Prenatal Development of Sternum and Ribs of Buffalo

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ABSTRACT

The cartilaginous precursor of sternum was noticed histologically at 54 days as the bilateral cores of cartilage cells. The earliest appearance of ossification was observed in 7th segment of sternum at 88 days of gestation. The 6th sternal segment showed ossification at 89 days. The last 4 segments of sternum i.e from 7th to 4th sternebra showed ossification at 92 days. Ossification began at 96 days in 3rd segment. At 59 days, ossification was first noted in the shaft (diaphysis) of the 2nd to 6th rib. At 64 days, diaphysis of all ribs i.e from 1st to 13th showed ossification.

Key words: Sternum, Development, Buffalo

Sternum develops from two ventral longitudinal cartilaginous bars in domestic animals (McGeady et al., 2006). Prenatal development of sternum and ribs has been studied in sheep (Wenham, 1981) and other domestic animals (Latshaw, 1987) but information is meagre in buffalo. Hence, the present study has been undertaken.

MATERIALS AND METHODS

A total of 46 buffalo foeti were collected from slaughter house with their age ranging from 41 to 280 days (2.8 to 91.6 cm CVRL). The age of the foetus was determined on the basis of the CVRL by using formula of Soliman (1975). The foetus of different age groups was stained by standard Alizarin red S method (Humason, 1962). Radiographs were also taken from some large foetii to study the primary and secondary ossification centres in ribs and sternum. The foetii having CVRL below 10.0 cm were fixed in 10% neutral buffered formalin and Bouin’s fixative and processed for serial paraffin sections of 5-6 µ and stained with hematoxylin and eosin (Humason, 1962).

RESULTS AND DISCUSSION

In buffalo cartilaginous precursor of sternum was identified first histologically as bilateral cores of cartilage at 54 days (Fig. 1). Subsequently they underwent endochondral type of ossification. These cartilaginous bars were fused on ventral median line at 88 days. Lindsay (1969) noted bilateral cores of cartilage for sternum at 50 days of gestation in bovine foetus which fused to form a median continuous cartilaginous precursor as observed in the present study.

The locus of ossification in the sternal segments was central and unpaired. The earliest appearance of ossification was observed in 7th segment of sternum at 88 days of gestation in buffalo (Fig. 2). Lindsay (1969) reported that ossification commenced by day 75 of prenatal life in bovine and 60 days onwards in sheep foetus (Wenham, 1981). In buffalo foetus, 2nd sternebra was the last to show ossification and it appeared first time at 143 days of gestation and appeared radiographically at 189 days.

In buffalo, the last 4 segments of sternum i.e from 7th to 4th showed ossification at 92 days whereas, ossification of 3rd segment was evident at 96 days (Fig. 2). At 125 days, 3rd sternal segment also appeared distinctly. Lindsay (1969) reported 3rd sternal loci at 76 days, 4th loci at 78-79 days and 6th loci at 86 days of gestation radiographically in bovine foetus. Wenham (1981) observed ossification of sternebrae in sheep foetus in caudo-cranial sequence as observed during the present study. In the present study, manubrium was found to be ossified from single centre as reported earlier (Getty, 1975). The cartilage present behind the 7th sternal segment failed to ossify and transformed into xiphoid cartilage in buffalo foetus.
Fig. 1. Photomicrograph of 54 days buffalo foetus showing developing 1st to 5th sternal segments (S1-S5) and manubrium (Ma).

H. & E. × 100

The 7th sternal segment appeared as elongated structure, whereas 3rd, 4th, 5th and 6th segments were rectangular in shape and 2nd sternaebra was quadrilateral. However, 1st sternebra was triangular at 216 days (Fig. 3). The inter-sternearal cartilages persisted between ossified sternebrae and contributed to the formation of cartilagenous joints in buffalo as reported earlier by Latshaw (1987) and McGeady et al. (2006) in domestic animals.

Ribs: In buffalo lateral extensions of the vertebral bodies of thoracic region transformed into ribs at 54 days. Latshaw (1987) reported that additional processes formed from each of the dense areas in the thoracic region. These processes extended ventrally and became the ribs in domestic animals. The rib processes also carried myotome cells with them into the body wall and these formed the inter-costal muscles.

The first pair of ribs was directly attached to the future definitive sternum in buffalo. Latshaw (1987) termed these ribs as true or sternal ribs in the adult. The processes of the more caudal ribs were not attached to the sternal primordia. Consequently their derivatives became the asternal or floating ribs in the domestic animals.

The size of primordial cartilages of ribs increased from anterior to the posterior. The ossification was first

Fig. 2. Photograph of sternum of buffalo foetus showing ossification centres of 88 days (A), 89 days (B), 92 days (C), 96 days (D) and 105 days (E). Note 1st to 7th sternal segments (S1-S7) and xiphoid cartilage (Xc).

Alizarin red S

Fig. 3. Radiograph of 216 days old buffalo foetus showing ossification centres in thoracic vertebrae, ribs and sternum. Note 1st thoracic spine (TS1), transverse process (TP), inter-vertebral disc (IVD), rib (R) and 1st to 7th sternal segments (S1-S7).

Fig. 4. Photograph of 125 days old buffalo foetus showing ossification centres in dorsal spines of thoracic vertebrae and supernumerary rib. Note 1st thoracic spine (TS1), 7th thoracic spine (TS7), 1st rib (R1) and 14th supernumerary rib (R14).

Alizarin red S
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noted at 59 days in shaft (diaphysis) of the ribs from 2nd to 6th and at 64 days in shaft of all ribs i.e. from 1-13. Wenham (1981) observed ossification in 12 of 13 pairs of ribs from 50 days onwards, whereas, Harris (1937) reported ossification in 1-10 ribs at 41 days and ribs from 1-13 at 43 days of gestation in sheep foetus.

The upper ends of the ribs were ossified whereas their distal ends were cartilaginous. At 88 days, sternal cartilages of last 4 pairs of ribs were extended from caudal part of sternum. At 92 days, costal cartilages of all the ribs were evident. McGeady et al. (2006) stated that ossification did not extend to the distal end of the primordial cartilaginous ribs. The cartilaginous portion of the rib which did not ossify persist as costal cartilage in all domestic animals.

Three ossification centres were observed in ribs viz., one each for the shaft, head and tubercular facet of the rib. Secondary ossification centres have appeared in heads of first 6 pairs of ribs at 155 days and tubercular facets radiographically appeared at 181 days. According to Getty (1975), the ribs ossified from 3 centres one each for the body, head and tubercle, however, the 3rd centre was absent in some of the caudal ribs. In the present study, incidence of supernumerary ribs i.e. 14th pair was also noted in one specimen (Fig. 4).

REFERENCES


