

Original Research Article

Morphometric analysis of spleen and its clinical importance.

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Abstract

Background & Methods: the aim of the study is to study Morphometric analysis of spleen and its clinical importance. The research protocol involved a detailed examination of morphological features, specifically focusing on presence of accessory spleen along with the shape and number of notches present on the borders of each spleen. Additionally, a morphometric analysis was conducted, encompassing measurements for length, width, and thickness. The tools employed for this purpose included Vernier calipers and a measuring tape.

Results: In the present study, the length of the spleen varied from 6.8 cm - 18.7cm. The breadth varied from 5.3 cm - 14 cm and the width was between 2.7 cm - 6.5cm. The mean values of the length, breadth, and width of the spleen in our study were, 12.3 cm, 8.12cm and 4.23 cm respectively, which were 11cm, 7cm and 3cm in the study which was done by Michels. In the Textbook of Gray's Anatomy, these values have been mentioned as 12 cm, 7 cm and 3 to 4 cm respectively.

Conclusion: This study provides estimates of spleen to help radiologist for the diagnosis of diseases related to splenomegaly and atrophy also used for haematologist and immunologist for the diagnosis of various gastrointestinal and haematological diseases in addition to forensic studies. The knowledge of morphological variations of spleen is crucial for clinicians during routine clinical examination of abdomen and for surgeons for splenic and spleen-related surgeries such as laparoscopic splenectomies, for radiologists to make correct diagnosis & also for anatomists for routine dissection. Detailed knowledge on spleen is important to avoid and prevent any complications and to obtain a good operative, as well as diagnostic intervention.

Keywords: Spleen, accessory spleen, splenic notches and variations.

Study Design: Observational Study.

1. Introduction

In humans, the spleen is the largest lymphatic organ. It is connected to the blood vascular system. It consists of a large encapsulated mass of lymphoid and vascular tissues. It is situated in the left hypochondrium and partly in the epigastrium, between the fundus of the stomach and the diaphragm. The shape of the spleen varies from a slightly curved wedge to a domed tetrahedron [1]. The average adult weight of the spleen is 150 gm, which varies from 80 to 350 gm [1] The spleen has two surfaces; superolateral or diaphragmatic and

inferomedial or visceral. It has two poles, the anterior and the posterior and two borders, superior and inferior.

The spleen is lobulated in the fetus, but the lobules normally disappear before birth. The notches in the superior border of the adult spleen are remnants of the grooves that separated the fetal lobules [2].

The spleen is enclosed by a capsule of uneven thickness that invaginates into the spleen parenchyma as trabeculae. The splenic tissue between the capsule and trabeculae forms the cords or pulp. Histologically, the cords can be categorized as red or white pulp. Spleen plays an important role in regulating the number and quality of erythrocytes, eliminating cellular debris from the blood, and responding against antigens and/or virulent pathogens that may have entered the systemic circulation [3,4].

Embryologically however, within the left dorsal mesogastrium around the 5th week of gestation multiple mesenchymal cells aggregate and give rise to lacunae of hematopoietic tissues. By the 8th week, the spleen has a segmented morphology based on arterial lobules, which gradually disappear around week 30, as the spleen develops its lymphoid structures. The immunological role of the spleen is mediated initially by the migration of B-lymphocytes which colonize these lacunae peripherally and then by T lymphocytes centrally around arterioles. As this tissue develops, a few nodules eventually fuse to form the spleen proper. The points of union of these nodules are believed to be the reason behind the splenic notches on its borders [5-7].

Accessory spleens may be found in the hilum, gastrosplenic ligament, lienorenal ligament, in greater omentum, along splenic vessels & very rarely scrotum [8]. Its incidence varies from 10-30% in autopsy series [9].

The notch on its superior border aids to identify the spleen and differentiate it from other abdominal organs. Therefore, a variation in the number and location of notches may impede the clinical diagnosis of an enlarged spleen. Although traditional anatomical literature has invariably reported that the spleen has only one or two main notches. The number of notches may vary from one to six. More recently, a case where one spleen had seven notches [10,11].

Materials and methods:

Over a span of two consecutive academic years, from 2021 to 2023, a total of 20 formalin-fixed spleens, obtained through standard dissection procedures from adult cadavers, were the subject of investigation at Osmania Medical College in Koti, Hyderabad, Telangana State, India.

The research protocol involved a detailed examination of morphological features, specifically focusing on presence of accessory spleen along with the shape and number of notches present on the borders of each spleen. Additionally, a morphometric analysis was conducted, encompassing measurements for length, width, and thickness. The tools employed for this purpose included Vernier calipers and a measuring tape. A statistical analysis was made i.e. mean, median, mode and standard deviation were calculated.

Subsequently, all recorded observations were systematically analysed and tabulated, including variable percentages. These findings were then compared with existing literature to enhance the contextual understanding of the observed spleen characteristics.

Results:

In the current study, an examination of 20 cadaveric spleens revealed distinct shapes among the specimens. Notably, 4 spleens exhibited a triangular shape[FIG:1], 6 spleens were identified as oval [FIG:2], 8 spleens presented a tetrahedral shape[FIG 3] and an additional 2 spleens were characterized by a wedge shape[FIG:4].



FIG:1



FIG:2



FIG:3



FIG:4

- ◆ Shapes of all the spleens were observed and it was found that 40% of spleens were tetrahedral in shaped, 30% with oval shape, 20% with triangularshape and 10% with wedge shape.
- ◆ Splenic notches were found majorly on superior border, with their number ranging between 1 and 4.
- ◆ 3 spleens showed notches in both superior and inferior boarders. [FIG.5,6]



FIG: 5



FIG:6

- ◆ 2 spleens showed notches in superior boarder extending into the diaphragmatic surface (FIG 7, 8) and no splenic notches are seen in 4 spleens.



FIG: 7



FIG: 8

- ◆ Among the 20 formalin-fixed spleens examined in this study, the presence of accessory spleens was noted in three specimens.
- ◆ The accessory spleens were located between the intermediate border and the inferior border (FIG:9, 10).



FIG: 9



FIG: 10

Statistical analysis was done. Mean, median mode and standard deviation were calculated and shown in the Table: 1

Table 1: Statistical analysis of length, breadth, thickness of the spleens in present study.				
PARAMETER	MEAN	MEDIAN	MODE	STANDARD DEVIATION
LENGTH	12.3	11.05	12	2.46
BREADTH	8.12	7.2	7.9	1.55
THICKNESS	4.23	3.9	3.9	0.85

DISCUSSION:

In all the spleens two poles, two borders and two surfaces were observed. The diaphragmatic surface of the spleen showed a uniform morphology, while its visceral surface showed gastric, renal, colic and pancreatic impressions due to their pressure on the spleen.

The present study has shown similar observations for the size of the spleens as in previous studies. In the present study, the length of the spleen varied from 6.8 cm - 18.7cm. The breadth varied from 5.3 cm - 14 cm and the width was between 2.7 cm - 6.5cm. The mean values of the length, breadth, and width of the spleen in our study were, 12.3 cm, 8.12cm and 4.23 cm respectively, which were 11cm, 7cm and 3cm in the study which was done by Michels [3]. In the Textbook of Gray’s Anatomy [1], these values have been mentioned as 12 cm, 7 cm and 3 to 4 cm respectively.

- ◆ Morphometric values of splenic lengths varied from 6.8 cm to 18.7cm, width 5.3 cm to 14 cm, and thickness varied from 2.7 cm to 6.5cm. (table: 2)

TABLE 2: Morphometric values of splenic lengths, widths, and thickness in the present study.		
S.NO	PARAMETER	RANGE OF MEASUREMENTS (CM)
1.	LENGTH	6.8 cm - 18.7cm
2.	BREADTH	5.3 cm - 14 cm
3.	THICKNESS	2.7 cm - 6.5cm

The spleen develops from the mesoderm. During its development, different lobules are formed, which fuse with each other later on. The indication of the lobulation in adult spleen is its notched upper border [12]. Sometimes, this lobulated appearance may persist in the spleen. That is why we can get many notches on the spleen, which can be seen on the superior as well as on the inferior borders. In the present study, the splenic notches were found on the superior as well as on the inferior borders. The number of notches varied from zero to six, but commonly, there were only one or two notches. These findings of the present study were in accordance with those of the earlier studies [13, 14].

During the development of the spleen, small masses of the splenic tissue may become detached from the main mass and may develop into accessory spleens [15]. In the present study, accessory spleen was found in 15% specimens. But some research workers [16,17] reported the incidence of the accessory spleen to vary from 10 to 35% specimens. They found the accessory spleen at the hilum of the spleen, in the gastrosplenic ligament, in the greater omentum, along the splenic vessels, along the pancreas and in the scrotum also. But in the present study, only the hilar region was taken into consideration, which may be the reason why we found only a small number of accessory spleens. Awareness on the possible presence of the accessory spleen is of importance, because if they are not removed during splenectomy, they may result in the persistence of the symptoms which indicated the removal of the spleen (eg. splenic anaemia) [18].

- In the present study, accessory spleen was found in 15% specimens.
- Shapes of all the spleens were observed and it was found that 40% of spleens were tetrahedral in shaped , 30% with oval shape, 20% with triangularshape and 10% with wedge shape. That is shown in comparison table 3.

TABLE 3: Compare the shape of spleen with present and previous study

STUDT	SHAPE OF THE SPLEEN [%]					
	Wedge	Tetrahedral	Triangular	Oval	Heart	Semilunar
Hollinshed Wh. et al. [1982]	44%	14 %	42%	-	-	-
Chaware Pn et al. [2012]	61.26%	21.62%	12.61%	3.6%	0.9%	-
Rao S et al. [2013]	40%	20%	32%	8%	-	-
Chaudari MI et al.[2014]	33.87%	32.25%	19.35%	8.06%	6.45%	-
Sangeeta M et al. [2015]	33.9%	15%	33.9%	9.4%	3.7%	3.7%
Naveena S. Int J Sci Stud 2019;7(1):53-56.	15%	15%	40%	30%	-	-
Present Study 2023	10%	40%	20%	30%	-	-

Conclusion: The knowledge of morphological variations of spleen is crucial for clinicians during routine clinical examination of abdomen and for surgeons for splenic and spleen-related surgeries such as laparoscopic splenectomies, for radiologists make correct diagnosis & also for anatomists for routine dissection. Detailed knowledge on spleen is important to avoid and prevent any complications and to obtain a good operative, as well as diagnostic intervention.

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