

THE BRANCHING PATTERN OF THE INTERNAL ILIAC ARTERY IN SOUTH INDIAN POPULATION

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ABSTRACT

Background: The internal iliac artery is the “artery of the pelvis”. It begins at the common iliac bifurcation at the level of the lumbosacral intervertebral disc at the superior margin of the greater sciatic foramen where it divides into an anterior trunk and posterior trunk, which passes back to the greater sciatic foramen. The anterior trunk, branches of internal iliac artery are superior vesical artery, inferior vesical artery, middle rectal artery, obturator artery, vaginal artery, uterine artery, internal pudendal and inferior gluteal arteries. The branches of the posterior division are iliolumbar, lateral sacral and superior gluteal artery. Knowledge of the anatomical variation is beneficial for the vascular surgeons & gynecologists for ligating the internal iliac artery or its branches during the pelvic surgery and also for the radiologists to perform and interpret angiograms of the pelvic region. Hence the present study was undertaken to present the anatomical knowledge of branching pattern of internal iliac arteries.

Materials and Methods: The present study was performed on 50 bisected pelvises from embalmed human cadavers of both genders from Department of Anatomy, Mandya Institute of Medical Sciences Mandya. The internal iliac artery was identified, finer dissections were made, and branching pattern and its variation were recorded and photographed using a digital camera.

Results: The branching pattern of internal iliac artery was classified in the modified Adachi classification. Out of 50 adult human pelvis specimens, Type 1a arrangement noted in 68% of specimens, Type II in 10%, Type III in 16% and Type IV in 6%. Type V was not found in any specimens.

Conclusion: Most common patterns of internal iliac artery were Type 1a. Study of these variations helps in avoiding the surgical and accidental iatrogenic injuries of the blood vessels.

KEY WORDS: Internal iliac artery, Internal iliac artery variations, obturator artery.

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INTRODUCTION

The internal iliac artery is the ‘artery of the pelvis’. From embryological point of view internal iliac artery is derived from umbilical artery that obliterates postnatally in distal part to form medial umbilical ligament and remains

permanent in its proximal part, this part is termed as internal iliac artery [1]. Common iliac artery bifurcates at pelvic brim opposite the sacroiliac joint, at the level of lumbosacral intervertebral disc and from this point internal iliac artery pass downwards and soon divides

into short posterior and larger anterior division [2]. It supplies most of the blood to the pelvic viscera, musculoskeletal part of pelvis; however it also supplies the gluteal region, medial thigh region and perineum [3]. The branches of anterior division include superior vesical artery, inferior vesical artery, middle rectal artery, vaginal artery, obturator artery, internal pudendal artery and inferior gluteal artery. The posterior division gives three branches i.e. Iliolumbar artery, lateral sacral artery and superior gluteal artery [4].

Variations in branching pattern of internal iliac artery have received attention of anatomists and surgeons since long time. Knowledge of anatomical variations is beneficial during pelvic surgery for vascular surgeons in ligating the internal iliac artery or its branches and radiologists for interpreting angiograms of pelvic region.

Endovascular treatment of aortoiliac aneurysm near or involving the internal iliac artery requires internal iliac artery occlusion before endografting to avoid retrograde filling of the aneurysm [5].

Hemorrhage in pregnancy is a leading cause of maternal mortality in developing countries. Internal iliac artery ligation is one of the life saving procedures in intractable pelvic hemorrhage [6].

Because of the clinical importance of branches of internal iliac artery in the field of surgery and interventional radiology, the present study was undertaken to observe the internal iliac artery and its branching pattern in pelvis and compared the finding with previous studies.

Adachi proposed that 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. His scheme is as follows:

TYPE I: The superior gluteal artery arises separately from internal iliac artery, and the inferior gluteal and internal pudendal vessel are given off by a common trunk. If the latter divides within the pelvis it is considered to be **TYPE IA**, where as if the bifurcation occurs below the pelvic floor it is considered as **TYPE IB**.

TYPE II: The superior and inferior gluteal arteries arise by a common trunk and the internal pudendal vessel separately. In this category **TYPE II A** includes those specimens in which the trunk common to the two gluteal arteries divides within the pelvis, and **TYPE II B** in which the division occurs outside the pelvis.

TYPE III: Three branches arise separately from the internal iliac artery.

TYPE IV: The three branches arise by a common trunk.

TYPE IV a: The trunk first gives rise to the superior gluteal artery before bifurcating into the other two branches.

TYPE IV b: First vessel is emerge from common trunk, which then divides into superior and inferior gluteal arteries.

TYPE V: The internal pudendal and the superior gluteal arteries arise from common trunk, and the inferior gluteal has a separate origin.

MATERIALS AND METHODS

Fifty dissected pelvic halves specimens from embalmed cadavers irrespective of age and gender was used for this study in the Department of Anatomy at Mandya Institute of Medical Sciences, Mandya during year 2013-14.

Adult pelvis irrespective of sex and race were included. However, deformed and disease pelvis were excluded from this study.

Procedure: After abdominal dissection a horizontal section through the abdomen at the fourth lumbar vertebral level was made. The pelvic specimens thus obtained were divided into equal halves by cutting through the pubic symphysis, the sacrum and coccyx by using meat and bone cutting machine. With use of dissection kit, the pattern of the variations that have occurred at the level of origin and division of the main trunk and any anomalous branches that have originated at this level were noted down and digitally photographed. The different branching patterns of internal iliac artery were studied and analyzed.

RESULTS

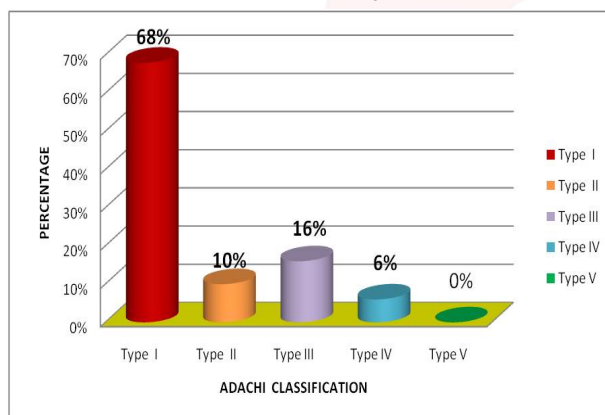
The branching pattern of internal iliac artery was classified as per modified Adachi classification.

In out of 50 specimens Type Ia arrangement was found in 20 specimens (40%), Type Ib in 14 specimens (28%), Type IIa in 2 specimens (4%), Type IIb in 3 specimens (6%), Type III in 8 specimens (16%), Type IVa in 3 specimens (6%), Type IV b & Type V in none of the specimens. (Table 1)

Table 1: Percentage distribution of Adachi classification in the present study (50 specimens).

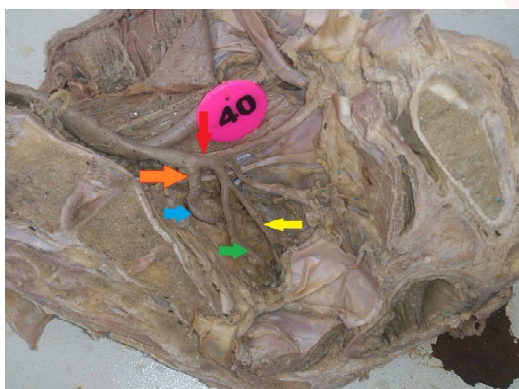
TYPE	NUMBER OF SPECIMENS	PERCENTAGE %
TYPE I a	20	40
TYPE I b	14	28
TYPE II a	2	4
TYPE II b	3	6
TYPE III	8	16
TYPE IV a	3	6
TYPE IV b	0	0
TYPE V	0	0
TOTAL	50	100

Graph 1: Bar diagram showing % distribution of Adachi classification in the present study.



So overall Type I in 34 specimens (68%), Type II in 5 specimens (10%), Type III in 8 specimens (16%) and Type IV in 3 specimens (6%). Type V was not observed in any of the specimens. (graph 1)

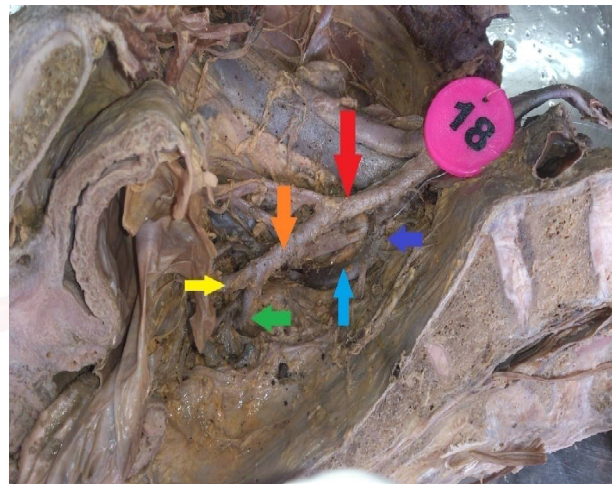
Fig. 1: specimen 40 : Red Arrow -Internal iliac artery , green arrow -Inferior gluteal artery , yellow arrow – internal pudendal artery , light blue – superior giuteal artery , orange arrow –posterior division.



Showing internal iliac artery with Adachi **Type Ia**

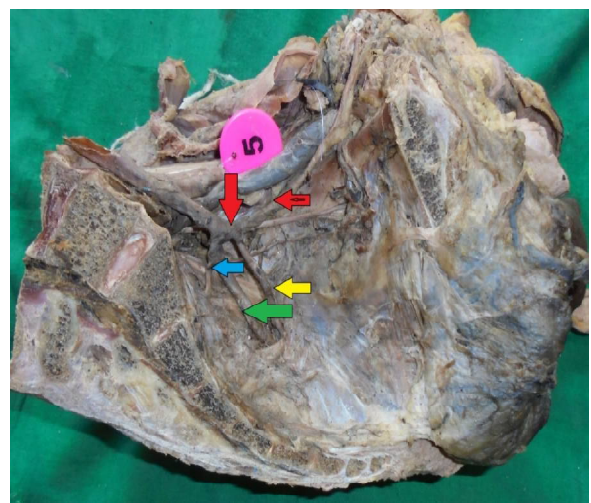
Ia pattern: Common trunk of anterior division of internal iliac artery gave internal pudendal artery and inferior gluteal artery with in the pelvis. From posterior division— superior gluteal artery,

Fig. 2: specimen 5: Red Arrow -Internal iliac artery , green arrow -Inferior gluteal artry , yellow arrow – internal pudendal artery , light blue – superior giuteal artery , orange arrow –anterior division , Dark blue – posterior division.



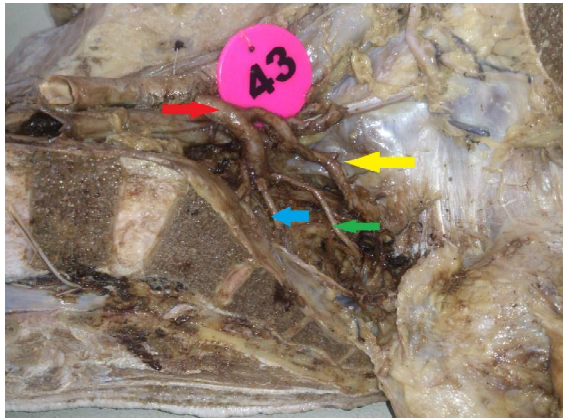
Specimen No 18: Showing internal iliac artery with Adachi **Type Ib pattern:** Common trunk of anterior division of internal iliac artery given internal pudendal artery and inferior gluteal artery below the pelvic floor. From posterior division— superior gluteal artery,.

Fig. 3: specimen 5: Red Arrow -Internal iliac artery , green arrow -Inferior gluteal artry , yellow arrow – internal pudendal artery , light blue – superior giuteal artery.



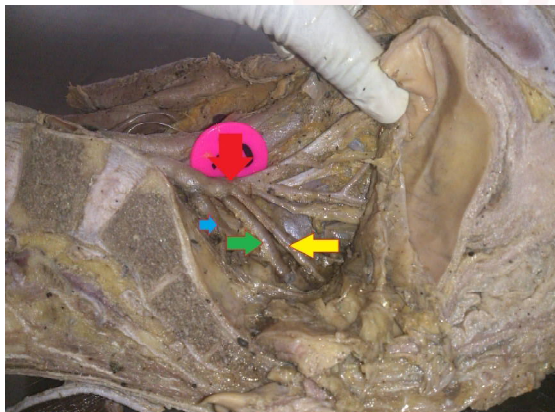
Showing internal iliac artery with Adachi **Type IIa pattern:** from anterior division arose — internal pudendal artery. From posterior division— two gluteal arteries(superior and inferior gluteal) divides within the pelvis.

Fig. 4: specimen 43 : Red Arrow -Internal iliac artery , green arrow -Inferior gluteal artery , yellow arrow – internal pudendal artery , blue – superior giuteal artery.



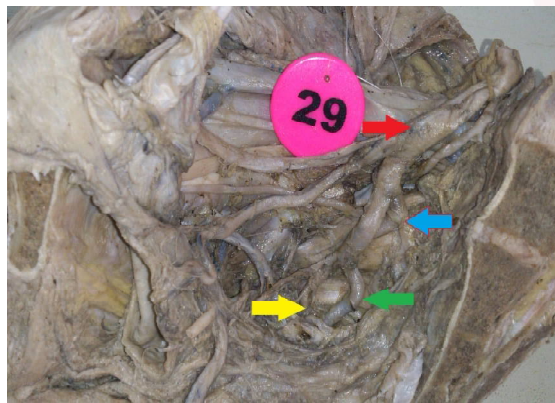
Showing internal iliac artery with Adachi **Type IIb pattern**: from anterior division arose — internal pudendal artery. From posterior division— two gluteal arteries(superior and inferior gluteal) divides below the pelvic floor.

Fig. 5: specimen 10 : Red Arrow -Internal iliac artery , green arrow -Inferior gluteal artery , yellow arrow – internal pudendal artery , light blue – superior giuteal artery , orange arrow —posterior division



SPECIMEN NO 10: Showing internal iliac artery with Adachi **Type III pattern**: Superior gluteal, inferior gluteal and internal pudendal artery arose separately.

Fig. 6: Specimen 29 : Red Arrow -Internal iliac artery , green arrow -Inferior gluteal artery , yellow arrow – internal pudendal artery , blue – superior giuteal artery,



SPECIMEN NO 29: Showing internal iliac artery with Adachi **Type IVa pattern**- common trunk of posterior division gave first superior gluteal artery then it divided into inferior gluteal and internal pudendal artery.

DISCUSSION

Vascular system is always an interesting topic for anatomists, vascular surgeons and interventional radiologists. Internal iliac artery is exceedingly variable in its manner of branching. Reasons for these arterial variations are multifactorial. It may be due to hemodynamic forces, fetal position in the uterus, genetic predisposition and the result of developmental anomalies during the formation of blood vessels.

According to Hollinshead the branches which arise from anterior and posterior trunks are exceedingly variable in its manner of branching. The superior gluteal, internal pudendal, and umbilical artery are the larger branches of the internal iliac artery. It may arise in various combination by common stems or as branches from each other similarly, the visceral branches except for the superior vesicle, which is apparently always derived from the umbilical artery show numerous variations, both in regard to the larger arterial stem from which they arise, and in regard to whether they arise independently or with other visceral branches [7].

The branches of internal iliac artery that leave the pelvis and all of them pierce the pelvic fascia. These are points of relative weakness which occasionally permit the formation of hernia along the gluteal or obturator arteries [8].

Internal iliac artery is principal artery of pelvis; therefore, to perform any surgery in pelvis region, knowledge of arterial pattern is essential for surgeon. Recently endovascular therapy for pathological condition like aneurysm is available. Isolated internal iliac artery aneurysm is found only in 2% cases. Internal iliac artery aneurysm can be treated with Catheter-based techniques by injecting embolization coils and other thrombogenic material into aneurysmal sac and its branches [9].

Prophylactic bilateral internal iliac artery ligation (BIIL) during pelvic surgery provides a

Table 2: Prevalence of Adachi types in different studies.

Author	Specimen number	Type I	Type II	Type III	Type IV	Type V
Lipshtuz (1918) [13]	181	40%	24%	17%	11%	7%
Braithwaite (1952) [14]	169	58.50%	15.30%	22.50%	3.86%	0%
Yamaki (1998) [15]	645	51.20%	23%	18%	4.10%	0%
Naveen (2011) [16]	60	83.50%	6.60%	9.90%	0	0
Fatu et al (2006) [17]	100	60%	20%	10%	1%	18%
Ramakrishna PK (2012) [18]	50	60%	8%	30%	2%	0
Shivakumar (2010) [18]	40	89%	11%	0	0	0
Thirupathi Rao et al (2013) [20]	45	66.68%	2.22%	24.40%	4.44%	2.20%
Present study (2014)	50	68%	10%	16%	6%	0

conductive environment to carry out extensive pelvic surgery that immensely benefits patients with malignancies [10].

Pseudoaneurysm of the uterine artery is an uncommon cause of delayed postpartum hemorrhage, which results from accidental arterial injury during obstetric surgery. It may coexist with an arteriovenous malformation. Embolization is the preferred treatment with high success rate [11].

The internal pudendal artery perforator thigh flap is a new option for soft tissue defects in the ischial region, including ischial pressure sores [12]. The branching pattern of internal iliac artery and its variations were observed, analyzed and compared with earlier studies by various authors to consolidate the finding for the benefit of clinicians in the treatment of patients with pelvis disease. The prevalence of Adachi types in different studies is shown in table no 2. The results of present study were compared with different study.

In the present study out of 50 specimens Type Ia arrangement was found in 20 specimens (40%), Type Ib in 14 specimens (28%), Type IIa in 2 specimens (4%), Type IIb in 3 specimens (6%), Type III in 8 specimens (16%), Type IVa in 3 specimens (6%), while Type IVb & Type V in none of these specimens. So overall Type I in 34 specimens (68%), Type II in 5 specimens (10%), Type III in 8 specimens (16%), Type IV in 3 specimens (6%) and Type V not observed in any of the specimens. These observations correlate with study by Lipshtuz¹³ in which they noted Type I arrangement was found in 40%, Type II in 24%, Type III in 17%, and Type IV in 11% and Type V in 17%.

According to Braithwaite [14] Type I arrangement was found in 58.5% which is less than present study. Type II is seen in 15.3%, which is higher value than present study and Type III in 15.3%, close to present study. Type IV in 3.86% which is lower than present study and Type V noted in none of them similar to present study.

Yamaki [15] conducted study on 645 pelvic halves of Japanese cadavers and he observed in Type I arrangement was found in 51.2%, Type II in 23%, which is higher than present study Type III in 18.3%, Type IV in 4.1% which is near to present study and Type V is absent as in present study.

Naveen [16] observed in Type Ia arrangement was found in 76.6% which is higher than present study, Type Ib in 6.6% which is less than present study, Type IIa in 6.6% which is close to the present study, Type III in 9.9% less than present study. Type IVb & Type V not observed in present study.

Fatu et al [17] observed in Type I arrangement was found in 60%, Type II in 20%, which is higher than present study Type III in 10%, Type IV in 1% and Type V in 18% which is of higher incidence compared than other. In present study we observed in none of them.

Ramakrishna P K [18] in 40 specimens observed Type I arrangement was found in 60%, Type III in 30% which is higher than present study, Type II in 8% which is close to present study, Type IV in 2% and Type V in none of the specimen similar to present study. Shivakumar [19] in 40 specimens observed Type I arrangement was found in 89%, which is higher than present study Type IIa in 11%, Type III, Type IV & Type V in none of specimens.

Thirupathi Rao et al [20] observed Type I arrangement in 66.68%, which is close to present study, Type II in 2.22% which is less than present study, Type III in 24.4% which is higher than in present study and Type IV in 4.4% whereas 6% in present study.

In most of the studies Type I arrangement is commonest and also most common type of pattern in present study. Second most common pattern is Type III and least frequent is Type IV. Type V was not observed in present study as contrast to the previous studies.

CONCLUSION

The vascular system is not important only for surgeon who is operating in pelvic region but also for interventional radiologists and physicians for finding some disease pathology involved in vascular system. So knowledge of normal arterial pattern or any variations of their patterns are necessary.

The internal iliac artery is the artery of pelvis. It supplies most of the blood to the pelvic viscera: mainly rectum, urinary bladder, prostate, and seminal vesical in male, in female uterus, vagina parietal layer of pelvis. It also supply in gluteal region, medial aspect of thigh and perineum.

Ligation of internal iliac artery has been used to control serious obstetric and pelvic bleeding. Of late, ligation of anterior division of internal iliac artery is being restored to produce pelvic compartment hypotension to control extensive pelvic hemorrhaging vessel.. The superior gluteal artery perforator flap can be transferred pedicle to treat sacral pressure sores or to be transferred freely for breast reconstruction. Coil embolization therapy for uterine fibroid tumor or any major uterine malignancy may reduce the chance of infertility in young patient.

The fact that internal iliac artery has extensive area of supply and is of great surgical importance. Therefore present study was undertaken to observe the branching pattern of internal iliac artery and to know the variations, if any in the arterial pattern.

The common trunk of internal iliac artery was classified as per modified Adachi classification. Type Ia arrangement in 68%, Type II in 10,

Type III in 16% and Type IV in 6%. Type V noted in none of them.

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Conflicts of Interests: None

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