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RESEARCH ARTICLE

MICROANATOMICAL OBSERVATIONS ON THE GALL BLADDER IN KUTTANAD DUCK (*Anas platyrynchos domesticus*)

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ABSTRACT

The study was aimed at observing the normal histological characteristics of gall bladder of Kuttanad ducks (*Anas domesticus*) using 72 ducks of various ages from day-old to 22 weeks. Gall bladder was a small sac lying on the visceral surface of liver. Its weight increased from 0.03 by day-old to 1.26g by 22 weeks. Thickness of wall increased from 13 µm to 169 µm by this age. Layers of gall bladder from inner to outer were: mucosa, muscularis, perimuscular connective tissue layer and serosa. There was no muscularis mucosa or submucosa. Mucosa consisted of simple, tall, columnar, homogeneous epithelium and lamina propria. Cytoplasm of epithelial cells was weakly acidophilic and at the free edge, appeared to be thickened probably due to the presence of microvilli. Nuclei were large, basal and oval. Lamina propria consisted of a layer of connective tissue with elastic and muscle fibres which was strongly folded into villus-like projections when the gall bladder was contracted and was much thinner with only small folds when the bladder was distended. Beneath lamina propria, the muscularis consisted of interlacing fascicles of smooth muscle fibers and abundant intervening connective tissue, forming a thin irregular and decussating fibromuscular coat. These muscular layers provided numerous spaces between their fibres, which were filled up with reticular, elastic or collagenous fibres and fibroblasts. Smooth muscle was found in longitudinal, transverse and oblique directions. Outer, circular or oblique layer was more constant and gave off strands passing into base of the villi. Longitudinal layer occurred only irregularly, as large bundles of fibres lying at the base of the villi. The perimuscular layer of dense connective tissue contained blood and lymphatic vessels (for abundant water reabsorption from bile) and nerves, and it formed an adventitia (fibrosa) on the surfaces in contact with liver. Other surfaces were covered with a serosa, which was moderately thick and vascular in some areas but thin and avascular in others. It was composed of coarse collagen fibres interspersed with small number of elastic fibres. Gall bladder provides a storage site for bile synthesized in liver and also concentrates it owing to ion-transporting activities of the epithelium lining the lumen. Lipids reaching the duodenum signal the release of polypeptide hormone, cholecystokinin from endocrine cells of mucosa into blood. Cholecystokinin has receptors in wall of gall bladder, which result in contraction of smooth muscle and release of bile via bile duct on to duodenum.

INTRODUCTION

The gall bladder provides a storage site for bile synthesized in the liver and also concentrates it owing to ion-transporting activities of the epithelium lining the lumen. Cyclostomes, birds like budgie and some members of the parrot family, and some mammals, including elephants, horses and cervids, have no gall bladder. This study was aimed at observing the normal histological characteristics of the gall bladder of the Kuttanad ducks (*Anas platyrynchos domesticus*).

MATERIALS AND METHODS

The study was conducted using 72 ducks of various ages. Six birds each were collected at fortnightly intervals from day-old to 22 weeks of age. The birds were anaethetised by chloroform and euthanized by bleeding the jugular vein. The abdominal cavity was opened and the sternum was also split open in the midline. The gall bladder was collected, fixed in 10 percent neutral buffered formalin for 48 hours, processed by routine histological techniques and embedded in high-melting paraffin. Five to six micron sections were taken and stained by routine histological procedures.

RESULTS

The gall bladder was a small sac lying on the visceral surface of the liver. Its weight increased from 0.03 by day-old to 1.26g by 22 weeks with a corresponding increase in the thickness of its wall from 13 to 169 µm. The gall bladder consisted of different layers from inner to outer as the mucosa, muscularis,

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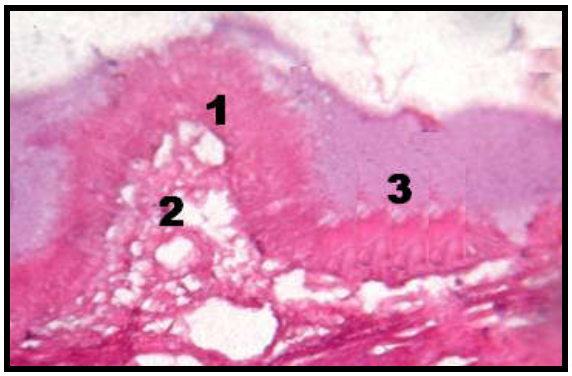
1. Folds

1. Epithelium 2. Surface with microvilli 3. Lamina propria

Fig. 2. C. S. of Gall Bladder at 22 weeks of age. H & E x 400

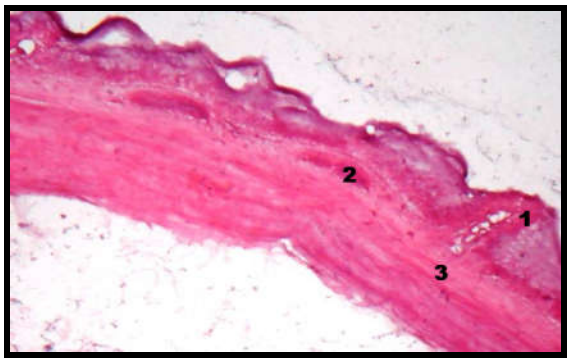


1. Epithelium 2. Lamina propria 3. Basophilic substance covering the epithelium

Fig. 3. C. S. of gall bladder at 16 weeks of age. H & E x 400

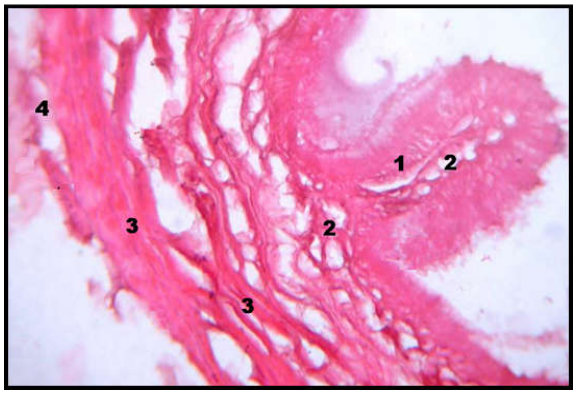
1. Mucous glands

Fig. 4. L. S. of neck of gall Bladder at 22 weeks of age. H & E x 100



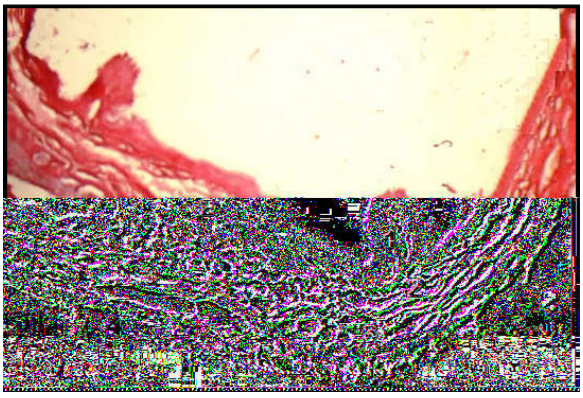
1. Villus 2. Longitudinal muscle layer 3. Circular muscle layer

Fig. 5. C. S. of neck of gall Bladder at 22 weeks of age. H & E x 100



1. Mucosa 2. Lamina propria 3. Muscular layer 4. Perimuscular connective tissue

Fig. 6. C. S. of gall Bladder at 20 weeks of age. H & E x 400



1. Villus 2. Lamina propria 3. Muscular layer 4. Serosa

Fig. 7. C. S. of gall Bladder at 20 weeks of age. H & E x 100

perimuscular connective tissue layer and serosa. When contracted, its mucosal surface was thrown into numerous typical ridges and folds (Fig. 1). But, when the gall bladder was filled with bile, these folds disappeared. The mucosa consisted of a simple, tall, columnar, homogeneous epithelium lining the lumen and lamina propria. The epithelium also covered the mucosal crypts, which were small epithelial diverticuli that sometimes gave the impression of being glands. There was no muscularis mucosa or submucosa. The cytoplasm of the epithelial cells had weak acidophilic characteristics. The nuclei were large, basal and oval. The cytoplasm in the region of the free edge appeared to be thickened due to the presence of microvilli (Fig. 2). The

luminal surface was covered by a basophilic substance (Fig. 3). The lamina propria of the mucosa consisted of a layer of connective tissue containing elastic fibres and muscle fibres which entered into villus-like projections (Fig. 2). There was absence of glands in this layer, except a few glands at the region of the neck (Fig. 4). Even though the gall bladder presented villus-like projections of mucosa when contracted (Fig. 2), the wall was much thinner with only small folds when the bladder was distended (Fig. 5).

Beneath the lamina propria, the muscular layer was consisting of interlacing fascicles of smooth muscle fibers and abundant intervening connective tissue, forming an irregular and decussating fibromuscular coat (Fig. 6). These muscular layers provided numerous spaces between their fibres which were filled up with the reticular, elastic or collagenous fibres with the presence of fibroblasts also. The smooth muscle, was not easily divided into definite layers. It ran in longitudinal, circular and oblique directions. The outer, circular or oblique layer was more constant and gave off strands passing into the base of the villus like projections of the mucosa. The longitudinal layer occurred only irregularly, usually as large bundles of fibres lying at the base of the villi (Fig. 5). The perimuscular layer of peripheral dense connective tissue (Fig. 6) contained blood and lymphatic vessels and nerves, and it formed an adventitia (fibrosa) on the surfaces in contact with the liver. The gall bladder had a serosal covering on other surfaces, which was moderately thick and vascular in some areas (Fig. 7) but thin and avascular in others. The serosa was composed of coarse collagen fibres interspersed with small number of elastic fibres.

DISCUSSION

The histological observations on the gall bladder in Kuttanad duck revealed a mucosa, muscularis and adventitia or serosa. The homogeneous simple columnar epithelium lining the lumen presented microvilli and was covered by a basophilic substance. Hayward (1965) opined that the established function of the large scale resorption of water and salts from the intracystic bile resulting in an increase in pigment concentration is probably accompanied by an adaptation of the fine structure of the epithelial cell surfaces and intercellular spaces. Yamada and Hoshino (1972) also reported the presence of sulfated, carboxylated and neutral mucopolysaccharide- protein complexes in the gall bladder epihtelium of domestic fowl. Stinson and Calhoun (1993) opined that the tight junctions present between the adjacent cells of gall bladder prevented the intercellular passage of fluids from the lumen of the organ. Hodges (1974) described the corium of the villi as infiltrated with lymphoid tissue in the adult bird. But such a gall bladder associated lymphoid tissue (GbALT) as also observed in domestic animals like ruminants (Chandrasekhar and Lalitha, 1993) was not seen in the gall bladder of Kuttanad ducks. This change may be attributed to a variation during the development or due to environmental or management variations resulting in a change in the immune status of the bird. The muscular layer presented outer, more constant circular or oblique layer and an irregular longitudinal layer agreeing with the observations of Calhoun (1954), in chicken. The perimuscular layer formed an adventitia (fibrosa) on the surfaces in contact with the liver and had nerves and blood and lymph vessels probably, in view of abundant water reabsorption from bile. It also had a serosal covering on other exposed surfaces in accordance with the findings of Calhoun (1954) and Hodges (1974), in chicken.

A bird's digestive system is extremely efficient because it has to keep up with the metabolic reactions of the bird. Among these, the function of the gall bladder is to make the process of digestion run more smoothly in the presence of fat. Bile is a liquid that the body uses to digest fat and neutralize acid. When large amount of fat is eaten, it signals the duodenum to release the polypeptide hormone, cholecystokinin (Greek term for "move," "sac," and "bile"), from endocrine cells of the mucosa into the blood. The cholecystokinin has receptors in the wall of the gall bladder, which result in the contraction of the smooth muscle and the release of the bile via the bile duct on to the duodenum. Thus, the intestines signal the gall bladder to secrete extra bile to help the digestion. If the gall bladder has been removed, the body does not have an extra store of concentrated bile to inject all-at-once to digest a large quantity of fat. But fat in reasonable amounts is perfectly digestible even after the surgical removal, especially if it is eaten in combination with other foods.

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