Insight into Vietnamese women's internal iliac artery anatomy

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SUMMARY

This study aims to assess the characteristics of the internal iliac artery and to examine correlations between the internal iliac artery and other anatomic structures in the pelvis. A cross-sectional study was conducted in the period between October 2019 and May 2020. Eighteen samples of the left and right internal iliac arteries were taken from formaldehyde-embalmed female cadavers at the Ho Chi Minh City University of Medicine and Pharmacy Department of Anatomy. The study showed that the origins of most internal iliac arteries were located by the lumbar vertebrae 4-5. The mean distance from the origin of the internal iliac artery origin to the sacral promontory was 33.95 ± 3.35 mm (on the left), and 31.70 ± 4.64 mm (on the right). The internal iliac artery always had two big branches – anterior and posterior. A third branch was an ilio-lumbar artery, often seen by 43.33%. The diameters of those internal iliac artery branches were comparable on both sides, and the branches of similar name had a little larger diameter on the left than on the right.

The internal iliac artery always has two large anterior and posterior branches; in some cases, it has a third branch called ilio-lumbar artery. The internal iliac artery's length from its origin to the initial branch division is comparable for both right and left sides. The distance from the internal iliac artery's origin to the sacral promontory is suggestive for surgeons to find the internal iliac artery after determining the sacral promontory.

Key words: Post-partum haemorrhage – Internal iliac artery – Anatomy

ABBREVIATIONS:

Postpartum hemorrhage (PPH)

World Health Organization (WHO)

The American College of Obstetricians and Gynecologists (ACOG)

Obstetrics and Gynecology (OB/GYN)

Digital Subtraction Angiography (DSA)

INTRODUCTION

Obstetrics and Gynecology is a medical domain that raises a considerable interest from experts over the world. Post-partum hemorrhage (PPH) currently remains one of the leading obstetric complications that cause maternal deaths in the world and in Vietnam (Say et al., 2014). There are about 14 million women over the world annually

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incurring PPH (Miller et al., 2004). The risk of maternal mortality due to hemorrhage is one per thousand live births in developing countries (100 over 100,000 live births). Almost all maternal deaths (about 99%) are due to PPH occur in low- and middle-income countries as compared to 1% in industrialized countries (Knight et al., 2009). As per ACOG statistics, it is estimated that there are about 140,000 maternal deaths due to PPH every year (Casanova, 2018). Currently, the leading cause of maternal mortality is still PPH (Lalonde et al., 2006). As per the World Health Organization (WHO) statistics of 2012, maternal mortality rate due to PPH accounted for 25% in Africa, 43% in Indonesia, and 53% in the Philippines (WHO, 2012). On average, there is a PPH maternal death every four minutes in the world. As per statistics in the United States, PPH rate increased by 26% during the period between 1994 and 2006.

In Vietnam, at TuDu hospital alone, there are 60,000 – 68,000 births per annum, and PPH rate was reported 5.18% (TuDu Hospital, 2018) in 2018. Medical and surgical treatment have been applied for PPH. Surgical intervention such as pressing balloon, hypogastric artery ligation, B-Lynch suture stitch, and uterine artery embolism are contributing to maternal mortality rate reduction (Dilly, 2006).

The internal iliac artery provides blood to nearly all internal and external female genitals. Therefore, the emergency management of bleeding complications such as PPH, placenta accrete, or uterine rupture has a close relation to the internal iliac artery and its branching. Internal iliac artery blockage is one of various treatment approaches to this obstetric accident. There is a considerable amount of literature describing the anatomy of the internal in general and the uterine artery in particular over the world, but there are many inconsistent points overall, and domestic documents are very limited. Clinical practitioners often refer to international documents. The issue is "What characteristics do the internal iliac artery and relevant anatomic changes have in Vietnamese females?"

To answer that question, a study on the anatomy of the internal iliac artery in Vietnamese women was conducted to have a panorama of the characteristics of the Vietnamese women's internal iliac artery for clinical reference. The study also wishes to visibilize references to the internal iliac artery, preluding many other studies on anatomy in the future. The main objective of this study is to define the internal iliac artery in relation to other anatomic structures in formaldehyde-embalmed female cadavers at Ho Chi Minh City University of Medicine and Pharmacy, Department of Anatomy.

MATERIALS AND METHODS

A cross-sectional study was conducted from October 2019 to May 2020. The target population was Vietnamese females aged over 18 years. Study subjects were formaldehyde-embalmed female cadavers who met inclusion criteria such as bilateral internal iliac arteries in dissected bodies to conveniently serve academic training at the University of Medicine and Pharmacy of Ho Chi Minh City.

All cases showing evidence of anatomical damages in the pelvic artery system during dissection process, or signs of pelvic distortions, or evidence of pelvic surgery, or tumor presence might cause changes in pelvic artery network structure. Those were exclusion criteria, as they could change the original vascular structure of interest.

Sample size

Estimated sample size for a mean

$$n = \frac{C}{(\Delta/\sigma)^2}$$

with 95% confidence interval, power 0.8, then C = 7.85

Estimated error in the study was selected 7 mm. Sample size for left internal iliac artery was 15 cadavers. The sample size for right the internal iliac artery was of 18 cadavers.

Sampling method

Random selection of cadavers was conducted at convenience over 23 cadavers dissected for research and training. All selected cadavers met

inclusion criteria.; Once the sample size was completed, the recruitment was stopped. The number of female cadavers available at dissection time was 23 of which 18 were selected (78%).

Data collection

Examination was conducted with dissecting instruments, and measuring was conducted with an electronic ruler of Mitutoyo, model 500-776. The ruler audit on its accuracy was certified and stamped by an independent auditor. The ruler accuracy unit was 0.01 mm. Abdominal viscera were displayed via lower laparotomy.

Fig. 1 describes how to explore the pelvis and the iliac artery system by dissecting and moving internal organs aside. Fig. 2 shows how to measure the artery diameter at its origin. Fig. 3 shows how to measure the distance between the internal iliac artery's origin and the sacral promontory. Fig. 4 shows how to measure the internal iliac artery's length. A thread was placed along and adjusted in form of the artery pathway from the origin to its end, and then two markers were defined on the thread; the distance between two markers was measured, in accordance with Le's method (Le et al., 2020). Fig. 5 shows how to dissect to find the anterior and posterior trunks of the internal iliac artery, and then to separate the branches of the anterior and posterior trunks. it also shows how to dissect external female genitals to the transverse perineal layer; and then determinesthe branches of uterine artery for external genitals. Dissections around to explore uterine artery features was made following Le's method (Le et al., 2020).

Data entry were conducted with Excel program, and coded and processed with IBM SPSS Statistics 20.

Ethics License

The study was approved by the Ethics Council for Bioresearch of the HoChiMinh City University of Medicine and Pharmacy, approval no. 562/ĐHYD-HĐĐĐ, dated 28/10/2019.

Fig. 1.- Dissecting and moving internal organs aside to explore internal iliac artery.

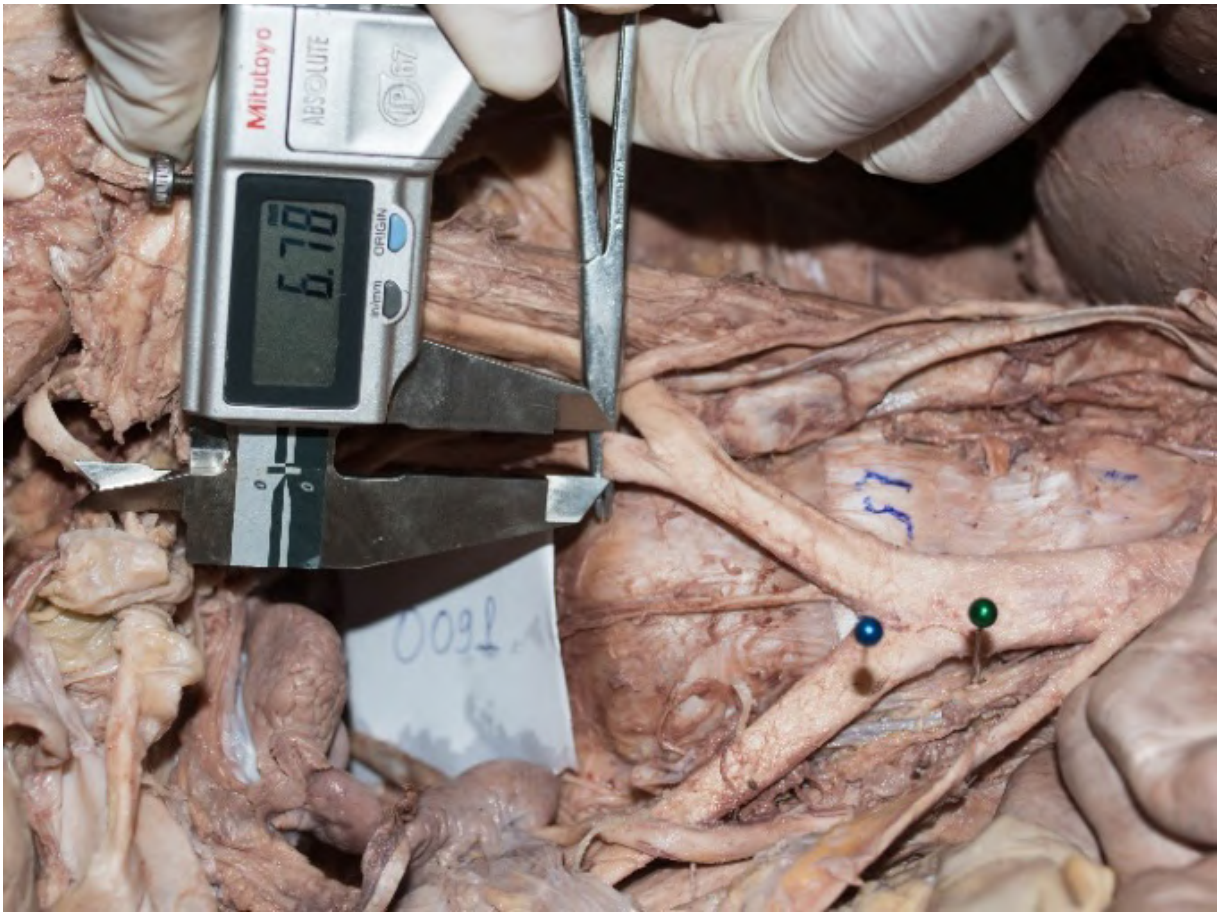

Fig. 2.- Measuring the internal iliac artery diameter at its origin.

Fig. 3.- Measuring the distance between Internal iliac artery origin and sacral promontory.

Fig. 4.- Measuring the Internal iliac artery length.

Fig. 5.- Dissecting to find the anterior and posterior trunks of internal iliac artery.

RESULTS

The mean age of cadavers was relatively high 70.50 ± 17.86 years. The youngest age was 33 years and the oldest 99 years. Cadaver preservation period ranged between 1 and 7 years. Causes of death and maternal parity were not available.

The origin of the internal iliac artery was mostly found at lumbar vertebral levels 4-5. The mean distance from the internal iliac artery origin to sacral promontory was 33.95 ± 3.35 mm (on the left) and 31.70 ± 4.64 mm (on the right) (Table 1).

Table 1. Origins of internal iliac artery.

Internal iliac artery origin by vertebral level	N of cases	
	Left	Right
L3	1 (5.56%)	0 (0%)
Inter-vertebral disc L3 – L4	2 (11.11%)	1 (5.56%)
L4	5 (27.78%)	3 (16.67%)
Inter-vertebral disc L4 – L5	2 (11.11%)	1 (5.56%)
L5	8 (44.44%)	13 (72.22%)

The internal iliac artery always had two large branches – anterior and posterior. A third branch was an ilio-lumbar artery, also frequently found by 43.33% (Table2).

Table 2. Number of Internal iliac artery branches.

N of branches	N of cases	Percent
2	17	56.67%
3	13	43.33%

The diameter of the anterior internal iliac artery branch ranged within 4.74-11.85 mm on the left, and 4.08-11.08 mm on the right. The diameter of the posterior branch ranged within 3.6-10.16 mm on the left, and 2.3-12.16 mm on the right. Ilio-lumbar branch had the diameter range of 1-2 mm (Table 3).

Table 3. Mean diameter of Internal iliac artery branches.

	Mean diameter (mm)		Largest diameter (mm)		Smallest diameter (mm)	
	Left	Right	Left	Right	Left	Right
Anterior branch	7.29 + 1.91	7.03 + 1.78	11.85	11.08	4.74	4.08
Posterior branch	6.03 + 1.86	5.93 + 2.21	10.16	12.16	3.60	2.30
Ilio-lumbar branch	1.49 + 0.29	1.31 + 0.23	2.08	1.68	1.08	1.02

The internal iliac artery's length ranged 30-50 mm (Table 4).

Table 4. Mean length of internal iliac arteries.

	Mean length (mm)		Largest length		Smallest length	
Artery	Left	Right	Left	Right	Left	Right
Internal iliac	42.62 + 2.98	42.28 + 4.31	47.85	50.10	38.06	31.52

Most of uterine arteries had an origin compatible with vertebral levels S2 to S3. The mean diameter of the uterine artery was measured at its origin 3.03 ± 0.85 mm (on the left), and 2.95 ± 0.79 mm (on the right) (Table 5).

Table 5. Origin of uterine artery.

Uterine artery origin by vertebral level	N of samples	Percent
S1	1	3.33%
S2	16	53.33%
Intervertebral S2 – S3	2	6.67%
S3	8	26.67%
S4	3	10%

The largest distance to the sacral promontory was measured 68 mm, and the smallest 33 mm. The largest distance to the vaginal artery was 115 mm, and the smallest 31 mm.

Table 6. Correlation of uterine artery origin.

	Mean distance (mm)		Largest distance		Smallest distance	
	Left	Right	Left	Right	Left	Right
Distance from uterine artery origin to sacral promontory	51.86 + 9.74	45.67 + 9.99	68.54	68.02	35.40	32.76
Distance from uterine artery origin to vaginal artery origin	60.63 + 1.71	64.28 + 25.16	96.32	115.60	32.43	31.30

The distance between the uterine artery and the ureter by the cervical edge was within 3.5-18 mm. The distance of the uterine-artery-ureter crossing point to cervical edge was 11-33 mm (Table 7).

Table 7. Correlation between uterine artery and ureter.

	Mean distance (mm)		Largest distance		Smallest distance	
	Left	**Right**	**Left**	**Right**	**Left**	**Right**
Distance from uterine artery to ureter by cervical edge	7.71 + 3.51	9.38 + 4.16	18.12	16.90	3.56	4.40
Distance from crossing point of uterine artery and ureter to cervical edge	19.28 + 4.01	19.87 + 5.12	26.10	33.16	11.12	13.70

The other branches (i.e., iliolumbar artery, lateral sacral artery, superior gluteal artery, inferior gluteal artery, middle rectal artery, obturator artery, inferior vesical artery, superior vesical artery, obliterated umbilical artery, internal pudendal artery) were also examined. However, those branches' characteristics will be assessed in another article with further study objectives.

DISCUSSION

The origin of the internal iliac artery in this study is comparable with those from the study ny Mamatha et al. (2015), in which 72% of internal iliac artery's origins came by vertebral level S1, 24% by L5-S1, and 4% by L5. The rates by Naveen et al. (2011) were 58.3% (S1), 40% (L5-S1), and 1.7% (L5), respectively.

As per Jean-Pierre Pelage et al., the internal iliac artery ended in two large trunks – anterior and posterior – in 77% of cases, 14% had three trunks, 3% had more than 3 trunks, and 4% had a unique trunk. In this study, all internal iliac arteries had two large branches, anterior and posterior. In some instances, an ilio-lumbar branch deviated ahead of the origins of the other two branches and became the third branch. The cases with a unique branch or more than 3 branches are rare in literature, and in our study, such rare cases were not detected (Pelage et al., 1999).

The internal iliac artery's diameter in this study was measured at 5 mm away from the artery's origin to obtain the most real size and to avoid false increase. The value was 9.69 ± 1.4 mm. According to Fatu et al. (2006), the internal iliac artery's mean diameter in females was 9.83 ± 1.57 mm, within the range of 4-11 mm. That study's results look quite comparable with theirs.

The uterine artery originates from the anterior branch of the internal iliac artery. Some authors considered the uterine artery an anatomic detail to identify the anterior branch of the internal iliac artery (Lipschitz, 2018). The uterine artery had its origin by sacral vertebral levels S2-S3 in about 87% of cases in the study.

At its origin, the uterine artery often sprang ahead of the sacral promontory with a mean distance of 48.77 ± 10.22 mm on both sides, in which the left distance was 51.86 ± 9.74, and the right 45.67 ± 9.99 mm. Almost all previous studies compared the uterine artery's location with the mid-sagittal plane. The selection of the sacral promontory as an anatomical correlation landmark of artery location is the new point of this study.

The ureter is the important mark in Ob/Gyn operations in the pelvis. The mean distance between the uterine artery's origin and the ureter was 8.34 ± 2.90 mm, in which the distances were 8.62 ± 3.33 mm (on the left), and 8.07 ± 2.47 mm (on the right). The ureter often crosses in front of or behind the uterine artery by the upper endocervical level. Eighty percent of cases had a uterine artery crossing the ureter by the upper edge of the cervix. The crossing point was 19.28 ± 4.01 mm away from cervix. This result is quite comparable with the value of 2 cm by other authors (Le et al., 2020).

The quick identification of artery origins has a great meaning in emergency management for PPH (Greenwood, 1987) and other uterine surgeries. The anatomical positions and correlations with surrounding structures provide surgeons with further information for quick and precise manipulation.

Limitations of the study: the anatomical assessment of embalmed cadavers is not as precise as those on fresh ones or by real clinical practice. The study should be conducted on fresh cadavers with better quality. It will be better to assess and measure the internal iliac artery conducted on DSA film, and then to compare results obtained

between formaldehyde-embalmed and fresh cadavers.

CONCLUSION

The internal iliac artery is an important artery providing blood to the pelvis and female genitals. The internal iliac artery always has two large branches, anterior and posterior, and in some cases, it has a third branch – an iliolumbar artery.

The length of the internal iliac artery from its origin to the first division site is equivalent for both sides. The distance from the internal iliac artery's origin to the sacral promontory suggests how to find the internal iliac artery after identifying sacral promontory.

The branches of the internal iliac artery are comparable between the left and right ones, in which uterine artery is an important one. The anatomical correlation of the ureter crossing the unternal iliac artery and the uterine artery, as well as the distance and crossing position are essential to locate the ureter in Ob/Gyn operations.

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Tham Nguyen, M.D. was Junior Lecturer in the Department of Anatomy at the University of Medicine and Pharmacy at Ho Chi Minh City, Vietnam. She did a fellowship in OB/GYN with Prof. Tuan Vo at University of Medicine and Pharmacy at HCMC, Vietnam (2020). "Insight into Vietnamese women's internal iliac artery anatomy" was her thesis in the OB/GYN fellowship program.

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