Original Article

DOI: 10.7860/IJARS/2022/53604.2801

Anatomy Section

Morphological and Morphometric Study of Spleen in Cadavers of Doaba Region of Punjab, India

JASVEEN KAUR[1], MAMTA SHARMA[2], AMBICA WADHWA[3]

ABSTRACT

Introduction: Spleen is a clinically important haemolymphoid organ. It can show a wide range of morphological variation. Size of spleen varies with age and in certain disorders. Splenomegaly is an important diagnostic tool in understanding the aetiology of various diseases.

Aim: To study the morphology, and analyse the morphometric dimensions of cadaveric spleens of Doaba region of Punjab.

Materials and Methods: The cross-sectional study was conducted in the Department of Anatomy at Punjab Institute of Medical Sciences, Jalandhar, Punjab, India. A total of 30 formalin fixed cadaveric spleens of both sexes were studied. The spleen specimens were observed for their morphological features and various morphometric parameters were measured on them.

Results: In the present study, the length of spleen ranged from 6.27-15.01 cm, and the mean length was 10.45±1.94 cm. The range of breadth was between 4.78 cm and 10.00 cm, and with the mean of 7.12±1.50 cm. The width of spleen varied from 2.96-6.50 cm, with the mean of 4.20±1.11 cm. Weight of spleen ranged between 34.35-269.25 g, and the mean weight was 139.08±63.07 g. On the superior border, the number of notches varied from 0-4, whereas on inferior border upto 3 notches were seen. The shape of spleen was wedge in majority (53.33%) of the specimens.

Conclusion: In the present study, the morphological and morphometric analysis of spleen in Doaba region of Punjab was found to be comparable to the other regions of India. However, it was observed that the mean length was comparatively higher. Also, the number of spleens with notches on both the superior and inferior borders were higher compared to other Indian studies.

Keywords: Morphometry, Splenic notches, Splenomegaly

INTRODUCTION

Spleen is a large encapsulated secondary haemolymphoid organ. It is situated in the left upper quadrant of the abdominal cavity, between the fundus of stomach and the diaphragm. In the healthy individuals its length is usually 12 cm, breadth 7 cm and width 3-4 cm [1]. The average weight of spleen is 7 ounces or 150 g, and shape is usually wedge, corresponding to the size of fist of an individual [2]. The shape of spleen is determined by the relations to the neighbouring viscera during development [3]. In an individual, the size of spleen varies not only with age but with other conditions also [4]. Splenomegaly is defined as the enlargement of spleen measured by weight and size [5]. It is an important diagnostic clue to understand the underlying disorders. There are some disorders that increase cell populations in spleen like malaria, kala azar and others that disturb the storage function like leukaemias and sarcoidosis [6].

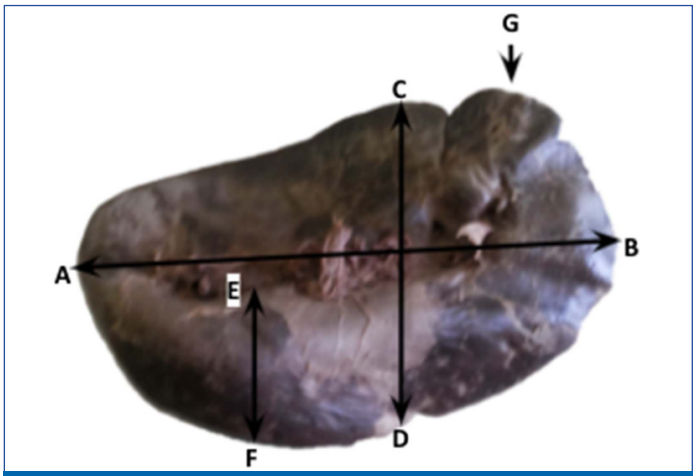
Geographical locations influence the incidence and aetiology of splenomegaly [7]. India has a vast landscape hence there is a changing spectrum of splenomegaly in different regions. Malaria is endemic in the country, and is a common cause for splenomegaly [8]. India is ranked fourth for total malaria burden and reports highest number of *Plasmodium vivax* cases in the world [9]. There is a prevalence of low density parasite infections present in Punjab region [9].

The knowledge of the anatomy and function of the spleen is essential for the assessment of its role in diseased conditions. Spleen shows a myriad range of variation, the knowledge of which is important to physicians, surgeons and radiologists [3]. Keeping this in mind, the present study was undertaken to perform a morphometric analysis of cadaveric spleens and compare the results with previous Indian studies.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Anatomy, at PIMS, Jalandhar from August 2017-July 2020. The Institutional Ethical Committee (IEC) approval was obtained vide letter no. PIMS/DP/Gen.163/1877-97.

A total of 30 formalin fixed cadaveric spleens of both sexes obtained from adult cadavers of Punjab region were studied. Damaged specimens were excluded. The spleen specimens were observed for their morphological features and various morphometric parameters were measured on them [Table/Fig-1].



[Table/Fig-1]: Showing the visceral surface of spleen; A-B) Maximum length of spleen (cm); C-D Maximum breadth of spleen (cm)' E-F Maximum width (cm); G - Notch

Vernier callipers were used to measure the length, breadth, and the width of spleen. Splenic notches were observed along the superior and inferior borders. Weight of the spleen was measured using an electronic weighing scale. Also, various shapes of spleen were observed.

STATISTICAL ANALYSIS

The data obtained was statistically analysed with Statistical Package for the Social Sciences (SPSS) version 21.0 software, and compared with existing Indian studies.

RESULTS

In the present study, the mean length of spleen was 10.45±1.94 cm. As seen in [Table/Fig-2], in 66.67% of the spleens the length was between 8.41-12.80 cm. The breadth of spleen varied from 4.78-10.00 cm, with a mean of 7.12±1.50 cm. [Table/Fig-2] shows that 60% of the spleens lie within the range of 6.01-9.00 cm.

Maximum width varied from 2.96-6.50 cm with the mean of 4.20±1.11 cm. As seen in [Table/Fig-2], in 40% of the spleens maximum width was between 2.51-3.50 cm and in 43.33% was between 3.51-5.50 cm.

Weight of the spleen ranged between 34.35-269.25 g, and the mean weight was 139.08±63.07 g. As seen in [Table/Fig-2] only 4 specimens weighed above 211 g, whereas in the rest, it was evenly distributed between 31-210 ranges.

[Table/Fig-3] depicts that, on the superior border the number of notches varied from 0-4, whereas on inferior border upto 3 notches were seen. In most of the spleens, notches were present on the superior border, whereas, in more than 50% they were absent in the lower border. In 2 spleens complete fissures were found on the diaphragmatic surface.

As seen in [Table/Fig-4], the shape of spleen was wedge in 53% of specimens. In the rest tetrahedral, oval, triangular and irregular shapes were seen.

Length (cm)		Breadth (cm)		Width (cm)		Weight (gm)	
Range	Number (%)	Range	Number (%)	Range	Number (%)	Range	Number (%)
6.21-8.40	3 (10)	4.51-6.00	09 (30)	2.51-3.50	12 (40)	31-90	09 (30)
8.41-10.60	10 (33.33)	6.01-7.50	08 (26.67)	3.51-4.50	07 (23.33)	91-150	09 (30)
10.61-12.80	10 (33.33)	7.51-9.00	10 (33.33)	4.51-5.50	06 (20)	151-210	08 (26.67)
12.81-15.00	7 (23.33)	9.01-10.50	03 (10)	6.51-8.00	05 (16.67)	211-270	04 (13.33)
10.45±1.94		7.12±1.50		4.20±1.11		139.08±63.07	

[Table/Fig-2]: Length, breadth and weight of spleen.

Notches on the superior border of spleen	Number of spleens (%)
0	02 (6.67)
1	07 (23.33)
2	10 (33.33)
3	07 (23.33)
4	04 (13.33)
Notches on the inferior border of spleen	**Number of spleens (%)**
0	16 (53.33)
1	07 (23.33)
2	06 (20)
3	01 (3.33)

[Table/Fig-3]: Notches on the superior and inferior border.

Shape of spleen	Number of spleens (%)
Wedge	16 (53.33)
Tetrahedral	07 (23.33)
Oval	02 (6.67)
Triangular	02 (6.67)
Irregular	03 (10)

[Table/Fig-4]: Shape of spleen.

DISCUSSION

The morphometric variations in the spleen plays an important role in the clinical correlation of spleen pathologies. In the routine practice, measurement of the length of spleen is a good indicator of actual splenic size [2]. Imaging techniques like ultrasongraphy, Computed Tomography (CT) imaging etc., are diagnostic for splenomegaly. On ultrasongraphy, normal spleen size is less than 13 cm superior to inferior axis, 6-7 cm in medial to lateral axis and 5-6 cm in anterior to posterior axis [5].

As seen in [Table/Fig-5], in the present study, the spleen length was longer than the other regions. In the present study, in 63.33% spleens, the length ranged between 8.41-12.80 cm, which shows that, even though the average length is high, the range is comparable with the previous studies [10-17]. The average breadth of spleen noted in present study was also higher than most of the previous studies, as shown in [Table/Fig-5]. The present study found the weight of the spleen to be 139.08±63.07 gm which was comparable to the previous studies. Chaware PN and Waghmode GT et al., have higher values as seen in [Table/Fig-5] [10,11], and Sharma S and Gupta V has observed 122.99 gm which was the lowest, whereas Chaudhari ML et al., has given the range between 80-150 gm [6,12].

Parameter	Setty SSR and Katikireddi RS, [13]	Chaware PN [11]	Sharma S and Gupta V [12]	Waghmode GT et al., [10]	Kawale Sugat G et al., [17]	Khade A and Bonde V [16]	Naveena S [15]	Srivani D et al., [14]	Present study
Sample size	50	111	28	74	50	64	20	40	30
Study region	Andhra Pradesh	Nagpur	Jammu region		Maharashtra		Telangana	Andhara Pradesh	Doaba region of Punjab
Length (cm)	10.15	9.66	8.26±2.51	9.78	7.96±1.364	9.48			10.45±1.94
Breadth (cm)	8.3	6.22	4.92±1.73	5.96	4.6±.76	6.42			7.12±1.50
Width (cm)	3.96	3.06	2.325±1.304	4.95	3.26±.89	3.62			4.20±1.11
Weight (g)	138.40	145.76	122.99±76.80	141.77	137.42±=40.574	101-200			139.08±63.07
Shape (highest %)	40% Wedge	61% Wedge	42.8% Wedge	55.40% Tetrahedral	70% Wedge	62.5% Wedge	40% Triangular	52.5% tetrahedral	53.33 Wedge
Notches									
Superior border (%)	64%	74.76%	78.57%				100%	77.5%	93.33%
Inferior border (%)	10%	24.32%	7.14%					50%	46.67%

[Table/Fig-5]: Comparison with previous Indian studies [10-17].

A notable feature seen in [Table/Fig-5] is that, the measurements in Punjab region are higher in comparison to Jammu region, whereas they are similar to the Southern region [12,13]. The variations in these dimensions can be attributed to the geographical conditions, genetic, socio-economic status and eating habits. India has a widespread landscape hence this can be attributed to the variations in dimension.

Notches on the superior and inferior borders of the spleen are as a result of development from different lobules. Notches on the superior border serve as a good tool for the palpation of spleen during splenomegaly [3]. In the present study, 93.33% spleens have notches on the superior border which is a common feature as in previous studies also, it has been observed as shown in [Table/Fig-5]. Notches on the inferior border have also been observed but are less as compared to superior border. [Table/Fig-5] depicts that in the present study it has been observed in 46% of spleens which is higher than most of the previous studies, except Srivani D et al., who observed in 50% spleens.

The shape of spleen mostly depends upon the neighboring visceral organs during development, which leads to a wide variation. As seen in [Table/Fig-5] [11-17], wedge shape is the most commonly observed shape. Studies by Chaudhari ML et al., and Srivani D et al., have observed tetrahedral shape as the most common [6,14]. In another study by Waghmode GT et al., and Naveena S found the highest frequency of triangular spleens [10,15].

Limitation(s)

Sexual dimorphism could not be studied due to the lesser availability of female cadavers.

CONCLUSION(S)

In the present study, the morphological and morphometric analysis of spleen in Doaba region of Punjab was comparable to the other regions of India. However, it was observed that the mean length was comparatively high. Also, the number of spleens with notches on the superior and inferior borders were higher. The variations observed in the Punjab region may be attributed to the genetical, geographical conditions and eating habits of the Punjabi population.

REFERENCES

[1] Standring S. Grays Anatomy: The Anatomical Basis of the Clinical Practice. 39th ed. Edinburg: Elsevier Churchill Livingstone; 2006. pp. 1239-44.
[2] Singh V. Text Book Of Anatomy: Abdomen and Lower Limb. 3rd ed. India:Elsevier; 2018. pp.98-103.
[3] Sangeeta M, Varalakshmi KL, Sahana BN. Cadaveric study of morphometry of spleen. J Med Sci Health. 2015;1(3):14-17.
[4] Saheb SH, Velichety SD, Haseena S. Morphological and morphometric study of human foetal spleen. Int J Anat Res. 2014;2(1):234-38.
[5] Chapman J, Bansal P, Goyal A, Alexandre M. Splenomegaly. [Updated 2020 Aug 10]. In: StatPearls [Internet]. Treasure Island(FL): StatPearls Publishing;2021 Jan.
[6] Chaudhari ML, Maheria PB, Lakhani C, Menezes VR. Morphological variations of human spleen and its clinical significance. Int J Med Res Rev. 2014;2(1):16-20. doi 10.17511/ijmrr.2014.i01.04
[7] Ghalaut PS, Atri SK, Gaur N, Jain S, Chahal A, Pahuja I, et al. To study the clinical profile and etiological spectrum of patients with splenomegaly in a tertiary care centre of North India. Int J Sci Res Pub. 2016;5(2):120-23.
[8] Asghar A, Naaz S, Agrawa D, Sharma PK. Morphometric study of spleen in North Indian adult population: CT Scan image based study. J Clin Diag Res. 2011;6(5):974-77.
[9] Kaura T, Kaur J, Sharma A, Dhiman A, Pangotra M, Upadhyay AK, et al. Prevalence of submicroscopic malaria in low transmission state of Punjab: A potential threat to malaria elimination. J Vector Borne Dis.. 2019;56:78-84.
[10] Waghmode GT, Porwal SS, Shinde PB, Waghmode UT. Morphological analysis of variations of spleen. Int J Anat Res. 2017;5(2.1):3693-97.
[11] Chaware PN. The morphological variations of the human spleen. J Clin Diag Res. 2012;6(2):159-62.
[12] Sharma S, Gupta V. Study on morphology of cadaveric spleen in Jammu region of India: A cross-sectional study. International Journal of Anatomy, Radiology and Surgery. 2020;9(4):AO18-AO21.
[13] Setty SSR, Katikireddi RS. Morphometirc study of human spleen. Int J Biol Med Res. 2013;4(3):3464-68.
[14] Srivani D, Sofia P, Pillai TJ, Lakshmi Devi CK. A study on morphological variations of spleen in fetal and adult specimens and it's clinical significance. Indian J Clin Anat Physiol. 2019;6(4):475-80.
[15] Naveena S. Clinical implications of morphological and morphometric variations in human spleen- A cadaveric study. Int J Sci Stud. 2019;7(1):53-56.
[16] Khade A, Bonde V. Morphological study of spleen. Global Journal of Research Analysis. 2018;7(1):176-78.
[17] Kawale Sugat G, Garonkar YS, Shaikh SI, Meshram MM. Morphological study of spleen. IOSR Journal of Dental and Medical Sciences. 2016;15(8):15-21.

PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Anatomy, Punjab Institute of Medical Sciences, Jalandhar, Punjab, India.
2. Professor, Department of Anatomy, Punjab Institute of Medical Sciences, Jalandhar, Punjab, India.
3. Professor and Head, Department of Anatomy, Punjab Institute of Medical Sciences, Jalandhar, Punjab, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Jasveen Kaur,
Associate Professor, Department of Anatomy, Punjab Institute of Medical Sciences, Jalandhar-144006, Punjab, India.
E-mail: jsvn.kr@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Dec 22, 2021
- Manual Googling: Feb 21, 2022
- iThenticate Software: Mar 01, 2022 (4%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? No
- For any images presented appropriate consent has been obtained from the subjects. No

Date of Submission: **Dec 21, 2021**
Date of Peer Review: **Jan 20, 2022**
Date of Acceptance: **Feb 21, 2022**
Date of Publishing: **Jul 01, 2022**