Microanatomical Studies on Copulatory Apparatus of the Emu (Dromaius novaehollandiae)

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ABSTRACT

The basal fibrolymphatic bodies of emu were phallus lined by stratified squamous cornified epithelium. A change of the epithelium from stratified squamous cornified to pseudostratified columnar was seen at the junction of the pars-cavernosa and pars-glandularis. The ejaculatory groove region was lined by pseudostratified columnar epithelium. The retractor penis cranialis was composed of smooth and skeletal muscle fibres whereas caudalis was purely striated in nature. The paracloacal vascular bodies composed of capillary cords (glomeruli) and lymphatic spaces lined the endothelium. There was a significant decrease in the height during non-breeding season. The surface lining cells showed intense reactions for periodic acid Schiff (PAS), pyroninophilia, succinic dehydrogenase, Alcian blue and alkaline phosphatase.

Key words: Copulatory apparatus, Emu, Microanatomical studies

Copulatory apparatus is well developed in emu consisting of an intermittent type phallus positioned on the floor of the caudal proctodeum of the cloaca. In emus, the phallus has a short, firm cartilage base that extends vertically only a few centimeters with a left twist that is covered with erectile tissue. The lymph cavities in the erectile tissue of the phallus were filled with lymph from adjacent paracloacal vascular bodies to create an erection. The left paracloacal vascular body was larger than the right, causing the erect phallus to curve to the left.

MATERIALS AND METHODS

Tissue pieces were collected from different parts of the male reproductive system of healthy adult male emu birds for histological and histochemical studies during the slaughter. Tissues were collected in different fixatives for routine paraffin embedding method (Singh and Sulochana 1978). Paraffin sections of 6 µ were cut and used for routine, special histological methods and were also subjected to the histochemical techniques. Cryostat sections of 20 µ were obtained from fresh tissues fixed in chilled neutral buffered formalin and was used for the acid phosphatase, alkaline phosphatase cobalt methods, oil red-o in propylene glycol method for fats, and Schultz's method for cholesterol. Frozen sections obtained from unfixed tissues were used for the demonstration of succinic dehydrogenase. Micrometric observations were recorded by using calibrated ocular micrometer and subjected to statistical method.

RESULTS AND DISCUSSION

The copulatory apparatus of emu was consisted of an intermittent phallus and its associated structures the ejaculatory groove region, paired retractor penis cranialis and caudalis muscles and paired paracloacal vascular bodies (PCVB). The phallus had a base and a free part consisting of pars-cavernosa and pars-glandularis. The fibrolymphatic bodies forming base of the phallus were composed of mucosa, cavernous, adventitial layers being supported by fibrous cartilage. The lining epithelium of base of phallus was stratified squamous cornified type (Fig. 1). A significant decrease in the height of the epithelium of the basal fibrolymphatic bodies was seen during non-breeding season (Table 1). Lymphatic nodules and Herbst's corpuscles were seen in the cavernous tissue of the fibrolymphatic bodies (Fig. 1) as reported by Rao and Vijayaragavan (2000) in drake.
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These Herbst's corpuscles were believed to be highly sensitive to vibrations and might be involved in the act of copulation. Lamina propria had a thick layer of loose connective tissue consisting of collagen, reticular and elastic fibres with occasional branched simple tubulo-acinar glands (Fig. 2).

The pars-cavernosa of emu phallus was consisted of an inner mucosa, middle cavernous tissue layer and an outer adventitia as reported in drake by Rao and Vijayaragavan (2000). The ejaculatory groove marked by mucosal folds with pseudostratified columnar type epithelium was continued in to the lumen of pars-cavernosa (Fig. 3). The lamina propria was made up of dense irregular connective tissue. The tunica adventitia of pars-cavernosa was composed of circularly arranged collagen bundles, elastic fibres, blood vessels and nerve fibres (Fig. 4), as reported in drake by (Biswal and Das, 1968; Rao and Vijayaragavan, 2000).

The pars-glandularis of emu phallus was consisted of a mucosa and an adventitia. An abrupt change in epithelium from stratified squamus cornified to pseudo stratified columnar secretory type was observed at junction of pars-cavernosa and pars-glandularis (Figs. 2, 4). The lamina propria was same as described earlier by (Rao and Vijayaragavan, 2000) in drake. The simple branched tubuloalveolar glands were observed in lamina propria and showed secreting columnar cells. The pars-glandularis did not show lymphatic spaces. Similar findings were observed in ducks, geese (Guzsal, 1974; Rao and Vijayaraghavan, 2000). The adventitia was made up of circularly arranged collagen, elastic and few reticular fibers along with blood vessels and nerve fibres as reported in drake (Rao and Vijayaragavan, 2000). An elastic ligament made up of few collagen fibres was seen in contact with the pars glandularis on its ventral aspect as reported in ostrich (Oliveira and Mahecha, 2000). The height of epithelium of pars cavernosa and pars glandularis of emu increased significantly during breeding season.

The ejaculatory groove region was consisted of mucosa, lymphatic sinuses, submucosa and a fibrocartilage. The mucosa was folded with secondary and tertiary folds and was lined by pseudostratified columnar non-ciliated epithelium (Fig. 3). The presence of transversely arranged smooth muscle cells in mucosa may help in tubular formation.
of the ejaculatory groove for the passage of semen during the ejaculation. The epithelium changed to stratified squamous cornified epithelium at its junction with the cloacal surface as reported by Fujihara et al. (1976) in drake. Lamina propria was thick and a layer of lymphatic sinuses was observed deeper to the lamina propria. A fibro cartilage was located deep under the submucosa. The retractor penis cranialis muscle of phallus was comprised of smooth and skeletal muscle fibres as separate bundles whereas, the retractor penis caudalis muscle contained purely skeletal muscle fibres like in drake (Rao and Vijayaragavan, 2000).

The para cloacal vascular bodies enclosed by a connective tissue capsule were comprised of capillary cords and endothelial lined lymphatic spaces (Fig. 5). The core of the bodies was crossed by numerous connective tissue trabaculae as reported earlier (Guzsal, 1974; Rao and Vijayaraghavan, 2000). The erection of the phallus may be evoked by engorgement of the lymphatic spaces with lymph from PCVB. The lymphatic sinuses were the link channels between the lymphatic cavities enclosing the para cloacal vascular bodies and the erectile spaces at the base of the penis (Rao and Vijayaraghavan, 2000) in drake. The epithelium of basal fibrolymphatic bodies showed strong reaction for pyroninophilia and PAS and moderately reaction for lipids staining (Fig. 6).

The lining epithelium of pars-cavernosa and pars-glandularis of phallus showed intense pyroninophilia, PAS reaction (Fig. 7), Alcian blue and succinic dehydrogenase (Fig. 8). Intense reaction for acidic muco-polysaccharides observed in the epithelium of pars-glandularis and fibrolymphatic bodies denoted its probable role in the lubrication and the protection of the penis and the cloaca before the act of copulation. These findings were almost similar to the observations of Rao and Vijayaragavan (2000) in drake. Intense reaction for PAS, Alcian blue staining, alkaline phosphatase and succinic dehydrogenase activities were observed in lining epithelium of ejaculatory groove region of the phallus.

**REFERENCES**


<table>
<thead>
<tr>
<th>Structure</th>
<th>X¹</th>
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<tbody>
<tr>
<td>Basal fibrolymphatic bodies</td>
<td>90.41 ± 0.15</td>
<td>67.58 ± 0.09</td>
<td>72.51**</td>
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<tr>
<td>Pars cavernosa</td>
<td>98.39 ± 0.09</td>
<td>74.41 ± 0.08</td>
<td>85.97**</td>
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<tr>
<td>Pars glandularis</td>
<td>52.64 ± 0.07</td>
<td>39.39 ± 0.09</td>
<td>49.64**</td>
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<td>Ejaculatory groove region</td>
<td>47.47 ± 0.079</td>
<td>35.57 ± 0.10</td>
<td>43.96**</td>
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**Highly significant (p ≤ 0.01)**