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RESEARCH

Anatomical Features of the Superior Vesical Artery and İts Relationship with Neighboring Arteries

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Abstract

Background The superior vesical artery (SVA) is one of the important arteries that supply the urinary bladder. This study aimed to investigate anatomical features of the SVA, its morphometric relationships with neighboring arteries.

Methods Totally, 102 (52 male and 50 female) fresh cadavers were dissected. The lengths of the common iliac artery (LCIA) and the internal iliac artery (LIIA) were measured. The distances between the umbilical and the first superior vesical arteries (UmbA-First SVA), and the umbilical and the last superior vesical arteries (UmbA-Last SVA) were calculated. The distance between the uterine and the first superior vesical arteries (UA-First SVA) was measured. The measurements were conducted in millimeters using the ImageJ software program.

Results The mean LCIA was 60.75 ± 15.03 mm on the right and 61.96 ± 16.17 mm on the left. The mean LIIA was 34.19 ± 14.33 mm on the right and 32.02 ± 14.58 mm on the left. The number of SVA ranged from 1 to 4. The mean UmbA-First SVA and UmbA-Last SVA were 14.59 ± 13.80 mm and 31.12 ± 17.47 mm for the right, respectively. Additionally, the mean UmbA-First SVA and UmbA-Last SVA were 13.87 ± 13.06 mm and 35.90 ± 18.26 mm for the left, respectively. A statistically significant difference was found for UmbA-First SVA according to gender and for UmbA-Last SVA according to sides. Lastly, the mean UA-First SVA was 18.05 ± 9.26 mm on the right and 23.39 ± 13.47 mm on the left.

Conclusion The results of the study may guide clinicians in bladder-focused pelvic surgeries, oncological treatments, endovascular operations, and interventional radiologic treatments.

Keywords Superior vesical artery · Umbilical artery · Uterine artery · Internal iliac artery · Morphometry · Anatomy

Abbreviations

CIA	Common iliac artery
First SVA	First superior vesical artery
Last SVA	Last superior vesical artery
IIA	Internal iliac artery
SVA	Superior vesical artery
UA	Uterine artery
UmbA	Umbilical artery

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1 Introduction

The superior vesical artery (SVA) is typically the first major branch arising from the anterior trunk of the internal iliac artery (IIA). It is located on the lateral pelvic wall, immediately inferior to the linea terminalis, and courses anteroinferiorly, medial to the periosteum covering the posterior surface of the pubis. The artery supplies the distal ureter, the urinary bladder, the proximal part of the ductus deferens, and the seminal glands. It also gives origin to the umbilical artery (UmbA) during fetal development, which regresses after birth to form the medial umbilical ligament. Occasionally, a segment of this artery remains patent and provides a minor vascular supply to the umbilicus [1–3].

The urinary bladder is supplied by several different arterial sources, and a significant portion of it is supplied by the SVA. Even unilateral ligation of the arteries supplying the bladder may result in ischemia in part of the bladder [4]. Therefore, it is important to be aware of the arterial supply to the urinary bladder and to protect these arteries. Cho et al. applied superselective embolization as a rapid and reliable treatment option for bladder bleeding and embolized the SVA bilaterally. Thus, they reported that this application gave good results in controlling bladder bleeding [5].

The complex anatomy of the pelvic region may increase the likelihood of complications from invasive procedures targeting this area [6, 7]. In addition, the lymph nodes to be removed during lymph node dissection are adjacent to major neurovascular structures, and complications such as bleeding of the SVA may occur during this procedure [8, 9]. Therefore, knowing the anatomical features of the SVA is important to prevent postoperative bleeding [10].

The existing literature contains a limited number of studies addressing the anatomical characteristics of the SVA. Moreover, most of these investigations have predominantly focused on its morphological features. The main goal of the present paper was to investigate the number and origin of SVAs, assert their morphometric relationships with neighboring arteries, and also to examine morphometric features of common iliac artery (CIA) and IIA.

2 Methods

After ethical approval was obtained from the Istanbul University Istanbul Faculty of Medicine Clinical Research Ethics Committee (Date, 01.28.2022, No., 2022/153), a total of 102 (52 male and 50 female) fresh cadavers were examined from the Council Forensic Medicine Institute (ATK, Istanbul, Turkey). The mean age of the male cadavers was 45.83 ± 18.37 years (range 20–89 years), and the mean age of the female cadavers was 53.04 ± 23.08 years (range 18–96 years). None of the specimens had any pathological findings such as burns, pelvic fractures, tumours, etc.

Upon opening the abdominal cavity during the routine autopsy, two experienced anatomists (E.T. and O.G.) carried out the dissections [11, 12]. Firstly, the abdominal aorta and its bifurcation were identified. Afterward, the course of the CIA and its terminal branches, the external iliac artery and IIA, was meticulously followed. The parietal peritoneum was dissected to expose the IIA and its branches, including the anterior and posterior trunks. The dissection continued with identification of the UmbA and the SVA, followed by careful exposure of their courses and branches. The number of superior vesical artery and their origin points were recorded for both the right and left sides in all cadavers.

2.1 Morphometric Measurements

Each specimen was photographed vertically from a standardized distance (10 cm) with a Sony RX100 VII, 20-megapixel camera, after placement of a 1 cm reference marker. The measurements of the following parameters were conducted in millimeters using the ImageJ software program on the captured images [13].

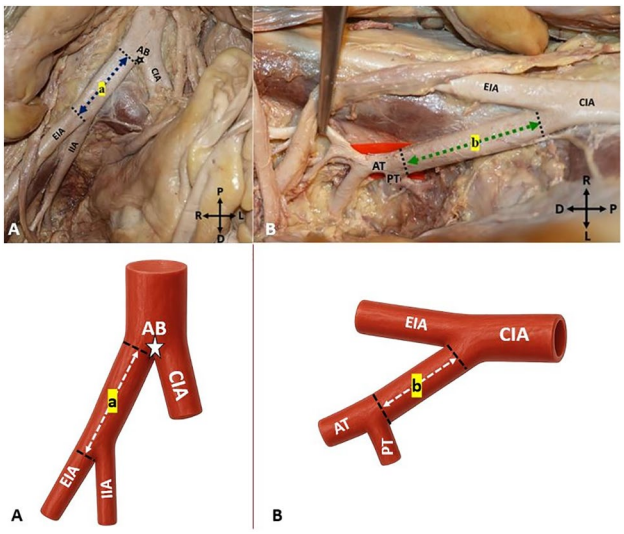

Fig. 1 Length of the common iliac artery (**A**) and the internal iliac artery (**B**) with their schematic illustrations (the illustrations for each are placed below the original image). a: *LCIA* length of the common iliac artery, b: *LIIA* length of the internal iliac artery, *AB* aortic bifurcation, *AT* anterior trunk, *CIA* common iliac artery, *D* distal, *EIA* external iliac artery, *IIA* internal iliac artery, *L* left, *P* proximal, *R* right, *PT* posterior trunk

1. *Length of the common iliac artery (LCIA)* The distance between the level of aortic bifurcation and the level where each common iliac artery divides into the external and internal iliac arteries (Fig. 1A).
2. *Length of internal iliac artery (LIIA)* The distance between the origin of the internal iliac artery and the level where it gives off the posterior trunk (Fig. 1B).
3. *Distance between the umbilical artery and the first superior vesical artery (UmbA-First SVA)* The shortest distance between the origin point of the umbilical artery and the origin point of the first superior vesical artery (Fig. 2).
4. *Distance between the umbilical artery and the last superior vesical artery (UmbA-Last SVA)* The shortest distance between the origin point of the last superior vesical artery and the origin point of the umbilical artery (Fig. 3).
5. *Distance between superior vesical arteries* The shortest distance between the origin points of the superior vesical arteries (Fig. 2).
6. *Distance between the uterine artery and the first superior vesical artery (UA-First SVA)* In case the uterine artery arises from the umbilical artery, the shortest distance between the origin point of the uterine artery and the origin point of the first superior vesical artery was measured. In instances of multiple uterine arteries branching from the umbilical artery, the earliest arising artery was selected as the reference (Fig. 4).

To ensure reliability, all measurements were performed by the same investigator in a randomized manner twice, with an interval of 15 days. Before measurements were conducted on each image, the ImageJ Software Program was appropriately calibrated.

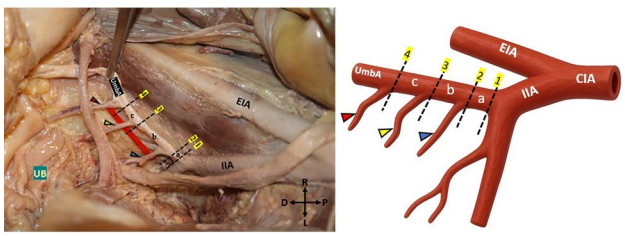

Fig. 2 Reference points and distances used for morphometric evaluation with schematic illustration-1. 1: Origin of the umbilical artery, 2: origin of the first superior vesical artery, 3: origin of the second superior vesical artery, 4: origin of the third superior vesical artery, a: *UmbA-First SVA* distance between the umbilical artery and the first superior vesical artery, b: *First SVA-Second SVA* distance between the first superior vesical artery and second superior vesical artery, c: *Second SVA-Third SVA* distance between the second superior vesical artery and third superior vesical artery), blue arrow: first superior vesical artery, red arrow: third superior vesical artery, yellow arrows: second superior vesical artery, *CIA* common iliac artery, *D* distal, *EIA* external iliac artery, *IIA* internal iliac artery, *L* left, *P* proximal, *R* right, *UB* urinary bladder, *UmbA* umbilical artery

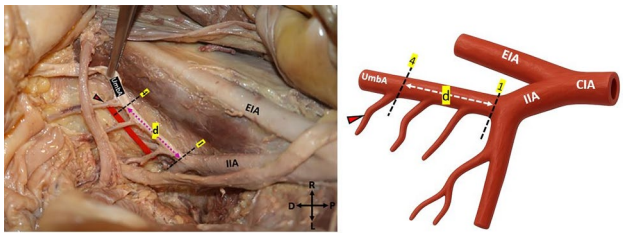

Fig. 3 Reference points and distances used for morphometric evaluation with schematic illustration-2. 1: Origin of the umbilical artery, 4: origin of the last superior vesical artery, d: *UmbA-Last SVA* distance between umbilical artery and the last superior vesical artery, *CIA* common iliac artery, *D* distal, *EIA* external iliac artery, *IIA* internal iliac artery, *L* left, *P* proximal, *R* right, red arrow: the last superior vesical artery, *UmbA* umbilical artery

2.2 Statistical Analysis

All values measured in the study were recorded in the Excel (Microsoft Co., WA, USA, 2016) program. For evaluation and analysis of data, IBM Statistical Package for the Social Sciences (SPSS) Statistics 21.0 was utilized. Frequency (n) and percentage (%) were used to express categorical variables; descriptive statistics in the form of mean and standard deviation were used to express continuous variables. Continuous variables were tested for normal distribution using the Kolmogorov–Smirnov test. The t-test was used to compare normally distributed continuous variables between two independent groups. If $p < 0.05$, the value was considered statistically significant. The Pearson correlation test was used to assess relationships between parametric values, while the Spearman correlation test was used for non-parametric values. Correlation coefficients (r) obtained from the data were evaluated using Mukaka's definition [14].

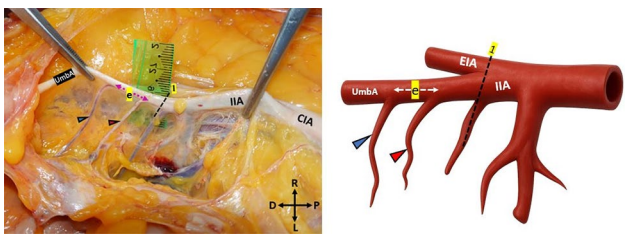

Fig. 4 Reference points and distances used for morphometric evaluation with schematic illustration-3 (female cadaver). 1: Origin of the umbilical artery, e: *UA-First SVA* distance between uterine artery and first superior vesical artery, blue arrow: first superior vesical artery, red arrow: uterine artery, *CIA* common iliac artery, *D* distal, *EIA* external iliac artery, *IIA* internal iliac artery, *L* left, *P* proximal, *R* right, *UmbA* umbilical artery

Table 1 Measurements of common iliac arteries and internal iliac arteries

	Male cadavers (n = 104 sides)		Female cadavers (n = 100 sides)		*p*-value		All cadavers (n = 204 sides)		*p*-value
	Mean + SD (mm)		Mean + SD (mm)		Mean + SD (mm)		Mean + SD (mm)		
	Right n = 52	Left n = 52	Right n = 50	Left n = 50	Right	Left	Right n = 102	Left n = 102	
LCIA	64.77 ± 14.00	65.06 ± 15.74	56.57 ± 15.05	58.73 ± 16.12	0.005	0.048	60.75 ± 15.03	61.96 ± 16.17	0.177
LIIA	34.46 ± 13.27	33.93 ± 15.20	33.91 ± 15.49	30.03 ± 13.77	0.847	0.178	34.19 ± 14.33	32.02 ± 14.58	0.137

LCIA length of the common iliac artery, *LIIA* length of the internal iliac artery, *n* number of samples, *mm* millimeter, *SD* standard deviation

Table 2 The number of SVA determined according to the right and left sides in all cadavers

	1 SVA	2 SVA	3 SVA	4 SVA
Male cadavers n = 104				
Right	8 (15.4%)	24 (46.1%)	19 (36.5%)	1 (2%)
Left	7 (13.4%)	27 (52%)	18 (34.6%)	–
Total	15 (14.4%)	51 (49%)	37 (35.6%)	1 (1%)
Female cadavers n = 100				
Right	25 (50%)	23 (46%)	2 (4%)	–
Left	21 (42%)	24 (48%)	4 (8%)	1 (2%)
Total	46 (46%)	47 (47%)	6 (6%)	1 (1%)

SVA superior vesical artery, *n* number of samples

3 Results

The mean LCIA was 60.75 ± 15.03 mm on the right side and 61.96 ± 16.17 mm on the left side. Similarly, the mean LIIA was calculated as 34.19 ± 14.33 mm on the right side and 32.02 ± 14.58 mm on the left side. A statistically significant difference was obtained between sexes regarding LCIA on both right and left sides ($p = 0.005$ for the right side and $p = 0.048$ for the left side). The detailed results of the morphometric measurements regarding LCIA and LIIA are demonstrated in terms of sex in Table 1.

The distribution of the number of SVA in terms of sex is shown in Table 2. SVAs were observed in numbers ranging from 1 to 4. The most frequently observed number for both males and females was 2, while 4 was the least frequent.

The distribution and the comparison of the UmbA-First SVA, UmbA-Last SVA, and the distance between the superior vesical arteries in terms of sex are given in Table 3. Similarly, the distribution and the comparison of these parameters in terms of sides are given in Table 4. A statistically significant difference was obtained for the UmbA-First SVA value according to sex ($p = 0.001$ for the right and left sides). Moreover, there was a statistically significant difference for the UmbA-Last SVA value according to sides ($p = 0.043$).

Table 3 Findings on the morphometric features of SVA with comparison between sexes

	Male cadaver Mean ± SD (mm)		Female cadaver Mean ± SD (mm)		*p*-value	
	Right	Left	Right	Left	Right	Left
UmbA-First SVA[a]	5.85 ± 5.72	5.51 ± 5.13	23.67 ± 13.90	22.57 ± 13.15	0.001	0.001
First SVA-Second SVA[a]	21.61 ± 17.42 (44)	21.69 ± 14.56 (45)	17.50 ± 10.49 (23)	19.81 ± 9.70 (28)	0.305	0.510
Second SVA-Third SVA[a]	17.94 ± 12.12 (20)	24.52 ± 18.82 (18)	17.78 ± 14.00 (2)	24.20 ± 17.92 (5)	0.493	0.487
Third SVA-Fourth SVA[a]	13.59 (1)	–	–	4.85 (1)	–	–
UmbA-Last SVA[a]	31.01 ± 19.09 (51)	35.62 ± 18.92 (48)	32.14 ± 15.55	36.18 ± 17.78	0.744	0.880

SD standard deviation, *mm* millimeter, *UmbA-First SVA* distance between the umbilical and the first superior vesical arteries, *First SVA-Second SVA* distance between the first and the second superior vesical arteries, *Second SVA-Third SVA* distance between the second and third superior vesical arteries, *Third SVA-Fourth SVA* distance between the third and fourth superior vesical arteries, *UmbA-Last SVA* distance between the umbilical and the last superior vesical arteries

[a]Numbers in parentheses indicate the total number of sides in that group

Table 4 Findings on the morphometric features of SVA with comparison between sides

	Right side Mean ± SD (mm)	Left side Mean ± SD (mm)	*p*-value
All cadavers (102 Right, 102 Left)			
UmbA-First SVA	14.59 ± 13.80 (102)	13.87 ± 13.06 (102)	0.624
UmbA-Last SVA	31.12 ± 17.47 (98)	35.90 ± 18.26 (98)	0.043
Male cadavers (52 Right, 52 Left)			
UmbA-First SVA	5.85 ± 5.72 (52)	5.51 ± 5.13 (52)	0.730
UmbA-Last SVA	30.06 ± 19.37 (48)	35.62 ± 18.92 (48)	0.080
Female cadavers (50 Right, 50 Left)			
UmbA-First SVA	23.67 ± 13.90 (50)	22.57 ± 13.15 (50)	0.696
UA-First SVA[a]	18.05 ± 9.26 (4)	23.39 ± 13.47 (3)	0.185
UmbA-Last SVA	32.14 ± 15.55 (50)	36.18 ± 17.78 (50)	0.252

SD standard deviation, *mm* millimeter, *UmbA-First SVA* distance between the umbilical and the first superior vesical arteries, *UmbA-Last SVA* distance between the umbilical and the last superior vesical arteries, *UA-First SVA* distance between the uterine and the first superior vesical arteries

[a]Numbers in parentheses indicate the total number of sides in that group

4 Discussion

This study aimed to analyze the prevalence and origin of SVAs, assess their morphometric relationships with neighboring arteries, and also perform morphometric measurements of CIA and IIA.

4.1 LCIA (Length of the Common Iliac Artery) and LIIA (Length of the Internal Iliac Artery)

The previous studies in the last ten years regarding LCIA and LIIA are listed in Tables 5 and 6 [15–21]. Most investigations of the LCIA have been conducted using preserved cadavers. Kim et al. uniquely employed computed tomography (CT) and reported mean LCIA values differentiated by sex and side [17]. Panagouli et al. conducted on 39 male and 37 female embalmed specimens. They reported that the mean LCIA was 60.3 ± 16.07 mm on the right side and 61.2 ± 17.91 mm on the left side [16]. In the present study, the mean LCIA was 60.75 ± 15.03 mm on the right side and 61.96 ± 16.17 mm on the left side. Moreover, a statistically significant difference was observed between sexes regarding LCIA on both right and left sides ($p = 0.005$ for the right side and $p = 0.048$ for the left side). The results of the study and the study of Panagouli et al. are almost the same.

Similar to previous studies with LCIA, most studies on LIIA have been performed on preserved cadavers. Ongidi et al. studied a total of 57 cadavers. They calculated the right LCIIA as an average of 38.52 mm and the left LCIIA as an average of 35.80 mm [19]. In the current study, the mean LIIA was 34.19 ± 14.33 mm on the right side and 32.02 ± 14.58 mm on the left side. The mean right and left values in the study are very close to the mean values reported by Ongidi et al. [19].

Knowing the average lengths of the CIA and IIA may be important to easily identify these arteries and their branching points in surgical procedures such as endoscopic extraperitoneal inguinal hernioplasty and artery ligation during acute bleeding. In addition, the significant difference between the right and left LCIA may be thought to be due to the left-sided location of the aorta. In this context, knowledge of this difference may be important for the success of the surgical procedure in invasive procedures involving both right and left LCIA.

4.2 UmbA-First SVA, UmbA-Last SVA, and the Distance Between Superior Vesical Arteries

In the current paper, SVAs were in numbers ranging from 1 to 4. The most frequently observed number for both sexes was 2, while 4 was the least frequent. Although 2 SVA morphology (49%) was the most common in males, 3 SVA morphology was seen at a significant rate of 35.6%, and single SVA morphology was seen in 14.4%. Similarly, in females, although 2 SVA morphology (47%) was the most common, single SVA morphology was calculated in 46%, and 3 SVA morphology in 6%.

The mean UmbA-First SVA and UmbA-Last SVA were 14.59 ± 13.80 mm (range 0–61.00 mm) and 31.12 ± 17.47 (range 0–91.46) mm for the right side, respectively. Additionally, the mean UmbA-First SVA and UmbA-Last SVA were 13.87 ± 13.06 mm (range 0–53.91) and 35.90 ± 18.26 mm (range 0–81.21) for the left side, respectively. A statistically significant difference was obtained for the UmbA-First SVA value according to sex ($p = 0.001$ for the right and left sides). Also, there was a statistically significant difference for the UmbA-Last SVA value according to sides ($p = 0.043$).

For the distance between superior vesical arteries, the distance between each of the SVAs between the first and fourth SVAs was measured, and there was no statistically significant difference between these SVAs according to sex (Table 3).

Even unilateral ligation of the arteries supplying the bladder may cause ischemia of a portion of the bladder [4]. Therefore, it is important to be aware of the arterial supplies of the urinary bladder and to protect these arteries. Cho et al. applied the superselective embolization method as a rapid and reliable treatment option for bladder bleeding and embolized SVA bilaterally. Thus, they reported that this

Table 5 Comparison of current data with previous studies of common iliac artery lengths

Author	Country	Study design	Age Mean ± SD	Reference points for measurement	Overall LCIA Mean ± SD (mm)	Right LCIA Mean ± SD (mm)	Left LCIA Mean ± SD (mm)
Boonruangsri et al. [15]	Thailand	Thai Mongoloids embalmed cadavers, 41 pelvises (23 male, 18 female)	67.19 ± 15.11	The midpoint of the line which drawn vertically from the common iliac bifurcation to the medial border of the internal iliac artery	51.9 ± 17.5	M: 43.4 ± 11.6 F: 48.1 ± 18	M: 45.3 ± 15.8 F: 55.6 ± 16.8
Panagouli et al. [16]	Greece	Caucasian (Greek origin) embalmed cadavers, 39 male and 37 female	–	The length of both the right and left CIAs was measured from the level of the bifurcation of the abdominal aorta to the level at which each CIA was divided into external and internal iliac arteries	–	60.3 ± 16.07 (range 33–114)	61.2 ± 17.91 (range 23–139)
Kim et al. [17]	Korea	Computed tomography, 3692 Asian patients	57.3 ± 8.7	CIA length was measured between the aortic bifurcation and the iliac bifurcation. Iliac artery length was measured between the aortic bifurcation and the femoral bifurcation	–	–	–
Katara et al. [18]	India	30 embalmed cadavers, 21 male and 9 female	–	–	–	T: 54.7 ± 13.2 M: 60.7 ± 9.7 F: 40.7 ± 9	T: 51.9 ± 12.6 M: 55.3 ± 11.8 F: 44 ± 11.3
Present study	Türkiye	102 fresh cadavers, 52 male and 50 female	M: 45.83 ± 18.37 F: 53.04 ± 23.08	The distance between the level of aortic bifurcation and the level where each common iliac artery divides into the external and internal iliac arteries	–	T: 60.75 ± 15.03 M: 64.77 ± 14.00 F: 56.57 ± 15.05	T: 61.96 ± 16.17 M: 65.06 ± 15.74 F: 58.73 ± 16.12

F female, *M* male, *T* total, *SD* standard deviation, *mm* millimeter, *LCIA* length of the common iliac artery

Table 6 Comparison of current data with previous studies of internal iliac artery lengths

Author	Country	Study design	Age Mean ± SD	Reference points for measurement	Overall LIIA Mean ± SD (mm)	Right LIIA Mean ± SD (mm)	Left LIIA Mean ± SD (mm)
Boonruangsri et al. [15]	Thailand	Thai Mongoloids embalmed cadavers, 41 pelvises (23 male, 18 female)	67.19 ± 15.11	From the beginning point of the internal iliac artery to the bifurcation point of this artery for the anterior and posterior trunks	54.1 ± 12	M: 53.4 ± 10.6 F: 49.2 ± 14.7	M: 54.7 ± 13.5 F: 47 ± 12.6
Ongidi et al. [19]	Kenya	57 embalmed cadavers, 48 male and 9 female	Between 18 and 65	The length of the artery was then made from the point of origin at the bifurcation of the common iliac artery to its terminal branching point	36.97 ± 14.12	38.52	35.80
Pradhan et al. [20]	Nepal	Embalmed cadavers, 15 male	–	–	26.1 ± 6.6 (range 13.3–34.2)	–	–
Nguyen et al. [21]	Vietnam	Embalmed cadavers, 18 female	–	The internal iliac artery's length from its origin to the initial branch division	–	–	–
Katara et al. [18]	India	30 embalmed cadavers, 21 male and 9 female			–	T: 38.6 ± 9.5 M: 36.5 ± 9.6 F: 43.3 ± 7.8	T: 42.8 ± 15.6 M:41.4 ± 10 F: 46 ± 24.9
Present study	Türkiye	102 fresh cadavers, 52 male and 50 female	M: 45.83 ± 18.37 F: 53.04 ± 23.08	The distance between the origin of the internal iliac artery and the level where it gives off the posterior trunk		T: 34.19 ± 14.33 M: 34.46 ± 13.27 F: 33.91 ± 15.49	T: 32.02 ± 14.58 M: 33.93 ± 15.20 F: 30.03 ± 13.77

F female, *M* male, *T* total, *SD* standard deviation, *mm* millimeter, *LIIA* length of the internal iliac artery

application had good results in controlling bladder bleeding [5]. Therefore, knowing the number of SVA may also guide in controlling bladder bleeding with superselective embolization. Moreover, in laparoscopic surgery of urological cancers, it is important to master the branching morphology of the pelvic arteries to make the application more safer [9, 10]. The lymph nodes to be removed are near major neurovascular structures [9]. This may cause serious bleeding during the surgical procedure, endangering the patient's life [9, 10]. Knowing the number of SVA may be important in minimizing these and similar complications.

No measurements similar to the morphometric values measured in the study could be found in the literature. In this study, the statistically significant difference observed between sexes in the UmbA-First SVA indicates that this measurement is greater in females compared to males. This asymmetry may be indicative of sex-related developmental variations arising during the embryogenesis of the pelvic vasculature. From a clinical perspective, this sex-based variation in the spatial relationship between the First SVA and the UmbA may necessitate increased awareness during interventions involving the UmbA-First SVA, particularly in females. Likewise, the statistically significant difference observed in the UmbA-Last SVA between sides indicates that this distance is greater on the left side. This variation may stem from asymmetrical embryological development of the artery between the left and right sides. This finding may highlight the clinical importance of recognizing the longer distance between the artery and UmbA on the left side when performing procedures involving the UmbA-Last SVA.

In pelvic surgeries such as hysterectomy, cystectomy, and pelvic lymph node dissection, inadvertent injury to the superior vesical arteries (SVAs) or the umbilical artery (UmbA) can result in severe hemorrhage. Accurate knowledge of the distance between these vessels may assist surgeons in planning dissections more precisely and minimizing vascular complications. This anatomical relationship is also critical in interventional procedures, such as pelvic tumor embolization or arterial embolization for bladder bleeding, where precise identification of the target vessel is essential. A better understanding of the spatial distance between the SVAs and the UmbA may improve the accuracy and success rate of catheter-based interventions.

4.3 UA-First SVA (Distance Between the Uterine Artery and the First Superior Vesical Artery)

In 7 sides (4 right and 3 left sides) of the female cadavers, the UA emerged from the UmbA. However, SVAs that arose from the UA were on 3 sides (3%) (2 right and 1 left side). The mean UA-First SVA was 18.05 ± 9.26 mm on the right side and 23.39 ± 13.47 mm on the left side (Table 4). In their CT study, Arfi et al. reported that the UA originated from a common trunk with the UmbA in 62.7% of 43 women [22]. Ostrowski et al. reviewed the UA-SVA relationship in the literature, and the UA-SVA relationship was well shown in the study. They reported that the pooled prevalence of the UA originated from the UmbA was 13.93% in a total of 16 articles [23]. In a recent cadaveric case report study by Hankyu Kim, a double UA was observed on the left side; the first UA originated from the anterior trunk, and the second one emerged from a common branch with the SVA and the inferior vesical artery [24]. In previous studies, a parameter similar to UA-First SVA could not be achieved. The prevalence of the SVAs originated from the UA in the current study is lowest among the studies in the literature, and is not consistent with the previous ones. This may be caused by different sample sizes.

It is stated that postpartum hemorrhage is responsible for as much as 25% of maternal deaths worldwide [25]. The UA embolization is one of the important treatment options for controlling postpartum hemorrhage [25, 26]. In this context, these values may be important both in terms of identifying the origin of the UA and in preventing injury to SVAs close to the UA in applications targeting the UA. Thus, complications that may cause bleeding of the artery that supplies the urinary bladder may be prevented.

This study has some limitations. In this study, the complete branching pattern of the IIA could not be revealed. This constituted a limitation for the study to be more comprehensive. In future studies, the revelation of the branching pattern of the IIA and the interpretation of the relationships between the other branches and the branches originating from the UmbA may make an important contribution to the literature. The present study is confined to the evaluation of UAs that branch from UmbA; no evaluation of other UAs has been conducted. The expansion of the study data set will allow for further investigation of the relationship with these branches in subsequent studies.

5 Conclusion

This study provides a comprehensive anatomical evaluation of the SVA, addressing both morphological and morphometric characteristics. It also includes morphometric analysis of CIA and IIA. The paper introduces novel insights by incorporating previously unexamined parameters such as UmbA-First SVA, UmbA-Last SVA, and the distance between SVA and UA-First SVA. Through a combination of quantitative and relational analyses, the study enhances the current understanding of pelvic vascular anatomy. These contributions are expected to advance existing anatomical knowledge and support safer practices in pelvic surgeries, oncological interventions, and interventional radiologic procedures involving the pelvic region.

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Data Availability All data which used for this study reported within the study.

Declarations

Conflict of interest The authors declare no competing interests.

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