



Gross Anatomy and Morphometry of the Brain in Guinea Fowl (*Numida meleagris*)

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Abstract

The gross anatomical structure and morphometry of brain in Guinea fowl was studied in 12 samples of the brain. The brain was observed characterized into four different parts viz. the cerebrum, cerebellum, optic lobe and medulla oblongata. The average brain weight was observed as 3.924 gms, while the average length and breadth (width) were 26.853 mm and 19.857 mm respectively. The largest part of the brain was identified as the cerebrum and it resembled the shape of a betel leaf which was divided into left and right cerebral hemispheres and measuring average length and width as 19.857 mm and 16.119 mm respectively, which showed smooth texture, devoid of gyrus and sulcus. The cerebellum was located behind the transverse sulcus. The optic lobes were interconnected with rest of brain with fissure. The pons and the medulla oblongata were located consecutively at the posterior part of the ventral section of the brain.

Keywords: Anatomical, Brain, Guinea Fowl, Morphometrical



Introduction

The brain is one of the most complex organs besides control the body by performing several functions. It is identified as the power center of living multi-cellular organism and the intelligence of that individual living multi-cellular organism can be decided on the functional ability of the brain. There is wide diversity in the structure and form of the vertebrate brain. The mammalian brain has been studied upto a wide extent, but the study on the brain in birds and in particular about the Guinea fowl it remained as the neglected arena may be due to the neglecting this species while choosing it as the study model. In order to expand the area of knowledge of this structure, the morphology of this organ was undertaken in the species of Guinea fowl. The research on the brain in birds is important for improving their welfare and deepening the knowledge about the functional neurology, physiology, anatomical development and even to know the behavior.

Materials and Methods

Twelve Guinea fowl birds without discriminating on the basis of their sex were identified at the meat shops. The heads of these predetermined birds were procured from those who have procured and slaughtered the birds at meat shops for meat purposes. The procured heads of birds were carried on ice at laboratory for further routine desired process of investigation. The craniums of heads were broken down carefully while exposing the brain. After its removal, the biometrical parameters of the brain were measured by measuring scale.

Results

The present endeavor of gross anatomical features of the brain in Guinea fowl birds were studied thoroughly. It has shown the texture in creamy greasy coloured with its covering as the meninges from outward to inwards viz. duramater, arachnoid and piamater. But the brain doesn't show prominent sulci and gyri. Therefore, the duramater and its attachment with the cranial cavity were observed without prominent differences. The careful removal of the brain from the cranial cavity has shown intact, thin, delicate and undifferentiated all the three layers of meninges altogether. The shape of whole brain was not comparable with any specified geometrical shape and also it was far away from the resemblance with the specific structure or object. The average brain weight was observed as 3.924 ± 0.124 gm, while the average length and breadth (width) were 26.853 ± 0.593 mm and 19.857 ± 0.398 mm respectively. Four different parts of the brain were identified viz. the cerebrum, cerebellum, optic lobe and medulla oblongata which showed major variations in shape with anatomically distinctive developed features. Cerebrum was identified as the largest part which comprised of more than 50% of the whole brain. The left and right cerebral hemispheres were observed firmly attached but there was the inter-hemispheric longitudinal fissure which may be considered as the bifurcating evidential line between left and right cerebral hemispheres. The cerebrum and cerebellum were separated by a small transverse fissure. The olfactory bulb was noticed as the small structure on the anterior part of the cerebrum (Figure 1). Various features of the brain were studied according to different topographical aspect viz. dorsal, ventral and lateral.

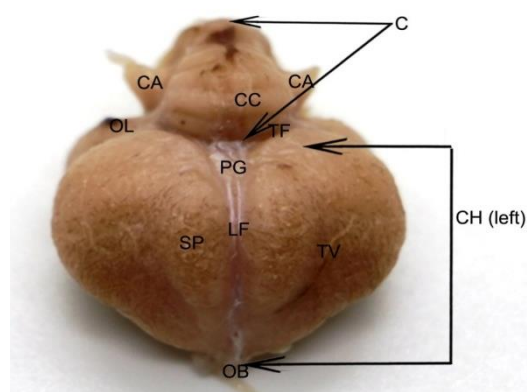


Figure 1: The dorsal (Anterior) view of the brain of Guinea fowl showing Cerebral Hemisphere (CH), Olfactory Bulb (OB), Telencephalic Vallecula/Groove (TV), Sagittal Prominence/Hillocks (SP), Longitudinal Fissure/Central fissure (LF), Transverse Fissure (TF), Optic Lobe (OL), Cerebellum (C), Cerebellar Convolutions/ Vermis (CC), Cerebellum Auricle/Flocculus (CA) and Pineal Gland (PG).

The dorsal surface of the brain in guinea fowl showed two viz. right and left cerebral hemispheres (Figure 2.) at the anterior part while cerebellum and medulla oblongata were at the posterior part. The tiny olfactory bulb was located medially at the extreme anterior end of the cerebrum. A cerebral longitudinal fissure was present between the right and left cerebral hemisphere and a transverse sulcus between the cerebrum and cerebellum. The formation of the cerebrum appeared like betel leaf or more resembled spade of playing cards. The cerebrum measured average length and width as 19.857 ± 0.398 mm and 16.119 ± 0.304 mm respectively. The cerebral surface showed smooth texture, and there was no gyrus and sulcus seen over it. However, on the dorsal surface of the cerebrum, there was a chamber formed by elliptical arc-shaped sulcus starting antero-sagittal and running postero-lateral upto mid of either side of the cerebrum and thereafter joining at either side of the pineal gland at the transverse sulcus. The groove was identified telencephalic vallecule and either side chambered protuberance was identified as sagittal prominence or hillocks. Between these two grooves, the pineal gland was observed located at the juncture of the transverse sulcus and the 2 cerebral hemispheres and covered by the duramater. The cerebellum was located behind the transverse sulcus. The average length, width and height of the cerebellum were recorded as 11.101 ± 0.206 mm, 7.773 ± 0.191 mm and 8.975 ± 0.262 mm respectively. An apparent vermis was present at the centre of the cerebellum with some transverse fissures. The transverse fissures were identified as folia or cerebellar convolutions and were 7-8 in number. The lateral prominence of the cerebellum was visualized as some elongated protuberance which was identified as cerebellar auricle or flocculus on each side of the vermis. The cerebellar auricle's length and width were calculated as 3.610 ± 0.142 mm and 2.549 ± 0.090 mm respectively.

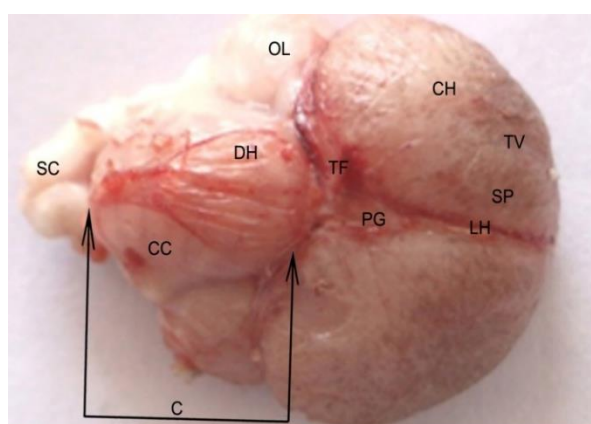


Figure 2: The dorsal view (Middle) of the brain of Guinea fowl showing Cerebral Hemisphere (CH), Telencephalic Vallecule/ Groove (TV), Sagittal Prominence/Hillocks (SP), Longitudinal Fissure/Central fissure (LF), Transverse Fissure (TF), Duramater (DH), Pineal Gland (PG), Optic Lobe (OL), Cerebellum (C), Cerebellar Convolutions/ Vermis (CC) and Spinal Cord (SC).

On the ventral aspect of the brain, the anterior part showed a small olfactory bulb on the cerebral hemisphere. There were no olfactory tracts. The orbital faces of the cerebral hemisphere were located in the anterior part of the brain. The optic chiasm occurs at the centre rear of the left and right cerebral hemispheres. The optic tract was comparatively developed and optic nerves were also clearly visible. The nerve fibers located at the optic tract was found traveling laterally to have the linkage with the optic lobe of the midbrain. The nerve fibers were forming the anatomical bridge between the optic tract and optic lobe. The optic lobe protruded from ventral to the lateral part of the midbrain. The parts behind the optic chiasm all belong to the brainstem structure. A small pituitary gland also known as hypophysis cerebri was found located just behind the optic chiasm. Diencephalon and midbrain were followed by the hypophysis cerebri. Further regressing backward at the ventral brain stem, a very superficial longitudinal sulcus, and a middle ventral fissure was observed which divided the pons and medulla into two equal parts. The pons and the medulla oblongata were located consecutively at the back. No apparent demarcation was observed between the midbrain and the pons. The pons and the medulla oblongata became narrow and thin progressed toward the spinal cord. The brain was perceived terminated at the spinal cord (Figure 3).

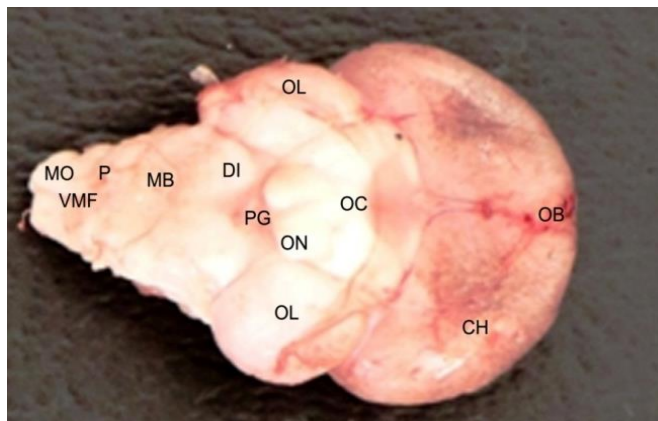


Figure 3: The ventral view of the brain of Guinea fowl showing Olfactory Bulb (OB), Optic Chiasma (OC), Optic Nerve (ON), Optic Lobe (OL), Pituitary Gland (PG), Diencephalon (DI), Cerebral Hemisphere (CH), Midbrain (MB), Pons (P), Medulla Oblongata (MO), Ventral Middle Fissure (VMF) and Spinal Cord (SC).

The lateral aspect of Guinea fowl brain showed the olfactory bulb, the cerebral hemisphere, the large optic lobes on either side, which were better, visualized laterally, the cerebellum showing the convolutions with cerebellar auricles. The optic lobes were interconnected with the rest of the brain with fissure. The length and width of the optic lobes were recorded as 10.154 ± 0.194 mm and 6.820 ± 0.162 mm respectively. Pons and medulla oblongata were also visualized. Cranial nerves viz. the trigeminal, the facial and the glossopharyngeal nerve could also be distinguished on the basis of their location (Figure 4).

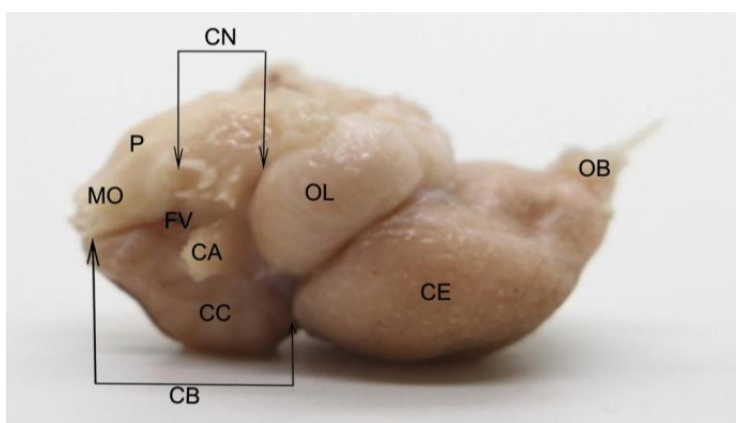


Figure 4: The lateral view of the brain of Guinea fowl showing Olfactory Bulb (OB), Cerebrum (CE), Optic Lobe (OL), Cranial Nerve (CN), Pons (P), Medulla Oblongata (MO), Cerebellum (CB), Fourth Ventricle (FV), Cerebellum Convolution/Vermis (CC) and Cerebellum Auricle/Flocculus (CA).

Discussion

The study has revealed the brain of guinea fowl with creamy white texture. The gross studies of the brain were performed with respect to its different planes and surfaces as dorsal, ventral and lateral. It has shown four; clearly, major differentiating division's viz. the cerebrum, cerebellum, optic lobe and the medulla oblongata. Gupta *et al.* (2016) has identified an identical structure in Vencobb broiler birds. Peng *et al.* (2008) were also observed the brain of African ostrich and marked alike with the presently discovered undivided four divisions. They had the underdeveloped midbrain without distinguishable as a separate part. Contrary, the optic lobe was uncovered as the highly developed rounded structure. The midbrain was lying just behind the optic chiasm and optic nerve was followed by the pons and medulla oblongata.

Pertaining to the shape of the whole brain, it was observed unmatched in comparison with any of the geometrical shapes and also it was far away from the resemblance with the specific structure or object. Gupta *et al.* (2016) identified similarity in shape with hourglass in Vencobb broiler birds. The average brain weight was observed as 3.924 ± 0.124 gm, while the average length and breadth (width) were 26.853 ± 0.593 mm and 19.857 ± 0.398 mm respectively. Peng *et al.* (2008), when observing the anatomical features of the African ostrich brain calculated the

average weight, length, and width of the total brain as 26.34 g, 59.26 mm, and 42.30 mm. The brain weight of ostrich was 8 times while the length and breadth (width) were double. However, these comparisons were with the contrary to the body weight of both the species, since the body weight of the African ostrich is nearly 200 times in relation to guinea fowl. The cerebrum was identified as the largest part of the brain and it resembled the shape of a betel leaf or spade kind of playing cards. Cerebrum was comprised of more than 50% of the whole brain. Its surface was observed smooth and devoiding of gyri and sulci. The cerebrum and cerebellum were separated by a small transverse fissure. The olfactory bulb was noticed as the small structure on the anterior part of the cerebrum. These were analogous to observations of Gupta *et al.* (2016) in brain of Vencobb broiler birds. The present observations were parallel to Peng *et al.* (2008) findings as the cerebrum was composed 59.65% of the brain's total length in relative to the brain of African ostrich.

The cerebral surface showed smooth texture, and there was no gyrus and sulcus seen over it. Similar results were shown by Gupta *et al.* (2016) in the brain of Vencobb broiler birds and Peng *et al.* (2008) in the brain of African ostrich. However, on the dorsal surface of the cerebrum, there was a chamber forming by elliptical arc-shaped sulcus that started antero-sagittal and runs postero-lateral upto mid of either side of cerebrum and thereafter meet at either side of the pineal gland. The groove was identified telencephalic vallecule and either side chambered protuberance was identified as sagittal prominence or hillocks. These were akin and analogous to the findings of Peng *et al.* (2008) in brain of African ostrich.

The anatomical observations on cerebellum in white leghorn variety of fowl by Pal *et al.* (2003), was found to be a round structure resembling a curled worm, which represented the vermiform lobe of mammals. The observations with relation to the ventral aspect of brain were similar as recorded by Peng *et al.* (2008) in the brain of African ostrich and were near to the findings of Gupta *et al.* (2016) in brain of Vencobb broiler birds. Diencephalon and midbrain were followed by the hypophysis cerebri. These structures were compared with the brain of African ostrich by Peng *et al.* (2008). Further regressing backward at the ventral brain stem, a very superficial longitudinal sulcus, a middle ventral fissure was observed which divided the pons and medulla into two equal parts. The pons and the medulla oblongata were located consecutively at the back. No apparent demarcation was observed between the midbrain and the pons. The pons and the medulla oblongata were followed by narrower and continuous structure, the spinal cord.

The lateral visualization of Guinea fowl brain showed the olfactory bulb, the cerebral hemisphere, the large optic lobes on either side, the cerebellum showing the convolutions with cerebellar auricles. The length and width of the optic lobes were recorded as 10.154 ± 0.194 mm and 6.820 ± 0.162 mm respectively. Pons and medulla oblongata were also visualized. The observations were akin and parallel to the investigation on the brain of African ostrich by Peng *et al.* (2008). Some cranial nerves viz. the trigeminal, the facial and the glossopharyngeal nerve could also be distinguished based on their location.

Conclusion

The current interpretation was accomplished on the specimens of the brain to study gross anatomical studies on the brain. The study revealed the following conclusion-

The three inseparable layers of meninges were there over the brain, which was located into the cranial cavity. Four different parts of the brain were identified viz. the cerebrum, cerebellum, optic lobe and medulla oblongata, which showed major variations in shape with anatomically distinctive developed features. The average brain weight was observed as 3.924 ± 0.124 gm, while the average length and breadth (width) were 26.853 ± 0.593 mm and 19.857 ± 0.398 mm respectively.

Conflict of Interests

There is no conflict of interest.

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