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Original Research Article

MORPHOMETRIC ANALYSIS OF HUMAN CADAVERIC SPLEEN: AN INSTITUTIONAL BASED STUDY

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ABSTRACT

Background: The spleen plays a crucial role within the hematologic and reticuloendothelial systems. The splenic notches located along the superior margin serve as a valuable clinical reference for the palpation of an enlarged spleen. Hence, the present study was conducted for morphometric assessment of cadaveric spleen.

Materials & Methods: A comprehensive examination was conducted on 50 formalin-fixed spleens from adult cadavers of both genders, with damaged specimens being excluded from the study. The morphological characteristics of the spleen specimens were meticulously analyzed, and various morphometric parameters were recorded. Measurements of the spleen's length, breadth, and width were taken using Vernier calipers. Additionally, splenic notches were noted along both the superior and inferior margins. The weight of each spleen was determined using an electronic balance. The study also documented the diverse shapes of the spleens. The collected data underwent statistical analysis utilizing SPSS software.

Results: Mean length, breath, width and weight were 10.96 cm, 7.85 cm, 4.84 cm and 141.7 gm respectively. On the superior border of the spleen, no notch was seen in 8 percent, one notch was seen in 24 percent of the patients while two notches were seen in 36 percent of the patients respectively. On the inferior border, one and two notches were seen in 24 percent and 20 percent of the patients respectively. No inferior notch was seen on inferior border in 52 percent of the patients.

Conclusion: The role of the spleen in the immune response and its function in defending against infections necessitates a conservative management strategy for cases of splenic rupture. A thorough understanding of the spleen's anatomy and physiological functions is crucial for evaluating its significance in various disease processes.

Keywords: Cadaveric, Spleen.

INTRODUCTION

The spleen plays a crucial role within the hematologic and reticuloendothelial systems. This organ is classified as intraperitoneal and is positioned in the left upper quadrant of the abdomen, lying posterior and lateral to the stomach. Anatomically, the spleen is located behind the 9th to 11th ribs on the left side of the body. It comprises two primary components: white pulp and red pulp.[1,2] The white pulp consists of lymphatic tissue that encircles a central arteriole and is predominantly made up of white blood cells, which are essential for initiating the adaptive immune response. Within the white pulp, the germinal center houses B-cells, while the adjacent marginal zone contains T-cells.[3,4]

The splenic notches located along the superior margin serve as a valuable clinical reference for the palpation of an enlarged spleen. Nonetheless, in certain anatomical variations of the spleen, these notches may manifest as fissures on both the costal

and visceral surfaces, resulting in the division of the spleen into multiple lobes. Additionally, the existence of notches along the inferior margin can complicate the delineation of the spleen's borders and its neighbouring structures, including the stomach and kidneys. In particular instances, fluid may accumulate within these splenic fissures due to their considerable depth, potentially leading to misinterpretation as lacerations during radiological assessments.[5-7] It hosts a wide range of immunological functions alongside its roles in hematopoiesis and red blood cell clearance. The physical organization of the spleen allows it to filter blood of pathogens and abnormal cells and facilitate low probability interactions between antigen presenting cells (APCs) and cognate lymphocytes. APCs unique to the spleen regulate the T and B cell response to these antigenic targets in the blood.[8] Hence; the present study was conducted for morphometric assessment of cadaveric spleen.

MATERIAL AND METHODS

The present study was conducted for morphometric assessment of cadaveric spleen. A comprehensive examination was conducted on 50 formalin-fixed spleens from adult cadavers of both genders, with damaged specimens being excluded from the study. The morphological characteristics of the spleen specimens were meticulously analyzed, and various morphometric parameters were recorded. Measurements of the spleen's length, breadth, and width were taken using Vernier calipers. Additionally, splenic notches were noted along both the superior and inferior margins. The weight of each spleen was determined using an electronic balance. The study also documented the diverse shapes of the spleens. The collected data underwent statistical analysis utilizing SPSS software.

RESULTS

Mean length, breath, width and weight was 10.96 cm, 7.85 cm, 4.84 cm and 141.7 gm respectively. In 96 percent of cases, the splenic artery (SA) arises from the celiac trunk, while in 2 percent of instances, it originates from either the abdominal aorta or the superior mesenteric artery, as well as the common hepatic artery. The distribution of anatomical courses was as follows: a suprapancreatic course was identified in 80 percent of cases, a retropancreatic course in 14 percent, an anteropancreatic course in 4 percent, and an intrapancreatic course in 2 percent. In most instances, the superior mesenteric artery (SA) divided into superior and inferior lobar arteries, accounting for 82 percent of cases, while trifurcation and quadrifurcation occurred in 16 percent and 2 percent of cases, respectively. On the superior border of the spleen, no notch was seen in 8 percent, one notch was seen in 24 percent of the patients while two notches were seen in 36 percent of the patients respectively. On the inferior border, one and two notches were seen in 24 percent and 20 percent of the patients respectively. No inferior notch was seen on inferior border in 52 percent of the patients.

Table 1: Morphometric analysis

Mean Length (cm)		Breath (cm)		Width (cm)		Weight (Kg)	
Range	**N (%)**	**Range**	**N (%)**	**Range**	**N (%)**	**Range**	**N (%)**
6.2 to 8.5	6 (12 %)	4.51 to 6	16 (32 %)	2.50 to 3.50	21 (42 %)	31 to 90	16 (32 %)
8.51 to 10.5	18 (36 %)	6.01 to 7.5	12 (24 %)	3.51 to 4.50	13 (26 %)	91 to 150	16 (32 %)
10.51 to 12.5	15 (30 %)	7.51 to 9	18 (36 %)	4.51 to 5.50	9 (18 %)	151 to 200	11 (22 %)
More than 12.5	11 (22 %)	More than 9	4 (8 %)	More than 5.50	(14 %)	More than 201	7 (14 %)
Mean	10.96 cm	7.85 cm		4.84 cm		141.7 gm	

Table 2: Distribution of cases according to origination of splenic artery

Splenic artery	Number	Percentage
From celiac trunk	48	96
From abdominal aorta	1	2
From superior mesenteric artery/ common hepatic artery	1	2
Total	50	100

Table 3: Distribution of cases according to course of splenic artery

Splenic artery	Number	Percentage
Suprapancreatic course	40	80
Retropancreatic course	7	14
Anteropancreatic course	2	4
Intrapancreatic course	1	2
Total	50	100

Table 4: Distribution of cases according to division of splenic artery

Splenic artery	Number	Percentage
Bifurcation	41	82
Trifurcation	8	16
Quadrifurcation	1	2
Total	50	100

Table 5: Distribution of cases according to notches on superior and inferior border

Border of spleen		Number	Percentage
Superior border	Zero	4	8
	One	12	24
	Two	18	36
	Three	11	22
	Four	5	10
Inferior border	Zero	26	52
	One	12	24
	Two	10	20
	Three	2	4

DISCUSSION

The spleen, recognized as the largest organ within the lymphatic system, is situated in the left hypochondriac region of the abdominal cavity, specifically between the fundus of the stomach and the diaphragm. It is located beneath the left costal margin, spanning the area between the ninth and eleventh ribs. Characterized by its spongy texture and reddish-purple hue, the spleen is highly vascularized. Typically, a healthy spleen is not palpable in the majority of individuals. It is enveloped by a delicate outer connective tissue capsule that provides both protection and the capacity for expansion, and it is internally divided into numerous smaller sections known as lobules. The spleen comprises an anterior and posterior segment, resting on the upper pole of the left kidney and the tail of the pancreas. It features three distinct borders: superior, inferior, and intermediate. Notably, the superior border exhibits a notch at its anterior end.[5-8] The organ presents two surfaces: the visceral surface, which is concave and irregular with various imprints, and the diaphragmatic surface, which is smooth and convex. The most pronounced concave imprint corresponds to the fundus of the stomach, while the left kidney leaves an impression on the intermediate and inferior borders. Additionally, the splenic flexure of the colon creates a colic imprint, and the tail of the pancreas leaves an impression situated between the hilum and the colic impression. The splenic hilum is located on the inferomedial aspect of the gastric imprint and contains nerves, splenic vessels, as well as attachments for the splenorenal and gastrosplenic ligaments.[9,10]

Mean length, breath, width and weight was 10.96 cm, 7.85 cm, 4.84 cm and 141.7 gm respectively. In 96 percent of cases, the splenic artery (SA) arises from the celiac trunk, while in 2 percent of instances, it originates from either the abdominal aorta or the superior mesenteric artery, as well as the common hepatic artery. The distribution of anatomical courses was as follows: a suprapancreatic course was identified in 80 percent of cases, a retropancreatic course in 14 percent, an anteropancreatic course in 4 percent, and an intrapancreatic course in 2 percent. Arumugam S et al examined the anatomy and morphological structure of spleens collected from cadavers. 50 spleens were collected from cadavers and examined to determine the presence of splenic notches or fissures. Of the 50 spleens, 40% had notches at the superior border, 10% had notches at the inferior border and 50% had no notches at either border. Fissures were present in five spleens (10%); of these, three showed incomplete fissures and the remaining two had complete fissures that divided the spleen into two lobes. They concluded that a bilobed spleen is a rare congenital malformation which should be considered distinct from other known splenic anomalies.[11]

In the present study, in most instances, the superior mesenteric artery (SA) divided into superior and inferior lobar arteries, accounting for 82 percent of cases, while trifurcation and quadrifurcation occurred in 16 percent and 2 percent of cases, respectively. The incidence of accessory spleen in cadavers was assessed by Mohammadi S et al. A total of six hundred and ninety-three spleens (comprising 541 males and 152 females) were surgically removed from cadavers. During the standard postmortem analysis, five instances of accessory spleens were identified. Among these cases, three were male and two were female. The accessory spleens were located at the splenic hilum. Their lengths varied from 2 to 3.5 cm, while their widths ranged from 0.5 to 2.5 cm. Histological examination confirmed the presence of the accessory spleens. The clinical significance of an accessory spleen is notable in certain anatomical locations, as it may resemble tumors such as those found in the pancreas and adrenal glands when located elsewhere.[12] In another similar study conducted by Das et al, authors studied the anomalous splenic notches. Considering the fact that there is paucity of literature on the presence of splenic notches, they performed the study on 100 formalin fixed cadaveric spleens to observe the presence of notches. The notches were observed on the superior and inferior border in ninety-eight and two cases, respectively. The anomalous presence of fissures on the diaphragmatic surface was observed in two cases. Presence of notches in the inferior border may be important for surgeons attempting splenic surgeries and radiologists interpreting CT scans.[13]

In the present study, on the superior border of the spleen, no notch was seen in 8 percent, one notch was seen in 24 percent of the patients while two notches were seen in 36 percent of the patients respectively. On the inferior border, one and two

notches were seen in 24 percent and 20 percent of the patients respectively. No inferior notch was seen on inferior border in 52 percent of the patients. An accessory spleen may be located in various anatomical sites, with approximately 75% of these instances occurring at the splenic hilum, where the blood vessels enter the spleen. The second most common site for accessory splenic tissue is adjacent to the tail of the pancreas, accounting for about 20% of occurrences. The remaining 5% of accessory splenic tissue can be identified in structures such as the gastrosplenic ligaments, lienorenal ligaments, the stomach wall, the intestinal wall, the greater omentum, the mesentery, or even within the pelvis or scrotum. A primary indication for the surgical excision of an accessory spleen, separate from the removal of the primary spleen, is the torsion of the accessory spleen. This condition may present with symptoms such as flank pain and nausea. The pain associated with torsion can result from inflammation due to infarction or strangulation, venous congestion caused by twisting of the vascular pedicle, or direct pressure on neighboring organs. If left untreated, torsion of an accessory spleen can lead to severe complications, including hemorrhagic shock, peritonitis, and bowel obstruction (d'Amico A et al).[14] Hence; adequate and through knowledge of anatomic landmarks of spleen helps the surgeons and clinicians in performing surgical procedures.

CONCLUSION

The role of the spleen in the immune response and its function in defending against infections necessitates a conservative management strategy for cases of splenic rupture. A thorough understanding of the spleen's anatomy and physiological functions is crucial for evaluating its significance in various disease processes.

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