Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

ORIGINAL RESEARCH

Variational anatomy of segmental branches of splenic artery in human cadaveric spleens by dissection method

[1]Dr. Sujata Netam, [2]Thirumalaraju Kalyani, [3]Dr. Rajeev Kumar Nayak, [4]Dr. Karikalan T

[1]Assistant Professor, Department of Anatomy, Atal Bihari Vajpayee Govt. Medical College, Vidisha, Madhya Pradesh, India
[2]Tutor, Department of Anatomy, Noida International Institute of Medical Sciences, Greater Noida, UP, India
[3]Senior Resident, Department of General Surgery, ASMC, Pratapgarh, UP, India
[4]Professor, Department of Forensic Medicine, Al Azhar Medical College and Superspeciality Hospital, Thodupuzha, Kerala, India

Corresponding author
Dr. Sujata Netam
Tutor, Department of Anatomy, Atal Bihari Vajpayee Govt. Medical College, Vidisha, Madhya Pradesh, India

Received: 22 May, 2022 Accepted: 28 June, 2022

Abstract

Background: The splenic artery provides the spleen's sole source of blood flow. This celiac axis branch is the largest, and its path is among the body's most complex. It follows the pancreas' superior border in the border's backward direction. It runs as a number of turns or loops.Because the spleen is crucial to living an infection-free life, spleen-preserving techniques such partial splenectomy and segmental resection are nowbeing developed. So, the purpose of the current study was to investigate the primary segmental and polar branches' properties (number, diameter, and length).

Methods: The Aam Admi Party Medical College and Hospital'sAnatomy Department served as the center of this study. The spleens were separated from their numerous attachments and the splenic vessels were cut, at least 5 cm away from the spleen's hilum, in order to remove them from the abdominal cavity.The total number of the splenic artery's primary segmental and polar branches was noted. At a distance of 1 cm from the branch's origin, the exterior diameter of segmental branches and polar arteries was measured. The Digital Vernier Caliper was used to take the measurements.Each parameter's mean, range, and percentage were computed.

Results: In our study, 119 human cadaver spleen was examined for the number of primary segmental branches of splenic artery, and it was found that 70.6% of spleens had 2 primary segmental branches for the splenic artery.It was found that 40.3% of spleens had inferior polar artery and 22.7% of human cadaver spleen have superior polar artery.Among studied human cadaver spleen, the diameters for the superior, and inferior polar artery were 1.28±0.54 mm and 1.21±0.45 mm, respectively. The length (in cm) for the superior, middle, inferior, and extra primary segmental branches were 1.58±0.62 cm; 1.01±0.55 cm; 1.80±0.87 cm; and 1.21±0.63 cm, respectively.

Conclusion: The numerous conservative splenic procedures depend on a better understanding of the vascular anatomy of the spleen; therefore, the current study contributes

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

to the existing of knowledge regarding the morphometry of the segmental branches of the splenic artery.

Keywords: Spleen, Splenic artery, Anatomy, Segmental branches, Polar branches

Introduction

The splenic artery provides the spleen's sole source of blood flow. This celiac axis branch is the largest, and its path is among the body's most complex. It follows the pancreas' superior border in the border's backward direction. It runs as a number of turns or loops. Prior to the left kidney and left suprarenal gland, the splenic artery is located. Before entering the spleen's hilum, it separates into two or three main branches through the splenorenal ligament, which is located posterior to the pancreas [1,2]. These branches split into four or five segmental arteries after entering the hilum. Each of these vessels nourishes a certain segment of the splenic tissue.Occlusion of a segmental artery frequently results in infarction of a portion of the spleen because there is limited collateral circulation between the segments [3,4].

It was once believed that the spleen played a little role in maintaining life, but today it is understood that the two primary functions of the human spleen. The phagocytic and immune, stem from its distinctive structure, when it comes to its cellular makeup & richness of its irrigation. The lymphoid tissue and the mononuclear phagocyte system are where the spleen cells originate [5,6].Because the spleen is crucial to living an infection-free life, spleen-preserving techniques such partial splenectomy and segmental resection are nowbeing developed.

Therefore, it is crucial for surgeons and radiologists to perform devascularization of a specific part of the spleen to perform partial splenectomy so that the spleen can be preserved. This is done in order to measure the length of terminal branches, trabecular arteries, and polar arteries, which in another way denote the distance of the artery from the visceral surface of the spleen [7,8]. In order to do a partial splenectomy with the least amount of blood loss and to ensure that the remaining spleen continues to function normally following partial resection, a flawless intrasplenic avascular demarcation between the segments must still be found.

So, the purpose of the current study was to investigate the primary segmental and polar branches' properties (number, diameter, and length). The numerous conservative splenic procedures depend on a better understanding of the vascular anatomy of the spleen, and the current work contributes to the body of knowledge regarding the morphometry of the segmental branches of the splenic artery.

Materials and methods

The Aam Admi Party Medical College and Hospital'sAnatomy Department served as the center of this study. 119 human spleens from both sexes were used in this investigation. Only 19 of the 119 spleen specimens came from female cadavers. It was challenging to conduct a comparison between the males and females due to the limited availability of female cadaver spleens. Therefore, a statistical analysis was conducted on the spleens from both sexes without taking sexual dimorphism into consideration.

The spleens were separated from their numerous attachments and the splenic vessels were cut, at least 5 cm away from the spleen's hilum, in order to remove them from the abdominal cavity. To remove the debris and the fatty tissue, they were then rinsed with tap water. The splenic artery and its branches were located and cleansed in each spleen. By carefully dissecting each spleen section by piece meal, the splenic artery's branches were followed. The splenic artery branches that did not supply the spleen were not taken into account.

The total number of the splenic artery's primary segmental and polar branches was noted, and the distance between the artery's terminal and the spleen's hilum was measured. At a distance of 1 cm from the branch's origin, the exterior diameter of segmental branches and polar

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

arteries was measured. The Digital Vernier Caliper was used to take the measurements. When taking the measurement, care was taken to ensure that the artery wasn't constricted by the calliper's edge. Additionally, any alterations in the morphology of the splenic artery's segmental branches and any intersegmental anastomosis, if any, that existed between the branches, were observed.

Statistical analysis

A Microsoft Excel spreadsheet was used for the statistical analysis. Each parameter's mean, range, and percentage were computed.

Results

In our study (Table 1), 119 human cadaver spleen were examined for the number of primary segmental branches of splenic artery, and it was found that 70.6% of spleens had 2 primary segmental branches for the splenic artery and four primary segmental branches were observed among 5.0% of human cadaver spleen.

Table 1: Distribution of primary segmental branches of splenic artery among studied human cadaver spleen (N=119).

Primary segmental branches	Number	%
One	0	0
Two	84	70.6
Three	29	24.4
Four	6	5.0

In our study (Table 2), 119 human cadaver spleen were examined for the distribution of the polar artery, and it was found that 40.3% of spleens had inferior polar artery and 22.7% of human cadaver spleen have superior polar artery. Both superior and inferior polar artery was observed among 6.7% of human cadaver spleen. Around one third (30.3%) of studied human cadaver spleen showed no polar artery.

Table 2: Distribution of polar artery among studied spleen specimen (N=119).

Polar artery	Number	%
Superior	27	22.7
Inferior	48	40.3
Both (Superior & Inferior)	8	6.7
None	36	30.3

In our study (Table 3), the diameter (in mm) of primary segmental branches of splenic artery and polar artery was measured among 119 human cadaver spleen, and the diameters for the superior, middle, inferior, and extra primary segmental branches were 2.08±0.70 mm; 1.97±0.57 mm; 1.96±0.69 mm; and 2.01±0.72 mm, respectively. Among studied human cadaver spleen, the diameters for the superior, and inferior polar artery were 1.28±0.54 mm and 1.21±0.45 mm, respectively.

Table 3: Diameter (in mm) of primary segmental branches of splenic artery and polar artery among studied spleen specimen (N=119).

Diameter (in mm)	Mean±SD	Median (Range)
Primary segmental branch		
Superior (n=119)	2.08±0.70	2.09 (0.59-3.98)
Middle (n=69)	1.97±0.57	2.06 (0.81-3.64)
Inferior (n=119)	1.96±0.69	1.94 (0.45-4.61)
Extra (n=6)	2.01±0.72	1.72 (1.40-3.11)

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

Polar artery		
Superior (n=27)	1.28±0.54	1.21 (0.33-2.62)
Inferior (n=48)	1.21±0.45	1.14 (0.31-2.75)

In our study (Table 4), the length (in cm) of primary segmental branches of splenic artery and polar artery was measured among 119 human cadaver spleen, and the length for the superior, middle, inferior, and extra primary segmental branches were 1.58±0.62 cm; 1.01±0.55 cm; 1.80±0.87 cm; and 1.21±0.63 cm, respectively. Among studied human cadaver spleen, the diameters for the superior, and inferior polar artery were 2.65±1.12 cm and 3.05±1.24 cm, respectively.

Table 4: Length (in cm) of primary segmental branches of splenic artery and polar artery among studied spleen specimen (N=119).

Length (in cm)	Mean±SD	Median (Range)
Primary segmental branch		
Superior (n=119)	1.58±0.62	1.49 (0.27-4.43)
Middle (n=69)	1.01±0.55	1.12 (0.17-2.26)
Inferior (n=119)	1.80±0.87	1.77 (0.17-4.89)
Extra (n=6)	1.21±0.63	1.43 (0.25-1.71)
Polar artery		
Superior (n=27)	2.65±1.12	2.41 (0.63-5.38)
Inferior (n=48)	3.05±1.24	3.14 (0.09-5.60)

Discussion

The splenic artery, which supplies the spleen, divides into two or three terminal branches at the hilum where it comes to an end. Superior, middle, and inferior primary branches are the names given to these. These branches provide blood to a section of the spleen that is divided by an avascular plane. These branches so characteristics arterial segments in the spleen. The primary segmental branches can therefore be thought of as these arteries.

The polar and segmental branches of the splenic artery showed considerable variations, as described by Michel et al., Gupta et al., Mikhail et al., and Garcia et al. [8,9,10,11].In our study, 119 human cadaver spleen were examined for the number of primary segmental branches of splenic artery, and it was found that 70.6% of spleens had 2 primary segmental branches for the splenic artery and four primary segmental branches were observed among 5.0% of human cadaver spleen. These findings are consistent with earlier research. Eighty percent had two and twenty percent had three primary branches, according to Michel et al., [8]. According to Gupta et al., 84% of primary branches had two branches, and 16% had three [9]. Mikhail et al., found that 77% of primary branches had two branches and 23% had three [10]. 85.70% of primary branches were two, and 14.30% were three, according to Katritsis et al., [12]. 85.58 percent of primary branches were two, while 14.42 percent were three, according to Chaware et al., [13].

In our study, 119 human cadaver spleen were examined for the distribution of the polar artery, and it was found that 40.3% of spleens had inferior polar artery and 22.7% of human cadaver spleen have superior polar artery. Both superior and inferior polar artery was observed among 6.7% of human cadaver spleen. Around one third (30.3%) of studied human cadaver spleen showed no polar artery. These findings correspond with those of earlier studies, as well. 65 percent of superior polar and 82 percent of inferior polar arteries were found by Michel et al., [8]. 60 percent superior and 80 percent inferior polar arteries had been reported by Katritsis et al., [12]. 40.53 percent of superior and 54.06 percent of inferior polar arteries were found by Chaware et al., [13].

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

The splenic artery in male measures 76.5 mm from its origin to where it divides into lobar arteries, whereas in females, it measures 76.05 mm [14]. According to Ashoka et al., the length of the splenic artery varied depending on the specimen: 8 cms - 10%, 8.1-9 cms - 34%, 9.1-10 cms - 44%, 10.1- 11 cms - 6%, and >11.1 cms - 6% [15]. The splenic artery is 10.6 cm on average long, according to Jauregui et al. [16]. The splenic artery has a mean length of 7.45 cm and a range of 2 to 11 cm, as per our study.

In our study, the diameter (in mm) of primary segmental branches of splenic artery and polar artery was measured among 119 human cadaver spleen, and the diameters for the superior, middle, inferior, and extra primary segmental branches were 2.08±0.70 mm; 1.97±0.57 mm; 1.96±0.69 mm; and 2.01±0.72 mm, respectively. Among studied human cadaver spleen, the diameters for the superior, and inferior polar artery were 1.28±0.54 mm and 1.21±0.45 mm, respectively. According to a study by Ignjatovic et al., segmental branches ranged in extracapsular length from 4.0 to 16.7 mm and in diameter from 0.4 to 2.2 mm [17]. In a study by Machalek et al., it was found that the superior branch's mean diameter was 4.2 mm and the inferior branch's mean diameter was 3.7 mm [18].

The importance of the spleen in preventing infection was discovered to be undervalued and it was believed that the other lymphatic organs of the body could perform its functions despite the fact that the spleen is the location where both B and T lymphocytes multiply and play a significant role in immune responses [19, 20]. However, a succession of animal research and patient follow-up investigations revealed its true significance in preventing blood born sepsis, where its function as a blood filter was proven to be extremely important [21,22].

As a result, today's surgeons prefer to save as much splenic tissue as they can by removing only the damaged portion of the spleen, despite the overwhelming evidence supporting splenectomy. A thorough understanding of the splenic artery's segmental branches is crucial for this.

Conclusion

An extremely vascular and brittle organ, the spleen. The largest secondary lymphoid organ, it serves both haematological and immunological purposes and includes 25% of the body's lymphoid tissue. After a splenic injury, total splenectomy is frequently performed, which causes a decline in immunity, predisposes the healthy host to overwhelming life-threatening infections, and alters the haematological picture. By ligating a specific segmental branch of the splenic artery, a partial splenectomy can be performed to get around this. The numerous conservative splenic procedures depend on a better understanding of the vascular anatomy of the spleen;therefore, the current study contributes to the existing of knowledge regarding the morphometry of the segmental branches of the splenic artery.

References

1. Susan S. Gray's anatomy: The anatomical basis of clinical practice. 40 Ed. Edinburg: Elsevier Churchill Livingstone, 2008.
2. Holibková A, Machálek L, Houserková D, Růzicka V. A contribution to the types of branching and anastomoses of the splenic artery in human spleen. Acta UnivPalackiOlomucFac Med. 1998;141:49-52.
3. Silva LF, Silveira LM, Timbó PS, Pinheiro SR, Barros LV, da Silva Filho AR. Morfometric study of arterial branching of the spleen compared to radiological study. Rev Col Bras Cir. 2011 May-Jun;38(3):181-5.
4. Borley NR, Healy JC, Standring S, editors. Gray’s Anatomy: The pancreas, spleen and the suprarenal gland. 39 Ed. Edinburg: Elsevier Churchill Livingstone, 2006.
5. Cooper MJ, Williamson RC. Splenectomy: indications, hazards and alternatives. Br J Surg. 1984;71:173-80.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 05, 2022

6. Kehila M, Abderrahim T. Les splénectomiespartielles avec nécessité de ligature des vaisseauxspléniques. A propos de quarantecas [Partial splenectomy requiring ligation of splenic vessels. Apropos of 40 cases]. Ann Chir. 1993;47:433-5..
7. Redmond HP, Redmond JM, Rooney BP, Duignan JP, Bouchier-Hayes DJ. Surgical anatomy of the human spleen. Br J Surg. 1989;76:198-201.
8. Michel NA. The variational anatomy of the spleen and the splenic artery. AmAnat.1942;70:21-72.
9. Gupta CD, Gupta SC, Arora AK, Singh PJ. Vascular segments in the human spleen. J Anat. 1976;121:613-16.
10. Mikhail Y, Kamel R, Nawar NNY, Rafla MFM. Observations on the mode of termination andparenchymal distribution of splenic artery with evidence of splenic lobation and segmentation. JAnat.1979;128:253-58.
11. Garcia JA, Lemes A. Arterial segmentation and sub- segmentation inhumanspleen.Acta Anatomica.1988;131:276-83.
12. Katritsis E, Parashos A, Papadopoulos N. Arterial segmentation of the human spleen by post-mortem angiograms and corrosion-casts. Angiology. 1982;33:720-7.
13. Chaware PN,Belsare SM,KulkarniYR,Pandit SV,Ughade JM. Variational anatomy of thesegmental branches of the splenic artery. J ClinDiagn Res 2012;6(3):336-38.
14. Daisy Sahni A, Indarjit B, Gupta CN, Gupta FM, Harjeet E. Branches of the splenic artery and splenic arterial segments. Clin Anat. 2003;16;371-7.
15. Ashok KR. Study of origin, course and branching pattern of splenic artery with its variations and clinical implications. Dissertation submitted to the rajiv Gandhi university of health sciences, Bangalore Karnataka. 2010; 41-57
16. Jauregui E. Anatomy of splenic artery. Rev FacCien Med UnivNac Cordoba. 1999;56:21-41.
17. Ignjatovic D, Stimec B, Zivanovic V. The basis for splenic segmental dearterialization; apost-mortem study. SurgRadiolAnat.2005;27:15-8.
18. Machálek L, Holibková A, Tůma J, Houserková D. The size of the splenic hilus, diameter of the splenic artery and its branches in the human spleen. Acta UnivPalackiOlomucFac Med. 1998;141:45-8.
19. Singh I. Textbook of Human Histology. 5 Ed. New Delhi: Jaypee Brothers, 2006.
20. Datta AK. Essentials of Human Anatomy (Thorax and Abdomen). 7th ed. Kolkatta: Current Books International, 2006.
21. King H, Shumacker HB. Splenic studies; susceptibility to infection after splenectomy is performed in infancy. Ann Surg.1952;136:239-42.
22. Morris DH, Bullock FD. The importance of the spleen in resistance to infection. Ann Surg. 1919;70:513-21.