

RESEARCH ARTICLE

Histological Study on Bird Cerebellum of *Pycnonotus leucotis*

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ABSTRACT

Histological study of the cerebellum in a bird white cheeked bulbul *Pycnonotus leucotis*, the result of the study showed that the cerebellum took the parts of the hindbrain, the histological study of the cerebellum revealed the presence of deep folds on its surface. The cerebellum consists of two areas, the cerebellar cortex, which is called the gray matter, which consists of three layers: the outer layer (the molecular layer), the middle (Purkinje cells) and inner layer (the granular layer). The second area of the cerebellum is called the medullary and the white matter.

Keywords: Cerebellum, Cortex, Medulla.

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INTRODUCTION

The white cheeked bulbul (*Pycnonotus leucotis*), family Pycnonotidae, order Passeriformes, class Aves and phylum Chordata. The cerebellum is the central organ of movement and body balance. The cerebellum of birds is characterized by its size and degree of specialization due to the increase in the spinocerebellar of the spinal cord.¹

The cerebellum represents the first part of the hindbrain, involved in coordinating the complex motor activities of vertebrates, as it has a role in coordinating the skeletal muscle, where it receives sensory information from the muscles and joints, it works to regulate the location of the body and maintain a balance of decisiveness.²⁻⁴

The cerebellum is attached to the midbrain by its rostral medullary in it is from the back to the medulla oblongata by its caudal medullary velum.^{5,6} The cerebellum divides with a part of deep transverse incisions into anterior lobe, middle lobe and posterior lobe, these three lobes are composed of lobes or folia.^{7,8}

Material and Methods

Samples were collected from the local markets of Baghdad, after anesthetized, the heads were cut off, explained and eradicated the brains, they were fixed in formalin solution coding 10% for 24 hours, then they were washed with water, dehydrated with ethyl alcohol, cleared with xylene, infiltrated and embedded with paraffin wax melting point (56-58)°C, a rotating microtome cut off blocks with a thickness of (7) micrometers.

Then the sections were colored with hematoxylin, the dual article with eosin, and a blue metallic tinted with fixed violet crystal clarify the cellular composition the cerebellum layers and to clarify the neurocytes and their ramification well.⁹

RESULTS

The cerebellum is surrounded on the outside by a thin layer of connective tissue called pia matter. The cerebellum is histologically composed of two regions:

- The cerebellum cortex is composed of gray matter, and its thickness reaches (480–540) micrometers at the top of the cerebellar folia in the sulci area it was (430–580) micrometers (Figure 1). The cerebellum cortex consists of three layers (Figure 2), from the outside to the inside: Molecular layer: It is the first layer of the cerebellar cortex layer, surrounded by the pia mater, and is superficially located, thick in the sulci area where it reaches thickness (260–310) micrometer, thin at the top of the cerebellar folia it reached (200–220) micrometer. This layer contains the surface part fusiform neuron, small pyramidal cells, the middle part of this layer contains stellate neurons and the deep part of this layer contains Basket cells they are pyramidal neurons or fusiform neurons whose dendrites are dendrites secondary and its branches fall to the Purkinje cells layer. As for its axons, they leave the cells and end with branches in the next layer (Figure 3).
- **Purkinje Cells Layer:** It is the form of a narrow layer located between the molecular layer and the granular layer, the thickness of this layer is at the top of cerebellar folia (15–17) micrometers. As for the area sulci, it reached

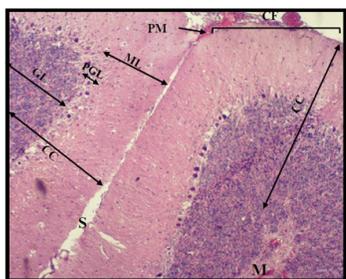


Figure 1: Cross section through the cerebellum of white choeked bulbul showing cerebelli folia (CF), suki (S), pia mater (PM), cerebellum cortex (CC), molecular layer (ML), Purkinje cells layer (PCL), granular layer (GL), medulla (M) (H & E, 4x).

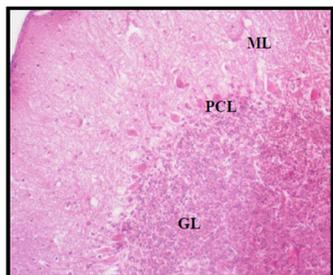


Figure 2: Cross section through the cerebellum cortex of white choeked bulbul showing: molecular layer (ML), Purkinje cells layer (PCL), granular layer (GL) (H & E, 10x).

its thickness (23–33) micrometers. This layer contains a large number of piriform neurons or round neurons; they are called Purkinje cells. These cells are the central nuclei; this layer also contains (the Golgi complex) located next to the Purkinje, which are stellate cells with a large nucleus (Figure 4).

- **Granular Layer:** It is located between the Purkinje layer and the medulla region this layer is thick at the top of the folia (250–290) micrometer and is thin in the area sucli where it has reached its thickness (130–230) micrometers. This layer contains large numbers of neurons called granular that are small, spherical in shape and contain large nuclei. In this layer, we notice the presence of thick myelinated mossy fibers coming from the medulla region to communicate with the granular cells in areas that take a lig Pigment cells glomeruli (Figure 5).
- **Medulla region:** The medulla region is called white matter and represents the medulla cerebellar folia, which are the myelinated axons of neurons within the medulla, there are neuroglia, some of which are large with a large nucleus and few cytoplasm with dendrites called Astrocyte, the other cells is called Oligodendroglia. It is arranged in rows surrounded by myelinated axons. In the medulla region, there are small blood vessels (Figure 6).

DISCUSSION

The current results noticed that the surface of the cerebellum is covered with a layer of the cerebellar cortex which is in the form of folds called the cerebellar folia.¹⁰⁻¹²

It comes to the cerebellum fibers coming from the telencephalon, the optic tectum, myelencephalon, spinal cord

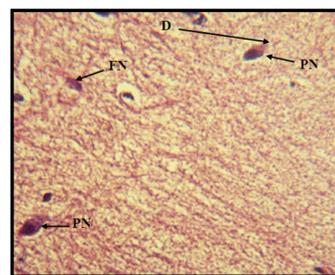


Figure 3: Cross section through the cerebellum cortex of white choeked bulbul showing Molecular layer, fusiform neuron (FN), pyramidal cells (PN), dendrites (D) (H & E, 100x).

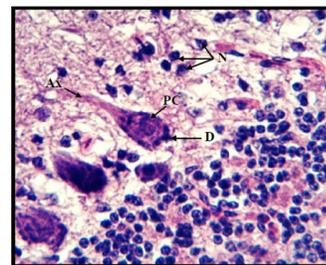


Figure 4: Cross section through the cerebellum cortex of white choeked bulbul showing Purkinje cells (PC), neuron (N), axon (Ax), dendrites (D) (H & E, 100x).

and trigeminal nerve nuclei,¹³ the cerebellar folia extend the axons in the medulla oblongata and spinal cord.^{14, 15}

The cerebellar cortex represents an external region of the cerebellum and consists of three layers from the outside to the inside, which are the molecular layer, the Purkinje cells layer and the granular layer was referred to by research;¹⁶ Matt, during his study of chicken birds.

The thickness of the molecular layer is greater in the sulci than the cerebellar folia, in the deep part of this layer, there are stellar neurons called Basket cells extending to the nerve fibers towards the Purkinje cells, and this is what the researchers referred^{16,17} to in their study on birds. Purkinje cells prepared a character of the cerebellum, the researcher has indicated.¹⁸ The Purkinje cells in the cerebellum of birds are similar to the Purkinje cells in the human cerebellum, but they are larger and less numerous than birds.¹⁵ Study showed Al-Qulzaji in the brain Anas olatyrhnochos the Purkinje cells change the density of their numbers with in one folia. The efferent fibers pathway the cerebellum consists of the axons of Purkinje cells.¹⁹ The granular layer contains a large number of round nuclei that are closely related to the color of hematoxylin, we appear upon microscopic examination as a granular layer²⁰ (Harvey and Napper, 1991). This is similar to what was found in the current study. Granule cells are receiver nerve impulses from the central nervous system.²¹ The afferent nerve fibers from the brain center the cerebellum, where they cross the cerebellar cortex, lacking complex connections between the dendrites of Purkinje cells and granule cells, and then extend to the medulla region. The pulp region represents the inner part of the cerebellum and contains nerve fibers, representing afferent and efferent nerve fiber from the cerebellar cortex.²²

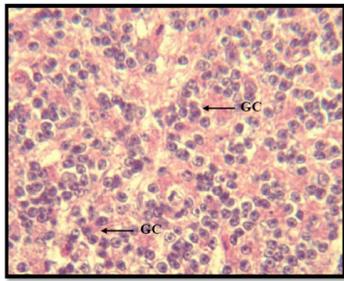


Figure 5: Cross section through the cerebellum cortex of white choeked bulbul showing granular layer, granular cell (GC) (H & E, 100x).

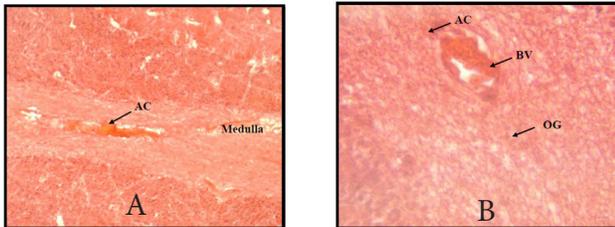


Figure 6: Cross section through the cerebellum medulla of white choeked bulbul showing: Astrocyte (AC), Oligodendroglia (OG), blood vessels (BV) (H & E, A- 10x – B-100x).

CONCLUSIONS

The study concluded that the cerebellum consists of cortex (Gray matter) and medulla (white matter). The cortex consists of three layers molecular, Purkinji cells and granular.

Due to the expansion of the spinocerebellar portion of the spinal cord, the cerebellum of birds differs from other vertebrates in size and degree of specialization. Histological study of the cerebellum in a bird white Choeked bulbul *Pycnonotus leucotis* revealed the presence of deep folds on its surface. The result of the study also, showed the cerebellum took the parts of the hindbrain. The current results noticed the cerebellar folia, in the cerebellar cortex. The human Purkinje cells in the cerebellum are similar to those in birds' cerebellums, but they are larger and fewer in number in birds.

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