Original Article

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Morphology of Cadaveric Spleen in Jammu Region of India: A Cross-sectional Study

Anatomy Section

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ABSTRACT

Introduction: Spleen is the largest lymphoid organ located in the left hypochondrium in human body. It shows a wide variation in its morphology that can be of great significance to the clinician.

Aim: The present study aimed to analyze morphology of cadaveric spleen with special reference to its length, breadth, width, weight and number of notches.

Materials and Methods: A total of 28 spleens from human cadavers were dissected and formalin fixed and dimensions (length, breadth and width) noted. Number of notches along with the borders of spleen was also noted grossly in the dissection hall of Department of Anatomy, ASCOMS, Sidhra, Jammu, Jammu and Kashmir over the period of one year from March 2019 to February 2020.

Results: Lengths of 28 spleens ranged from 4 cm to 15.5 cm, their breadths from 1.7 cm to 8 cm, width from 0.7 cm to 6 cm. Weight had a range from 28.27 to 350 gm. The most common shape of spleens observed was wedge followed by tetrahedral. The number of spleens showing notches on superior border were (78.57%), inferior border were (7.14%) and in both the borders were (14.28%). Absence of splenic notch was not observed in the present study. Two spleens (7.14%) with more than five notches were observed. Incidentally Authors found anomalous splenic fissures in 10.71% (3/28) specimens along inferior border and diaphragmatic surface extending onto visceral surface. One complete fissure was also observed.

Conclusion: In the present study, the values of length, breadth width and weight of spleen were proportional and comparable to other reported studies in various regions of our country. However, it was observed that there are more number of anomalous spleens in terms of fissures and number of notches in the present study. Therefore, further studies with more number of cadaveric subjects are required to determine any morphological difference in our subset of population of North India.

Keywords: Borders, Fissures, Dimensions, Notches, Spleen shapes

INTRODUCTION

Spleen is a part of lymphohematopoietic system. It is a large encapsulated deep red coloured mass of lymphoid tissue situated in the left hypochondrium between fundus of stomach and diaphragm in the abdominal cavity. Its shape varies from wedge shape to tetrahedral. Its length is 12 cm, breadth is about 7 cm and width 3-4 cm. As the weight of spleen varies with the age so its weight ranges from 80 gm to 300 gm. In an adult its weight is around 150 gm. Spleen develops from mesoderm in the cephalic part of dorsal mesogastrium of developing foregut during 6th week of intrauterine life. Fetal spleen is lobulated and later on lobules fuse as the septa between them disappear. Few septa persist along the superior border in the form of notches in adult spleen [1]. Spleen sometimes may retain its lobulated form and deep anomalous notches and fissures are seen on its surfaces and borders [2].

Spleen has two ends namely - Medial end and a Lateral end, two surfaces namely -Visceral and Diaphragmatic, three borders namely -Superior, Inferior and an Intermediate and two angles namely - Anterior basal and Posterior basal. Superior border is the sharpest and hilum lies along the intermediate border. The long axis of spleen follows the contour of 10th rib and extends from the superior pole of left kidney to just posterior to midaxillary line [1]. Splenomegaly has always remained mystery not just for physicians but for radiologist and surgeons as well due to variations in its dimensions and anomalous notches, fissures and shapes. Hence, the present study was undertaken to analyse various morphological dimensions of human cadaveric spleen to guide young surgeons, radiologists and physician of the region and can be of help to them once they undertake clinical, radiological examination of spleen or perform splenectomies or other abdominal surgeries.

MATERIALS AND METHODS

This Cross-sectional study was conducted in the Department of Anatomy, Acharya Shri Chander College of Medical Sciences and Hospital, Sidhra, Jammu over one year period from March 2019 to February 2020. A total of 28 formalin fixed spleens from adult human cadavers were studied. Spleen was obtained by dissection starting from incision given on the skin. The muscles of anterior abdominal wall were reflected, the peritoneal cavity was opened and spleen removed for examination. Spleen was washed in tap water. Weight of spleen was measured using electronic weighing scale. Verniers caliper was used to measure the length. Length of spleen was recorded as the greatest distance between the two ends of the spleen, width of spleen was recorded at the level of maximum thickness and breadth was recorded as the maximum distance between two points at the same level on the superior and inferior borders. Splenic notches were observed along with all the borders of spleen and any anomalous variation was noted.

STATISTICAL ANALYSIS

Average length, breadth and width of spleen was estimated and standard deviation with 95 percentile confidence interval was calculated using SPSS version 22 (descriptive analysis).

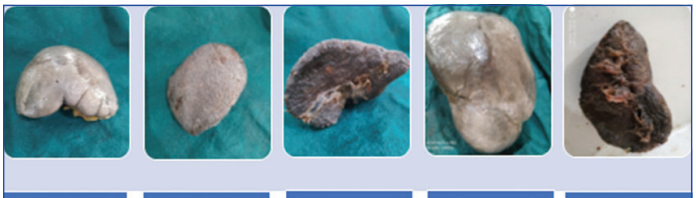
RESULTS

A total of 28 formalin fixed cadaveric spleens were studied and it was found that 12 spleens were wedge shaped, six spleens were tetrahedral, four spleens were triangular shaped, two were oval and two were irregular. Additional dome shaped (7%) of the spleen were also noted in the present study. All the different

shapes of spleen with their frequency are shown in [Table/Fig-1,2]. Splenic notches were counted in each spleen. There were 10 spleens with 1 notch, 10 spleens had 2 notches, six spleens had 3 notches, five notches were present in one spleen and there was one spleen with six notches [Table/Fig-3,4].

Shapes	Number	Percentage
Wedge	12	42.8%
Tetrahedral	6	21.4%
Triangular	4	14.2%
Irregular	2	7.14%
Dome	2	7.14%
Round/Oval	2	7.14%

[Table/Fig-1]: Shapes of the spleen.
Twelve spleens were wedge shaped out of 28(42.8%). Additional dome shaped (7%) of the spleen were also noted in the present study



[Table/Fig-2]: Variation in shapes of spleen.

Number of notches	1	2	3	4	5	6
Number of spleens (%)	10 (35.7%)	10 (35.7%)	6 (21.4%)	0	1 (3.6%)	1 (3.6%)

[Table/Fig-3]: Number of notches.
20 of 28 spleens had either one or two notches (71.4%)

[Table/Fig-4]: Spleens with variations in notches.

All the spleens were measured for their gross morphological values which include their length, breadth and width. Lengths of spleen varied from 4 cm to 15.5 cm, breadth 1.7 to 8 cm and width varied from 0.7 to 6 cm. The range of varied lengths, widths, and thickness of all the spleens is tabulated in [Table/Fig-5-7]. Out of 28 spleens, six spleens were found with varying lengths between 4 cm and 6 cm, eight spleens were having lengths between 6 cm and 8 cm, and 10 spleens with 8 cm to 10 cm of varied lengths and four spleens had length more than 10 cm. Variations in splenic lengths were analysed. The length varied from 4 cm to 15.5 cm with an average length of 8.26 cm.

Breadth of the spleens varied from 1.7 cm to 8 cm with an average breadth of 4.92 cm. However, in 12 specimens, the breadth was in the range of 3 cm to 5 cm, in four specimens it ranged from 1 cm to 3 cm, in eight specimens it ranged from 5 cm to 7 cm while in four specimens breadth was more than 7 cm [Table/Fig-6]. The width varied from 0.7 cm to 6 cm with an average width of 2.325 cm. In 14 spleens the width ranged from 0 to 2 cm, 11 spleens had width ranging from 2 cm to 4 cm, three spleens had width in the range of 4 cm to 6 cm [Table/Fig-7]. The weight of the spleen was in the range of 28.27 gm to 350 gm with an average weight of 122.99 gm. There were eight spleens with weight ranging from 25 to 75 gm, 10 spleens had a weight range of 75 to 125 gm, six spleens weighed between 125 to 175 gm and four spleens weighed more than 175 gm [Table/Fig-8]. The variation in notches of the spleen along the superior, inferior and both the borders were mentioned in [Table/Fig-4,9]. The number of notches present on the superior border varied from 0 to 6, while on inferior border it was not more than two. We have noticed six notches on the superior border of spleen which is uncommon variation [Table/Fig-9]. Anomalous splenic fissure was found in two (7.14%) spleens on diaphragmatic surface

Length of Spleen (cm)	Number of spleen (%)
4-6 cm	6(21.4%)
6-8 cm	8(28.6%)
8-10 cm	10(35.7%)
>10 cm	4(14.3%)

[Table/Fig-5]: Length of the spleen.
The length varied from 4 cm to 15.5 cm with an average length of 8.26cm, SD = 2.51 with 95% CI 8.267±0.932 (±11.27%)

Breadth of the spleen (cm)	Number of spleen (%)
1-3 cm	4 (14.3%)
3-5 cm	12 (42.9%)
5-7 cm	8 (28.5%)
>7 cm	4 (14.3%)

[Table/Fig-6]: Breadth of the spleen.
Breadth of the spleens varied from 1.7 cm to 8 cm with an average breadth of 4.92 cm. SD = 1.73 with 95% CI 4.9286±0.642 (±13.03%)

Width of the spleen(cm)	Number of spleen (%)
0-2 cm	14 (50%)
2-4 cm	11 (39.3%)
4-6 cm	3 (10.7%)

[Table/Fig-7]: Width of the spleen.
The width varied from 0.7 cm to 6 cm with an average width of 2.325 cm SD = 1.304 with 95% CI2.3250.±483(±20.78%)

Weight of the spleen (gm)	Number of spleen (%)
25-75 gm	8 (28.6%)
75-125 gm	10 (35.7%)
125-175 gm	6 (21.4%)
>175 gm	4 (14.3%)

[Table/Fig-8]: Weight of the spleen weight of the spleen was in the range of 28.27 gm to 350 gm with an average weight of 122.99 gm SD = 76.80 with 95% CI 122.99±28.45 (±23.13%).

S. No.	Type of variation	Number of spleens	percentage
1	Notches in superior border	22	78.57%
2	Notches in inferior border	2	7.14%
3	Notches in both the borders	4	14.28%
4	Anamalous splenic fissure in diaphragmatic surface	2	7.14%
5	Complete splenic fissure	1	3.57%

[Table/Fig-9]: Variation in splenic notches along splenic borders.
78.57% (22/28) splenic notches were observed in superior border

[Table/Fig-10]: Anamalous fissures along borders of the spleen. (anomalous splenic fissure in (3/28)10.71% of specimens).

extending into visceral surface and one complete splenic fissure which is also an uncommon variation [Table/Fig-9,10].

DISCUSSION

Many variations have been seen in the morphology and morphometry of spleen. They play a significant role in studying possibilities of the occurrence of splenic pathologies. In the present study done on total 28 spleens, different shapes of spleens were observed and the wedge shaped spleens were found with the highest frequency of 43 %, with 21% tetrahedral, 14% triangular. Such proportion of various shapes of the spleen was found to be similar with Chaudhari ML et al., who in 2014 showed 33.87% of cadaveric spleen having wedge shape among 62 spleens [3], Sangeeta M et al., in 2015 showed frequency of wedge shaped spleen as 33.9% in 53 cadavers [4]. In another study by Umarani S et al., the most common one was the wedge shape (50%) followed by triangular (15%) and irregular shape (12.5%) [5]. Higher frequencies of wedge shaped spleen (73.33%) were observed by Siva Chidambaram R and Sridhar S, and 61.26% by Chaware PN et al., and Setty SRS and Katikireddi RS, [6-8]. In the present study the splenic notches were found on the superior, inferior and intermediate borders. The number of notches varied from 0-6, but commonly, there were one or two notches. These findings of the present study were in concurrence with the past study by Tenaw B and Mache A, who found the presence of 0-4 splenic notches in their study on 100 spleens [9]. These variations in number of splenic notches can misguide a clinician in differentiating the renal tumor from splenomegaly. The maximum number of splenic notches found in the present study was six and spleen with absence of notches was not observed, which is comparable with a previous study done by Das S et al., on 20 cadavers [10]. In the present study the length of the spleen varied from 4 to 15.5 cm with an average of 8.26 cm. The breadth varied from 1.7 to 8 cm with an average of 4.92 cm and the width ranged from 0.7 to 6 cm with an average of 2.325 cm. The mean values of length, breadth and width of the spleen in our study were 8.267 cm, 4.92 cm and 2.325 cm, respectively. Umarani S et al., reported the mean values of length, breadth and width which were 11 cm, 7 cm and 3 cm [5] while similar values from other studies conducted by Agarwal KK et al., who found the mean values of length, breadth and width of the spleen to be 9.66 cm, 6.22 cm and 3.06 cm, respectively [11].

The present study found the average weight of spleen to be 122.99 gm which is comparable to older studies by Chaware PN et al., and Kawale Sugat G et al., wherein average weight observed was 145.76 grams and 137.42 grams, respectively [7,12]. Several Authors were previously reported the incidence of splenic notches in the superior border and inferior border as 98% & 2% (Das S et al., [10] 2008), 74.76% & 24.32% (Chaware PN et al., [7], 70% & 14% (Setty SRS and Katikireddi RS, [8] and 95% & 3.33% (Patil GV et al., [13] of spleen's studied, respectively. But in the present study it was 78.57% & 7.14%, respectively [Table/Fig-11]. Absence of splenic notch was not seen in our cadavers as opposed to other studies Rao S et al., where it was found in as many as 16.66% spleens [8].

S. No.	Study	Notches in Superior Border	Notches in Inferior Border
1	Das et al., (2008) [10]	98%	2%
2	Chaware PN et al., (2012) [7]	74.76%	24.32%
3	Setty SRS and Katikireddi RS, (2013)	70%	14%
4	Patil GV et al., (2014) [13]	95%	3.3%
5	Siva Chidambaram R et al., (2015) [6]	63.33%	10%
6	Present study	78.57%	7.14%

[Table/Fig-11]: Comparison with other studies on splenic notches.

Das S et al., and Nayak S et al., reported that the incidence of anomalous splenic fissure was 1% but in the present study we noted in 10.74% of the spleens studied which is high in number in comparison to previous studies [10,14]. One was complete fissure and rest two was along diaphragmatic surface extending upto visceral surface which is also an uncommon finding. An anomalous fissures can be result of mechanical pressure by the adjacent viscera or may be congenital. Congenital splenic fissure can appear as splenic laceration in the patient with suspected intra-abdominal trauma during splenic scintigraphy as reported by Smidt KP et al., and Hansen RM and Spiegelhoff DR, [15,16].

Limitation(s)

However, limitation of the present study was availability of small number of spleens for analysis and long term studies with more number of cadaveric subjects are required to determine any morphological difference in our subset of population of north India.

CONCLUSION(S)

The routine clinical examination of the abdomen is incomplete without spleen examination for physicians, surgeons, internists and other peripheral level workers. Knowledge of shape, size, borders, weight and length is imperative for diagnosis of splenomegaly and associated disorders. Surgeons need this knowledge for various abdominal surgeries including splenectomy. Radiologist require them it to rule out splenic lacerations and injury. In the present study, the values of length, width and weight of spleen were proportional and comparable to other reported studies in various regions of the country. Shapes of spleen were also in similar frequency except for dome shaped spleen which was found in higher number in the present specimens. Additional splenic notches and anomalous splenic fissure including complete splenic fissure observed in higher number in the specimens which can masquerade as splenic lacerations on radiological examinations.

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