE THYMUS WITH REFERENCE TO ITS IMMUNOLOGICAL IMPORTANCE IN QUAIL, CHICKEN AND DUCK

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ABSTRACT: A comparative histomorphological study was conducted on thymus of broiler chicken, duck and quail. The thymus of all three species of post-hatch (adult) birds showed a thin connective tissue capsule. However, fine septa originating from the capsule divided the organ into incomplete but distinct lobules in chicken, whereas lobules were ill defined in both quail and duck. Each lobule, in turn, was composed of a peripheral cortex, densely studded with lymphocytes and a central medulla that was enriched with epithelial reticular cells. So, the cortex appeared more basophilic than that of medulla. But the concentration of lymphocyte, an immune competent cell was highest in chicken followed by duck and quail. Hassall's corpuscles like structures were found inside the medulla as pale stained diffuse body. General histo-architecture was almost similar in all the birds.

Key words: Thymus, histology, chicken, duck, quail.

INTRODUCTION

Poultry (quail, chicken and duck) industry is an economically significant and the most rising sector around the globe. But poultry farmers face many constraints namely diseases and abiotic stress factors that affect the immune system resulting in disorganization of the histological architecture of concerned organs, immune suppression, poor production and mortality (Hussan *et al*., 2009). Infectious diseases are of great concern to chickens, quails and pheasants. However, ducks and wild birds are naturally resistant to it (Sun *et al*., 2011). Better understanding of the role of avian immune system in maintaining optimum health would enable us to formulate effective control strategies against biotic and abiotic stresses including acute heat stress (Hussan *et al*., 2009).

The thymus and cloacal bursa are the primary lymphoid organs that generate, differentiate and mature T and B lymphocytes respectively (Hui *et al*., 2012). The presence of thymus is essential for the development of peripheral lymphoid tissues and is solely responsible for cell

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mediated immunity (CMI) and immune surveillance (Hasseb *et al*., 2014).

Now a days, rise in temperature due to global warming and frequent infections due to erratic climatic factors results in significant immune suppression and huge mortality in broiler chickens (*Gallus domesticus*) (Al- Ghamdi 2008). On the other hand, the other two poultry birds, i.e. duck (*Anas platyrhynchos*) and quails (*Coturnix coturnix japonica*) show very less mortality. In respect to the above immunological points of view, the comparative histology of the thymus of the poultry birds appears interesting and literature on its comparative histology in different poultry birds is meagre. Therefore, the present work was carried out to understand the difference in histological architecture and frequency of immune competent cells of the thymus of these poultry birds.

MATERIALS AND METHODS

Ethical approval: The present study was conducted after prior approval of the Institutional Animal Ethics Committee of the College (No. 433/ CPCSEA/ OVC). The quail (*Coturnix coturnix japonica*) and chickens (*Gallus domesticus*) were procured from Central Poultry Development Organization (CPDO) and ducks (*Anas platyrhynchos*) from Central Avian Research Institute (CARI), Bhubaneswar, Odisha.

Sample collection: The study was carried out on apparently healthy adult birds of either sex, six each from quail, broiler chicken and ducks of 4-6 wks, 3-4 months and 8-10 months of age respectively. All the birds were killed by cervical sub-luxation method. After careful ventro-lateral neck dissection the thymus glands were identified as bilateral series of oval/ elongated, pale red structures (lobes) along the jugular vein. Each intact thymic lobe was collected after washing with normal saline. These tissue samples were devoid of any gross pathological lesions.

Preparation of tissues for histological study: The representative tissue samples obtained from the birds were fixed in 10% buffered neutral formalin (BNF). After routine tissue processing, the tissue pieces were cleared in xylene, followed by paraffin embedding to prepare paraffin blocks. The tissue blocks were then cut by semi motorized rotary microtome (Leica RM 2245) to obtain 5- 6 micron thick serial paraffin sections. The sections were mounted on clean, grease free, albumenized glass slides. Then the tissue sections were subjected to routine haematoxylin and eosin (H & E) staining for histo-morphological study (Bancroft and Gamble 2007). Photographs from the selected fields were taken under low (×10) and high (×40) magnification.

RESULTS AND DISCUSSION

The histological study revealed that the thymus was covered by a thin connective tissue capsule in all three species of birds. The fine septa originated from the capsule and divided the organ (lobe) into smaller, complete lobules in chicken (Fig. 3). The septa were comparatively ill- defined and the lobules were rather indistinct in both quail (Fig. 1) and duck (Fig. 5). Each lobule was comprised of a central medulla and a peripheral cortex which was densely populated with lymphocytes. Thus, the cortex was stained more deeply (basophilic) than that of medulla. This histological feature characterized the thymus of all three types of birds in the present study. Under higher magnification, the cords of lymphocytes were noticed both in cortex and medulla interspersed

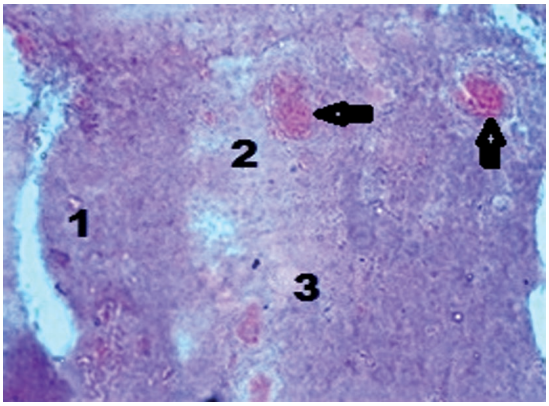

Fig. 1: Photomicrograph of thymus in quail showing cortex (1), medulla (2), Hassall's corpuscles (3) & blood vessels (arrow) (H & E stain x10).

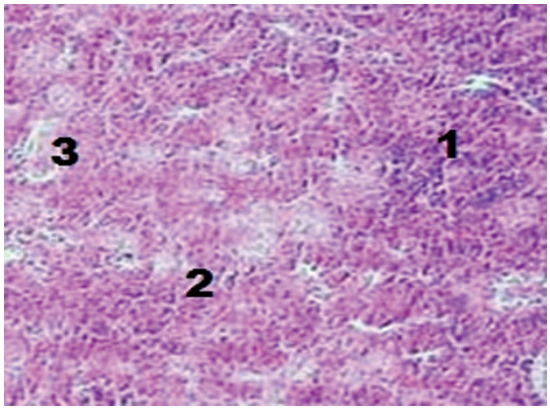

Fig. 2: Photomicrograph of thymus in quail showing cortex (1), medulla (2) and Hassall's corpuscles (3) (H & E stain x40).

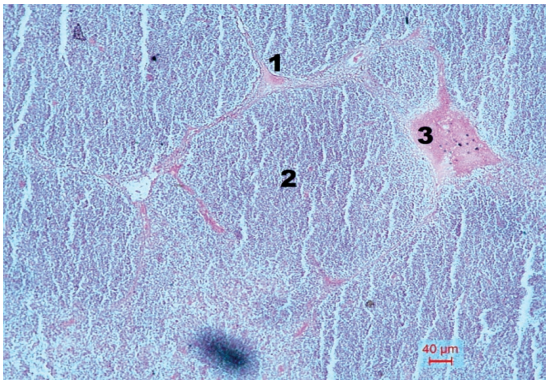

Fig. 3: Photomicrograph of thymus in chicken showing septa (1), lobule (2) and blood vessel (3) (H & E stain x10).

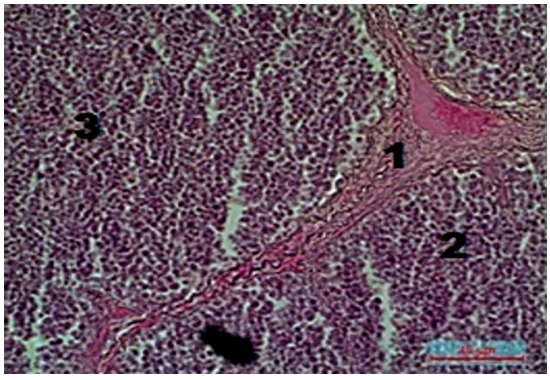

Fig. 4: Photomicrograph of thymus in chicken showing septa (1), lobule (2) and cortex (3) (H & E stain x40).

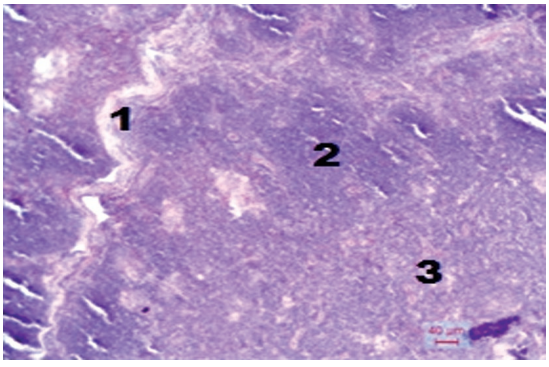

Fig. 5: Photomicrograph of thymus in duck showing septa (1), cortex (2) and medulla (3) (H & E stain x10).

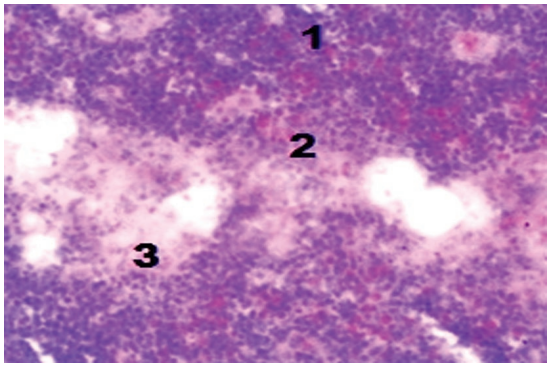

Fig. 6: Photomicrograph of thymus in duck showing cortex (1), medulla (2) and Hassall's corpuscles (3) (H & E stain x40).

among the stellate reticular epithelial cells. But the concentration of lymphocytes appeared more in chicken (Fig. 4) followed by duck (Fig. 6) and quail (Fig. 2). The thymocytes (T-lymphocytes) were usually smaller than those in cortex. The characteristic feature of medulla in all the thymus was the presence of thymic corpuscle (Hassall's corpuscle) -like profiles called reticular structures, not typical of mammalian thymus. These appeared as pale stained diffuse body consisting of vacuolated, squamous (flattened) reticular cells. The vesicular structures contained acidophilic material or even degenerating reticular cells (Fig. 1, 5, 6). Many blood vessels were also elucidated along the septa as well as other parts of the organ in all these birds. The general histological features of thymus in all the birds were more or less same.

The thymus regulates cell mediated immunity as it produces and cultivates T lymphocytes (thymocytes) from lymphoblasts, the precursors of T lymphocytes. The differentiation and manifestation of T lymphocytes in the thymus is completed only after the migration of T cells from the cortex to the medulla. But only a few lymphocytes actually mature into T lymphocytes as maximum thymocytes are inactivated due to incompatibility with the MHC (major histocompatible complex) and/ or are recognized by autoantigens (Cheng *et al*., 2003). Histological analysis showed that a greater number of T lymphocytes are available for selection by the thymus as cortex is larger than the medulla. During the process of T lymphocyte cultivation and selection of Hassall's corpuscles in the medulla seem to play a central role in generation of antigenic properties of the surrounding cells and become mature to scavenge apoptotic cells and cell debris (Samuelson 2007, Khan *et al*., 2014). Hence, Hassall's corpuscles indirectly participate in immunological activities of the prenatal and adult thymus.

The histological architecture of the thymus of chicken in the present study corroborates with the findings of Khan *et al*. (2014) in broiler chickens. The medulla was comprised of epithelial reticular cells which mainly serve as structural support for lymphocytes, macrophages etc. Similarly our result in duck thymus compares well with the observations of Sultana *et al*. (2011). The number of Hassall's corpuscles was more in medulla in the present study because we considered the adult duck rather than ducklings. More number of Hassall's corpuscles may be due to generation of more apoptotic cells and cell debris in adult duck than that of ducklings. So was the case in chicken and quail. However, these structures were not well defined in case of chicken. The same is well established in mammalian thymus that describes increase in thymic corpuscles with age and even medullary tissue replacement by the adipose tissue. This is termed as involution of thymus (Samuelson 2007). The present histological findings of thymus in quail are comparable with those of sparsely available literature (Fitzgerald 1969, Sabiha 1993).

CONCLUSION

The general histo-architecture of thymus was almost similar in all the birds in the present study except some minor variations. The results of the present study will be helpful to understand the normal distribution pattern of immune cells namely lymphocytes in the thymus of post-hatch (adult) birds. In this regard it could be useful in further immunological or immunohistochemical study.

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