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A study on morphology and morphometry of spleen in Santhal pargana division of Jharkand state

Keshav Krishna[1,*] and Nand Kishor Karmali[1]

[1] Department of Anatomy, Phulo Jhano Medical College, Dumka, Jharkhand, India.
* Correspondence: keshavkrishna234@gmail.com

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Abstract: Background: The spleen is a crucial intra-peritoneal hemo-lymphoid organ that is related to various abdominal viscera and the diaphragm. It is known for its variable size and shape and receives its blood supply from the tortuous splenic artery and is drained by the splenic vein. Palpation of the spleen is possible in certain pathological conditions. Notches on the spleen are a result of incomplete fusion of the embryonic splenunculi. In blunt trauma to the abdomen, the spleen is the most common intra-abdominal organ to rupture.
Aims: The study aimed to investigate the variations in morphology, morphometry, shape, size, and weight of cadaveric spleens in the Santhal-Pargana Division of Jharkhand, India.
Materials and Methods: The study was conducted on 30 dissected human spleens of both sexes. The spleen was removed by detaching it from various attachments, and the splenic vessels near its hilum were cut with the help of scalpel, scissors, and forceps. The shape, notches, length, breadth, thickness, and weight were studied.
Results: The study found that a wedge shape was the most common (40%). The mean weight of the spleen was 145.13 gm, and the average number of notches on the superior border was 2. The mean length, breadth, and thickness were 10.8 cm, 6.83 cm, and 4 cm, respectively. These findings were consistent with most similar studies on the spleen, although some studies had different results.
Conclusion: The study reaffirmed that the spleen is quite variable in shape and size. Splenomegaly may be more prevalent due to some endemic diseases. This knowledge is important for clinicians, physicians, radiologists, surgeons, and for routine anatomical dissection. The findings of the study may also contribute to a better understanding of the structure and function of the spleen, which can aid in the diagnosis and treatment of various diseases and injuries related to this organ.

Keywords: Spleen; Morphologic; Morphometric; Weight.

1. Introduction

Among the four pure lymphatic organs, the spleen is an important intra-peritoneal hemo-lymphatic viscera that does not filter lymph, although it is a pure lymphatic organ. It is usually a wedge-shaped organ situated in the left hypochondrium, with two surfaces - superolateral (diaphragmatic) and inferomedial (visceral), three borders - superior, inferior, and intermediate, and two poles - anterior and posterior. The inferomedial surface is concave and irregular, related to the fundus of the stomach in the upper part, to the left kidney in the lower part, the left colic flexure at its anterior end, and the tail of the pancreas at its hilum. Its superolateral surface is convex and smooth, related to the diaphragm and the 9th to 11th ribs. The peritoneal ligaments related to it are the gastro-splenic and lienorenal ligaments.

In the anatomical position, the long axis of the spleen is parallel to the long axis of the 10th rib, oriented downwards and laterally. During palpation by clinicians in a supine position, its long axis lies parallel to the 11th rib [1,2]. Its medial end lies 5 cm from the midline at the level of the 10th thoracic spine, and its lateral end lies at the mid-axillary line on the 11th rib. Normally, the spleen is not palpable but becomes palpable below the left costal margin when it overtly enlarges to more than double its dimension, known as splenomegaly [3]. The causes of splenomegaly are hematological (e.g., myeloproliferative), vascular (e.g.,

portal hypertension), protozoal infections (e.g., malaria, kala-azar), autoimmune, and infiltrative (e.g., storage disorders and tumors).

The spleen is quite variable in size and shape. The size varies with age, being largest during puberty and decreasing thereafter [1]. The adult spleen is usually 9-14 cm long, 6-8 cm wide, and 3-5 cm thick [1]. Other than a wedge shape, it can be quadrangular, triangular, oval, and irregular [1–5]. It is a site for RBC formation in fetal life and serves as a site of maturation for T and B cells. It plays an important role in humoral immunity, removing senescent RBCs from the blood. Its removal predisposes to sepsis in the long term [1].

The spleen derives its blood supply from the tortuous splenic artery, a branch of the celiac trunk. Before entering the splenic hilum, it divides into superior and inferior branches, and in the hilum, they further divide into four or five segmental branches, which supply the spleen segmentally with little communication between them [1]. The spleen supplies blood to its parenchyma by three ways: open circulation, closed circulation, and compromised. Venous drainage is via the splenic vein, which combines with the superior mesenteric vein behind the neck of the pancreas to form the portal vein.

The spleen develops in the dorsal mesogastrium from masses of mesenchymal tissue known as "splenunculi" [2]. These splenunculi later fuse to form the spleen proper, which is evidenced by the presence of one or two notches on the superior border of the spleen near its anterior end. Sometimes, one of these splenunculi fails to fuse, resulting in an accessory spleen [2].

Despite being well protected by the rib cage, the spleen is one of the most common intra-abdominal organs to be damaged or ruptured in blunt abdominal trauma, such as in a road traffic accident [2].

The present study aimed to elucidate the variations in the morphology and morphometry of cadaveric spleens, including their shape, size, length, breadth, thickness, notches, and weight, in the population of the Santhal-Pargana Division of Jharkhand, India.

2. Material and Method

The study was conducted on 30 adult dissected human spleens of both sexes obtained from the Department of Anatomy, Phulo Jhano Medical College, Dumka, and from the Department of Forensic Medicine and Toxicology, Phulo Jhano Medical College and Hospital, Dumka, Jharkhand. The spleen was removed by detaching it from various attachments and by cutting the splenic vessels near its hilum using a scalpel, scissors, and forceps. In this study, the following details of the spleen were observed:

1. Shape
2. Size and dimensions, including length, breadth, and thickness.
3. Weight
4. Notches

The length was measured as the greatest distance between the two poles of the spleen, breadth as the maximum distance between two points at the same level on the superior and inferior border of the spleen, and thickness at the thickest part of the spleen using a digital vernier caliper. The weight of the spleen was measured using a digital weighing machine.

3. Results

The present study aimed to investigate and document the morphologic and morphometric features of 30 adult spleens, comprising both sexes, which were obtained from the Department of Anatomy, Phulo Jhano Medical College, Dumka, and the Department of Forensic Medicine and Toxicology, Phulo Jhano Medical College and Hospital, Dumka, Jharkhand. The spleens were meticulously dissected, and the splenic vessels near the hilum were carefully cut using scalpels, scissors, and forceps to detach them from various attachments. This study aimed to assess the shape, size, weight, and notches of the spleen, which were carefully observed and recorded using digital vernier calipers and a digital weighing machine.

The length, breadth, and thickness of the spleen were measured as the greatest distance between the two poles, maximum distance between two points at the same level on superior and inferior border, and maximum thickest part, respectively, using digital vernier calipers. The weight of the spleen was measured using a digital weighing machine. A total of 30 spleens were analyzed, and their morphologic and morphometric features were recorded. The findings are summarized in Tables 1-3 and Figure 1.

The data obtained from this study provide a valuable reference for further research on the spleen's structure and function in the population of Santhal-Pargana Division of Jharkhand, India. The findings may also have clinical implications for the diagnosis and treatment of various diseases involving the spleen. Overall, this study provides a comprehensive analysis of the morphologic and morphometric features of adult spleens and highlights the importance of further research in this area.

Table 1. Morphologic assessments of spleen

Shape	No. of spleens	Percentage	No. of notches in superior border	No. of specimens	Percentage
Wedge	12	40%	0	3	10%
Oval	7	23.30%	1	8	26.70%
Triangular	6	20%	2	9	30%
Tetrahedral	3	10%	3	5	16.70%
Irregular	2	6%	4	5	16.70%

Table 2. Morphometric Measurements of spleen

Range (cm)	Length*		Breadth†		Thickness‡	
	Number	Percentage	Number	Percentage	Number	Percentage
3.5 to <4	-	-	-	-	12	40%
4 to <4.5	-	-	-	-	16	53.30%
4.5 to 5	-	-			02	06%
6 to <7	-	-	19	63.30%	-	-
7 to <8	-	-	10	33.30%	-	-
8 to <9	02	6%	01	3.30%	-	-
9 to <10	06	20%	-	-	-	-
10 to <11	08	26.70%	-	-	-	-
11 to <12	07	23.30%	-	-	-	-
12 to <13	05	16.70%	-	-	-	-
=13	02	6%	-	-	-	-

*Length - Mean: 10.80, S.D- 1.45
†Breadth - Mean: 6.83, S.D- 0.45
‡Thickness - Mean: 4.00 S.D- 0.28

Table 3. Weight of spleen

Weight (gm)	Number of spleens	Percentage
100 to <125	2	6.7%
125 to <150	17	56.7%
150 to <175	10	33.3%
175 to 200	1	3.3%

Mean: 145.13, S.D- 16.21, Range: 110 to 194

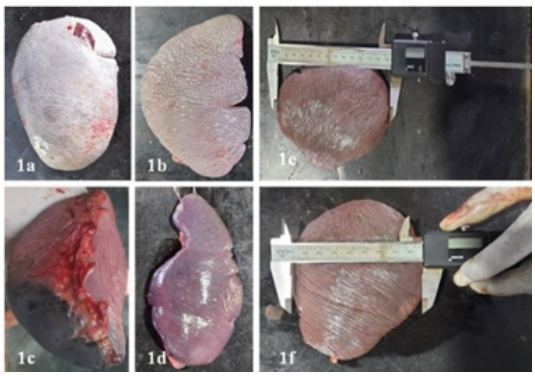

Figure 1. Morphological and morphometric assessments of spleen (1a- Oval shape, 1b- Wedge shape, 1c- Triangular shape, 1d- Irregular shape, 1e- Measurement of length, 1f- Measurement of breadth)

4. Discussion

In this study, various shapes of the spleen were observed and categorized into wedge, oval, triangular, tetrahedral or irregular. The most common type of shape observed was wedge, which was recorded in 12 out of 30 spleens (40%). This finding is consistent with several previous studies [6–9,11] that also reported wedge-shaped spleens as the most common type. However, some other studies [12–14] reported tetrahedral and triangular shapes as the most common, respectively. In one study [10], wedge and triangular shapes were present in equal proportions. The variations in spleen shape observed in different studies may be attributed to the location of various adjacent organs during embryonic development [1].

In this study, splenic notches were observed more frequently on the antero-superior border of the spleen, with an average of two notches, while they were less common on the inferior border. This finding is consistent with many standard textbooks [1–5] and previous studies [6–11,14–18]. During organogenesis, the spleen is formed by the fusion of various splenunculi, and their incomplete fusion manifests as notches.

In this study, morphometric measurements were recorded to evaluate the length, breadth, and thickness of the spleen. The average length of the spleen was found to be 10.8 cm, which is consistent with other studies [1–3,6,7,15,16]. The average breadth was recorded as 6.83 cm, which is similar to the average breadth reported in previous studies, ranging from 4.6 cm to 6.84 cm [1–3,6,7,15,16]. The average thickness of the spleen in this study was found to be 4 cm, which is consistent with the thickness observed in other studies, ranging from 3.24 cm to 4.95 cm. The average weight of the spleen was found to be 145.1 gm, which is consistent with most other studies [7,11,13,15], but differs from one study by Agrawal et al. [9].

Table 4. Comparison of morphometric measurements and weight of spleen with previous studies

Author(s)	Shape (most common)	Avg. Length (cm)	Avg.Breadth (cm)	Avg.Thickness (cm)	Avg.Weight (g)
Sangma et al. [11]	Wedge (41.8 %)	9.91	6.14	3.35	149.09
Kawale et al. [7]	Wedge (61.3 %)	7.96	4.6	3.26	137.42
Chaudhari et al. [6]	Wedge (33.9 %)	9.59	6.58	4.54	-
Khade et al. [8]	Wedge (62.5 %)	9.48	6.42	3.62	150
Sangeeta et al. [10]	Wedge (33.9 %) Triangular (33.9 %)	9.68	6.84	3.61	-
Agrawal et al. [9]	Wedge (41.7 %)	10.152	6.01	3.24	156.01
Waghmode et al.[14]	Tetrahedral (55.4 %)	9.78	5.96	4.95	141.77
Chaware et al. [17]	Wedge (61.26 %)	9.66	6.22	3.06	145.76
Present study	Wedge (40 %)	10.8	6.83	04	145.13

The present study investigated the dimensions of the spleen in different demographic populations and genders, as well as the weight of the spleen in adults. The results are summarized in Table 4. The weight of the spleen in adults was found to range from 70 gm to 200 gm, with splenomegaly being defined as a spleen weight greater than 230 gm in autopsy evaluations [12]. Splenomegaly can have infectious or non-infectious causes, and in the Santhal Pargana geographical region, it has been associated with parasitic infections such as malaria and kala-azar (Leishmaniasis) [18]. Further research is needed to explore this area in more detail.

5. Conclusion

In conclusion, variations in the shape, size, and weight of the spleen have been documented in previous studies, with minimal variations observed in the present study that may be attributed to demographic influences. Knowledge of the morphology and morphometry of the spleen is important for radiologists, surgeons, and physicians in various medical procedures and examinations. Additionally, the study of the spleen's anatomy and dissection is important for routine Anatomy class room studies. The findings of this study have important clinical implications, as they contribute to a better understanding of this organ and its management in various medical conditions.

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Conflicts of Interest: "Authors declare that they do not have any competing interests."

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