RESEARCH ARTICLE

Study of Histological Structure of Mesencephalon in White Cheeked Bulbul (*Pycnonotus leucotis*)

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ABSTRACT

The histological structure of *Pycnonotus leucotis* was investigated to fill the dearth of information on the histology of mid-brain from available literature and help understand its brain. The brain is wide and short and its length 1.5 cm, and it consists of three regions. The middle region is the mesencephalon. The mesencephalon was divided into optic tectum and tegmentum. The optic tectum consists of six main layers, while the tegmentum contains nuclei of cranial nerves.

Keywords: Mesencephalon, Optic tectum, Tagmentum.

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INTRODUCTION

The avian nervous system consists of the central nervous system, including the brain and spinal cord, the peripheral nervous system, cranial and spinal nerves, autonomic nerves, ganglia, and sense organs.[1] The optic tectum is the dorsal part of the mesencephalon of brain vertebrates, such as fishes, amphibians, reptilians, birds, and mammalians. The optic tectum is the main process of the brain. In the mammalians, the optic tectum refers to the superior colliculus; it does preliminary visual processing and controls eye movements. The optic tectum is useful in directing actions, such as auditory input in owls and input from the thermosensitive pit organs in snakes.[2,3] There are about 10,000 know species of birds, over three times the number of mammalian species, and it is therefore not surprising that birds present numerous visual specializations that require sophisticated visual processing. The eagles and falcons have visual acuity that is double that of primates.[4,5] The white-cheeked bulbul (*Pycnonotus leucotis*), family Pycnonotidae, order Passeriformes class Aves and phylum Chordata.

MATERIALS AND METHODS

The study of the brain (Mesencephalon) in bird white-cheeked bulbul *P. leucotis*. The study was conducted on six birds, which were obtained from the local city of Baghdad. The animal lay on dissecting tray on its back, cut the head from the body, inserted the scissors under the front of the brain, and cut attachments to the brain. After cutting the nerves attaching the brain to the skull, it removes from the skull and then placed in the fixed solution (formalin concertation of 10%).[6] Then carried out the washing process by tap water and dehydrated in ethyl alcohol, then cleared in xylene, then infiltrated and embedded in wax paraffin at melting temperature (56–58)°C.

The section thickness was 5 µm and stained with haematoxylin and eosin, then mounting sections in Canada balsam. The sections were microscopic measurements by using ocular and stage µms, and they were filmed to clarify the histological structure using the light microscope supplied by a camera.

RESULTS

The general morphological structure of the white cheeked bulbul *P. leucotis* showed the brain was wide and short, with an average length 1.5 cm and it consisted of three regions, the fore region called forebrain (Prosencephalon), which consists of telencephalon and diencephalon. The telencephalon was the cerebral hemispheres, which have two lateral compartments separated by median groove and crossed from the front by the olfactory lobes, each connected to the olfactory nerve. The diencephalon represents a small area located between the two cerebral hemispheres. The middle region was in the mid brain (Mesencephalon), represented by optic lobes.

The hind region called the hind brain (Rhombencephalon) consists of the large cerebellum and consists of pons and medulla oblongata, which is wide on its front side and narrowed from its posterior side and connects to the spinal

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cord (Figure 1). The mid brain consists of the optical tectum and the tegmentum. The optical tectum represents in the dorsal region and is located above the roof's ventricles. The tegmetum represents the area of the bottom of the mesencephalon.

Optic Tectum

The histological structure of the optic tectum in the brain of the Iraqi bulbul showed that the optic tectum consists of six main layers, and the third layer of ten secondary layers (Figure 2), has reached the thickness of 438 µm ranging from the pia mater outside to optic ventricle (Ependymal cells) is as follows:

- The stratum opticum (SO).
- The stratum griseum et fibrosum (SGF).
- The stratum griseum centrale (SGC).
- The stratum album centrale (SAC).
- The stratum griseum periventriculare (SGP).
- The stratum fiberosum periventriculare (SFP).

The Stratum Opticum (SO)

It is the first layer of the optic tectum layers, which surrounds the pia matter of affection and will be the site is smeared. Its thickness was 710 µm, and was made up of fibers optic nerve, which are diffuse. These nerve fibers were bundled together from axons that continue with the second layer, and contains this layer on small spherical neurons (Neuronal cells) were multipolar, which diameter was 5 µm, as well as the glial cells and these cells, are distributed among nerve fibers (Figures 2 and 3), the diameter of glial cell was 3 µm.

The Stratum Griseum et Dibrosum Superficial (SGFS)

It is the second main layer of optic tectum layers and represents the largest layers of optic tectum of a thickness 320 µm, divided into 10 successive secondary layers. It includes cellular and porons layers of sequential shape. It contains this layer on stellate multipolar neurons with a diameter 8 µm, fusiform neurons with a diameter 9 µm, pyramidal multipolar with a diameter 3 µm, and gail cells with a 3 µm diameter (Figures 2 and 3).

The Stratum Griseum Central (SGC)

The third layer of the optic tectum layer is a wide cell irregular irregularity rate of 123 µm thickness, the neuron axes in this class are diffused and tilted towards the upper layers of the optic tectum, however, there are many different and interconnected types of cells. In this class, there are pyramidal multipolar neurons with a diameter of 13 µm, fusiform neurons with a diameter of 4 Mm, multipolar neurons with a diameter 6 µm and gail cells diffuse within the class (Figures 2 and 3).

The Stratum Album Centrale (SAC)

The fourth layer of optic tectum layers whose thickness has reached to 135 m, the same as the efferent fibers tracts. The neurons in this class are cells of multipolar neurons with a

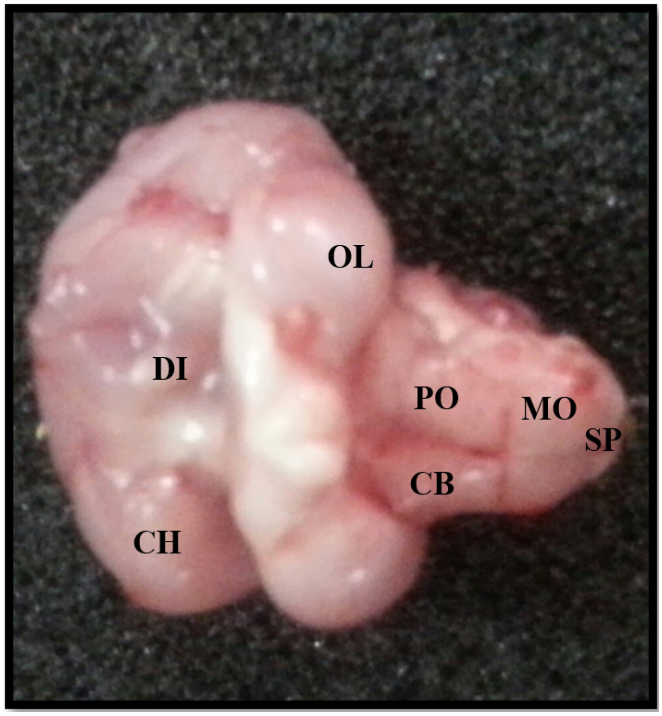

Figure 1: Ventral view of the white-cheeked bulbule showing: Cerebral hemisphere (CH), diencephalon (DI), optic lobe (OL), pons (PO), cerebellum (CB), medulla oblongata (MO), spinal cord (SP).

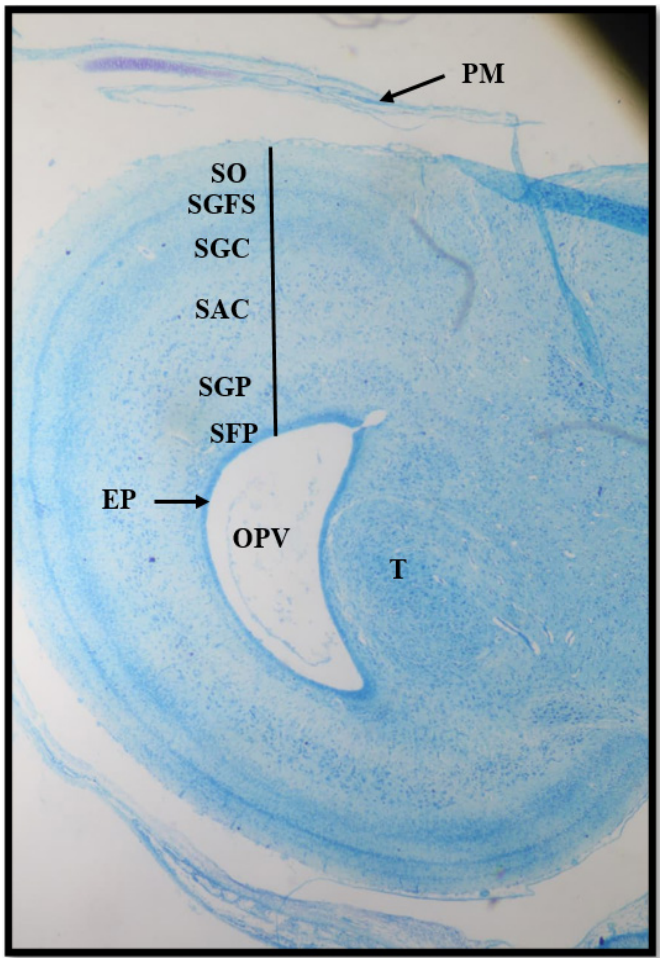

Figure (2): Transverse section through optic lobe in brain of the bird showing: optic ventricle (OPV), pia matter (PM), stratum opticum (SO), stratum grisum et fibrosum superficial (SGFS), stratum griseum central (SGC), stratum album central (SAC), stratum griseum periventricular (SGP), stratum fiberosum periventriculare (SFP), ependymal cell (EP), tegmentum (T) (Methylene blue, 10x).

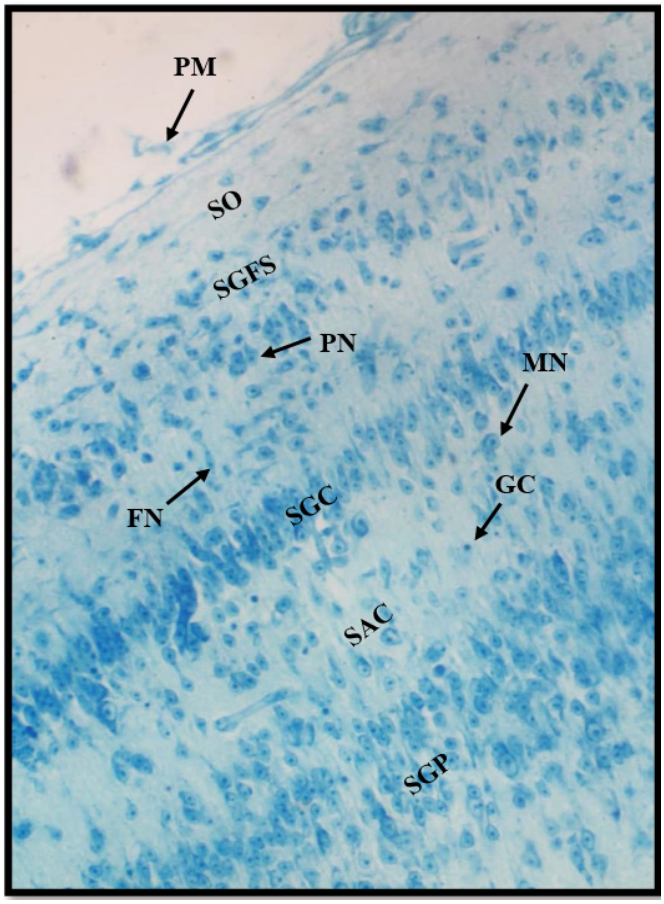

Figure 3: Transverse section through stratum opticum (SO), grisum et fibrosum superficiale (SGFS), griseum centrale (SGC), album central (SAC) and stratum grisum perventricular (SGP) showing: fusiform neuron (FN), pyramidal neuron (PN), glial cell (GC), multipolar neuron (MN). (Methylene blue, 40X).

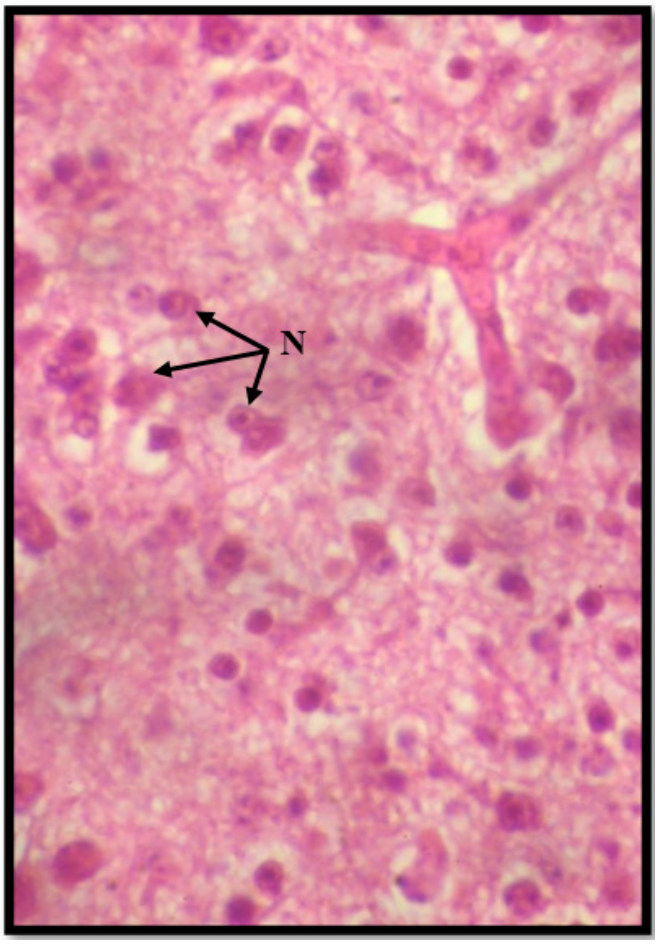

Figure 4: Transverse section through tegmentum showing nuclei of cranial nerves (N). (H&E, 100X).

diameter of 5 µm as well gail cells whose diameter was 3 µm (Figures 2 and 3).

The stratum griseum periventricular (SGP)

It is the fifth class of optic tectum layers and the advantage of this class was a logic area, at of thickness 43 µm, neurons are in this multipolar class with a diameter 5 µm (Figures 2 and 3).

The Stratum Fiberosum Periventriclare (SFP)

The main layer is the sixth layer of the optic tectum, is the rate of its thickness of 38) µm, and represents a layer of fibrins surrounding of optic ventricle located above the ependymal layer which is the expression of a row of cuboidal cells, contains the stratum fiberosum periventricular, the layer contains the axons and dendrites of the neurons, which extends part of them transversely within this layer and the other section extends to the upper layers of the roof. The cells this layer are multipolar, which a diameter 5 µm (Figure 2).

Tegmentum

The ventral region of the mesencephalon is tegmentum, and it is composed of nuclei of cranial nerves (Figures 2 and 3). Its thickness was 399 µm.

DISCUSSION

The midbrain serves important functions in motor movement, located within the brain stem. The tectum makes up the rear portion of the midbrain is formed by two paired rounded swellings (the optic lobes in the fishes, amphibians, reptilians, and birds) (the superior colliculus in the mammalian). The optic tectum receives input from the retina and the visual cortex and participates in a variety of visual reflexes.

In the present study, showed the average length of the birdbrain was 1.5 cm and the olfactory lobes represented the end of the cerebral hemispheres.[7,8] The mesencephalon (midbrain) is composed of two optic lobes are connected at the midline, and the optic tectum covers the mesencephalon, and at their bottom edges merges with the tegmentum.[9-11]

The size and structure of the optic lobes vary among species; the tectal function of the brain appears to be constant among all vertebrates.[12]

In some vertebrates, including fishes and birds the tectum is one of the largest components of the brain. In mammals and primates, the massive expansion of the cerebral cortex reduces the tectum (superior colliculus) to a much smaller fraction of the whole brain. It remains important in terms of function as the primary integrating center for eye movements.[8,13]

The mesencephalon was large in all fishes consisting of two different layers.[12] In elasmobranch fishes, the tectum is less prominent than in teleost fishes, being smaller than the telencephalon or cerebellum and its structure is less well-differentiated into distinct cell types and layers. The number of layers of optic tectum in sturgeon fish *Acipenser* and squirrel fish *Holocentrus* were six man layers.[14-16]

In the frog, five different optic centers are distinguished, three of them are located in the thalamus, the nucleus of the basal optic root, and the optic tectum are mesencephalic centers,[17] and the number layers of optic tectum in frog *Rana* are nine main layers.[18-20]

In the birds, the mid brain was characterized by the size of its optical lobes, to increase the visual perception of the birds. Therefore, its optical system is more complex than vertebrates.[21]

In the Mammalia, the superior colliculus replaces the optic lobes[13] and the number of layers of superior culliculus in tree shrew and rats are five main layers,[22,23] while in the cat, monkey squirrel and mice are seven main layers.[24-27]

The optic tectum's microscopic structure in birds is more developed than the corresponding structure in fishes, amphibians, and reptilians.[8]

The stratum opticum is found below the pial surface and contains fibers from the contralateral retina, which spread over the tectum after crossing in the chiasma.

The optic stratum is about 51 μm thick and appears to be a zone of closely packed fibers in the white-cheeked bulbul.

The neuropil of the pigeon tectal superficial layers is made up of small nervous elements.[28]

The stratum griseum et fibrosum superficile (SGFS) is 320 μm. The main optic terminal layers the SGFS, the greater part of the cellular as similar research[29] on the viper optic tectum.

This layer comprises small vertically oriented neurons and horizontal nerve cells many of which are local circuit neurons. The marginal optic tract carrying all the optic fibers in diencephalic optic nuclei and the mesencephalic optic tectum.[30,31]

The superficial layers of the viper tectum,[29] which receive fibers from her retina, some layers contain many fibers (stratum margin, opticum, and album centrale), the optic fibers layers, are composed of 200–250 tight fascicles containing thin fibers, nearly all of which are myelinated.

The SGFS of the tectal cortex are sensitive to stationary and moving stimuli and have small visual receptive fields.[32] Other research[33] showed the presence of sonic hedgehog gene (Shh) that encodes peptides acting on the differentiation of neurons in the optic tectum in its embryonic stages.

The stratum griseum centrale (SGC) is 123 μm and there are three cell types in this layer, the small fusiform perikaryon and two prominent dendrites passing superficially and deeply in the radial plane. The second cell type is a large pyramidal perikaryon, and the apical dendrites are two to three in number while the basal dendrites of the pyramidal cells are variable in number and pass in all direction. The third cell type is multipolar neurons and this agreed with other results. It showed this layer is cellular, containing multipolar neurons of large size in chicken,[34] either in Japanese quail contains stellate cells.[35] Some layers contain some neural cell bodies, fibers and synapses (SFGS, SGC).[36]

The first cells to be formed in the development of the chick optic tectum are the large, multipolar neurons of the SGC and these appear in the rostrocentral portion of the tectum between the third and fourth days of incubation and the last cells to arise on the ninth day form the deepest laminae of the SGFS.[37]

CONCLUSIONS

The study concluded that the mesencephalon (mid brain) consists of optic tectum, which covers the mesencephalon and the tegmentum, representing the bottom of the mesencephalon and containing the nuclei of the cranial nerves.

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