

Usefulness of knowledge in anatomy of the internal iliac artery in its ligation during life-threatening pelvic haemorrhages

Vasitha Abeysuriya^a, S H Dodampahala^b, Lal Chandrasena^c

Abstract

Introduction: Post-Partum haemorrhage is a significant cause of maternal mortality. Bilateral internal iliac artery ligation is a life-saving procedure to control massive obstetric and gynaecological haemorrhages. Bilateral internal iliac artery ligation results in toning down the pulsatility making the arterial flow a slow venous flow encouraging the clot formation of the damaged pelvic vessels. This study assesses the retroperitoneal anatomy and regional variations of the internal iliac artery.

Methods: The study was based on examining 45 pelvic halves (23 right sides and 22 left sides), which were dissected during the gross anatomy laboratory at the faculty of medicine, Ragama, University of Kelaniya, from 2020 -2023. There were all adult pelvises. The internal iliac artery and its major branches were carefully dissected and examined. Adachi classification was used to classify the distribution pattern of the internal iliac artery. The study was done on the donated cadavers, and the nature of the study did not warrant any special ethical clearance. No conflict of interest.

Results: No anatomical deviation has been noted with regard to the levels of division of aorta, common iliac artery, the division into internal and external iliac arteries and the division of anterior and posterior branches of the internal iliac artery from that of classical anatomical literature. It was also noted that there had been no significant deviation of anatomical relations with regard to the structures as described in the internal iliac artery in our study. In our study, Type Ia was found in 35/45 (78%) of the specimens, Type IIa in 3/45 (6%), Type III in 7 (16%), and no specimens were found with Type IV and Type V.

Conclusion: Our study showed no significant anomalies of the pelvic anatomical structural relations to the internal iliac artery. The type Ia branching pattern was found to be the commonest.

Key words: anatomy, internal iliac artery, pelvis haemorrhage, emergency procedures in haemorrhage, pelvis

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^a Faculty of Medicine Ragama, University of Kelaniya, Sri Lanka.

^b Professor in Obstetrics and Gynaecology, Faculty of Medicine, University of Colombo, Sri Lanka.

^c Nawaloka Hospital Research and Education Foundation, Nawaloka Hospitals PLC, Colombo, Sri Lanka.

Correspondence: VA, e-mail: vasithaabey@hotmail.com

 <https://orcid.org/0000-0002-0986-7917>

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Introduction

Pelvic haemorrhage is a significant cause of maternal mortality. Bilateral internal iliac artery ligation is a life-saving procedure to control massive obstetric and gynaecological haemorrhages. This procedure significantly reduces the pulse pressure and blood flow rate, abolishing the 'trip hammer effect' of arterial pulsation and resulting in reduced blood flow, allowing effective thrombosis within the small bleeding vessels¹⁻⁴. No tissue necrosis occurs due to adequate collateral circulation in the pelvis from the significant pelvic anastomoses. An increased understanding of retroperitoneal anatomy and regional variations of the internal iliac artery is needed to reduce the risk of intraoperative and postoperative complications⁴⁻⁶. To our knowledge, there has been no study in this regard. Therefore this study aims to assess the retroperitoneal anatomy and regional variations of the internal iliac artery.

Methods

The study was based on examining 45 pelvic halves (23 right sides and 22 left sides), which were dissected during the gross anatomy laboratory at the faculty of medicine, Ragama, the University of Kelaniya, from 2020-2023. There were all adult pelvises. The internal iliac artery and its major branches were carefully dissected and examined. Adachi classification was used to classify the internal iliac artery distribution pattern into five types with eight groups. There was no contact or direct involvement with the patients. The study was done on the donated cadavers, and the nature of the study did not warrant any special ethical clearance. No conflict of interest.

Anatomical consideration⁷⁻⁹

The abdominal aorta bifurcates into the left and right common iliac arteries at the fourth and fifth lumbar vertebra levels. Each further bifurcates into two main branches - the external and internal iliac arteries, which descend into the true pelvis. The internal iliac artery on either side arises at the level of the lumbosacral intervertebral disc and in front of the sacroiliac joints. Internal iliac artery courses infero-medially over the pelvic brim and down to the pelvic cavity. At the upper margin of the greater sciatic foramen, about 3.5-5.0 cm from its origin, it divides into an anterior division that continues in line with the parent vessel towards the ischial spine. The anterior division runs anteriorly along the lateral pelvic wall and supplies most of the pelvic viscera. The posterior division passes backwards

towards the foramen and runs posteriorly to the pelvic wall and gluteal region⁷⁻⁹.

Branches of the internal iliac artery⁷⁻⁹

Anterior division

- **Visceral branches:** Uterine artery, middle rectal artery, inferior gluteal artery, vaginal artery, superior and inferior vesical artery.
- **Parietal branches:** Internal pudendal artery, obturator artery, inferior vesical artery.

Posterior division

- **Visceral branches:** None.
- **Parietal branches:** Iliolumbar artery, lateral sacral artery, superior gluteal artery.

The important anatomical relations of the internal iliac artery are⁷⁻⁹

- **Anterior** – ureter.
- **Posteromedial** – internal iliac vein.
- **Posterolateral** – external iliac vein, obturator vein, obturator nerve.
- **Anteromedial** – covered by peritoneum with the terminal end of the ileum and cecum on the right side.
- **Lateral** – Psoas major muscle, internal obturator muscle.

Adachi's classification⁸

In 1928, Adachi classified the internal iliac artery distribution pattern into five types with eight groups. In this classification, Adachi proposed that the umbilical artery was a continuation of the main stem of the internal iliac artery, and the superior gluteal, the inferior gluteal and the internal pudendal arteries were principal branches of the umbilical artery from an embryological point of view.

The Adachi classification

Type I: The superior gluteal artery is the first to arise independently from the main stem. The inferior gluteal and internal pudendal arteries arise from a common trunk, the second branch. When the trunk divides within the pelvis, it is type Ia. If the division occurs outside the pelvis, it is type Ib.

Type II: The superior and inferior gluteal arteries arise from a common trunk, and the internal pudendal artery independently arises from a significant stem, the second branch. If the bifurcation of the superior gluteal and inferior gluteal arteries occurs within the pelvis, it is type Ia. If the division occurs outside the pelvis, it is type Ib.

Type III: All three major branches arise separately from the internal iliac artery; the internal pudendal artery is the last branch.

Type IV: The superior gluteal, inferior gluteal, and internal pudendal arteries arise from a common trunk. If the superior gluteal artery arises first from the common trunk and the trunk later divides into the inferior gluteal and internal pudendal arteries, it is type IV. If the internal pudendal artery branches off first from the common trunk, which later divides into the superior gluteal and inferior gluteal arteries, it is type IVb.

Type V: A common trunk gives rise to the superior gluteal and internal pudendal arteries, and then the inferior gluteal artery arises independently from the common trunk.

Type I: the superior gluteal artery (SGA) arises independently with the inferior gluteal (IGA) and internal pudendal arteries (IPA) arising from a common trunk which dividing inside (Type IA) or outside (Type IB) pelvic cavity.

Type II: the SGA and IGA arteries arise from a common trunk, which divides inside (Type IIA) or outside (Type IIB) the pelvic cavity, with the IPA arising independently.

Type III: the SGA and IGA and IPA arteries all arise from the internal iliac artery independently.

Type IV: the SGA, IGA and IPA arteries arise from a common trunk.

Type V: the IPA and SGA arise from a common trunk with the IGA having a separate origin.

(UA. Umbilical artery)

Statistical analysis

The descriptive data was presented as percentages according to Adachi classification.

Results

No anatomical deviation has been noted with regard to the levels of division of aorta, common iliac artery, the division into internal and external iliac arteries and the division of anterior and posterior branches of the internal iliac artery from that of classical anatomical literature. In our study, it was also noted that there had been no significant deviations of pelvic anatomical relations with that of internal iliac artery. In our study, Type Ia was found in 35/45 (78%) of the specimens, Type IIA in 3/45 (6%), Type III in 7 (16%), and no specimens were found in Type IV and Type V. Our data was compared with some of the available data (Table 1).

Discussion

According to our study, type Ia was the commonest. The frequency of occurrence of type II was less than that of type III. This was different to the results of Adachi and many other studies^{8,9}. In comparison, it is seen that the present findings are in keeping with the previous studies in type Ia being the commonest (8-11). Type Ib, IIB, IV, or V were not found in the present study. Types I, III and II, are in the order of the commonest to least in our study where type II was more than that of type III in Adachi's classification⁸.

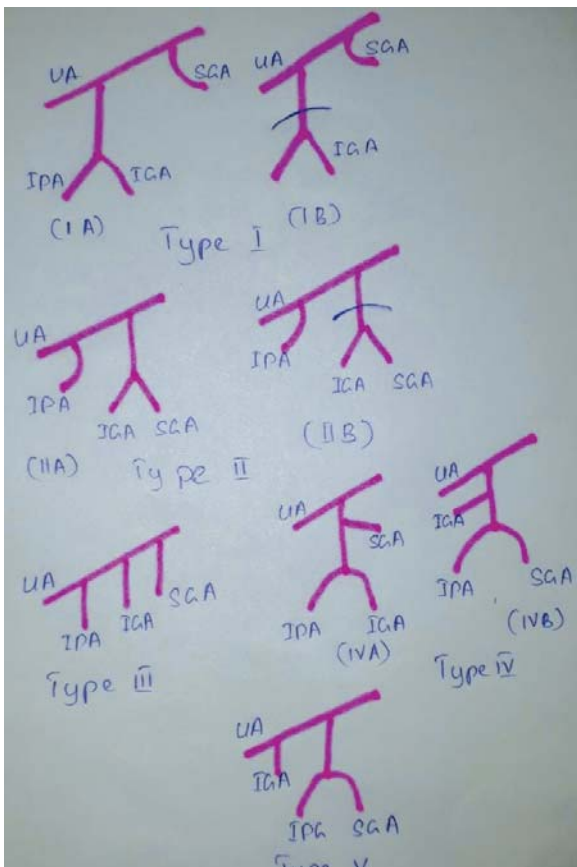


Figure 1. Adachi's classification.

Table 1. The comparison of our study findings with available literature (based on Adachi classification)

Study	Year	Sample size (N)	Adachi classification (Variations presented as % from the each study sample)						
			Ia	IIa & IIb	III	IVa & IVb	V		
Adachi ⁸	1928	118	51.2	23.1	18.2	4.1	0.8		
			Ia	Ib	IIa	IIb	IVa	IVb	V
Braithwaite ⁹	1952	169	48.5	10	11.8	3.5	22.5	2.4	1.2
			Ia	Ib	IIa	IIb	IVa	IVb	V
Fischer ¹⁰	1959	50	46	4	12	14	16	2	6
			Ia	Ib	IIa	IIb	IVa	IVb	V
Roberts and Krishingner ¹¹	1967	167	45	6	25	1.8	14.4	5.4	1.8
			Ia	IIa	III	IV	V		
Findings of the Present study	2023	45	78	6	16	-	-		

These may be due to variability in different ethnic groups.

No anatomical deviation has been noted with regard to the levels of division of aorta, common iliac artery, the division into internal and external iliac arteries and the division of anterior and posterior branches of the internal iliac artery from that of classical anatomical literature⁷. It was also noted that there has been no significant deviation of anatomical relations with regard to the structures as described, with that of the internal iliac artery in our study.

Pelvic haemorrhage can result in maternal morbidity and mortality. Internal iliac ligation is a lifesaving surgical procedure. It should be considered with no delay where conservation of the uterus is desired in young women with intractable pelvic haemorrhage giving the chance

of future fertility¹⁰⁻¹². It is also mandatory to control haemorrhage following a hysterectomy and after gynaecological surgeries. Surgeons and Gynaecologists need to learn lifesaving procedure of internal iliac artery ligation. The comprehensive understanding of retroperitoneal anatomy and regional variations of the internal iliac artery will reduce the risk of operative complications¹⁰⁻¹³.

Conclusion

Our study showed no significant anomalies in relation to the gross anatomical structure relations to the internal iliac artery. The type Ia branching pattern was found to be the commonest. Comprehensive knowledge and understanding of retroperitoneal anatomy and regional variations of the internal iliac artery will reduce the risk of operative complications.

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Authors' contributions

VA, HD and LG formulated the concept and design of the study, acquisition of data and analysis, and drafted the article. All authors reviewed the manuscript.

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Availability of data and materials

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Data collection and ethical approval

Nawaloka Research and Education Foundation, Nawaloka hospital PLC, Colombo.

Competing interests

The authors declare that they have no competing interests.

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