RESEARCH ARTICLE

Gross Morphometrical Study on the Brain of Fowl (*Gallus domesticus*)

Sunil K Gupta[1], Sabbineni Haswitha[2], Amandeep Kaur[3]

Abstract

Morphological study was conducted on the brain of nine fowl aged from 2 to 6 months. The pear-shaped brain lodged in the cranial cavity was 3.34 ± 0.08 g in weight, with a length of 26.69±0.40 mm and width of 20.60 ± 0.17 mm. It consisted of cerebral hemispheres, pineal body, optic lobes, and cerebellum when viewed from the dorsal surface. On ventral surface, from cranial to caudal end it had olfactory bulbs, orbital faces of the cerebral hemispheres, optic chiasma, optic tract, optic lobes, hypophysis cerebri, midbrain (cerebral peduncles), pons and medulla oblongata, which was continued into the spinal cord. Olfactory bulbs present on the tapered cranial end of cerebral hemisphere were so closely attached with each other that were giving the appearance as a single structure. The cerebral hemispheres were obtuse triangular and devoid of gyrus and sulci. The cerebellum was located behind the transverse sulcus and had gyri and sulci. It was round structure resembling a curled worm and was 11.80±0.25 mm in length and 8.53±0.21 mm in width.

Keywords: Avian anatomy, Avian brain, Fowl, Gross morphometry

Ind J of Vet Sci and Biotech (2019): 10.21887/ijvsbt.14.4.9

Introduction

The birds are considered as an intelligent class of vertebrates, and in ancient time these were reared for carrying messages and fighting purposes. Balance and equilibrium are different in bipedal cursorial and quadruped (Pal *et al.,* 2003). The brain is responsible for maintenance of many body functions (equilibrium of the body) by making coordination of somatic motor activity and by regulating the muscle tone. The size and shape of the brain and its parts are related to the animal's type of limb movement, the center of gravity and species posture (Mondal, 1997). Now a days fowls are mainly reared for egg and meat purposes, and the brain is also consumed as meat. The objective of the present work was to study the gross morphometry of brain of fowl (*Gallus domesticus*).

Materials and methods

The study was conducted on the brain of nine fowl aged from 2 to 6 months. The fowl heads were procured from the local abattoirs. After collection of the heads, these were properly washed with fresh tap water and fixed in 10% formalin. After complete fixation, the cranial cavity was opened very carefully and the brain was dissected out for further study. Different parts of the brain were measured with the help of digital Vernier caliper, non-elastic thread, and scale. Statistical analysis was done as per Snedecor and Cochran (1994).

Results and discussion

The pear-shaped brain lodged in the cranial cavity of fowl was 3.34 ± 0.08 g in weight with the volume of 3.22 ± 0.08 ml. The maximum length and width of the brain were 26.69 ± 0.04 mm and 20.60 ± 0.17 mm, respectively. Our observations are identical to that of Pal *et al.* (2003) who reported weight, volume, length and width of the brain in fowl 3.15 ± 0.222 g, 3.00 ± 0.163 mL, 26.3 ± 0.048 mm and 20.5 ± 0.064 mm, respectively. Fowl brain was divided into three parts, *viz*, forebrain, and hindbrain. It consisted of cerebral hemispheres, pineal body, optic lobes, and cerebellum when viewed from the dorsal surface (Fig. 1). On ventral surface, from cranial to caudal end it had olfactory bulbs, orbital faces of the cerebral hemispheres, optic chiasma, optic tract, optic lobes, hypophysis cerebri, midbrain (cerebral peduncles), pons and medulla oblongata, which was continued into the spinal cord (Fig. 2). From dorsal view, it was noticed that the two cerebral hemispheres were at the anterior part of the brain. There were two small olfactory bulbs in the intermediate of the head end of the cerebrum. These olfactory bulbs were so closely attached with each other that was giving the appearance of a single structure (Figs 1 and 2).

Between the two cerebral hemispheres, a less developed longitudinal fissure was present (Fig. 1). The cerebrum was

[1-3]Department of Anatomy and Histology, College of Veterinary Science and A.H., Mhow, N.D.V.S.U. Madhya Pradesh, India

Corresponding Author: Sunil K Gupta, Department of Anatomy and Histology, College of Veterinary Science and A.H., Mhow, N.D.V.S.U. Madhya Pradesh, India, email: vetskgupta@rediffmail.com

How to cite his article: Gupta, S.K., Haswitha, S., Kaur, A.J. (2019). Gross Morphometrical Study on the Brain of Fowl (Gallus domesticus). Ind J of Vet Sci and Biotech., 14(4):32-35

Source of support: Nil

Conflict of interest: None

Submitted: 25/02/2019 **Accepted:** 10/03/2019 **Published:** 20/4/2019

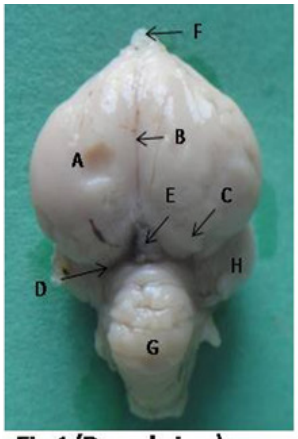

Fig.1 (Dorsal view)

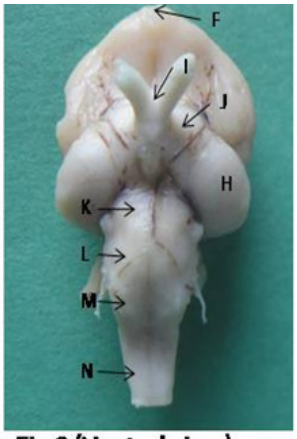

Fig.2 (Ventral view)

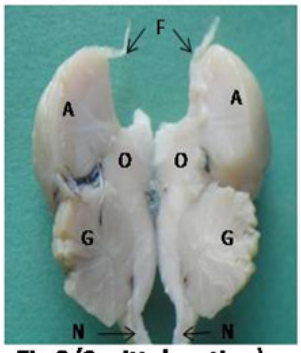

Fig.3 (Sagittal section)

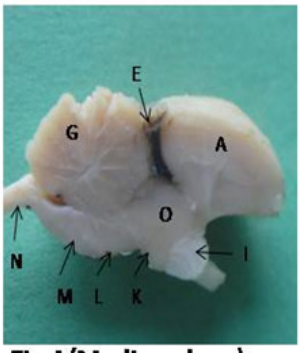

Fig.4 (Median plane)

Figs 1 to 4: A: Cerebral hemisphere, B: Longitudinal fissure, C: Cambered supersulcus, D: Transverse sulcus, E: Pineal body, F: Olfactory bulb, G: Cerebellum, H: Optic lobe, I: Optic chiasma, J: Optic tract, K: Cerebral peduncle, L: Pons, M: Medulla oblongata, N: Spinal cord, O: Thalamus

an obtuse triangle. The cerebral surface was smooth and there was no evidence of gyrus and sulci on it as reported by Batah *et al.* (2012) in chicken. However, on the dorsal surface of the cerebrum, there was a cambered super sulcus bending posterior-medially and so-called telencephalic vallecula. The triangular shaped cerebral hemisphere was pointed (tapers) and thin at the cranial end, while the caudal end was rounded and thick (Fig. 1). Its length was 16.24 ± 0.26 mm with a maximum width of 11.59±0.12 mm. The cerebrum appeared as triangular in chicken (Batah *et al.*, 2012), obtuse triangle in ostrich (Peng *et al.*, 2010), trapezoid in white stork and tapers in the Pekin ducks and grey goose (Peng *et al.*, 1994).

The cerebellum was located behind the transverse sulcus. It was round structure resembling a curled worm, representing the vermiform lobe of the mammalian brain (Figs 1 and 3). It was 11.80 ± 0.25 mm in length and 8.53±0.21 mm in width. The same was observed by Batah *et al.* (2012) in chicken and Pal *et al.* (2003) in fowl, and they further reported that the mean ± SD of cerebellum length and width were 11.669±0.61 mm and 8.6 ± 0.39 mm in chicken and 15.08 ± 0.94 mm and 9.59±0.14 mm in fowl, respectively. According to Peng *et al.* (2010) in ostrich, these parameters were 24.36 ± 0.015 mm and 18.42 ± 0.010 mm, respectively. The rostral surface of the cerebellum, which was laterally compressed, accommodated into a 'V' shaped notch between the caudal poles of the cerebral hemisphere and optic lobes. The anterior end of the cerebellum was found to be closely associated with the caudal pole of the cerebral hemisphere due to the wide separation of the optic lobes on either side (Fig. 1). However, in an eagle owl, the cerebellum design was spade and cauliflower-shaped situated forwardly to cover the diencephalon dorsally and backwardly to cover the medulla oblongata (Abd-Alrahman, 2013). The cerebellum was separated from the medulla oblongata by the fourth ventricle. This is in agreement with the findings of Pal *et al.* (2003) in fowl. The mid-dorsal surface of the cerebellum presented a series of transverse gyri and sulci. The cerebellum was connected with the midbrain rostrally and with the medulla oblongata caudally by the peduncles. In a sagittal section, it was found that the vermiform cerebellum was divided into ten primary folia. The cerebellum was divided into an outer cortex/gray matter and inner medulla/white matter (Figs 3 and 4), the same was reported by Abd-Alrahman (2013) in eagle owl and Pal *et al.* (2003) in fowl and they further identified this folia or lobules as lingual, central lobule, culmen, declive, folium, tuber, vermis, pyramid, uvula and nodule. However, Peng *et al.* (2010) in ostrich reported that there was 18–19 transverse sulcus distributed on the cerebellar vermis, dividing the vermis into lobules.

Diencephalon was located at the center of the cerebral hemispheres and occupied the anterior of the brain stem, and its post-limit was between the posterior commissure or the location of the pineal body and the midbrain. It was linked bilaterally with the optic lobe of the mid brain. The diencephalon was considered of two cycloid eminences/ thalami (Figs 3 and 4). The hypothalamus was seated at

Table 1A: Morphometric parameters (mean ± SE) of the brain of fowl

Brain weight (g)	*Brain length (mm)*	*Brain width (mm)*	*Midbrain width (mm)*	*Optic lobe length (mm)*	*Optic lobe width (mm)*
3.34 ± 0.08	26.69 ± 0.04	20.60 ± 0.17	4.55 ± 0.09	10.17 ± 0.13	6.10 ± 0.10

Table 1B: Morphometric parameters (mean ± SE) of the brain of fowl

Cerebrum length (mm)	*Cerebellum length (mm)*	*Cerebellum width (mm)*	*Medulla oblongata length (mm)*	*Medulla oblongata width (mm)*	*Optic tract width (mm)*
16.24 ± 0.26	11.80 ± 0.25	8.53 ± 0.21	6.41 ± 0.25	7.31 ± 0.13	5.04 ± 0.06

the back side of the optic chiasma and was linked with the hypophysis cerebri by means of an infundibular stalk of 2.48 x 2.10 ± 0.07 mm diameter. The small-sized midbrain was 4.55 ± 0.09 mm in length and 9.17 ± 0.17 mm in width when measured from the ventral surface. It was situated between the posterior commissure and the diencephalon. The posterior extremity was linked with the pons and medulla oblongata directly. The dorsal surface of the rostral half of the midbrain was covered by the occipital pole of the cerebral hemisphere, and the caudal half was covered by the cerebellum.

The optic lobe was located at the bilateral of the midbrain and was converge at the ventral median line. These were a pair of oval eminences protruded on the ventral and lateral surfaces of the midbrain (Figs 1 and 2). These were 10.17 ± 0.13 mm in length and 6.10 ± 0.10 mm in width. The optic tracts connecting the optic lobe to optic chiasma were 2.46±0.06 mm in length with a width of 5.04 ± 0.06 mm (Fig. 2). The pons and medulla oblongata were located at the ventral surface of the cerebellum (Figs 2 and 4). There was a longitudinal super sulcus at its ventral center, the fissure mediana ventralis. A less developed transverse super sulcus was dividing this segment into an anterior part (pons) and a posterior part (medulla oblongata). The pons was 2.23 ± 0.10 mm in length and 4.89±0.09 mm in width, while the length and width of medulla oblongata were 6.41±0.25 mm and 7.31±0.13 mm, respectively. In fowl, the brain was divided into three parts, i.e., forebrain, and hindbrain, but the components forming these parts of the brain were not resembling with the mammalian brain. The cerebral hemisphere was smooth and devoid of gyrus and sulci, whereas in cerebellum the gyri and sulci were present on its outer surface and ventrally it was separated from the pons and medulla oblongata by the fourth ventricle.

Acknowledgments

Authors thank the Dean of the College of Veterinary Science and A.H. and University authorities for the facilities provided for this work.

References

Abd-Alrahman, S.A. (2013). Anatomical and histological study of the cerebellum in nocturnal raptor species/ eagle owl (Bubo bubo). Journal of Babylon University / Pure and Applied Sciences.21: 388-393.

Batah, A.L., Ghaje, M.S. and Sh, N.A. (2012). Anatomical and histological study for the brain of the locally breed chicken (Gallus domesticus). Journal Thi-Qar Science.3: 47-53.

Mondal, R.K. (1997). Comparative Gross Anatomical and Histomorphological Studies on Cerebellum of Fish, Amphibia, Reptiliaand Mammalia. Ph.D. Thesis, W.B.University of Animal and Fisheries Science, Calcutta.

Pal, B., Chowdhury, S. and Ghosh, R.K. (2003). Comparative anatomical study of the cerebellum of man and fowl. Journal of Anatomical Society of India. 52: 32-37.

Peng, K., Feng, Y., Zhang, G., Liu, H. and Song, H. (2010). Anatomical study of the brain of the African ostrich. Turkish Journal of Veterinary and Animal Sciences.34: 235-241.

Peng, K.M., Niu, H.P., Chen, J.A., Zhang, D.R., Yang, Q.Y. and Zhang, J.Y. (1994). Comparative anatomy of the brains of oriental white stork, duck and goose. Journal Heilongiiang Agriculture University.7: 81-87.

Snedecor, G.W. and Cochran, W.G. (1994). Statistical Methods. 8th edn. Indian Edition, Oxford and IBH Publishing Company, New Delhi.