

Prenatal Gross Morphometrical Study of Spleen in Kosali Cattle

A. Rajput¹, S. P. Ingole², D. Chaurasia^{3*}, B. K. Dewangan,⁴ S. K. Deshmukh⁵, A. K. Nag⁶ and S. K. Thakur

Department of Veterinary Anatomy, College of Veterinary Science and Animal Husbandry Anjora, DSVCKV, Durg

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ABSTRACT

The present study was conducted on 24 Kosali foeti to study prenatal gross morphometrical development of the spleen. Kosali is the newly registered native cattle breed of Chhattisgarh, India, mostly reared in villages on agricultural residue. As per the CRL, foeti were categorised into four groups with six foeti in each group i.e. Group I (below 20cm CRL), Group II (Above 20 up to 40 cm CRL), Group III (Above 40 up to 60 cm CRL) and group IV (Above 60 cm CRL). The shape of spleen was oval and elongated in all four groups. The color of spleen varied from plum red in group I to bluish red in group IV. In group I, the spleen was directed straight dorsoventrally between twelfth to tenth rib and in group IV, spleen was directed obliquely downward and forward from tenth rib to five cm above the xiphoid cartilage. Weight of spleen increased 117 times from group I to group IV. The maximum length of spleen was increased 5.56 times and in percentage 456.06 from group I to group IV and was significant. The five times increase in width of spleen was recorded from group I to group IV and was significant. The location of hilus relative to maximum total length shifted dorsoventral from group I to group III.

Key words: Cattle, Spleen, Morphology, Morphometry

INTRODUCTION

Kosali cattle is thirty sixth registered breed of India and the first recognized breed of Chhattisgarh. This breed is well known for disease resistance and survival in a hot climates (Jain *et al.*, 2017) with the least cost management by feeding agricultural waste products like paddy straw among rural people. Along with being the largest secondary lymphoid organ, the spleen produces immunological responses to blood-borne antigens and houses around 25% of the body's lymphocytes (Gadre *et al.*, 1985). The spleen is comprised of two functionally and morphologically distinct compartments, the red pulp and the white pulp. The red pulp is involved in blood storage and phagocytosis, whereas the white pulp is the primary region for immune response and B-lymphocyte maturation (Gupta *et al.*, 2017). A number of researches were carried out on spleen concerned with immune response. Very few studies were carried out on the prenatal development of spleen in cattle. The present project was undertaken to establish the gross morphology and biometry of spleen in prenatal Kosali foeti.

MATERIAL AND METHODS

The present study was carried out in twenty four Kosali foeti. Foeti were collected immediately after the death of Kosali cow in nearby districts (Rajnandgaon, Balod, Durg). Weight, volume, and crown rump length of foeti (Joubert, 1956) were measured immediately after collection. As per the CRL, foeti were categorized into four groups with six foeti in each group i.e. Group I (below 20cm CRL), Group II (Above 20 up to 40 cm CRL), Group III (Above 40 up to 60 cm CRL) and group IV (Above 60 cm CRL). After midventral abdominal, paracostal and flank incision, abdominal cavity was exposed and topography and morphology of the spleen were studied in situ. After recording morphology and topography in situ spleen was separated and morphometrical measurements were recorded.

RESULT AND DISCUSSION

The spleen was oval elongated in shape, in all four groups, corroborated with previous reports of Raghavan. (1964) in ox and Frandson *et al.* (2017). The spleen was fixed in position by two ligaments formed by peritoneal reflection, Thanvi *et al.* (2021). Spleen having dorsal and ventral end, cranial and caudal border, parietal and visceral surface (Fig. 1 and 2) topographical location in

1,6,7. P.G. Scholar, 2. Professor, 3. Professor and Head, Department of Veterinary Anatomy, 4. Ph.D Scholar, 5. Assistant Professor

*Corresponding Author: E-mail: durgavet2010@gmail.com

Table 1: Mean $\pm$ SE of gross parameters of Spleen

S. No	Parameter	Group 1	Group 2	% Inc (Gr 1-2)	Group 3	% Inc (Gr 2-3)	Group 4	% Inc (Gr 3-4)
1	Weight (gm)	0.21 $\pm$ 0.02 ^d	2.87 $\pm$ 0.34 ^c	1267%	7.61 $\pm$ 0.52 ^b	165%	24.59 $\pm$ 0.68 ^a	223%
2	Volume (ml)	0.17 $\pm$ 0.01 ^d	2.68 $\pm$ 0.41 ^c	1476%	7.29 $\pm$ 0.85 ^b	172%	24.37 $\pm$ 0.93 ^a	234%
3	Maximum length (cm)	2.41 $\pm$ 0.27 ^d	5.35 $\pm$ 0.23 ^c	122%	8.67 $\pm$ 0.77 ^b	62%	13.40 $\pm$ 1.04 ^a	55%
4	Width	0.81 $\pm$ 0.08 ^d	1.97 $\pm$ 0.07 ^c	143%	2.85 $\pm$ 0.38 ^b	45%	4.17 $\pm$ 0.50 ^a	45%
5	Thickness (cm)	0.28 $\pm$ 0.03 ^c	0.49 $\pm$ 0.07 ^{bc}	75%	0.60 $\pm$ 0.11 ^b	22%	1.12 $\pm$ 0.12 ^a	87%
6	Location of hilus (cm)	0.36 $\pm$ 0.04 ^c	2.03 $\pm$ 0.21 ^b	464%	2.05 $\pm$ 0.20 ^b	1%	3.23 $\pm$ 0.33 ^a	58%
7	Area of peritoneal part (cm ²)	2.70 $\pm$ 0.27 ^d	7.10 $\pm$ 0.57 ^c	163%	12.05 $\pm$ 1.35 ^b	70%	21.10 $\pm$ 1.24 ^a	75%
8	Nonperitoneal part (cm ²)	3.80 $\pm$ 0.35 ^d	6.67 $\pm$ 0.89 ^c	76%	15.30 $\pm$ 0.45 ^b	129%	22.50 $\pm$ 0.89 ^a	47%
9	Total lateral surface area	6.50 $\pm$ 0.58 ^d	13.65 $\pm$ 1.43 ^c	110%	27.30 $\pm$ 1.03 ^b	100%	43.50 $\pm$ 1.90 ^a	59%
10	Length of cranial border (cm)	3.12 $\pm$ 0.34 ^d	7.16 $\pm$ 0.31 ^c	129%	10.56 $\pm$ 0.87 ^b	48%	17.73 $\pm$ 1.23 ^a	68%
11	Length of caudal border (cm)	2.00 $\pm$ 0.23 ^d	4.05 $\pm$ 0.22 ^c	103%	6.50 $\pm$ 0.57 ^b	60%	11.16 $\pm$ 0.91 ^a	72%
12	Splenic index	33.35 $\pm$ 1.52 ^b	50.75 $\pm$ 5.51 ^a	52%	32.23 $\pm$ 1.45 ^b	-36%	30.78 $\pm$ 1.72 ^b	-4%
13	Relative volume	0.15 $\pm$ 0.01 ^c	0.25 $\pm$ 0.02 ^{ab}	67%	0.17 $\pm$ 0.03 ^{bc}	-32%	0.31 $\pm$ 0.03 ^a	82%
14	Relative weight	0.28 $\pm$ 0.10 ^a	0.25 $\pm$ 0.02 ^a	-11%	0.18 $\pm$ 0.02 ^a	-28%	0.29 $\pm$ 0.02 ^a	61%
a,b,c,d in each row, means with different superscripts are significantly different (P<0.05)								

relation to stomach (Fig.3) was similar to observations reported by Sisson (1975) in ox, König and Leibich. (2004) in domestic animals, Dyce *et al.* (2010) and Ellenport (2012) in pig, Colville and Bassert (2016), Abed Muslih and Mirhish (2017) in gazelle spleen, Shringi *et al.* (2017) in White Yorkshire pig, Jaji *et al.* (2019) in dromedary camel, Chaurasia *et al.* (2019) in Surti goat fetuses and Bhagyalakshmi and Balasundaram (2021) in sheep. The color of spleen varied from plum red color in group I, brownish red in group II, bluish red

in group III, and bluish red with more tinge towards blue in group IV.

In group I, spleen was directed straight dorsoventrally between tenth to twelfth rib. The dorsal end was rounded and broad. The dorsal one-third part of spleen overhang on visceral surface of dorsal sac of rumen and lower two third part was located on dorsal sac of rumen. The ventral narrow blunt end was extended up to the middle of left dorsal accessory groove. In group II spleen was directed straight from dorsal end of the thirteenth rib to ventral end of eighth rib. Very small portion only about 0.5 cm of dorsal rounded broad end of spleen overlies on visceral surface of dorsal sac of rumen. The ventral narrow blunt end was extended just cranioventral to the reticulum. In group III, spleen was extended obliquely downward and forward from dorsal end of the thirteenth rib to lower end of the ninth rib. In group III, dorsal rounded broad end of spleen was present fully on parietal surface of dorsal border of dorsal sac of rumen (Fig. 1). Whereas, parietal surface of ventral extremity of spleen was related with visceral surface of liver in lower part of left lobe. The visceral surface of spleen at ventral extremity was related with left surface of reticulum. In group IV, spleen was directed obliquely downward and forward from tenth rib to five cm above the xiphoid cartilage. The ventral extremity of spleen is related to left surface of reticulum and the remaining part of spleen is related

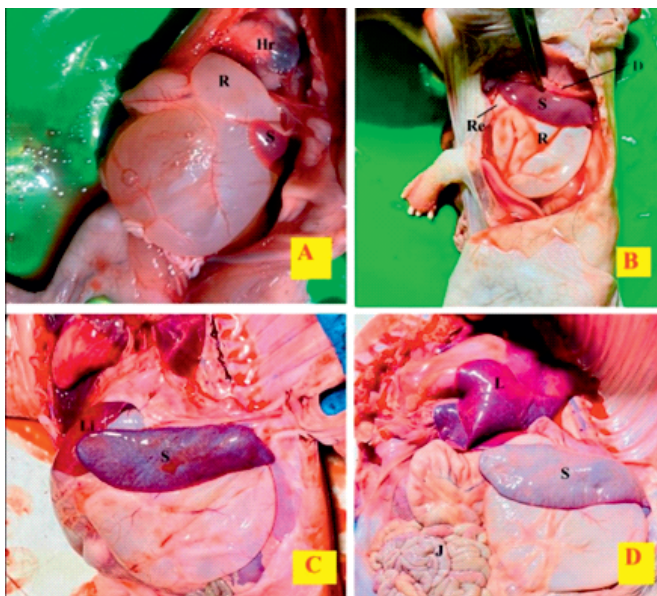


Fig 1. Photographs of spleen in situ group I (A), group II (B) group III (C) and group IV (D) showing diaphragm (D), heart (Hr), rumen (R), reticulum (Re), lung (L), liver (Li) and spleen (S)

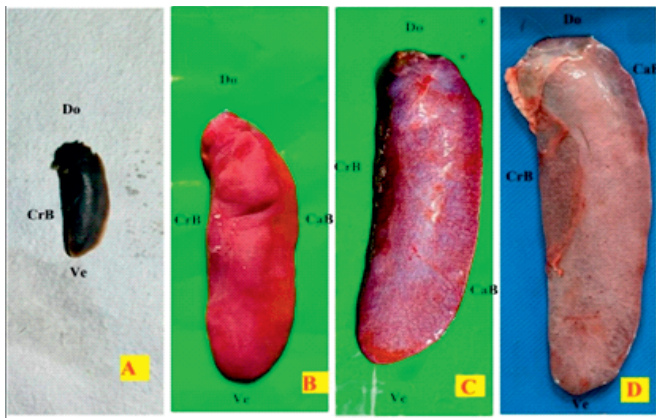


Fig 2. Photographs of parietal surface of spleen group I (A), group II (B) group III (C) and group IV (D) showing left dorsal extremity (Do), ventral extremity (Ve), cranial border (CrB) and caudal border (CaB)

with dorsal sac of rumen. Great topographical variation in spleen from group I to group IV in the present study could be attributed to developmental changes, movement of developing stomach, and physiological adaptation.

A maximum thirteen times increase in the weight of spleen was observed from group I to group II. Whereas, from group II to group III minimum 2.65 time increase in weight of spleen was recorded. The weight of spleen increased 117 times from group I to group IV. The weight was increased significantly from group I to group IV. The volume of spleen was increased maximally sixteen-fold from group I to group II. The volume of spleen increased 3.34 times from group III to group IV. Recorded volume was significantly increased from group I to group IV.

The maximum length of spleen was increased 5.56 times and in percentage 456.06 from group I to group IV and which was significant. The recorded maximum length was increased in percentage maximum (121.99) from I to group II followed by 62.05 from group II to group III and minimum 54.55 from group III to group IV. The maximum width of spleen in all groups was recorded at upper part of lower third of spleen. The five times increase in width of spleen was recorded from group I to group IV and was significant. The thickness of spleen increased from dorsal end to the hilus than decreased toward ventral end. Thickness of spleen increased from group I to group IV. Hilus was located in cranial border nearer to dorsal end. The location of hilus relative to maximum total length shifted dorsoventral from group I to group III. The location of hilus relative to maximum length was at 14.93 percent in group I at 26.00 percent in group II,

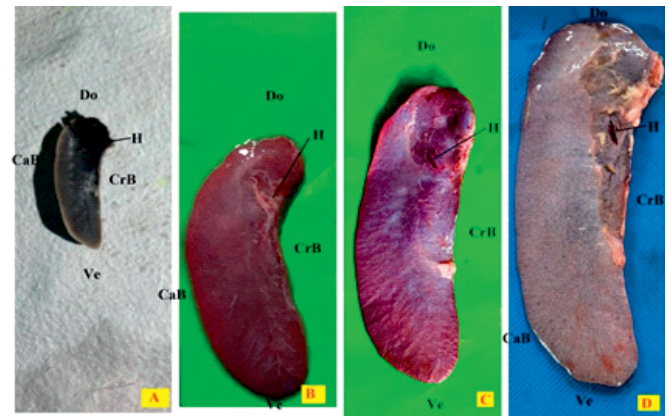


Fig 3. Photographs of visceral surface of spleen group I (A), group II (B) group III (C) and group IV (D) showing left dorsal extremity (Do), ventral extremity (Ve), cranial border (CrB) caudal border (CaB) and hilus (H)

at 42.29 in group III and at 41.00 in group IV. The cranial border was thin and slightly concave in all groups of spleen. Whereas, caudal border was thick and rounded in curvature. The significant increase in thickness of cranial and caudal border was recorded from group I to group IV. The significant increase in crown rump length, weight of foeti, splenic weight, volume, length, width, location of hilus, area of peritoneal part, area of non-peritoneal part, length of cranial border, length of caudal border, from group I to group IV is indicative of symmetrical exponential growth in foetus and spleen both with advancement of prenatal age. Similar developmental biometrical observations were reported earlier by Khan *et al.* (2003) in cattle at 2, 3, 4 and 5 years of postnatal age, Chaurasia *et al.* (2019) in the spleen of 30 Surtifoetus stages from 44 to 144 days (4.0 to 41.0 cm crown rump length; CRL) and Bhagyalakshmi and Balasundaram (2021) at early, mid and late prenatal stage in sheep. Maximum percentage increase was noted from group I to group II could be attributed to faster growth in early prenatal stage in comparison to late prenatal stage.

Total area of parietal surface was increased two times from group I to group II and group II to group III, while from group III to group IV it was increased only one and half times (Fig 2). The increase in surface area in parietal surface was significant among the groups. The visceral surface of spleen was divided into attached ruminal smaller non-peritoneal part and larger peritoneal part in all groups (Fig. 3). The increase in peritoneal and non-peritoneal area was significant among the groups. Relative weight of spleen was non-significant among the groups.

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