The Pharma Innovation Journal 2019; 8(9): 361-363

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2019; 8(9): 361-363

www.thepharmajournal.com
Received: 04-07-2019
Accepted: 08-08-2019

Rajalakshmi K
Department of Veterinary Anatomy and Histology, Rajiv Gandhi Institute of Veterinary Education and Research, Kurumbapet, Tamil Nadu, India

Sridevi P
Department of Veterinary Anatomy and Histology, Rajiv Gandhi Institute of Veterinary Education and Research, Kurumbapet, Tamil Nadu, India

Siva Kumar M
Department of Veterinary Anatomy and Histology, Rajiv Gandhi Institute of Veterinary Education and Research, Kurumbapet, Tamil Nadu, India

Correspondence
Sridevi P
Department of Veterinary Anatomy and Histology, Rajiv Gandhi Institute of Veterinary Education and Research, Kurumbapet, Tamil Nadu, India

Gross anatomical studies of neurocranium of Emu (*Dromaius novaehollandiae*)

Rajalakshmi K, Sridevi P and SivaKumar M

Abstract
Neurocranium was composed of the unpaired occipital, sphenoid and paired parietal, frontal and temporal. The occipital bone was composed of three parts, squamous part (Supraoccipital), lateral or exoccipital and basal part (Basioccipital) all of which contributed in the formation of foramen magnum. From the floor of the foramen magnum, the hemispherical single occipital condyle projected ventrally. The supra occipital presented a median external occipital protuberance from which a median occipital crest extended upwards and joined the nuchal crest. Sphenoid formed the major part of the floor of the cranial cavity with basi-phenoid caudally and pre-sphenoid rostrally. The orbital wings of presphenoid also contributed to the formation of the inter-orbital septum. The parietal was located in between the frontal and supra-occipital bones. The frontal bone was the largest of all cranial bones and formed the highest point of skull. The orbital plates of the frontal formed the medial wall of the orbit and were fused medially with each other and formed the inter-orbital septum. The temporal bone formed the lateral wall of the cranial cavity and consisted of two parts, namely squamous temporal and ear capsule (os-oticum). The orbital wings of pre-sphenoid and orbital plates of frontal bones of either sides were connected medially and formed the inter-orbital septum. The caudal part of the perpendicular plate of ethmoid also joined the inter-orbital septum.

Keywords: Gross anatomical, neurocranium, emu, *Dromaius novaehollandiae*

Introduction
In general the avian skull was composed of neurocranium and splanchnocranium, which were separated by the large orbital cavities. In birds the skull bones were light in weight and were generally fused to provide protection to the brain. Nickel *et al*., 1977 [5] in domestic birds reported that due to the large sized orbital cavities there was a nasal disposition of the ethmoid which was not a part of the neurocranium. In large birds, the small sized neurocranium and large sized splanchnocranium was related to its feeding habits. The avian skull bones articulate with each other permitting a certain degree of movement. A characteristic feature of the avian skull was the single occipital condyle which made the atlanto-occipital joint a much more mobile articulation than in mammals and allowed considerable rotation of the head, Mc lelland (1990) [3]. The present study was undertaken to elucidate the gross morphological features of the bones of neurocranium in the skull of emu.

Materials and Methods
The present study was conducted on three adult emu birds, brought for post morterm to the department of Veterinary Pathology at Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry. Skull was removed after natural maceration and the gross morphological features of the neurocranium was studied.

Results and Discussion
Emu skull had a pyramidal appearance. The apex was narrow and flat while the base appeared large, wide and rounded. The skull was composed of two components neurocranium (Cranial bones) and splanchnocranium (Facial bones). The large orbital cavities separated the neurocranium and splanchnocranium. The Neurocranium was composed of the unpaired occipital, sphenoid and paired parietal, frontal and temporal. The parietal, temporal and sphenoid were pneumatic. Ethmoid due to its nasal disposition was not involved in the formation of neurocranium.

Occipital bone

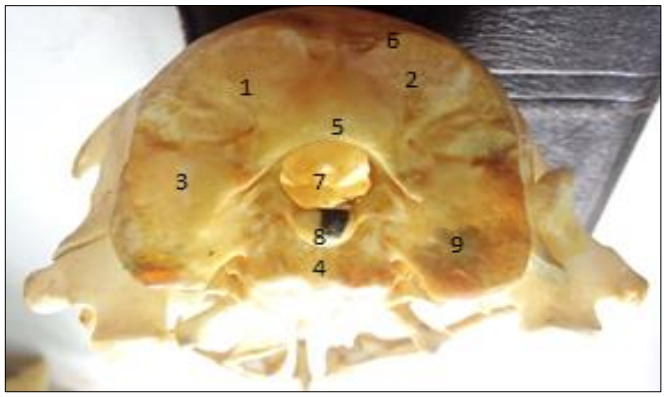

Fig 1: Caudal view of posterior aspect of Emu skull 1. Occipital 2. Supraoccipital 3. Exoccipital 4. Basi occipital 5. Medial external occipital protruberance 6. Nuchal crest 7. Foramen magnum 8. Occipital condyle 9. Para occipital process

The occipital bone (Fig 1) was composed of three parts, squamous part (supraoccipital), lateral or exoccipital and basal part (basioccipital), all of which contributed in the formation of foramen magnum, which was slightly transversely oblong in shape. Kumar and Singh, 2014 [2] had observed that the foramen magnum was broader horizontally in emu. The hemispherical single occipital condyle which was convex basally projected ventrally from the floor of the foramen magnum. Similar observations were noticed in ostrich by Moselhy *et al.,* 2018 [4]. A characteristic feature of the avian skull was the single occipital condyle which made the atlanto-occipital joint a much more mobile articulation than in mammals and allowed considerable rotation of the head Mc lelland (1990) [3]. The occipital bone with its foramen magnum was situated basally and horizontally in pigeon, almost vertically and nuchally in duck and goose, whereas in fowl it took up a middle position between these two extremes Nickel *et al.*, 1977 [5]. In contrast, Kumar and Singh, 2014 [2] observed a pear shaped occipital condyle in emu. The squamous occipital formed a part of the posterior thick wall of the neurocranium and was separated from the parietals above by the nuchal crest. Supra occipital presented a superior lateral U shaped area and a ventro lateral wing shaped area. The intermittent area constituted the median external occipital protuberance from which a median occipital crest extended upwards and joined the nuchal crest (Fig 1). A similar medial occipital protruberance and crest was noticed in ostrich by Moselhy *et al.,* 2018 [4] and in mammals by Dyce *et al.,* 2002 [1]. Just lateral to the median occipital crest on either side, close to the nuchal crest a pneumatic foramen was observed. The basi -occipital was seen as a depressed fossa below, as well as on either sides of the single occipital condyle and was separated from the basi sphenoid behind, by a raised transverse ridge. Paired lateral occipital was in the form of a broad U shaped Para occipital process (Fig 1), which presented on its medial face a concave facet for articulation with mandible. A similar finding was noticed in ostrich by Moselhy *et al.,* 2018 [4]. The external acoustic meatus was observed between the zygomatic process of squamous temporal and para occipital process. At the junction between basi and lateral occipital, 3 to 4 foramina was observed. Hypoglossal foramen was observed between the para occipital process and basisphenoid. A fontanelle was observed between supraoccipital and parietal bones. Nickel *et al.,* 1977 [5] had also observed a fontanelle in duck and goose on either side between supraoccipital and parietal bones.

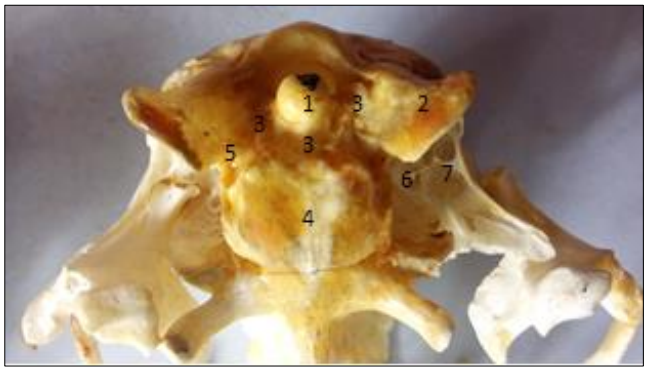

Fig 2: Ventral view of posterior aspect of Emu skull 1. Occipital condyle 2. Para occipital process 3. Basi occipital 4. Basi sphenoid 5. Hypoglossal foramen 6. External acoustic meatus 7. Foramen auditory tube

Sphenoid formed the major part of the floor of the cranial cavity with basiphenoid caudally and presphenoid rostally (Fig 2) which is in agreement with Nickel *et al.,* 1977 [5] in domestic birds

Basisphenoid had a body and a pair of temporal wings which was observed laterally between it and the parasphenoid wings of presphenoid. Basispenoid was separated from body of presphenoid by a traverse ridge and formed the medial boundary of external acoustic meatus and the foramen for the auditory tube was observed craniomedially. Nickel *et al.,* 1977 [5] in duck and goose, observed that the basispenoid had distinct muscular process and grooves.

Fig 3: Ventral view of Emu skull 1. Foramen magnum 2. Occipital condyle 3. Basi occipital 4. Basisphenoid 5. Temporal wing of basisphenoid 6. Presphenoid 7. Parasphenoid wings of presphenoid

Pre sphenoid presented a body with a pneumatic foramen in the midline, a pair of orbital wings and a pair of laterally pointed short thick rod like process (Fig 3), the parasphenoid wings, which articulated with the pterygoid bone. The orbital wings of presphenoid also contributed to the formation of interorbital septum. These finding concurs with the observations of Moselhy *et al.,* 2018 [4] in ostrich. According to Nickel *et al.,* 1977 [5] in domestic birds the root of pre sphenoid was perforated by eustachian tube.

The parietal was located in between the frontal and supraoccipital bones Nickel *et al.,* 1977 [5] in fowl observed that the parietals were thin bony plates inserted between supra occipital and frontal bones. (Fig 4). The parietals participated in the formation of roof of the cranial cavity. The parietofrontal suture demarcated parietal from the frontal bone. The parietal was compressed laterally by the temporal

fossa in front and zygomatic process of squamous temporal behind. All these finding are in accordance with Moselhy et *al.,* 2018 [4] in ostrich.

Fig 4: Dorsal view of Emu skull 1. Parietal 2. Frontal 3. Fronto-parietal suture 4. Frontal process of frontal 5. Nasal process of frontal 6. Post orbital process of frontal 7. Interfrontal suture 8. Supra orbital fissure

The frontal bone was the largest of all cranial bones and formed the highest point of skull (Fig 4). It had three surfaces external, internal and orbital, two borders lateral and medial and three processes frontal, post orbital and nasal. Similar observations were reported by Moselhy *et al.,* 2018 [4] in ostrich but Nickel *et al.,* 1977 [5] in domestic birds and Kumar and Singh 2014 [2] in emu had reported an orbital process. The external surface slopped cranially, caudally and laterally and presented an elevation dorsally. The internal concave surface lodged the cerebrum. The orbital surface was formed by the orbital plate which formed the caudomedial limit of the orbit, where it presented a large optic foramen, behind which was the opthalmic foramen. The orbital plate was demarcated from the lacrimal by a suture. The orbital plates formed the medial wall of the orbit and were fused medially with each other and formed the interorbital septum. The supraorbital margin formed the lateral border. Interfrontal suture formed the medial border. The supraorbital fissure was found between the postorbital process laterally and the lacrimal bone medially. Postorbital process was short and blunt. The nasal process joined the nasal bone anteriorly. The frontal process which roofed the frontal sinus was leaf shaped and situated medially between the posterior parts of the nasal bone of either side and formed a suture in front with the frontal process of premaxilla.

Fig 5: Lateral view of Emu skull 1. Squamous temporal 2. Temporal fossa 3. Zygomatic process of the squamous temporal 4. Orbital process of squamous temporal 5. Interorbital septum 6. Otic process of quadrate 7. Articular part of zygomatic process of squamous temporal 8. Orbital plate of frontal

The temporal bone (Fig 5) formed the lateral wall of the cranial cavity and was situated between parietal and lateral occipital behind, frontal dorsally and sphenoid medially. It consisted of two parts namely squamous temporal and ear capsule (os-oticum). The ear capsule a large irregular pneumatic cavity layed between the lateral part of the occipital above, basisphenoid medially, and squamous temporal laterally. External acoustic meatus wide and was situated below the para occipital process and presented a transverse oro-basal concave articular groove which articulated with the otic process of quadrate bone. The foramen for the auditory tube was observed at junction between the body of basisphenoid and presphenoid. The squamous temporal was located between the parietal, frontal and sphenoid bones and formed the lateral wall of the cranium. It had two processes orbital and zygomatic between which was a large slightly concave temporal fossa. Orbital process was a short pointed process and faced downwards. Moselhy *et al.,* 2018 [4] in ostrich did not observe orbital process. According to Nickel *et al.,* 1977 [5] in domestic birds the orbital process in duck and goose was long and stout, slender in fowl and rudimentary in pigeon. The zygomatic process was in the form of a broad thin concave bony plate behind the temporal fossa and lateral to the otic process of the quadrate bone and was continued below by a long thick rostroventrally directed process, the articular part of which articulated with quadrate bone. Both the processes were separated by the temporal fossa and gave origin to temporalis muscle. Nickel *et al.,* 1977 [5] in fowl observed a zygomatic process which was fused with the orbital process.

The orbital wings of presphenoid and the orbital plates of frontal bones of either sides were connected medially and contributed to the formation of interorbital septum. The caudal part of the perpendicular plate of ethmoid also joined the interorbital septum.

The roof of the cranial cavity was formed by frontal and parietal. The floor was formed from before backwards by the presphenoid, basisphenoid and basioccipital. The lateral wall was formed by the temporalis. The posterior wall was formed by supra occipital and lateral occipital. The horizontal plate of ethmoid formed the anterior wall.

Acknowledgement

Authors are thankful to the Dean, Rajiv Gandhi Institute of Veterinary Education and Research, Puducherry for providing the basic infrastructure for carrying out this research work.

References

1. Dyce KM, Sack WO, Wensing CJG. Textbook of Veterinary Anatomy. 3rd Ed. Saunders, Philadelphia, London, New York, St. Louis, Sydney, Toronto, 2002, 789- 791.
2. Kumar P, Singh G. Gross Anatomy of Axial Skeleton in Emu (*Dromaius novaehollandiae*). Indian Journal of Veterinary Anatomy. 2014; 26(2):87-91.
3. McLelland J. A color of atlas of avian anatomy, Wolfe Publishing Ltd, 1990.
4. Moselhy AA, Sherif KH, Mohamed A, Hanaa M, El-Ghazali. Anatomical Features of Bones and Bony Cavities of The Ostrich Skull (*Struthio camelus*). Int. J Anat. Res. 2018; 6(2.3):5390-5398. Doi: 10.16965/Ijar.2018.213.
5. Nickel R, Schummer A, Seiferle E. Anatomy of the Domestic Birds, chapter (Skeleton of the head), Verlag Paul Parey, Berlin and Hamburg, 1977, 20-25.