Original Article

Morphometric Features of the Splenic artery: A Cadaveric Study

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Abstract

Background: The splenic artery, the lineal artery, is the biggest branch of the coeliac trunk in adults and the second largest in foetuses. It travels in a convoluted manner in the stomach bed. The course and branching pattern of the splenic artery sometimes exhibit morphological differences—the current research aimed to examine the differences in the morphometric characteristics of the splenic artery. **Material and Methods:** This cadaveric investigation was conducted at the Government Stanley Medical College's Department of Anatomy in Chennai. Fifty embalmed cadavers preserved in 10% formalin were used in the research. The research examined the morphology of the splenic artery, including its origin, branches, length, course, tortuosity, branching pattern, and number of terminal branches. Three approaches were used to study the differences in the splenic artery pattern: dissection, histology, and analysis. **Results:** Of the specimens examined in this research, 21 came from female cadavers and 29 from male cadavers. The splenic artery in 20 cadavers varied in length from 9.1 to 10 cm (40%), with all specimens originating from the coeliac trunk. In 32% of the cadavers, the splenic artery ran intrapancreatically, whereas in 68% of them, it ran suprapancreatically. In 98% of the specimens, splenic artery tortuosity was found. **Conclusion:** This paper provides an extensive anatomical review of the examined specimens, emphasizing frequent variations and frequencies. Understanding these distinctions is crucial for radiologists and surgeons performing procedures on the upper abdomen to prevent major issues.

Keywords: Splenic Artery, Anatomic Variation, Anatomy, Surgery, Computed Tomography.

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Introduction

Another name for the splenic artery is the lienal artery. It is the biggest branch of the coeliac trunk in adults and the second largest artery in foetuses, behind the common hepatic artery. Near its end, the Splenic Artery sends out the Left gastroepiploic artery, the Short gastric arteries, and several branches to the Pancreas. Before the splenic artery enters the spleen's hilum, it often splits into two or, in rare cases, three branches. As they hit the hilum, the superior and inferior branches—also referred to as superior and inferior polar arteries—split into four or five segmental arteries, each of which supplies a section of splenic tissue.[1,2]

Injury to the spleen is among the most commonly encountered cases of abdominal trauma, accounting for about 2% of the total trauma cases. More than 94% of traumatic splenic injuries are caused by blunt trauma. The causes for splenic trauma have been attributed to stabbing and high-velocity weapons. Injuries can vary from minor capsular tears to localized vascular injuries, including pseudoaneurysms and arteriovenous fistulae, to severe fractures accompanied by active arterial hemorrhage. The spleen is highly vascular; it is prone to arterial bleeding, which can cause hemoperitoneum and unstable hemodynamics, which often requires splenectomy.[3,4]

Nonoperative therapy and spleen-preserving procedures such as partial splenic artery embolisation and closure of the splenic artery's terminal branches have recently supplanted complete splenectomy. Hypersplenism, thrombocytopenia, splenic artery aneurysms, and splenic tumours have all been treated using splenic artery embolisation and ligation. The investigative methods for identifying vascular diseases have greatly improved. Non-invasive imaging techniques, including magnetic resonance imaging, computerised tomography, and ultrasound, have supplanted the invasive X-ray angiography.[5-7]

Knowledge of anatomical variations in the Splenic Artery system plays a vital role in the context of liver and pancreas transplantation, arterial chemo-embolization for visceral organ tumours (especially the management of gastric cancer and pancreatic cancer), hepato-biliary-pancreatic surgical procedures, and upper abdominal surgery. Limited literature is available on the anatomical variations in the morphological patterns of the splenic artery.8-10 This prompted us to undertake this research to ascertain the prevalence and delineate the primary morphological and metric variations of the superior artery's origin, course, and terminal and polar branches.

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Materials and Methods

This cadaveric study was conducted in the Department of Anatomy, Stanley Medical College, Chennai, using the conventional dissection method. The study included 50 embalmed cadavers fixed in 10% formalin meant for the first M.B.B.S. students. Ethical committee approval was obtained from the Institutional Ethical Committee, Stanley Medical College, Chennai. The specimens damaged during dissection and specimens with evidence of surgeries or any mass lesions are excluded from the study. Two methods studied the variations in the pattern of the splenic artery: the dissection method and the histological method. Dissection of the specimens was done according to the Cunningham manual of practical anatomy.[11] The peritoneal cavity was examined, and the stomach was rotated superiorly. The celiac trunk was located and cleaned, and its branches were tracked. The splenic artery was tracked distally. The splenic artery's origin, course, and branches were traced, and the variations were noted. The histological method included five distal segments of the Splenic Artery, which were 1 cm long and were removed during splenectomy in cadavers. The extracted specimens were placed in 10% formalin solution, washed in water, and dried in alcohol at progressively increased concentrations. The specimens were dipped in paraffin and then cut with a microtome of 6 microns. At last, they were stained with the Orceina and Verhoeff technique and viewed under the microscope. SPSS version 16 was then used to input and analyse the data.

Results

Fifty adult cadavers were used in the present cadaveric research to examine the morphology of the splenic artery, including its origin, branches, length, course, tortuosity, branching pattern, and number of terminal branches. Of the specimens examined, 21 were from female cadavers and 29 from male cadavers.

No specimens came from the superior mesenteric artery or the gastro-duodenal trunk; all came from the coeliac trunk. Hilar branching was seen in just 8% of cases, whereas prehilar branching accounted for 92%. Twenty cadavers had splenic artery lengths ranging from 9.1 to 10 cm (40%), thirteen cadavers had splenic artery lengths ranging from 8.1 to 9 cm (26%), and seven cadavers had splenic artery lengths above 11.1 cm (14%). We observed that the splenic artery length varied from 10.1 to 11 cm (12%) in 6 cadavers and less than 8 cm (8%), respectively, in the remaining 4. 6 cm was the smallest length measured, while 13.5 cm was the longest. The splenic artery length in the current research was 9.48 cm on average for all 50 cadavers, ranging from 6 to 13.5 cm.

In the current research, we looked at the path of the splenic artery in 68% of the suprapancreatic and 32% of the intrapancreatic cadavers. In terms of splenic artery tortuosity, we discovered that 98% of samples had non-tortuous arteries, while 2% of specimens had non-tortuous splenic arteries.

In this research, 27 cadavers (54%) had the scattered pattern, 23 cadavers (46%) had the bundled pattern with small terminal arteries, and four cadavers (8%) had the splenic artery reach the hilum without branching. When the number of terminal branches was examined, the majority of the observed specimens had two branches (52%), followed by three (34%), and four (14%).

Histological Study of Splenic Artery

In the present study, we took 5 bits of Splenic artery tissues, which were processed for histological analysis. After staining with eosin and hematoxylin, the tissue sections are viewed under light microscopy.

It showed three layers:

- Tunica intima
- Tunica media
- Tunica adventitia

Tunica intima comprises flattened endothelial cells supported by the internal elastic lamina. Tunica media has smooth muscle fibres. Tunica adventitia has collagen fibres with vasa vasorum.

Table 1: Characteristics among the observed specimens (n=50)

Parameters	Frequency (n=50)	Percentage (%)
Gender		
Male	29	58
Female	21	42
Origin		
Coeliac trunk	50	100
Gastrolienal trunk	0	0
Superior mesenteric artery	0	0
Branching pattern		
Prehilar	46	92
Hilar	4	8
Length of splenic artery (cm)		
< 8	4	8
8.1 – 9	13	26
9.1 – 10	20	40
10.1 – 11	6	12
> 11.1	7	14
Course		
Suprapancreatic	34	68
Retropancreatic	16	32
Tortuosity		
Tortuous	49	98
Non-tortuous	1	2

Terminal branching pattern		
Distributed	22	44
Bundled	24	48
No branching	4	8
No. of terminal branches		
2	26	52
3	17	34
4	7	14

Discussion

The number of surgeries done on the spleen and its blood arteries is increasing. Embolization or ligation of the splenic arteries is commonly employed in portal hypertension, oncological disorders, and other hematological conditions such as pancytopenia, thrombocytopenia, hemolytic anemia, and Banton's syndrome. A thorough understanding of the anatomy of the splenic artery is essential for surgeons to know the various manifestations of the splenic artery because it is often involved in gastrointestinal hemorrhage, organ transplantation, trans-arterial chemoembolization of neoplasms, infusion therapy, and iatrogenic injuries. The present cadaveric study was undertaken to study the morphometric features of the splenic artery.[12,13] The study was undertaken among 50 cadaveric heart specimens at the Department of Anatomy, Government Stanley Medical College, Chennai. We have discussed our observations under the following headings.

Origin of the splenic artery: The present study showed that the Splenic artery originated from Coeliac trunk in all 50 cadavers (100%) which is more than Pandey et al10 (90.6%), Shoumara et al,[14] (97.2%), Oh et al,[15] (98.7%), Petrella et al,[16] (92.1%), and Ashok et al,[17] (96%). Studies conducted by Mikhail Y et al,[18] (100%) and Daisy Sahni et al,[19] (100%) have reported findings similar to our observations.

Branches of the splenic artery

The present study showed prehilar branching pattern in 92% and hilar branching pattern in 8% of 50 cadavers, which is more or less similar to Pandey et al,[10] (97%). In the present study, % prehilar branching pattern of 98% is more than that of Ashok et al (88%),[17] Sangeetha et al,[20] 83%). We observed hilar branching pattern among 2% of the specimens in the present study, which is less than the observations made by Ashok et al (12%) and Sangeetha et al (17%).[17,20]

Length of the splenic artery

In the present study, the length of the splenic artery in 20 cadavers (40%), the length ranged between 9.1 to 10 cm; in 13 cadavers (26%), it ranged between 8.1 to 9 cm; in 7 cadavers (14%) it was more than 11.1 cm; in 6 (12%) between 10.1 cm – 11cm and in remaining four cadavers (8%) it was less than 8 cm. The minimum length observed was 6 cm, and the maximum was 13.5cm. The average length of the splenic artery was 9.48 cm, similar to the observations made by Jaruregui,[21] (10.6 cm) and Daisy Sahni et al,[19] (10.2 cm).

Course of the splenic artery

In the present study, the course of the splenic artery was found to be suprapancreatic along its entire length in 34 cadavers (68%), in 16 cadavers (32%), the artery was situated behind the pancreas, i.e., retropancreatic, which very well coincides with Ashok et al (32%).[17] The suprapancreatic course in the present study is less than that of Pandey et al,[10] (74%) and greater than that of Xu et al (43%).[22] The retropancreatic course in the present study is less than Pandey et al,[10] (18.5%) and XU et al (30.4%).[22]

Tortuosity of the splenic artery

The splenic artery's tortuosity lets the spleen move and the stomach expand without blocking blood flow through the splenic artery when it goes through the stomach bed. Other theories suggest the spleen moves with breathing, the artery can stretch, the damping system is made to protect the splenic tissue, the growth of an artery held in place by its pancreatic branches, and developmental reasons. Chaudhary et al,[23] (2%) reported a non-tortuous straight Splenic artery. In the present study, a straight non-tortuous Splenic artery was seen in one cadaver (2%), which coincides with the observations of Shweta et al.[23]

Branching pattern and number of terminal branches of the splenic artery: In the present study the distributed type was observed in 24 cadavers (48%) which is less than Pandey et al,[10] Xu et al,[22] Naga Jyothi et al,[24] Ashok et al,[17] and short terminal arteries in a bundled arrangement in 22 cadavers (44%) which is less than Pandey et al,[10] but greater than Xu et al,[22] Naga Jyothi et al,[24] Ashok et al.[17] In the present study, four cadavers (8%) showed a splenic artery that entered the hilum without branching, which is greater than Pandey et al,[10] and less than Ashok et al.[17] In the present study two terminal branches was the most common which was found in 26 cadavers (52%) which is similar to Ashok et al,[17] but less than the observations made by Katrisitis et al,[25] Garcia et al,[26] Sow et al,[27] Treutner et al,[28] Daisy Sahni et al,[19] Pandey et al,[10] Anasuya et al,[29] Nagajyothi et al.[24] We observed three branches in 17 cadavers (34%) which is greater than Katrisitis et al,[25] Garcia et al,[26] Sow et al,[27] Treutner et al,[28] Daisy Sahni et al,[19] Ashok et al,[17] Nagajyothi et al,[24] and four branches in 7 cadavers (14%) which is less than Pandey et al,[10] Anasuya et al,[29] greater than Ashok et al.[17]

Conclusion

The splenic artery in 20 cadavers varied in length from 9.1 to 10 cm (40%), with all specimens originating from the coeliac trunk. In the examples that were seen, the path of the splenic artery was mostly suprapancreatic and convoluted. The most common final division pattern was bifurcated, with two terminal branches. An extensive anatomical review of the examined specimens is given in this paper, emphasising frequent variations and frequencies. Understanding these distinctions is crucial for radiologists and surgeons doing upper abdomen procedures to prevent any major issues.

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Conflicts of interest

There are no conflicts of interest.

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