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Topography and morphology of immune organs in broad breasted bronze Turkeys

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Abstract

The present study was formulated to study the topography and morphological structure of immune organs such as bursa of Fabricius, thymus, spleen and Harderian gland in turkeys. The post-natal immune organs were collected from day-old to ten months of age on monthly intervals from Broad Breasted Bronze variety of turkeys. Each group was consisted of six numbers of birds. The bursa of Fabricius in turkey was an unpaired pouch-like diverticulum noticed on the dorsal wall of the proctodeum of cloaca and it was connected to the proctodeum by a short stalk. The lumen was completely occluded by plica which were longitudinally oriented longer and shorter mucosal folds. The thymus was observed as a lobulated, paired structure situated in the subdermal connective tissue along either side of neck and extended up to the anterior thoracic region. The thymus of turkey was appeared as a creamy white coloured paired gland viz., right and left. Each made up of long chains of 6-8 lobes extended from cervical region to anterior part of thoracic cavity. The spleen of turkey was an elliptical shaped organ located on the supero-dorsal aspect at the junction between the glandular and muscular stomach on the right side of body cavity. The Harderian gland was located within the orbital cavity at antero- ventro medial aspect of eye ball. It lied flat against the eye ball and had loose attachment to the periorbital fascia and ocular muscles.

Keywords: Topography, morphology, immune organs, Turkey

Introduction

In poultry industry, the turkey is one of the diversified species plays a substantial role in economic status and viable livelihood for small and marginal farmers (Prabakaran *et al.*, 2020) [29]. It is an important source of animal protein in many parts of the world and are resistant to most of the diseases except few economically important diseases. Hence, emphasis should be given to prevention which needs thorough understanding of immune organs. The immune system plays a pivotal role in the maintenance of optimum health by protecting from diseases and adverse abiotic factors. The defence mechanism of body has innate and adaptive or acquired immunity. The innate immunity is given by physical barriers (skin and mucous membrane) and phagocytic cells whereas the adaptive immunity is contributed by T cells, which confers cell mediated immunity and B cells for humoral immune response (Penchev, 2020) [27]. The immune system of birds is constituted by primary immune organs viz., bursa of Fabricius and thymus and secondary immune organs such as spleen, Harderian gland and mucosa associated lymphoid tissues.

Understanding the topographic location of these immune organs and its morphology is essential to understand physiology and immunology. The anatomy of immune organs in birds is broadly investigated in various species of birds especially focused in chicken. But the data on turkey is negligible. Hence, this study was formulated to elucidate the topography and morphology to provide reference to physiology, immunology and pathology of immune organs.

Materials and Methods

The post-natal immune organs viz., bursa of Fabricius, thymus, spleen and Harderian gland of

turkey were collected from day-old to ten months of age on monthly intervals from Broad Breasted Bronze variety of turkeys. Each group was consisted of six numbers of birds. They were apparently healthy and vaccinated against Newcastle disease.

The samples for the study were collected from turkey farms at Dharmapuri, Krishnagiri, Salem and Namakkal districts. The study was carried out at the Department of Veterinary Anatomy, Veterinary College and Research Institute, Namakkal.

The age, sex and live body weight of birds were recorded. After the bird was sacrificed, a skin incision was made on ventral aspect of neck to expose the cervical thymus and thoracic cavity was opened to locate the thoracic thymus. The body cavity was opened by making a mid-ventral incision behind the keel region to identify the bursa of Fabricius and spleen. A sagittal section of head was done to locate the Harderian gland. Subsequently, the *in-situ* topographic anatomy was studied and immune organs were collected, washed in normal saline and weighed. The insitu topography and morphological features were studied for Bursa of Fabricius, thymus, spleen and Harderian gland.

Results and Discussion

1. Bursa of fabricius

Topography

The bursa of Fabricius in turkey was an unpaired pouch-like diverticulum noticed on the dorsal wall of the proctodeum of cloaca (Fig 1) as noticed by He *et al.* (2015) ^[13] in yellow quail and Ayman *et al.* (2020) ^[5] in Sonali chicken. It was connected to the proctodeum by a short stalk as mentioned by Tamilselvan *et al.* (2017) ^[34] in guinea fowl, Singh *et al.* (2019) ^[32] in Chabro bird and Deka *et al.* (2020) ^[8] in Pati duck and had communication with the proctodeal lumen by a small opening (Dimitrov *et al.*, 2017) ^[9]. Apart from general humoral immune response, as the bursa of Fabricius was closely connected to the intestinal system through which environmental antigens stimulate the local immune system (Ifrah *et al.*, 2017) ^[14]. In contrary, Dahariya *et al.* (2020) ^[7] observed the bursa of Fabricius at the dorsal aspect of colorectum in Hansli and Vencobb broiler chicken.

Morphology

The bursa of Fabricius was appeared as an oval shaped sac-like organ and creamish white in colour whereas it was sac-like grey black coloured in CARI Shyama variety of chicken (Jain *et al.*, 2010) ^[17], pale yellow coloured cylindrical caecum like structure with pointed apex in Indigenous ducklings (Sultana *et al.*, 2011) ^[33] and brown coloured circular to oval shaped structure in yellow quails (He *et al.*, 2015) ^[13]. The differences in the shape of organ might be due to species variation. It had a base connected to the dorsal wall of proctodeum and an apex which was free with a blunt blind end. In dissimilarity, Ayman *et al.* (2020) ^[5] described the bursa of Fabricius as smooth globular to oval organ with slight compression at anterior and posterior extremities in Sonali chicken. As stated by Karadag *et al.* (2015) ^[18] in long legged buzzard and Hassan *et al.* (2015) ^[12] in quail, the lumen was completely occluded by plica which were longitudinally oriented longer and shorter mucosal folds (Fig 2). The plica which was located at the middle of bursa of Fabricius was observed as thicker and longer than rest of the regions but Lavanya *et al.* (2019) ^[21] in Japanese quail and Singh *et al.* (2019) ^[32] in Chabro bird observed numerous

smaller and larger plica throughout the mucosa. It might be due to species variation.

2. Thymus

Topography

In turkey, the thymus was observed as a lobulated, paired structure situated in the subdermal connective tissue along either side of neck and extended up to the anterior thoracic region (Fig 3) as noted by and Haseeb *et al.* (2014) ^[11] in Aseel chicken. In contrary, Mestanova and Varga (2016) ^[22] described that the paired thymus was arranged in string like pattern at cervical region of neck close to jugular vein in chicken.

In the neck region, the cervical part of thymus was related to trachea, jugular vein, common carotid artery and vagus nerve on either side. The right thymus also had relation to esophagus along the neck and crop at the level of thoracic inlet. The terminal lobe of thoracic thymus was related to the thyroid gland and brachiocephalic artery on either side. Whereas, Ali (2017) ^[2] in local chicken mentioned that the thymus had relation to jugular vein, common carotid artery, oesophagus and trachea at cervical region, brachial plexus at base of neck and thyroid gland at anterior thoracic region.

Morphology

The thymus of turkey was appeared as a creamy white coloured paired gland viz., right and left. Each made up of long chains of 6-8 lobes extended from cervical region to anterior part of thoracic cavity. The shape of the lobes varied from irregular, elongated and oval to flattened structure. The adjacent lobes were not clearly separated and connected to each other throughout its length. Contradicting to this, Muthukumaran *et al.* (2011) ^[24] stated that the pale red to pink coloured thymus was constituted by six to eight lobes with irregular elliptical shape in turkey. Also in contrary, the thymic lobes were elongated to flattened and pale white to yellowish white in colour with five lobes in both right and left thymus in Indigenous ducklings (Sultana *et al.*, 2011) ^[33], seven to nine lobes on right side and six to eight on left side in Aseel chicken (Haseeb *et al.*, 2014) ^[11], six to eight lobes in each thymus, yellowish to pinkish in colour and shape varied from flat to irregular in in turkey Ali (2016) ^[1] and five to eight lobes in Sonali chicken (Ayman *et al.*, 2020) ^[5]. It may be attributed to species and age difference.

Each thymus was divided into cervical part and thoracic part according to its topographical location. The cervical part of the thymus was constituted by four to five lobes which began at ninth cervical vertebra and extended caudally up to thoracic inlet. But, Ayman *et al.* (2020) ^[5] in Sonali chicken described that the cranial end of thymus began at third cervical vertebra and the caudal end was located at thoracic inlet. The proximal cervical part had relatively smaller sized lobes than distal part. The thoracic part of the thymus was short, continued from the cervical part and consisted of two to three lobes which extended from thoracic inlet to the anterior thoracic region. No morphological difference

3. Spleen

Topography

The spleen of turkey was an elliptical shaped organ located on the supero-dorsal aspect at the junction between the glandular and muscular stomach on the right side of body cavity (Fig 4). This observation agrees with the findings of Sultana *et al.* (2011) ^[33] in Indigenous ducklings, Indu *et al.* (2011) ^[15] in

White Pekin duck and Mustafa and Desoky (2020) [23] in Japanese quail. It was related ventrally to the right lobe of liver, medially to the second part of duodenum, laterally to the proventriculus and gizzard. It was covered by the peritoneum and held in position by peritoneal attachment to the stomach, liver and duodenum as mentioned by Onyeausi (2006) [26] in guinea fowl.

The present study findings were in disagreement with Whittow (2000) [36] who reported that the spleen was situated dorsal to gonads, ventral to liver, lateral to stomach and opposite to dorsal surface of right lobe of liver in birds. In contrary, Reshag and Hamza (2017) [31] stated that the spleen was covered by right lobe of liver in Indigenous chicken.

Morphology

In turkey, the spleen was elliptical shaped and reddish brown in colour. Whereas it was reddish-brown and round in fowl, oval in pigeon and triangular in sea birds (Whittow, 2000) [36], pink and round in indigenous chicken (Reshag and Hamza, 2017) [31], brownish red and round in Chinese yellow quail (Piao *et al.*, 2018) [28] and reddish brown coloured, elongated to ovoid in Kadaknath fowl (Verma *et al.*, 2018) [35]. As noticed by Onyeausi (2006) [26] in guinea fowl and Indu *et al.* (2011) [15] in White Pekin ducks, it showed dorsal and ventral surfaces. The flat dorsal surface had hilus and related to the proventriculus and gizzard. The ventral surface was convex and related to the liver and duodenum. It concurs with the reports of Whittow (2000) [36] in birds. The anterior extremity was broad and posterior extremity was narrow. Dissimilar to this, Onyeausi (2006) [26] stated that both surfaces of spleen were smooth and had hilus on the ventral surface and Verma *et al.* (2018) [35] observed hilus on the medial surface in Kadaknath fowl.

4. Harderian gland

Topography

In turkey, the Harderian gland was located within the orbital cavity at antero- ventro medial aspect of eye ball. It lied flat against the eye ball and had loose attachment to the periorbital fascia and ocular muscles (Fig 5) whereas it was seen only at ventro-medial aspect of orbit in ostrich (Altunay and Kozlu, 2004) [3], quail (Kozlu and Altunay, 2011) [20] and turkey (Khayoon *et al.*, 2019) [19]. In contrast, Beheiry *et al.* (2020) [6] stated that the gland was located at ventro-medial aspect of eyeball and extended posteriorly from optic nerve to anterior part of eyeball in flying and non-flying birds. It was located ventral to the eyeball with constriction in the middle in chicken (Rana *et al.*, 2020) [30] and dorso-posterior aspect of eyeball in broiler and native chickens (Jahan *et al.*, 2006) [16]. Rostrally, the gland was attached to the anterior margin of orbit formed by lacrimal bone and medially related to the interorbital septum. In concurrence, Nawrot *et al.* (2016) [25] in capercaillie also stated that it was situated adjacent to interorbital septum between medial straight muscle, pyramidal third eyelid muscle and ventral oblique muscle. These findings infer that the location of Harderian gland and its topographical relationship varied with strain and species of bird. The location of Harderian gland within the orbit might be due to its role in lubrication to the surface of the eyeball and nictitating membrane.

Morphology

The Harderian gland of turkey was a paired orbital gland, yellowish in colour and appeared as human foot print shaped structure. But, the gland was light pink coloured, hour-glass

shaped structure in White leghorn (Ashok *et al.*, 2000) [4], droplet shaped in ostrich (Altunay and Kozlu, 2004) [3] bi-lobed in broiler and native chicken (Jahan *et al.*, 2006) [16], tear drop shaped in quail (Kozlu and Altunay, 2011) [20], flat elongated in capercaillie (Nawrot *et al.*, 2016) [25], pink to red, tear-like shaped with narrow head in turkey (Khayoon *et al.*, 2019) [19] and pinkish white to reddish brown, oval and flat with pointed anterior extremity in pigeon (Beheiry *et al.*, 2020) [6]. As observed by Beheiry *et al.* (2020) [6] in duck, goose and ibis, the gland was characterized by wider enlarged anterior end, narrow band like middle part and wider flattened posterior end but in contrary, the middle part of gland between extremities had groove in duck and goose and isthmus in ibis.

The gland had two surfaces viz., medial and lateral. The medial surface was convex and related to the lacrimal bone and inter-orbital septum whereas the lateral surface was concave and related to the eye ball. It concurs with the finding of Beheiry *et al.* (2020) [6] in duck, goose and ibis who observed that the surface towards the periorbital fascia was convex and the surface towards eyeball was concave. Contradicting to this, Rana *et al.* (2020) [30] in chicken stated that the Harderian gland showed concave dorsal surface opposed to eyeball and convex ventral surface towards periorbital fascia. The medial border was concave and lateral border was anteriorly convex and posteriorly concave. A single duct left from anterior enlarged end of the gland, ran forwards and opened on the medial canthus. This concurs with the results of Beheiry *et al.* (2020) [6] in duck, goose and ibis and Rana *et al.* (2020) [30] in chicken who also found that the duct left from anterior extremity of gland and opened into the conjunctival sac. According to the location, the differences were found in the surfaces and its relation with adjacent structures in birds.

As noted by Frahm and Mohammadpour (2015) [10] in Canadian ostrich, both right and left Harderian gland showed the similar morphology. No gross morphological difference was observed between male and female turkeys.



Fig 1: Photograph showing the topography of bursa of Fabricius in Broad Breasted Bronze turkeys

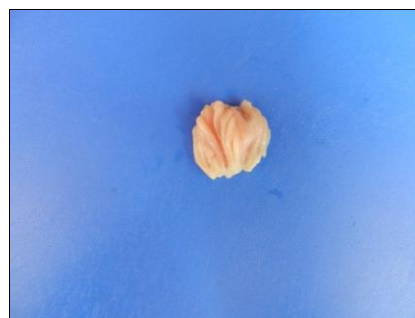


Fig 2: Photograph showing interior morphology of bursa of Fabricius in Broad Breasted Bronze turkeys



Fig 3: Photograph showing the insitu topography of thymus along the neck in Broad Breasted Bronze turkeys



Fig 4: Photograph showing the insitu topography of spleen in Broad Breasted Bronze turkeys



Fig 5: Photograph showing the insitu topography of harderian gland in Broad Breasted Bronze turkeys

Conflict of Interest

Not available

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Not available

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