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Original Research Article

Morphometric study of the segmental branches of the splenic artery in human cadaver spleens by dissection method

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ABSTRACT

Introduction: Spleen is the largest lymphoid organ. It is supplied by splenic artery the largest branch of coeliac trunk. It traverses through the lienorenal ligament to reach near the hilum of the spleen, where it divides into two or three primary branches, each of which is subdivided mostly into two or four secondary branches. Moreover, a superior polar arteries and inferior polar arteries are given from splenic trunk or from one of its primary branches, which goes to the poles of the spleen, without entering the hilum. The present study was undertaken to know about the morphometry of the segmental branches of splenic artery and polar arteries

Material and method: The present study was conducted on 79 adult human cadaver spleens by dissection method of unknown sex, fixed in 10% formalin solution, collected from the Department of Anatomy and Forensic Medicine, Mysore Medical College and Research Institute, Mysore.

Results: Two primary segmental branches were seen in 56 (70.9%) specimens, three primary segmental branches in 19(24.1%) specimens and four primary segmental branches in 4(5.1%) specimens. Superior polar artery was present in 18(22.8%) specimens and inferior polar artery was present in 32(40.5%) and both superior and inferior polar artery was seen in 5(6.3%) specimens. The length of primary segmental branches varied from 0.2 cm to 4.9 cm. The length of polar arteries varied from 0.7 cm to 5.7 cm. The diameter of primary segmental branches varied from 0.6 mm to 4.7 mm. The diameter of polar branches varied from 0.4 mm to 2.8 mm.

Conclusion: The present study adds up to the existing knowledge regarding the morphometry of the segmental branches of splenic artery, as the various splenic conservative surgeries are dependent on better understanding of the vascular anatomy of the spleen.

KEY WORDS: Splenic artery, Segmental branches, Polar artery.

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INTRODUCTION

Spleen is the largest lymphoid organ. It is supplied by splenic artery the largest branch of coeliac trunk [1]. It traverses through the lienorenal ligament to reach near the hilum of the spleen, where it divides into two or three primary branches, each of which is subdivided mostly into two or four secondary branches. Moreover, a superior polar arteries and inferior polar arteries are given from splenic artery or from one of its primary branches, which goes to the poles of the spleen, without entering the hilum.

The partial removal of the spleen is possible,

as the spleen is divided into segments, separated by fibrous septa and each segment is supplied by its own main artery [2]. The presence of splenic segmentation could be attributed to its development or to the terminal division of the artery. Better anatomical knowledge about segmental distribution of splenic artery and its variations are important for the partial removal of the organ. The present study adds up to the existing knowledge regarding the morphometry of the segmental branches of splenic artery, as the various splenic conservative surgeries are dependent on better understanding of the vascular anatomy of the spleen.

AIMS AND OBJECTIVES:

1. To study the segmental branches of splenic artery.

2. To study the polar arteries

3. To measure the length of primary segmental and polar branches.

4. To measure the diameter of primary segmental and polar branches.

MATERIALS AND METHODS

The present study is conducted on 79 Human cadaver spleens, irrespective of their age and sex, fixed in 10% formalin solution, collected from the department of Anatomy and Forensic Medicine, Mysore Medical College and Research Institute, Mysore, , Karnataka, India.

The gross dissection was done by following the guide lines of Cunningham's Manual. The spleen was identified and freed from the posterior abdominal wall and stomach by cutting through the gastrosplenic and lienorenal ligaments. The splenic artery was cut about 10 cm proximal to hilum of spleen, then the spleen was removed. The fascia and fat was cleared at the hilum to expose the segmental branches of the splenic artery. Firstly, the primary segmental branches of the splenic artery and polar arteries if any were identified and noted, then the length of segmental branches and polar arteries was measured directly by using the Digital Vernier Calliper.

The external diameter of segmental branches and polar arteries was measured at 1 cm distal to its origin directly by using the Digital Vernier Calliper. Care was taken that the artery is not compressed by edge of the calliper while taking the measurement.

RESULTS

Table 1: Number of primary segmental branches of splenic artery.

Sl. no.	Primary segmental branches	Number of specimens (79)	Percentage (%)
1	One	Nil	0
2	Two	56	70.9
3	Three	19	24.1
4	Four	4	5.1

Superior polar artery was present in 18 (22.8%) specimens and inferior polar artery was present in 32 (40.5%) specimens and both superior and inferior polar artery was seen in 5 (6.3%) specimens.

Table 2: Polar artery.

Sl. no	Polar artery	Number of specimens (79)	Percentage (%)
1	Superior Polar Artery	18	22.8
2	Inferior Polar Artery	32	40.5
3	Superior & Inferior Polar Artery (Both)	5	6.3
4	None (no polar artery)	24	30.4

Fig. 1: Specimen showing the Superior polar artery.
MT- Main Trunk, SPA- Superior Polar Artery,
SPB - Superior Primary Branch, IPB – Inferior Primary Branch

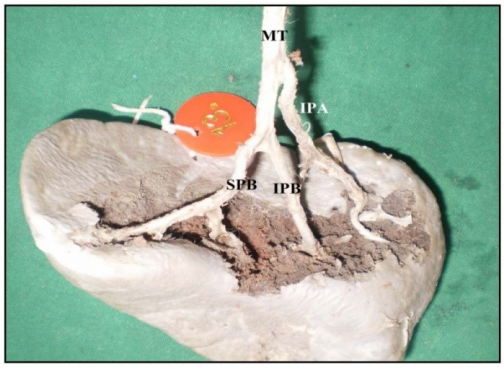

Fig. 2: Specimen showing the Inferior polar artery.

MT- Main Trunk, SPA- Superior Polar Artery,
SPB - Superior Primary Branch, IPB – Inferior Primary Branch, IPB – Inferior Primary Branch

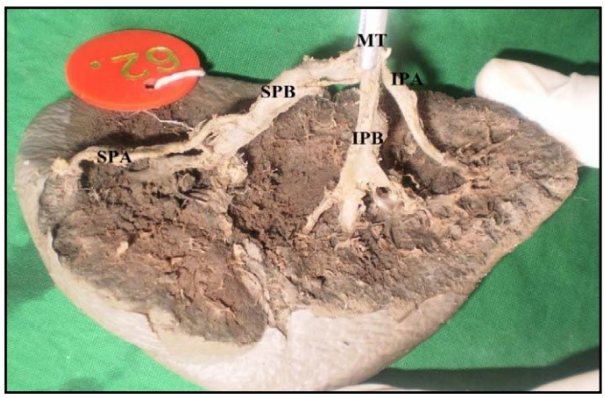

Fig. 3: Specimen showing both Superior polar artery and Inferior polar artery.
MT – Main Trunk, SPB - Superior Primary Branch, IPB – Inferior Primary Branch, IPA- Inferior Polar Artery

Two primary segmental branches were seen in 56 (70.9%) specimens, three primary segmental branches were seen in 19 (24.1%) specimens and four primary segmental branches were seen in 4 (5.1%) specimens.

Superior polar artery was present in 18 (22.8%) specimens and inferior polar artery was present in 32 (40.5%) specimens and both superior and inferior polar artery was seen in 5 (6.3%) specimens.

The length of superior PB varied from 0.3 cm to 4.5 cm, the mean was 1.69 cm and the median was 1.5 cm.

The length of middle PB varied from 0.2 cm to 2.30 cm, the mean was 1.12 cm and the median was 1.2 cm.

The length of inferior PB varied from 0.28 cm to 4.9 cm, the mean was 1.91cm and the median was 1.8 cm.

The length of extra PB varied from 0.3 cm to 1.8 cm, the mean was 1.3 cm and the median was 1.55 cm.

The length of superior polar artery varied from 0.7 cm to 5.49 cm, the mean was 2.76 cm and the median was 2.5 cm.

The length of inferior polar artery varied from 1.0 cm to 5.70 cm, the mean was 3.16 cm and the median was 3.25 cm.

The diameter of superior PB varied from 0.60 mm to 4.09 mm, the mean was 2.19 mm and the median was 2.1mm.

The diameter of middle PB varied from 0.9 mm to 3.7 mm, the mean was 2.08 mm and the median was 2.10 mm.

The diameter of inferior PB varied from 0.5 mm to 4.70 mm, the mean was 2.05 mm and the median was 2.05 mm.

The diameter of extra PB varied from 1.5 mm to 3.2 mm, the mean was 2.1 mm and the median was 1.8 mm.

The diameter of superior polar artery varied from 0.40 mm to 2.7 mm, the mean was 1.39 mm and the median was 1.3 mm.

The diameter of inferior polar artery varied from 0.4 mm to 2.8 mm, the mean was and the 1.3 mm median was 1.2 mm.

Table 3: Length of primary segmental branches and polar artery.

Length	Superior primary segmental branch	Middle primary segmental branch	Inferior primary segmental branch	Extra primary segmental branch	Superior polar artery	Inferior polar artery
No	79	46	79	4	18	32
Mean	1.6957	1.1257	1.9175	1.3	2.7679	3.1609
Standard Deviation	0.73992	0.66486	0.98927	0.7	1.20199	1.3386
Minimum	0.3	0.2	0.28	0.3	0.7	1
Maximum	4.5	2.3	4.9	1.8	5.49	5.7
Median	1.5	1.2	1.8	1.55	2.5	3.25

Table 4: Diameter of primary segmental branches and polar artery.

Diameter	Superior primary segmental	Middle primary segmental branch	Inferior primary segmental branch	Extra primary segmental branch	Superior polar artery	Inferior polar artery
No	79	46	79	4	18	32
Mean	2.1987	2.0809	2.0553	2.1	1.3944	1.3094
Standard deviation	0.81936	0.68598	0.81445	0.8	0.65122	0.56664
Minimum	0.6	0.9	0.5	1.5	0.4	0.4
Maximum	4.09	3.7	4.7	3.2	2.7	2.8
Median	2.1	2.1	2.05	1.8	1.3	1.2

DISCUSSION

Spleen is supplied by splenic artery, which terminates at the hilum by dividing into 2 or 3 terminal branches. These are named as superior, middle and inferior primary branches. These branches supply a particular part of the spleen which is separated by an avascular plane. Thus, these branches divide the spleen into definite arterial segments. So these arteries can be considered as the primary segmental branches [3]. In the present study two primary branches were seen in 56 (70.9%) specimens, three in 19 (24.1%) specimens and four in 4 (5.1%) specimens. Other studies showed only 2 to 3 primary branches. In this study we have observed 2 to 4 primary branches. The comparison of number of primary branches with the previous studies is given in Table 5.

In some spleens, a branch arising from splenic artery itself or one of its primary branch which does not pierce the hilum, but goes to the poles of spleen. These are known as superior and inferior polar arteries. These arteries also supply a particular segment of spleen, which can be considered as the polar segments [7].

In our study we observed superior polar artery was present in 18 (22.8%) specimens and inferior polar artery was present in 32 (40.5%) specimens and both superior and inferior polar artery was seen in 5 (6.3%) specimens.

During surgical procedures, to access and in ligation of arteries, the detailed knowledge of anatomy of each segmental branches are important. In our study we noted the length and diameter of each primary segmental branches and polar branches.

The length of primary branches varied from 0.2 cm to 4.9 cm. The length of polar arteries varied from 0.7 cm to 5.7 cm. The diameter of primary branches varied from 0.60 mm to 4.7 mm. The diameter of polar branches varied from 0.4 mm to 2.8 mm.

A study conducted by Ignjatovic D et al [13] noted that the extracapsular length of segmental branches ranged from 4.0 to 16.7 mm and calibres from 0.4 to 2.2 mm. A study conducted by Machalek L et al [14] noted the mean diameter of superior branch was 4.2 mm and inferior branch was 3.7 mm.

Table 5: Comparison of number of primary segmental branches of splenic artery with the previous studies.

Author	No of specimens studied	Number of primary segmental branches		
		2	3	4
Gupta CD et al. (1976) [4]	50	84%	16%	-
Mikhail Y et al. (1979) [5]	25	77%	23%	-
Katrisis E et al. (1982) [3]	70	88.70%	14.30%	-
Mandarin LCA (1983) [6]	25	68.20%	10.60%	4.50%
Garcia PJA (1988) [7]	181	92.82%	7.18%	-
Sow ML (1991) [8]	32	84%	16%	-
Silva LFA (2010)[9]	-	93.34%	6.66%	-
Chaware PN et al. (2012) [10]	-	85.58%	14.42%	-
Swamy VL et al. (2013) [11]	60	66%	17%	17%
Londhe SR et al. (2013)[12]	50	90%	10%	-
Present study	**79**	**70.90%**	**24.10%**	**5.10%**

Table 6: The comparison of polar arteries with the previous studies.

Author	Polar artery		
	Superior	Inferior	Both
Mikhail Yet al [5]	18%	50%	12%
Garcia PA et al[7]	29.28%	44.75%	10.49%
Chaware PN et al [10]	28.82%	42.34%	11.70%
Swamy VL et al [11]	41.60%	25%	16.60%
Londhe SR et al [12]	32%	56%	24%
Present study	**22.80%**	**40.50%**	**6.30%**

CONCLUSION

The spleen is a highly vascular and friable organ. It is the largest of secondary lymphoid organ, which contains 25% of the body's lymphoid tissue and has both haematological and immunological functions. Total splenectomy is commonly done after a splenic injury, which leads to decrease in the immunity and predisposes the normal host to overwhelming life threatening infections and also creates an altered haematological picture. To overcome this, partial splenectomy can be done by ligating a particular segmental branch of splenic artery. The present study adds up to the existing knowledge regarding the morphometry of the segmental branches of splenic artery, as the various splenic conservative surgeries are dependent on better understanding of the vascular anatomy of the spleen.

Conflicts of Interests: None

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