Macroscopic study on the cerebrum of post hatch broiler chicken with reference to age

Avnish Kumar Gautam, Sanjay Ray, Partha Das, Arun Kumar Mandal, Nirmal Kumar Tudu, Dharmendra Singh and Moffijul Islam

Abstract
A study was conducted on the seventy (70) day old broiler chicks which were reared up to 42 days (market age) of post hatch period. The whole experimental period of study was divided into seven (07) groups, each containing ten (10) birds irrespective of sex accordingly. The cerebrum was the largest part of brain and triangular to oval in outline. The length of cerebrum was varied from 9.19 mm to 16.07 mm with mean value of 9.38±0.04 mm to 15.07±0.13 mm from group I to group VII. The Width of the whole cerebrum ranged between 14.04 mm to 20.14 mm with value of 14.18±0.21 mm to 19.70±0.1 mm from Group I to group VII. A highly significant difference was observed in the length as well as width in Group I to group VII with the advancement post hatch period.

Keywords: Gross morphometry, broiler chicken, age, cerebrum

Introduction
Domestic fowl or chicken are most widely utilized among all poultry birds for consumption as well as research purpose. Most commercial broilers grow very fast to gain body weight quickly and reach its desired slaughter weight. Brain research in the birds is important for bird’s welfare and knowledge about the nervous function, physiology, anatomical development and behavior. The brain of the birds has three chief segments that is cerebrum, cerebellum and medulla oblongata. Besides these there are well developed optic lobes is present that indicates the birds have good sense of vision, whereas it has very poor sense of smell as olfactory lobe is ill develop. The avian cerebral hemispheres are pear in shape structure. The right and the left hemispheres were separated by a median longitudinal fissure and it is separated from cerebellum by a transverse fissure. The cerebral hemispheres of birds consist of two regions that are dorsal pallium and ventral subpallium. The pallium consisted of outer and large inner cortical areas. The outer area is the hyperpallium (wulst) and the inner cortical area is dorsal ventricular ridge (DVR). The dorsal ventricular ridge has three sub divisions that are mesopallium, nidopallium, and arcopallium. The subpallium occupied the inner parts divided into the striatum and the pallidum. The well developed cerebral in birds help in body movements during flight and also provides a great capacity for learning, memory, attention, integration and consciousness [3]. The cerebral hemispheres represented the largest part of the prosencephalon and it contains (90%) of the neurons found in the central nervous system [4]. Age wise information on the gross morphometry of cerebrum is limited therefore investigation was made to explore the same in broiler chicken.

Materials and Methods

Ethical approval
The present retrospective study was duly approved by the Institutional Animal Ethics Committee (IAEC), Faculty of Veterinary and Animal sciences, West Bengal University of Animal & Fishery Sciences, Kolkata-37. (References no. IAEC/67/III, B, dated 19/08/2019).

Rearing of Birds
A total of seventy (70) day old broiler chicks were reared up to 42 days (market age) in the experimental pens (cage system) at Department of Animal Nutrition, West Bengal University of Animal and Fishery Sciences, Belgachia, Kolkatta- 700037, India. Standard management practice (housing, feeding, vaccination etc.) has followed uniformly for all the birds. All the birds were given feed (starter followed by grower feed) and water ad libitum throughout the
experimental period. The whole experimental period of study was divided into seven (7) at weekly interval (days 3, 7, 14, 21, 28, 35 & 42). The birds were randomly allocated to seven (07) groups (Groups I to VII), each containing ten (10) birds irrespective of sex accordingly.

**Collection of specimen**
The birds were euthanized by injecting overdose of Sodium pentobarbital IP at the dose rate of 120 mg/kg at weekly interval and brain samples were harvested carefully[9]. The head of the birds was carefully separated at the level of second cervical vertebrae. The cranial cavity was exposed very carefully with the help of forceps, scissors, and scalpel. The meninges covering of the brain and its attachment with cranial bones was cut followed by serving of rostral attachment of olfactory lobes and optic nerves at the level of optic chiasma on the ventral surface of the brain; the intact brain was removed from the cranial cavity. The length and width (mm) of cerebrum was measured by using Vernier caliper. All values were expressed as means ±SEM. The statistical significance was considered at $P<0.05$.

**Statistical analysis**
All the recorded data were analysed statistically as per the standard method given by [10] with SPSS software 19.0.

**Results and Discussion**
The cerebrum was the largest part of whole brain. Its shape was varied from triangular to oval in shape and covered completely the diencephalon and largely the midbrain. The cerebrum was segmented into two symmetrical half, left and right cerebrum hemispheres which were separated by interhemispheric or longitudinal fissure. The cerebrum was separated from cerebellum by a small transverse fissure (Fig.1). This fissure was narrow and bridged over by meninges (Fig.2). Its dorsal surface was slightly convex smooth due to absence of elevations (gyri) and depression (sulci). A very faint, indistinct vallecula was observed on the dorsolateral aspect of brain in broiler chicken. Wulst was present on either side of cerebrum hemisphere between the interhemispheric fissure and the vallecula. The rostral end of cerebrum hemisphere was narrow pointed, while caudal end was gradually wider. The present findings are in accordance with [11] who recorded that the mean of the length of cerebral was varied from 8.93 mm to 10.21 mm with an average value of 9.39 ± 0.78 mm on day 21 and 11.91 ± 0.93 mm and 12.17 ± 0.96 mm on day 84 in Vanaraja chickens. Present findings were significantly lower than the observation of [6] who reported that the length of left and right cerebral hemisphere was 142 mm and 128 mm respectively. Length and width of the cerebrum hemisphere is significantly ($P<0.05$) increased with advancement of age from group I to group VII as reported by [11] in Vanaraja chickens.

The Width of the whole cerebrum ranged between 14.04 mm to 20.14 mm with mean value of 14.18±0.21 mm to 19.70±0.1 from group I to group VII (Table 1 and Fig.4). The present observations are in accordance with the previous reports where total cerebral width was recorded to be 20.74 mm in domestic chickens [5] and 20.50±0.46 mm in African Ostrich at the age of 9-10 month [10]. In Vanaraja chicken the width of left and right cerebral hemisphere in female 9.13 ± 0.81 mm and 9.39 ± 0.78 mm on day 21 and 11.91 ± 0.93 mm and 12.17 ± 0.96 mm on day 84 respectively. Similarly, width of left and right cerebral hemisphere in male 9.33 ±0.83 mm and 9.49 ± 0.88 mm on day 21 and 12.70 ± 1.21 mm and 12.96 ± 0.14 mm on day 84 respectively [11]. The width of left and right cerebral hemispheres was 10.9±0.09 mm and 11.2± 0.05 mm in wild African Parrot [15] and 11.41± 0.25mm in wild rock pigeon [16]. But in Sturnus vulgaris the width of left and right cerebral hemispheres was very much higher i.e. 8.93 cm and 8.13 cm [6]. In present study the length as well as width of cerebrum was found increased with the advancement of age from group I to group VII as earlier reported by [11].

**Conclusion**
The cerebrum hemispheres of brain in broiler chicken were roughly triangular to oval in shaped. The length and width of cerebrum was varied from 9.19 mm to 16.07 mm and 14.04 mm to 20.14 mm respectively from day 3 to day 42 of post hatch broiler chicken. A highly significant difference was observed in length as well as in width from group I to Group VII.

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Table 1: Gross morphometric observation of cerebrum of brain from group I to VII

<table>
<thead>
<tr>
<th>Groups</th>
<th>Cerebrum Length (mm)</th>
<th>Cerebrum width (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean±SE</td>
<td>SD</td>
</tr>
<tr>
<td>I</td>
<td>9.38±0.04</td>
<td>0.13</td>
</tr>
<tr>
<td>II</td>
<td>9.64±0.14</td>
<td>0.45</td>
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<tr>
<td>III</td>
<td>10.09±0.33</td>
<td>1.05</td>
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<tr>
<td>IV</td>
<td>12.53±0.15</td>
<td>0.49</td>
</tr>
<tr>
<td>V</td>
<td>13.1±0.12</td>
<td>0.39</td>
</tr>
<tr>
<td>VI</td>
<td>13.86±0.23</td>
<td>0.75</td>
</tr>
<tr>
<td>VII</td>
<td>15.07±0.13</td>
<td>0.42</td>
</tr>
</tbody>
</table>

a-g Values within a column with no common superscripts are significantly ($P<0.05$) different.

Fig 1: Photograph of dorsal view of brain of 3day old post hatch broiler chick showing cerebrum (CR), cerebellum (CB), pineal body (P), optic lobe (OP), longitudinal fissure (LF) and transverse fissure (TF).

Fig 2: Dorsal view of in situ brain with meninges of 42 day old post hatch broiler chicken showing cerebrum (CR), cerebellum (CB) and olfactory lobe (OP).

Fig 3: Photograph of brain of 28th day old post hatch broiler chicken showing the length of cerebrum hemispheres.

Fig 4: Photograph of brain of 35 day old post hatch broiler chicken showing the width of cerebrum hemispheres.

Reference


