Microanatomical Studies on Ductus Arteriosus with Relation to Foetal Age in Buffalo (*Bubalus bubalis*)

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**ABSTRACT**

The present study was conducted on ductus arteriosus in buffalo foetii from 4.2 cm CVRL (48 days) to 99.5 cm CVRL (298 days). At 4.2 cm CVRL, tunica intima was composed of an endothelial cell lining. At 10.5 cm CVRL foetus, all the tunics viz. intima, media and adventitia were well defined. Tunica media became more muscular and composed of loosely arranged smooth muscle fibres in connective tissue matrix containing very fine wavy elastic fibres at 34 cm CVRL. The ductus arteriosus did not show any remarkable changes from 26-40 cm CVRL foetus. The distinguishing feature was the formation of intimal cushions at 50 cm CVRL foetus i.e. 186 days. At 99.5 cm CVRL foetus (298 days) there was decrease in smooth muscle cells and increase in collagenous ground substance resulting in narrowing of lumen and obliteration of ductus arteriosus after birth.

**Key words:** Buffalo, Ductus arteriosus, Foetus, Microanatomy

Ductus arteriosus is derived from the 6th pharyngeal arch on the left side (Ohale, 1993). During the pharyngeal arch remodeling ductus arteriosus acquires a muscular vessel wall (Mujahid and Gaikwad, 2000). The microscopic changes leading to obliteration of ductus arteriosus started well before birth. Studies on the ductus arteriosus have been reported in goats (Ohale, 1993). But scanty literature is available on histological changes during differentiation and closure of ductus arteriosus in buffalo. Hence, the present study has been undertaken on the ductus arteriosus of heart in prenatal buffalo.

**MATERIALS AND METHODS**

The present study was conducted on heart samples of 12 buffalo foetii of different gestational age obtained from non-descript buffaloes slaughtered at abattoir, Saharanpur and Veterinary Clinics, GADV ASU, Ludhiana. The foetal body length was measured as curved crown rump length (CVRL). The approximate age of the foetus was calculated by using the formula given by Soliman (1975).

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Y = 28.66 + 4.496 \times \text{CVRL} < 20 \text{ cm} \\
Y = 73.544 + 2.256 \times \text{CVRL} \geq 20 \text{ cm}
\]

Where Y is age in days and X is CVRL in centimeters.

Based on CVRL, the foetii were divided into three groups i.e. group I (0-20 cm), group II (21-40 cm) and group III (above 40 cm). The tissue samples were fixed in 10% neutral buffered formalin and Bouin’s fixatives immediately after collection. The tissues were processed for paraffin block preparation by acetone-benzene schedule. The paraffin sections of 5-7 µ were stained with hematoxylin and eosin, Masson’s trichrome, Verhoeff’s, Gridley’s and Holmes stains to study the histomorphological details (Luna, 1968).

**RESULTS AND DISCUSSION**

In the present study, ductus arteriosus was observed in buffalo foetus of 4.2 cm CVRL (48 days of gestation) onwards (Fig. 1). The wall of ductus arteriosus was made up of tunica intima, media and adventitia. Tunica intima was composed of an endothelial lining and was rarely complete at this stage. All the tunics of ductus arteriosus were well differentiated at 10.5 cm CVRL (75 days of gestation) foetus (Fig. 2). A wavy pattern of internal elastic membrane was noticed. A sub-endothelial vascular connective tissue layer was observed at 25 cm CVRL (130 days of gestation) foetus.

Tunica media in 4.2 cm CVRL (48 days of gestation) foetus was composed of mesenchymal cells with few differentiating smooth muscle cells. In 13 cm CVRL (87 days of gestation) foetus, there was an increase in connective tissue and smooth muscle fibres. In 34 cm CVRL foetus, the tunica media was composed of loosely...
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arranged smooth muscle fibres in a connective tissue matrix containing very fine wavy elastic fibres (Fig. 3). The composition and wavy pattern of elastic fibres increased from group I to group II. The muscle fibres in outer third of media were circularly arranged with scattered longitudinal muscle fibres and vice-versa towards inner portion. Subintimal fibres which were perpendicular, were also observed at some places. The amount of collagen, reticular and neuronal elements were comparatively less in all the age groups. This was in agreement with findings of Mujahid and Gaikwad (2000) and Szyszka-Mroz and Wozniak (2003).

In 4.2 cm CVRL (48 days of gestation) foetus, the tunica adventitia was poorly defined and above 10.5 cm CVRL (75 days of gestation) the layer was composed of fibrous tissue along with vasa-vasorum and nerve fibres (Fig. 2). The lumen of ductus arteriosus was round in group II and became stellate shaped at 24 cm CVRL. Similar observations were reported by Macdonald et al. (1983) in pigs. The ductus arteriosus did not show any remarkable changes from 25 cm CVRL to 40 cm CVRL (130-164 days of gestation) foetus, but these were remarkable in ductus arteriosus of more than 40 cm CVRL (164 days of gestation) foetus.

The distinguishing feature was the formation of intimal cushions at 50 cm CVRL foetus (186 days of gestation). The inner part of tunica media showed an increase in ground substance between muscle fibres. This ground substance contained fine wavy elastic fibres and collagen fibres. At 74 cm CVRL foetus (240 days of gestation) the cellular elements from tunica media penetrating gaps in the fragmented elastic membrane was noticed. There was decrease in smooth muscle cells and increase in collagenous ground substance resulting in narrowing of lumen. This would ultimately result in obliteration of lumen of ductus arteriosus after birth.

This was evident from present observations that ductus arteriosus showed a normal histological structure of muscular artery up to 40 cm CVRL foetus, but the structural changes started from 40 cm CVRL onwards which ultimately led to the obliteration of ductus arteriosus after birth.

REFERENCES


