EARLY ANATOMICAL AND EMBRYOLOGICAL DESCRIPTION OF PECTEN OCULI IN CATTLE EGRET (BUBULCUS IBIS)

Eman Youssri Salah El-Din*, Ahmed Imam Dakrory
Zoology Department, Faculty of Science, Cairo University, EGYPT
*Correspondence: e_youssri@yahoo.com

ABSTRACT: Early development of the pecten oculi of the cattle egret (Bubulcus ibis) was investigated. Different embryonic developmental stages of cattle were collected from eggs. Embryos were fixed in Bouin’s solution, dehydrated, clearing, embedded, sectioned, and stained with Hematoxylin-Eosin and for examination using light microscopy. The early development of pecten was recorded according to Hamburger-Hamilton’s stages (HH 28, 29, 33, 34, 35 and 36). The primordial of pecten is formed by fusion of the ectodermal edges of the optic fissure inward. It grows into a tall thin plate protruding from a broad base. Vasularization appears in the broad base of the plate-like pecten, and then become numerous. Also, pigmentation becomes evidence.

KEYWORDS: Eye, Pigmentation, Plated pecten, Pleated pecten

INTRODUCTION

The most attractive characteristic of the ophthalmological picture is the pecten oculi. The latter is a highly vascular and heavily pigmented structure, placed in the vitreous chamber, along the course of the fetal fissure of the eye of all birds.

The gross morphology, morphogenesis, histomorphology and histochemistry of the pecten oculi in the Gallus domesticus were recorded. The pecten pleated type, found in a large number of neognaths, is well studied during its development of chick embryo, in chick and pigeon embryos, in the chick. Development of the pecten was investigated in Gallus gallus. The development and histochemical study on the pecten was investigated. The early embryogenesis of the pecten was reviewed. Pecten development was recorded in Passer domesticus. Embryonic developmental stages of avian pecten were recorded. The structure morphology of developmental pecten connected with the upper end of the retinal fissure was observed.

Scanning Electron Microscopic Studies of the pecten oculi in Coturnix coturnix was recorded. Investigation to the structure of pecten in ostrich, duck, pigeon, turkey, and starling. Morphological and histological descriptions were reported using light microscopy in sparrow hawk pecten. The pecten of Buteo buteo was investigated using stereomicroscopy and light and scanning electron microscopy. Morphometric and morphological description using light, transmision and scanning microscopy of the Pecten in Melopsittacus undulatus. The pecten of Milvus migrans has been examined using scanning electron microscopy. Light and electron microscopy of the pecten have been described; in Ring-billed Gull, and chicken. This manuscript follows the development of pecten in different developmental stages.

MATERIALS AND METHODS

The classification of Cattle egret; Bubulcus ibis (Family: Ardeidae, Order: Ciconiiformes)
Different stages of embryos were taken out of the shells where total body length was estimated (3, 3.8, 4.8, 5.5, 6.0 cm total body length). So the parameter used to determine the different developmental stages were the total body length. Using the total body length is not accurate were it is depended on many factors. So, standardization was using 22 stages as stander (HH 28, 29, 33, 34 and 35) respectively to the corresponding total body length. Embryos were fixed in Bouin’s fixative over night.

Large embryos were treated with EDTA solution; this facilitates the process of sectioning after embedding in paraffin wax.

Embryos were treated with ascending series of ethyl alcohol and cleared with xylene. The specimens were transferred into a melted paraffin wax in an oven at 58°C. After changing the paraffin wax twice (one hour for each), specimens were blocked. This was followed by sectioning of the embryos transversely at 8 and 10 micrometer thickness using Reichert microtome.

The sections of each specimen were mounted serially on microscopic slides and prepared for staining. Staining was carried out by haematoxylin and eosin. Fully formed stage was stained by Mallory’s triple stain. Several serial sections were photographed.

RESULT AND DISCUSSION

Stages HH 28, 29; Formation of the Pecten Primordial (total body lengths: 3, 3.8cm)

The development of the pecten is synchronized with closure of the optic fissure. The closure of the retinal fissure begins distally from its proximal end. So, the proximal portion of the fissure appears as a double ridge on the inner surface of the cup projected inwards due to the cellular proliferation through the entire region of the edges of the fissure (Fig.1, RE.F). Generally at distal position of the optic cup, the fissure edges came into an extension and became gradually shorter. The mesenchymatous tissue filled the whole open part of the fissure containing blood vessels, the arteriae cuplae opticae (Fig.2, CU.O). The first appearance of pecten primordial as a low ridge along the line of the fusion of the optic fissure, projected into the vitreous humor. The pecten primordial arises as a single ridge which formed due to fusion of double ridge of the optic cup (Fig.3, PE.PM). A tunnel-like form contains the mesenchymal tissue (MS) at the most distal portion of pecten primordia (Fig.4). As development proceeded, on the ventral surface of eye, the cauda of the optic nerve (Fig.5, CA.OP) formed a low ridge along the pecten primordial with subsequent closure of optic fissure. The cells of pecten primordial and the optic nerve were similar in appearance. In early developmental stages, the pecten lacks the vascularization.

Stages HH 33, 34; Organization of plate-like pecten and vascularization (total body lengths: 4.8, 5.5cm)

Closure of retinal fissure was in progress. At the distal portion of the pecten, the mesenchymal tissues fuse to the epical end of the pecten (Fig.6). During these stages, the pecten increases in its height (Fig.7) and grow as a thin plate based on a broad base (the crista intraocularis; triangular shape).
Fig. 1: at 3cm total body length, retinal fissure shares in formation of pecten (PE). Scale bar: 25µm
Fig. 2: at 3cm total body length, the arteriae cuplae opticae is evidence. Scale bar: 25µm plays some nutritional role in
Fig. 3: at 3cm total body length, the pecten primordial appears. Scale bar: 25µm
Fig. 4: at 3.8cm total body length, a tunnel like pecten is present. Scale bar: 25µm
Fig. 5: at 3.8cm total body length, the cauda of optic nerve are evidence. Scale bar: 25µm
Fig. 6: at 4.8cm total body length, fusion to mesenchymal tissue at epical part of pecten distally. Scale bar: 25µm

**ABBREVIATIONS:**

Fig. 7: at 4.8 cm total body length, lighting pecten with a broad base with thin plate. Scale bar: 25 µm

Fig. 8: at 4.8 cm total body length, two types of cells share in formation of pecten; outer ones and inner ones. Scale bar: 12.5 µm

Fig. 9: at 5.5 cm total body length, blood vessels scattered within triangular base of pecten, with well organized optic nerve. Scale bar: 25 µm

Fig. 10: at 6.0 cm total body length, pigmented cells and blood vessels in the pecten characterize. Scale bar: 25 µm

Fig. 11: at 7.3 cm total body length, the pecten appears to fold. Scale bar: 25 µm.

Fig. 12: at 7.3 cm total body length, abundant blood vessels found within the pecten. Scale bar: 62.5 µm

Figs. 1-10: Photomicrographs of haematoxylin and eosin stain transverse sections passing through the eye region of different embryonic stages of *Bubulcus ibis*.

Figs. 11-12: Photomicrographs of Mallory’s triple stain transverse sections passing through the eye region of different embryonic stages.

**ABBREVIATIONS:**

- NE.LA: neural layer of retina
- PG.LA: parented layer of retina
- SC: sclera
- VTS: vitreous space
The cells (Fig.8) which share in formation of the pecten organize itself in a different manner; the outer (superficial) ones arranged in regular way. The deeper ones concentrated in the broad base were randomly arranged. A few blood vessels scattered in the triangular base (Fig.9). The cauda of the optic nerve is parallel to the pecten along its whole length (Fig.9).

Stage HH 35; Pigmentation and vascularization as evidences (total body length: 6.0cm)

Complete obstruction of the optic fissure is recorded; at the apex of the most distal part of pecten, the mesenchymal tissue accumulates. The pigment cells within the pecten are firstly detected (Fig.10). Its concentration and distribution in the pecten is varied; the degree of pigmentation was more dominant in the apical and peripheral portion than the basal part, and more condensed in the distal part than the proximal one. Numerous blood vessels (Fig.10) present in the plate of the pecten than previous stage, but still pecten characterized by its cellular components than vascular ones.

Stage HH 36; Pleat formation of the pecten (total body length: 7.3cm)

Pecten is characterized by slightly folding, increase in its height, and highly vascularization (Figs.11, 12).

DISCUSSION

Recently, pecten is formed by neuroectodermal cells covered by a vascular mesodermal core; choroidal tissue of the earliest descriptions to pecten was a portion of choroid coat which had passed through retinal fissure and proliferated inside the eye. Pecten was similar to choroidal tissue in its extreme vascularity. Pecten is not continuous with the choroid, but is apart from it by fibres of the optic nerve. Further, its blood-feed is related to vessels in optic nerve, not with choroidal vessels, while were denied this idea. suggested that pecten was an ectodermal structure. In contrast, reported that, the rudiment of pecten is derived from mesoderm which grows' into the fissure after the appearance of the vitreous humour and does not become pigmented until relatively late, after the development of nerve fibres have isolate the pecten from the rest of the mesoderm. The most peripheral portion of optic fissure remained open in the chick, until considerably later stage, although, the optic fissure is closed rapidly from proximol to distal part.

Pigmented cells are a constant feature of all pectens as appears in current study. But, there is a controversial in the origin of pigmented and intervascular cells. The researches consider the pigmented cells to be glial in its origin. Others are contrary this opinion. Glial cells of the second cranial nerve next to the proximal pecten were identical to cells of the primitive pecten in size, shape and its staining. Generally, nerve cells proliferated in the ventricular zone only, while, glial cells divided throughout the central nervous system. So, cells of pecten (precursors of the pigmented cells) are throught to be glial in origin. The morphological characteristic of the pecten prove that it has an important physiological role. In fact, a number of researchers...
have suggested that the pecten plays some nutritional role in retinal support \textsuperscript{5, 20, 31, 33}. Devoid of nervous tissue in pecten is unlikely the sense organ theories of pecten function \textsuperscript{31}, while \textsuperscript{32} reported sensory properties for pecten. Different possibilities expected for pecten roles \textsuperscript{31}, mechanism of accommodation, regulate the intraocular tension, an optical instrument and formation of images on retina.

The development of this structure has been clarified from time to time but with very contrary results, so that the present manuscript is perhaps justified if only as a consideration of the different possibilities.

**CONFLICT OF INTERESTS**

The authors have no conflict of interests.

**ACKNOWLEDGMENTS**

This work had financially supported by Zoology Department, Faculty of Science, and Cairo University.

**REFERENCES**

24. Gallego, M. L. V. 2015. Imaging of physiological retinal structures in various raptor species using optical coherence tomography (oct). tierärztliche fakultät der ludwig – maximilians - universität münchen,