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Age Wise Internal Morphometrical Studies on the Heart of Pre-natal Non-descript Sheep

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ABSTRACT

Background: Heart is the central organ of circulatory system that pumps blood into the blood vessels and performs many vital functions. Its development before birth must be studied to safeguard the animal from the occurrence and consequences of various developmental anomalies. The detailed morphometry of different internal parameters of heart especially in pre-natal sheep has not yet been reported.

Methods: The foeti of sheep were divided into two age groups *viz*. mid prenatal (51-100 days) and late prenatal (101 to 150 days) with fifteen animals in each age group. The various internal parameters were recorded by using digital weighing machine, graduated measuring cylinder, digital Vernier's calliper, non-stretchable nylon thread and graduated scale. The data recorded was statistically analysed by independent t test with IBM SPSS 25.0 version software.

Result: The average thickness of left ventricular wall of heart was measured as 2.85±0.15 mm and 4.28±0.07 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Similarly, the average diameter of left atrio-ventricular opening of heart was measured as 2.06±0.27 mm and 6.08±0.36 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. The average length of septal papillary muscle in right ventricle was measured as 1.12±0.10 mm and 3.29±0.21 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Further, the average length of moderator band in heart was measured as 1.45±0.11 mm and 4.34±0.23 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Similarly, the average length of chordae tendinae in right ventricle of heart was measured as 0.97±0.0 9 mm and 3.50±0.34 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages.

Key words: Age, Heart, Internal morphometry, Pre-natal, Sheep.

INTRODUCTION

The circulatory system plays a vital role in smooth working of the body of the animal (Jaiswal *et al*., 2017a, Jaiswal *et al*., 2017b and Janqueira and Carneiro, 2005). Heart is the central organ of circulatory system that pumps blood into the blood vessels and performs many vital functions (Sathapathy *et al*., 2013 and Sathapathy *et al*., 2014). The faulty development of heart may result in ectopia cordis, dextrocardia, hypoplasia, patent foramen ovale, persistent ductus arteriosus, valvular malformation *etc*. Very often, these developmental anomalies of the heart cause foetal death and thereby severe economic loss to the farmers. Due to close similarities in many of the systems between the animals and human being, the animals have always become a choice of interest for research purpose, which indirectly help the human being. The detailed morphometry of different internal parameters of heart especially in pre-natal sheep has not yet been reported. Hence, the present study would help explore the new avenues and provide key information for the future research aimed at elucidating the importance of age wise morphometrical development of heart in safeguarding the occurrence and consequences of various developmental anomalies especially in prenatal sheep.

MATERIALS AND METHODS

For this investigation, thirty foeti of either sex of non-descript sheep were collected from the local slaughter house situated at Laxmisagar and Jadupur, Bhubaneswar between July, 2020 to December, 2020. The adhering amniotic fluid from the body of the foeti was wiped by wet cotton. The crown rump length (CRL) for each foetus was measured in centimetres (cm) with the help of non-stretchable nylon thread and graduated scale. Further, the CRL was placed on the standard CRL-Gestation Age Curve to estimate the approximate age of the foeti in days (Noden and Lahunta, 1985). The collected sheep foeti were divided into two age groups *viz*. mid prenatal (51-100 days) and late prenatal

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(101 to 150 days) with fifteen animals in each age group. This is a part of doctoral research work, where 4 samples were taken in each mentioned age group to record the data. The average weight of the hearts of foeti was taken in digital weighing balance and the average volume of the organs was measured in a graduated measuring cylinder by water displacement method (Dahariya *et al.*, 2020). Further, the various internal parameters of the heart such as thickness of atrial and ventricular walls, thickness of interatrial and interventricular septa, diameter of left and right atrio-ventricular openings, diameter of openings of cranial and caudal venacava into right atrium, diameter of opening of coronary sinus into right atrium, diameter of systemic aorta and pulmonary trunk at the origin, length and width of different papillary muscles in the ventricles, length and width of moderator bands and chordate tendinae in the ventricles, number of chordate tendinae in the ventricles of the heart, etc. were measured by using digital Vernier's calliper. The recorded data were subjected to routine statistical analysis (Snedecor and Cochran, 1994) and independent t test with IBM SPSS 25.0 version software.

RESULTS AND DISCUSSION

The average weight of the sheep foetus was measured as 109.18±24.75 g and 946.00±100.08 g in mid prenatal and late prenatal stages respectively. Similarly, the average weight of the heart was measured as 1.16±0.24 g and 8.40±0.81 g in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. The average volume of the heart was measured as 1.21±0.26 cc and 8.26±0.70 cc in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages.

The average thickness of right atrial wall of heart was measured as 0.51±0.07 mm and 1.21±0.04 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between ages. The average thickness of left atrial wall of heart was measured as 0.80±0.08 mm and 1.79±0.11 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Further, the average thickness of right ventricular wall of heart was measured as 1.82±0.16 mm and 3.78±0.12 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. The average thickness of left ventricular wall of heart was measured as 2.85±0.15 mm and 4.28±0.07 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Similarly, the average thickness of interatrial septum of heart was measured as 0.52±0.05 mm and 1.03±0.02 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Further, the average thickness of interventricular septum of heart at base was measured as 1.93±0.12 mm and 5.16±0.23 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. The average thickness of interventricular septum of heart at mid was measured as 1.96±0.12 mm and 5.20±0.23 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Similarly, the average thickness of interventricular septum of heart at apex was measured as 2.01±0.13 mm and 5.15±0.19 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages.

The average diameter of right atrio-ventricular opening of heart was measured as 2.47±0.24 mm and 7.46±0.35 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Similarly, the average diameter of left atrio-ventricular opening of heart was measured as 2.06±0.27 mm and 6.08±0.36 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Further, the average diameter of opening of cranial vena cava into right atrium of heart was measured as 2.29±0.23 mm and 5.75±0.28 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. The average diameter of opening of caudal vena cava into right atrium of heart was measured as 3.05±0.28 mm and 6.52±0.18 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Similarly, the average diameter of opening of coronary sinus into right atrium of heart was measured as 0.96±0.09 mm and 1.63±0.03 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Further, the average diameter of aorta of heart at its origin was measured as 2.56±0.16 mm and 5.32±0.26 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. The average diameter of pulmonary trunk of heart at its origin was measured as 2.33±0.16 mm and 4.86±0.21 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages.

The average length of anterior papillary muscle in right ventricle was measured as 2.97±0.22 mm and 5.62±0.17 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. The average width of anterior papillary muscle in right ventricle was measured as 0.97±0.07 mm and 3.72±0.21 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Further, the average length of posterior papillary muscle in right ventricle was measured as 1.52±0.20 mm and 4.57±0.22 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. The average width of posterior papillary muscle in right ventricle was measured as 0.96±0.07 mm and 2.77±0.17 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. The average length of septal papillary muscle in right ventricle was measured as 1.12±0.10 mm and 3.29±0.21 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Further, the average width of septal papillary muscle in right ventricle was measured as 0.97±0.06 mm and 2.08±0.11 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages.

The average length of antero-lateral papillary muscle in left ventricle was measured as 2.47±0.14 mm and 5.65±0.35 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. The average width of antero-lateral papillary muscle in left ventricle was measured as 1.31±0.14 mm and 3.35±0.20 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Further, the average length of postero-medial papillary muscle in left ventricle was measured as 2.89±0.26 mm and 7.16±0.39 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. The average width of postero-medial papillary muscle in left ventricle was measured as 1.12±0.11 mm and 3.09±0.13 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages.

The average length of moderator band in heart was measured as 1.45±0.11 mm and 4.34±0.23 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. The average width of moderator band in heart was measured as 0.63±0.06 mm and 1.52±0.09 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Further, the average length of chordae tendinae in right ventricle of heart was measured as 0.97±0.09 mm and 3.50±0.34 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. The average width of chordae tendinae in right ventricle of heart was measured as 0.11±0.00 mm and 0.63±0.13 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages.

The average number of chordae tendinae in antero-lateral papillary muscle in left ventricle of heart was found as 5.27±0.15 and 7.13±0.19 in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Similarly, the average number of chordae tendinae in postero-medial papillary muscle in left ventricle of heart was observed as 5.33±0.1 and 7.07±0.21 in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Further, the average length of chordae tendinae in left ventricle of heart was measured as 1.22±0.20 mm and 5.06±0.29 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages. Further, the average width of chordae tendinae in left ventricle of heart was measured as 0.10±0.00 mm and 0.31±0.03 mm in mid prenatal and late prenatal stages respectively with significant ($p \leq 0.01$) differences between the ages.

Due to availability of very scanty literature in this field, the above recorded data could not be compared.

CONCLUSION

The various internal parameters of the heart such as thickness of atrial and ventricular walls, thickness of interatrial and interventricular septa, diameter of left and right atrio-ventricular openings, diameter of openings of cranial and caudal venacava into right atrium, diameter of opening of coronary sinus into right atrium, diameter of systemic aorta and pulmonary trunk at the origin, length and width of different papillary muscles in the ventricles, length and width of moderator bands and chordate tendinae in the ventricles, number of chordate tendinae in the ventricles of the heart, *etc*. showed significant variations ($p \leq 0.01$) between mid prenatal and late prenatal ages in the non-descript sheep. There is no previous information on these parameters of heart especially in the pre-natal sheep. Further, the present study provided a detailed baseline data on the age wise morphometrical development of heart especially of internal parameters in pre-natal sheep that could be utilised for studying various congenital developmental anomalies in different breeds of sheep and comparisons could be made with other domestic animals.

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REFERENCES

Dahariya, N., Sathapathy, S., Mishra, U.K., Patra, R., Dehury, S., Joshi, S.K., Sahu, S.K. and Samal, L. (2020). Gross morphological and biometrical studies on the spleen in various chicken genotypes. Journal of Entomology and Zoology Studies. 8(5): 623-625.

Jaiswal, S., Singh, I., Mahanta, D., Sathapathy, S., Mrigesh, M., Pandit, K. and Tamilselvan, S. (2017a). Gross and morphometrical studies on the heart of Uttara fowl. Journal of Entomology and Zoology Studies. 5(6): 2313-2318.

Jaiswal, S., Singh, I., Mahanta, D., Sathapathy, S., Mrigesh, M., Pandit, K. and Tamilselvan, S. (2017b). Histological, histomorphometrical, histochemical and ultrastructural studies on the heart of Uttara fowl. Journal of Entomology and Zoology Studies. 5(6): 2365-2370.

Janqueira, L.C. and Carneiro, J. (2005). Basic Histology Text and Atlas. 11th Edn., The McGraw-Hill Companies, pp. 245.

Noden, D.M. and Lahunta, A.D. (1985). Embryology of Domestic Animals: Developmental Mechanisms and Malformations. Williams and Wilkins, Berlin, Germany, pp. 2.

Sathapathy, S., Khandate, S.P., Dalvi, R.S., Charjan, R.Y. and Salankar, A.M. (2013). Biometry of the heart and its vessels in young and adult of local non-descript goats (*Capra hircus*). Indian Journal of Veterinary Anatomy. 25(2): 111-112.

Sathapathy, S., Dalvi, R.S., Joshi, S.K. and Singh, M.K. (2014). Biometry of the heart and its vessels in kids of local non-descript goats (*Capra hircus*). Pantnagar Journal of Research. 12(3): 416-418.

Snedecor, G.W. and Cochran, W.G. (1994). In: Statistical Methods. 8th Edn., Oxford and IBH Publishing House, Calcutta, India.