

# The Splenic Artery and Segmental Branches Morphometric Study in Humanoid Cadaver Spleens by Method of Dissection

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## ABSTRACT

In the human body; the major lymphatic organ is the spleen supplied by the splenic artery, the main division of the celiac trunk. It crosses the lienorenal ligament and approaches the spleen hilum where it splits into 2-3 main branches, each of which divides mainly into 2-4 secondary branches. Also, inferior and superior polar arteries arise from the primary branches or splenic trunk and pass into the spleen pole without entrance in the hilum. The purpose of this analysis was to understand the segmental branches morphometry of the polar and splenic arteries.

**Methods:** The analysis was performed on 86 spleens collected from adult human cadavers of not known gender, stored in formalin 10% solution obtained from the Anatomy and Forensic Medicine Department, by dissection.

**Place and Duration:** In the department of anatomy, Multan Medical and Dental College and Bacha Khan Medical Complex Swabi for six months duration, from August 2021 to January 2022.

**Results:** In 59 (68.6%) spleen samples; there were 2 primary branches, 23 (26.7%) samples have three primary branches, and 4 (4.7%) specimens have four primary branches. 20 (23.3%) samples have superior polar arteries, 34 (39.5%) have inferior polar arteries, and both inferior and superior polar arteries in 7 (8.1%) samples. The superior polar artery length varies from 0.8-5.51 cm, with 2.80 cm of average length and 2.4 cm median length. The inferior polar artery length ranged from 0.9-5.90 cm, with 3.17 cm of average length and 3.30 cm median length. The superior PB diameter ranged from 0.8-4.12 mm, with 2.20 mm average length and 2.4 mm median length. The mean diameter of middle PB ranged from 0.8 mm to 3.6 mm, with an average of 2.10 mm and 2.4 mm median length. The PB inferior diameter ranged from 0.6 mm to 4.4 mm, with an average of 2.13 mm and 2.10 mm median length. The superior polar artery diameter ranged from 0.5-3.1 mm, with 1.40 mm average length and 1.4 mm of median. The inferior polar artery diameter varies from 0.5-2.9 mm, with 1.3 mm of an average diameter with 1.4 mm median.

**Conclusions:** As various splenic sparing surgeries depend on better information of the vascular anatomy of the spleen, this analysis enhances the current information about the segmental branches' morphometry of the splenic artery.

**Keywords:** Splenic artery, Polar artery and Segmental branches

## INTRODUCTION

In the human body; the major lymphatic organ is the spleen supplied by the splenic artery, the main division of the celiac trunk<sup>1-2</sup>. It crosses the lienorenal ligament and approaches the spleen hilum where it splits into 2-3 main branches, each of which is mainly divided into 2-4 secondary branches<sup>3-4</sup>. Also, inferior and superior polar arteries arise from the primary branches or splenic trunk and pass into the spleen pole without entrance in the hilum<sup>5-6</sup>. The splenic partial elimination is probable because its division into sections parted by a fibrous septum, and every section has its individual major artery blood supply. The occurrence of spleen segmentation can be accredited to its progression or final artery division<sup>7-8</sup>. Improved structural information of segmental distribution and lesions of the splenic artery is important for partial organ removal<sup>9</sup>. Since various spleen-sparing surgeries depend on improved knowledge of the spleen vascular anatomy, this study complements the current understanding of the segmental branches' morphometry of the splenic artery<sup>10</sup>.

**Objectives:** 1. To learn about the splenic artery and its segmental branches. 2. Examine the polar arteries. 3. Assess the dimension of the segmented and main pole branches. 4. Evaluate the diameter of the polar branches and primary segmental branches.

## METHODS

The analysis was performed on 86 spleens collected from adult human cadavers of not known gender and age, stored in formalin 10% solution obtained from the Anatomy and Forensic Medicine Department, by dissection. The gross dissection was performed according to the instructions in the Cunningham Manual. The identification of the spleen was done and released from the stomach and posterior wall of abdomen by dissecting the lienorenal and gastrosplenic ligament. About ten cm proximal to the spleen hilum; splenic artery was cut, after which it was

removed. The fat and fascia near the hilum were removed to reveal segmental splenic artery branches. First, major segmental branches of the polar and splenic arteries, if present, were recognised and recorded, and after that the lengths of polar arteries and segmental branches were evaluated directly by means of a digital vernier caliper. The outer diameter of the polar arteries and segmental branches were assessed directly 1 cm distal from their origin by means of a digital vernier caliper. During the measurement, care was taken not to press the artery against the edge of the caliper.

## RESULTS

20 (23.3%) samples have superior polar arteries, 34 (39.5%) have inferior polar arteries, and both inferior and superior polar arteries in 7 (8.1%) samples.

Table 1: Numeral of splenic artery with its primary segmental branches

Sr. no.	Primary segmental branches	Numeral of specimens (86)	%age
I	One	Nil	0
II	Two	59	68.6
III	Three	23	26.7
IV	Four	4	4.7

In 59 (68.6%) spleen samples; there were 2 primary branches, 23 (26.7%) samples had three primary branches, and 4 (4.7%) specimens had four primary branches. The dimension of the superior PB ranged from 0.4-4.3 cm, with 1.70 cm average length and 1.2 cm of median. The mean dimensions of middle PB vacillated from 0.3-2.1 cm, with 1.13 cm average length and 1.1 cm median length. The dimension of the inferior PB vacillated from 0.30-5.1 cm, with 1.92 cm average length and 1.6 cm median length.

Table 2: Distribution of Polar artery

Sr. no	Polar artery	Numeral of specimens (79)	%age
I	Inferior Polar Artery	34	39.5
II	Superior Polar Artery	20	23.3
III	None (no polar artery)	25	29.1
IV	Superior & Inferior Polar Artery (Both)	7	8.1

The extra length of PB varies from 0.4-1.7 cm, with 1.4 cm of average length and 1.59 cm median length. The superior polar artery length varies from 0.8-5.51 cm, with 2.80 cm of average length and 2.4 cm median length. The inferior polar artery length

ranged from 0.9-5.90 cm, with 3.17 cm of average length and 3.30 cm median length. The superior PB diameter ranged from 0.8 mm to 4.12 mm, with 2.20 mm average length and 2.4 mm median length. The mean diameter of middle PB ranged from 0.8 mm to 3.6 mm, with an average of 2.10 mm and 2.4 mm median length. The PB inferior diameter ranged from 0.6 mm to 4.4 mm, with an average of 2.13 mm and 2.10 mm median length. The extra PB diameter fluctuated from 1.9-3.9 mm, with 2.3 mm of an average and 1.2 mm of median. The superior polar artery diameter ranged from 0.5 mm to 3.1 mm, with 1.40 mm average length and 1.4 mm of median. The inferior polar artery diameter varies from 0.5-2.9 mm, with 1.3 mm of an average diameter with 1.4 mm median.

Table 3: Dimension of polar artery and primary segmental branches

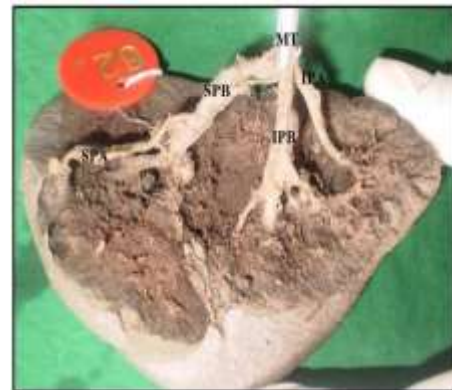
Length	Superior primary segmental branch	Middle primary segmental branch	Inferior primary segmental branch	Extra primary segmental	Superior polar artery	Inferior polar artery
No	86	49	86	5	20	34
Standard Deviation	0.740	0.670	0.990	0.8	1.210	1.34
Mean	1.70	1.13	1.92	1.4	2.80	3.17
Maximum	4.3	2.1	5.1	17	5.51	5.9
Minimum	0.4	0.3	0.30	0.4	0.8	0.9
Median	1.2	1.1	1.6	1.59	2.4	3.30

Table 4: The polar artery and primary segmental branches diameter.

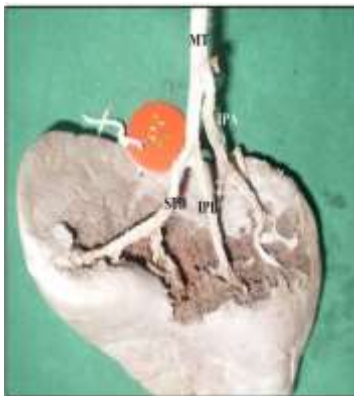
Diameter	Superior primary segmental	Middle primary segmental branch	Inferior primary segmental branch	Extra primary segmental branch	Superior polar artery	Inferior polar artery
No	86	49	86	5	20	34
Standard deviation	0.821	0.690	0.820	0.5	0.660	0.570
Mean	2.20	2.10	2.13	2.3	1.400	1.310
Maximum	4.12	3.6	4.4	3.9	3.1	2.9
Minimum	0.8	0.8	0.6	1.9	0.5	0.5
Median	2.4	2.4	2.10	1.2	1.4	1.4



Superior polar artery



both inferior and superior polar arteries



Inferior polar artery

## DISCUSSION

The splenic artery supplies the spleen, which divides into 2 or 3 terminal branches and ends at the hilum. These are the so-called superior, middle and inferior main branches<sup>11-12</sup>. The specific part of the spleen is supplied by these branches divided by the avascular plane. Therefore, these arteries split the spleen into different arterial sections<sup>13-14</sup>. Therefore, these branches are taken as the main segmental arteries. In this analysis, among 56 (70.9%) spleen samples; there were 2 primary branches, 19 (24.1%) samples had three primary branches, and 4 (5.1%) specimens had four primary branches. Additional analyses institute only 2- 3 primary branches. We observed 2-4 major branches in this study. In a few spleens, branches that arise from the splenic artery itself or from its main branches, do not penetrate the hilum, but enter the spleen poles and are called the inferior and superior polar arteries. These similarly supply the spleen specific segment, which are regarded as the polar segments<sup>15-16</sup>.

Table-5: comparative studies of splenic artery with its primary segmental branches with earlier studies

Writer	Polar artery		
	Superior	Inferior	Both
Garcia PA et al	29.28%	44.75%	10.49%
Mikhail Yet al	18%	50%	12%
Swamy VL et al	41.60%	25%	16.60%
Chaware PN et al	28.82%	42.34%	11.70%
Londhe SR et al	32%	56%	24%
Current study	23.3%	39.50%	8.1%

In our study, 18 (22.8%) samples have superior polar arteries, 32 (40.5%) have inferior polar arteries, and both inferior and superior polar arteries in 6 (5.2%) samples. A detailed information of the anatomy of the individual segmental branches is vital for accessing and ligating the arteries during surgical procedures. In this analysis, the superior polar artery length varies from 0.8-5.49 cm, with an average of 2.76 cm and 2.8 cm median length.

Table-6: comparative studies of polar arteries with earlier studies

Writer	No of analyzed specimens	Numerical of primary segmental branches		
		Two	Three	Four
Mikhail Y et al. (1979)	25	77%	23%	-
Gupta CD et al. (1976)	50	84%	16%	-
Mandarin LCA (1983)	25	68.20%	10.60%	4.50%
Katrisis E et al. (1982)	70	88.70%	14.30%	-
Sow ML (1991)	32	84%	16%	-
Garcia PJA (1988)	181	92.82%	7.18%	-
Chaware PN et al. (2012)	-	85.58%	14.42%	-
Silva LFA (2010)	-	93.34%	6.66%	-
Londhe SR et al. (2013)	50	90%	10%	-
Swamy VL et al. (2013)	60	66%	17%	17%
Current study	86	68.6%	26.7%	4.7%

The superior polar artery length varies from 0.8-5.51 cm, with 2.80 cm of average length and 2.4 cm median length<sup>17-18</sup>. The inferior polar artery length ranged from 0.9-5.90 cm, with 3.17 cm of average length and 3.30 cm median length. The superior PB diameter ranged from 0.8-4.12 mm, with 2.20 mm average length and 2.4 mm median length<sup>19</sup>. The mean diameter of middle PB ranged from 0.8 mm to 3.6 mm, with an average of 2.10 mm and 2.4 mm median length<sup>20</sup>. The PB inferior diameter ranged from 0.6 mm to 4.4 mm, with an average of 2.13 mm and 2.10 mm median length.

**CONCLUSION**

The spleen is an extremely vascularized and fragile organ. It is the second major lymphatic organ, containing 25% of lymphoid tissue in the body, and has haematologic and immunologic roles. Complete splenectomy is usually performed following spleen injury, predisposing to immunosuppression and predisposing the normal host to life-endangering contaminations and infections, and generates a different haematologic depiction. To remedy this, a partial splenectomy can be performed by ligation of the specific splenic artery segmental branch. As various sparing spleen surgeries depend on better information of the spleen vascular anatomy, this analysis enhances the current information about the segmental branches' morphometry of the splenic artery.

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