MORPHOLOGICAL ANALYSIS OF VARIATIONS OF SPLEEN

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ABSTRACT

Background: Spleen is encapsulated vascular and lymphoid organ. Clinically study of spleen is significant in immunological and haematological disorders. Context and purpose of the study is to study morphological variations of spleen and to compare them with previous studies.

Materials and Methods: Present study carried out with 74 spleens at the Department of Anatomy, Navodaya Medical College, Raichur, Karnatka, India, furthermore we observed for various morphological features.

Results: Out of 74 spleens 11 spleens were triangular, 41 spleens were tetrahedral and 22 spleens were wedge shaped. The mean length was 11cm, the mean breadth was 7.1cm, the mean width was 5.45cm, the mean weight was 141.77gms and the mean volume was 140.45cm³.

Conclusion: 74 normal spleens were studied with shapes, lengths, breadths, widths, weights and volumes were analysed. Present study will help radiologists, physicians and surgeons in diagnosing disorders of spleen.

KEY WORDS: Volume of spleen, Shape of spleen, Disorders of spleen, Lymphoid organ.

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INTRODUCTION

Spleen is secondary lymphoid organ as it is the site of maturation of lymphocyte and their activation and initiation of an immune response, spleen is organ of haemopoiesis before bonemarrow development [1]. The spleen is the grave yard of dead red blood cells as the spleen is the site of red blood cell destruction [2]. The spleen has third highest blood perfusion rate [3]. The spleen is called as melancholy as ancient Greece scientist thought that the spleen was the source of black bile [4].

The spleen is not essential for life as removal of spleen does not leads to sudden death [5]. Dimensions and functions of spleen were discovered in 20th century [6]. It may become haemopoietic in pathological conditions. It is situated between diaphragm and fundus of stomach in the left hypochondrium and partly in the epigastrium. The spleen has two surfaces diaphragmatic and visceral [1]. Spleen develops in dorsal mesogastrium. The process of formation of spleen occurs at several adjoining areas which fuse to form lobulated

spleen Early lobulated character of the spleen disappears but notches at upper border remains [7].

Spleen has visceral and diaphragmatic surfaces, anterior and posterior extremities and inferior and superior borders [1]. Accessory spleens may be present in 4.50% cases, in the form of roundish nodules at the hilum of the spleen [8].

Visceral surface presents gastric, renal colic and pancreatic impressions Diaphragmatic surface is smooth and convex, directed upwards, backwards and to the left. Superior border separating the gastric impression from the diaphragmatic surface is thin, convex and presents one or two notches close to the lateral end. Inferior border separates the renal impression from diaphragmatic surface and extends obliquely coinciding with the lower border of the left 11 rib.

Posterior extremity or medial end is blunt and rounded, directed upwards backwards and medially towards vertebral column. Anterior extremity or lateral end is broad and represented by a border, which extends between superior and inferior borders. It is directed downwards, forwards and to the left Anterior basal angle is the junction of the superior border and lateral end and it represents the most forward projecting part of spleen. Posterior basal angle is the junction of the inferior border and lateral end of spleen [9].

Splenomegaly is important diagnostic sign in malaria, kalaazar, inflammatory and degenerative disorders [10]. In splenomegaly, the anterior border, anterior part of diaphragmatic surface and notched superior border may become clearly palpable below the left costal margin [11].

MATERIALS AND METHODS

74 spleens collected from department of anatomy R.G.I.M.S. Srikakulam , NRI.I.M.S. Visakhapatnam and N.M.C. Raichur. Intact normal human cadaveric spleens were selected only 7 spleens from female cadaver were available. dissection was done with standard method of cadaveric dissection 9 measurement were calculated by Vernier calliper and electric weighing machine.

Length = greatest distance between two poles

Breadth = greatest distance between two points at superior and inferior Borders

Width = greatest width

Volume [12] = $(0.36 \times \text{Length} \times \text{Breadth} \times \text{Width}) + 28$

Different shapes were observed. The obtained data analysed and compared with previous studies.

RESULTS

In all 74 spleens two poles anterior and posterior, two borders superior and inferior and two surfaces diaphragmatic and visceral were observed.

Gastric, renal, colic and pancreatic impressions were seen at the visceral surfaces of all 74 spleens.

Out of 74 spleens 11 spleens were triangular shaped, 41 spleens were tetrahedral shaped and 22 spleens were wedge shaped oval and irregular shaped spleens were not seen in present study.

Fig. 1: Showing the triangular spleen.

Fig. 2: Showing the wedge shaped spleen.

Fig. 3: Showing the tetrahedral spleen. **Fig. 4:** Showing the measurement of the Splenic Morphometric parameters.

In Table 1 in present study weight of spleen varied between 56gms. – 344gm. 65 spleens (87.83%) varied between 100gms. to 200gms. Only 2 spleens varied between 250gms to 350gms. Five spleens are having less weight varied between 50gms to 99gms. Average weight of spleen was 141.77gms.

Table 1: Weights of spleen in present study.

Sr. No.	Weight of spleen in grams	Number of spleens
1	50gms to 99gms	5
2	100gms to 149gms	42
3	150gms to 199gms	23
4	200gms to 249gms	2
5	250gms to 299gms	1
6	300gms to 350gms	1

In Table 2 in present study length of spleens varied between 72mm to 137mm 62 spleens their lengths varied between 82mm to 118mm. Only four spleen varied between lengths 120mm to 139mm . Eight spleens have less length varied between 70mm to 79mm Average length

was 97.89mm.

Table 2: Lengths of spleens in present study.

Sr. No	Length of spleen in millimetres	Number of spleens
1	70mm to 79mm	8
2	80mm to 89mm	14
3	90mm to 99mm	18
4	100mm to 109mm	17
5	110mm to 119mm	13
6	120mm to 129mm	3
7	130mm to 139mm	1

In Table 3 in present study breadth of spleens varied between 38mm to 92mm 72 spleens varied between 41mm to 79mm. Only seven spleens varied between breadth 70mm to 89mm. Eight spleens have less breadth varied between 30mm to 49mm. Average breadth was 59.58mm.

Table 3: Breadth of spleens in present study.

Sr. No.	Breadth in millimetre	Number of spleens
1	30mm to 39mm	1
2	40mm to 49mm	7
3	50mm to 59mm	33
4	60mm to 69mm	25
5	70mm to 79mm	6
6	80mm to 89mm	1
7	90mm to 99mm	1

In Table 4 in present study width of spleen varied between 11mm to 74mm . 71 spleens were varied between 31mm to 69mm. Average width was 49.78mm

Table 4: Widths of spleen in present study.

Sr.No.	Width in millimetre	Number of spleens
1	20mm to 29mm	2
2	30mm to 39mm	11
3	40mm to 49mm	23
4	50mm to 59mm	29
5	60mm to 69mm	8
6	70mm to 79mm	1

In Table 5 in present study notches of spleens varied between 0 to 3 notches. 57 spleens have only one notch . Four spleen were present without notch. Two notches were present in 12 spleens. Only one spleen was present with three notches.

Table 5: Number of notches of spleen in present study.

Sr.No.	Number of notches	Number of spleens
1	0	4 (5.41%)
2	1	57 (77.03%)
3	2	12 (16.22%)
4	3	1 (1.36%)

In Table 6 in present study volume of spleen were measured in unit cubic centimetre. volume of spleen were varied between 55.57cm³ to 363.77cm³. Only seven spleens were present with largest volume varied between volume 200cm³ to 400cm³. 15 spleens were having less volume varied between volume 50cm³ to 99cm³. Average volume was 140.45cm³

Table 6: volumes of spleen in present study.

Sr.No.	Volume of spleen in cm ³	Number of spleens
1	50 to 99	15
2	100 to 149	33
3	150 to 199	19
4	200 to 249	5
5	250 to 299	1
6	300 to 349	0
7	350 to 400	1

Table 7: Comparison of shapes of spleen between previous studies and present study.

Previous studies	Shape of the spleen				
	Wedge	Triangular	Tetrahedral	Oval	Irregular
Rao et al. [16]	40%	32%	20%	8%	-
Hollineshead [17]	44%	42%	14%	-	-
Chaware et al [18]	61.26%	12.61%	21.62%	3.60%	0.90%
Chaudhari ML [19]	33.87%	19.35%	32.25%	8.06%	6.45%
M Sangeeta et al [20]	33.90%	33.90%	15%	9.40%	-
Present study	29.74%	14.86%	55.40%	-	-

Table 8: Comparison of lengths, breadths, widths, weights and volumes between previous studies and present study.

Previous studies	Length	Breadth	Width	Weight		Volume	
				Average	Range	Average	Range
Michels N A [23]	11cm	7cm	-	-	-	-	-
Text book of Gray's Anatomy [1]	12cm	7cm	3-4cm	150gms	80gms to 300gms	-	-
Chaudhari et al [19]	9.59 cm	6.59cm	4.54 cm	150gms	80gms to 350gms	-	-
Chaware et al [18]	9.66 cm	6.22cm	3.06 cm	145.76 gms	80gms to 300gms	-	-
Sivanageswara Rao et al [15]	10.15 cm	8.30 cm	3.96 cm	138.4gms	30gms to 300gms	-	-
M Sangeeta et al [20]	9.68 cm	6.84 cm	3.61 cm	-	53gms to 444gms	-	-
Present study	9.78 cm	5.96cm	4.95 cm	141.77 gms	100gms to 200gms	140.45 cm ³	55.57cm ³ -363.77 cm ³

Socioeconomic status, feeding habits, geographical conditions and genetic factors are different in western countries and India that is why values in present study were slightly lower than previous studies. Morphometric volume of spleen was not considered by previous

DISCUSSION

According to Sir Alfred Cuschier spleen varies in shape and three morphological types are desired [13]. According to studies of Prassopolous spleen shapes are crecentric, rhomboid and triangular [14].

According to Sivanageswara Rao et al wedge shaped (40%), Triangular shaped (32%), Oval shaped (8%) and tetrahedral shaped (20%) [15]. In present study tetrahedral shaped spleens were more (55.4%) than previous studies. Triangular (14.86%) and wedge shaped (29.74%) were less than previous studies. Oval and irregular shaped spleens were not found In present study, those shapes were present in previous studies.

According to Malawatkar the dimensions of the spleen are 1.4cm x3.5cm x 7cm [21] Herald Ellis discovered odd numbers related to dimensions of the spleen 1inches thickness, 3 inches width, 5 inches length, 7 ounces weight, related to 9th to 11th ribs. According to Sir Alfred Cushier the normal dimensions of the spleen are 3cm x 9cm x 13 cm [22].

studies. Previous studies on volume of spleen were based on ultrasonography image of spleen, computed tomography image of spleen and Magnetic resonance imaging image of spleen. In present study morphometric volume of spleen is considered. Volume of spleen in present study was varied between 55.57cm³ to 363.77cm³ and average volume was 140.45cm³.

CONCLUSION

In present study includes shape, number of notches, length, width, thickness, weight and volume of the spleen. Morphometric Volume of spleen is most important factor in diagnosis of various disorders of spleen, which was not considered by previous studies. Morphometric analysis in present study will be helpful for surgeons, and physicians in diagnosis and treatment of different disorders of spleen

Conflicts of Interests: None

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