

Clinical Implications of Morphological and Morphometric Variations in Human Spleen – A Cadaveric Study

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Abstract

Introduction: Spleen is a vital lymphatic organ located in the left hypochondrium of the human body. Morphological variations of spleen and its clinical importance need to be discussed at dissection tables during routine anatomy dissection hours.

Purpose: The aim of this study is to assess the anatomical variations of spleen by its morphometric analysis in adult human cadavers with a possible discussion on its clinical significance.

Materials and Methods: A total of 20 adult human cadaveric spleens were studied at ESIC Medical College, Sanathnagar, Hyderabad, Telangana State, India, in a duration of 3 consecutive academic years, 2016–2019. The present study was based on observing morphological features such as shape, number of notches, and analyzing morphometric measurements such as length, width, and thickness of all spleens.

Results: Shapes of all the spleens were observed and it was found that 40% of spleens were triangular shaped with the highest frequency. Splenic notches were found majorly on superior border, with their number ranging between 1 and 4. Morphometric values of splenic lengths varied from 8.5 cm to 21cm, widths 4 cm to 8.5 cm, and thickness varied from 2.5 cm to 6.5cm.

Conclusion: The present study brings a clear concept on morphological and morphometric variations of spleen, which possibly enhances the basic as well as clinical knowledge of medical professionals.

Key words: Cadaver, Dissection, Hypochondrium, Morphological, Morphometric, Splenic notch, Variations

INTRODUCTION

Spleen is an encapsulated secondary lymphoid organ located in the left hypochondrium of abdominal cavity. Its shape is variable and size, weight of the spleen change with age, and genders. Its measurements in an adult are length 12 cm, width 7 cm, and thickness 3–4 cm. It weighs around 150 g in an adult. Spleen has medial and lateral ends, superior, intermediate and inferior borders, diaphragmatic, and visceral surfaces. Superior border is sharp and usually shows one or two

notches. Development of spleen occurs from the dorsal mesogastrium of developing foregut. A mesenchymal condensation develops in the dorsal mesogastrium which differentiates during the 5th week of intrauterine life. Fetal spleen is lobulated developmentally and the fetal lobules are separated by grooves, which remain as notches on the superior border in an adult spleen. Spleen cannot be palpable over the abdomen unless it increases 2 or 3 times to its normal size. Abnormally enlarged spleen (splenomegaly) can be palpated at its lateral end (anterobasal angle) below the left costal margin which can be seen in conditions such as iron deficiency anemia, thalassemia, sickle cell anemia, tuberculosis, malaria, and lymphoma.

The aim of the present study was to assess the morphological variations of spleen by its morphometric analysis in adult human cadavers with a possible discussion on its clinical significance.

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MATERIALS AND METHODS

A total of 20 formalin fixed spleens, dissected from the adult cadavers by standard dissection procedures, were studied in a period of 3 consecutive academic years, 2016–2019, at ESIC Medical College, Sanathnagar, Hyderabad, Telangana State, India. All the spleens were observed for their morphological features such as shape and number of notches on borders and studied for their morphometric analysis. The morphometric measurements were taken for length, width, and thickness using Vernier caliper, measuring tape. All observations were analyzed and tabulated with their variable percentages which were compared with available literature.

RESULTS

In the present study, of 20 cadaveric spleens studied, it was found that eight spleens were triangular shaped [Figure 1], six spleens were oval [Figures 2 and 3], three spleens were

tetrahedral shaped [Figure 4], and three spleens were found to be in wedge shape [Figure 5]. All the different shapes of spleen with their frequency are shown in Table 1.

Splenic notches were found majorly on superior border, with their number ranging between 1 and 4. Of 20 spleens, there were 12 spleens which showed only one notch on their superior border. Five spleens were found with two notches, two spleens were found with three notches, and only one spleen had four notches with their variable presence on superior and inferior borders. A number of

Table 1: The present study observations on shapes of spleen

Shape	Number of spleens (%)
Triangular	8 (40)
Oval	6 (30)
Tetrahedral	3 (15)
Wedge	3 (15)

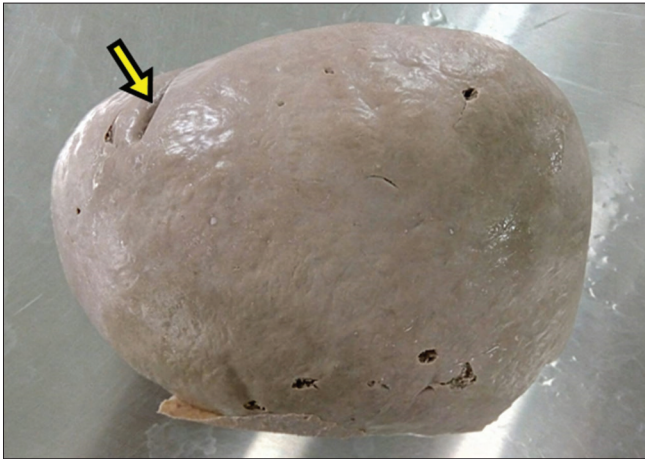


Figure 1: Triangular-shaped spleen with one notch on superior border

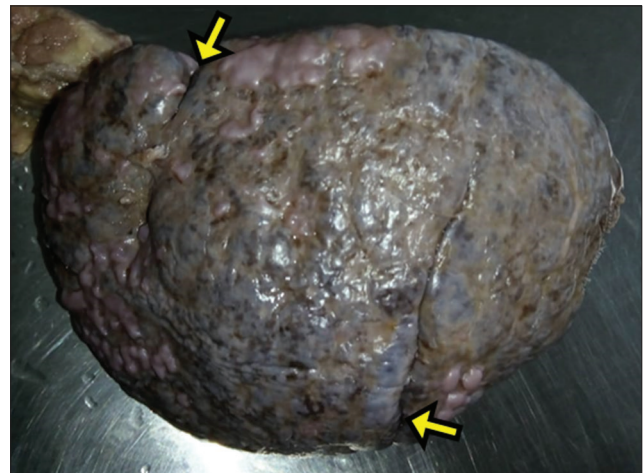


Figure 3: Oval-shaped spleen with one notch on superior border and one notch on inferior border



Figure 2: Oval-shaped spleen with one notch on superior border

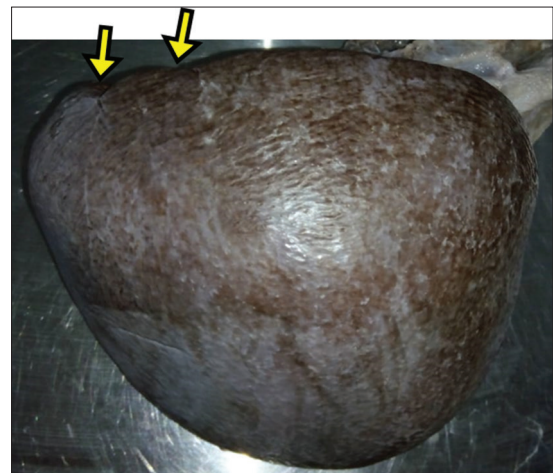


Figure 4: Tetrahedral-shaped spleen with two blunt notches on superior border

splenic notches observed on all the spleens are shown in Table 2 with their frequency.

All the spleens were measured for their morphometric values which include their length, width, and thickness.

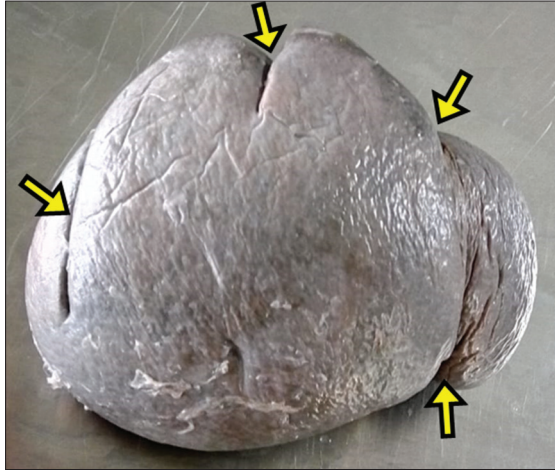


Figure 5: Wedge-shaped spleen with three notches on superior border and one notch on inferior border

Table 2: The present study observations on number of splenic notches

Number of splenic notches	Number of spleens (%)
1	12 (60)
2	5 (25)
3	2 (10)
4	1 (5)

Table 3: Varied lengths, widths, and thickness of all spleens in the present study

Parameter	Range of measurements (cm)
Length	8.5–21
Width	4–8.5
Thickness	2.5–6.5

Table 4: Splenic length variations in the present study

Range of splenic length (cm)	Number of spleens (%)
8.5 cm–10.5 cm	11 (55)
14 cm–17.5 cm	7 (35)
20 cm–21 cm	2 (10)

Table 5: Comparison of variations in shapes of spleen

Shape of spleen	Tenaw and Muche ^[1]	Chaudhari <i>et al.</i> ^[2]	Sangeeta <i>et al.</i> ^[3]	Present study
Triangular	38%	19.35%	33.9%	40%
Oval	19%	8.06%	9.4%	30%
Tetrahedral	14%	32.25%	15%	15%
Wedge	24%	33.87%	33.9%	15%

Splenic lengths varied from 8.5 cm to 21 cm, widths 4 cm–8.5 cm, and thickness varied from 2.5 cm to 6.5 cm. The range of varied lengths, widths, and thickness of all the spleens is tabulated in Table 3.

Splenic lengths varied from 8.5 cm to 21 cm, in which 11 spleens were found with varying lengths between 8.5 cm and 10.5 cm, seven spleens were having lengths between 14 cm and 17.5 cm, and there were two spleens found with 20 cm–21 cm of varied lengths. Variations in splenic lengths were analyzed and shown in Table 4 with their range of measurements and frequency.

DISCUSSION

Studying variations in morphology and morphometry of spleen play a significant role in understanding the possibilities of the occurrence of splenic pathologies. In the present study, different shapes of spleen were observed and the triangular-shaped spleens were found with the highest frequency of 40% of the total of 20 spleens studied. Similar to the present study, a previous study done on 21 cadaveric spleens shown 38% of triangular-shaped spleens with the highest frequency.^[1] In another study done on 62 cadaveric spleens, it was wedge-shaped spleen shown highest frequency of 33.87%;^[2] similarly, a study done on 53 cadavers also shown wedge-shaped spleens with a highest frequency 33.9%;^[3] whereas in the present study, wedge-shaped spleens were found with a lowest frequency (15%). The present study observations on shapes of spleen were compared with the previous studies in Table 5.

The presence of a splenic notch can be helpful in palpating the spleen clinically, but variations in number of splenic notches can misguide a clinician in differentiating the renal tumor from splenomegaly. The maximum number of notches found in the present study was four and there was no spleen found without a notch which is compared with a previous study done on 20 cadaveric spleens where maximum number of splenic notches found were six and only one spleen was stated as without a notch.^[4] The comparison of splenic notch variations is tabulated in Table 6.

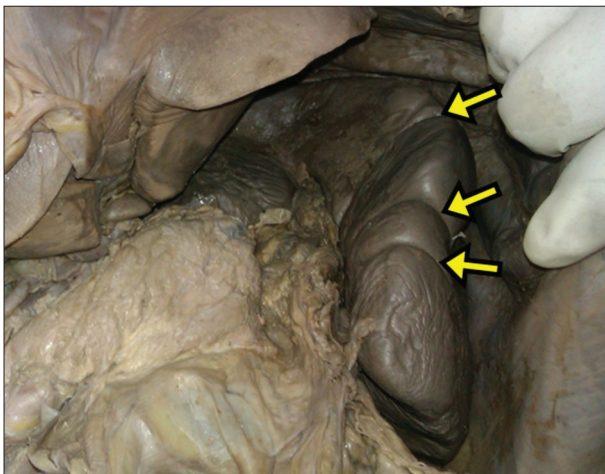
There were various sonographic studies done on linear dimension of spleen – length, width, and thickness.^[5]

Table 6: Comparison of variations in number of splenic notches

Author	Maximum number of notches	Spleens without notches (%)
Agarwal <i>et al.</i> ^[4]	6	5
Present study	4	0

Table 7: Comparison of variations in morphometric measurements

Author	Range of length (cm)	Range of width (cm)	Range of thickness (cm)
Setty and Katikireddi ^[7]	7.5–15.5	2–6	4.5–12.5
Biswal <i>et al.</i> ^[8]	7–>13	4–>10	2–>6
Present study	8.5–21	4–8.5	2.5–6.5

**Figure 6: Exceptionally large spleen with three deep notches on superior border**

Computed tomography studies on other intra-abdominal organs have shown morphological variations and also reduction in the amount of parenchyma with the advancing age.^[6] In the present study, splenic lengths observed were varied from 8.5 cm to 21 cm, widths 4 cm–8.5 cm, and thickness varied from 2.5 cm to 6.5 cm. In a previous study done on 50 cadaveric spleens shown variations in length 7.5 cm–15.5 cm, width 2 cm–6 cm, and thickness 4.5 cm–12.5 cm,^[7] and similarly, another study shown variable values ranging between 7 cm and >13 cm for

length, 4 cm – >10 cm for width, and 2 cm – >6 cm for thickness.^[8] The variations in morphometric measurements were compared with the previous studies in Table 7.

In the present study, there was one spleen found to be exceptionally large and its morphometric measurements were – length 21 cm, width 8.5 cm, and thickness 6.5 cm [Figure 6] that possibly explains splenomegaly.

CONCLUSION

The morphological and morphometric analysis of spleen should be carried out actively at institutional level to study the variations and their clinical implications which definitely helps a clinician in diagnosing and assessing the progression of splenic pathologies. The present study analysis shown varied types of shapes, varied number of notches, and varied range of morphometric values, which may provide a significant information to surgeons planning for a partial splenectomy by preserving the splenic tissue. The present study hopefully brings an enlightenment for further research studies on spleen and also encourages the medical students to carry out such studies which focus on clinically relevant anatomical variations.

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