International Journal of Anatomy and Research,
Int J Anat Res 2014, Vol 2(2):363-68. ISSN 2321- 4287

Original Article

STUDY OF VARIATIONS IN ANTERIOR DIVISION OF INTERNAL ILIAC ARTERY

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ABSTRACT

Background: The internal iliac artery is the chief pelvic artery. It supplies to the all pelvic viscera, musculoskeletal part of the pelvis. The branches of the anterior trunk of the internal iliac artery are the superior and inferior vesical, middle rectal, vaginal, obturator, uterine, internal pudendal and inferior gluteal. Knowledge of internal iliac artery is very helpful in pelvic surgery practice.
Methods: 50 adult human pelvic halves were procured from embalmed cadavers of J.J.M. Medical College and S.S.I.M.S & R.C, Davangere, Karnataka, India for the study.
Results: Middle rectal artery took origin from anterior division in 42 specimens (84%), most frequently with internal pudendal artery in 32 specimens (64%) and was found to be absent in 8 specimens (16%). The obturator artery took origin most frequently from the anterior division of Internal iliac artery in 36 specimens (72%), from posterior division in 9 specimens (18%), from external iliac artery in 1 specimen (2%) and from inferior epigastric artery in 3 specimens (6%). The superior vesical artery, inferior vesical artery, uterine artery, vaginal artery and superior gluteal artery were found to be constant in their origin and course.
Conclusions : The branches anterior division of internal iliac artery shows multiple variations, knowledge about these variation are helpful in pelvic surgeries.
KEYWORDS: Middle rectal, Internal pudendal artery, obturator artery, inferior vesicle artery.

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Access this Article online

Quick Response code

Web site: International Journal of Anatomy and Research
ISSN 2321-4287
www.ijmhr.org/ijar.htm

Received: 17 April 2014
Peer Review: 17 April 2014 Published (O):31 May 2014
Accepted: 12 May 2014 Published (P):30 June 2014

INTRODUCTION

In general, arteries pursue the shortest and the most direct course in order to reach their objective and that this course is partly determined by mechanical convenience. The angle at which branches leave a main arterial stem certainly depends to a considerable extent on haemodynamic factors. Each internal iliac artery, approximately 4 cm long, begins at the common iliac bifurcation, level with the lumbosacral intervertebral disc and anterior to the sacroiliac joint. It descends posteriorly to the superior margin of the greater sciatic foramen where it divides into an anterior trunk, which continues in the same line towards the ischial spine and a posterior trunk, which passes back to the greater sciatic foramen. The branches of the anterior trunk of the internal iliac artery are the superior and inferior vesical, middle rectal, vaginal, obturator, uterine, internal pudendal and inferior gluteal[1].

According to Braithwaite JL the obturator artery is more variable and arises as a direct branch from the anterior division of internal iliac artery

in 41.4% of instances, from theinferior epigastric artery in 19.5%, from the superior gluteal artery in 10%,from the inferior gluteal-internal pudendal trunk in 10% and by a double originin 6.4%. In only 23% of instances is a similar origin noted on both sides[2].

According to Lipschutz B Probably, no artery in the human body of proportionate size has so voluminous a literature as the obturator artery. It has been the subject ofrepeated anatomical research. Middle rectal artery is not constant. It is present in only 72 per cent of the subjects observed. It varies in its calibre and origin.The middle rectal artery arises most frequently as a branch of the internal pudendal artery. This origin occurs in 54 per cent of the cases observed[3].

The vaginal artery passes medially from the internal iliac and anastomose freely with descending branches of the uterine artery on each side, to form two somewhat irregular arterial channels, the azygos arteries in the midline, on the anterior and posterior aspects of the vagina. An inferior vesical artery supplies the fundus of the bladder, the prostate, seminal vesicles, vas deferens and the lower end of ureter[4].

In between 20 and 30% of subjects the place of the obturator artery is taken by an enlarged pubic branch of the inferior epigastric artery. This branch descends almost vertically to the upper part of the obturator foramen. The artery usually lies in contact with the external iliac vein and on the lateral side of the femoral ring; in such cases it would not be endangered in the operation for strangulated femoral hernia. Occasionally, however, it curves along the free margin of the lacunar ligament, and if in such circumstances a femoral hernia occurred, the vessel would almost completely encircle, and might constrict, the neck of the hernial sac; moreover, it would be in great danger of being wounded if an operation were performed for strangulation. Occasionally, some of the branches of the internal pudendal are supplied by an additional vessel called the accessory pudendal, which generally arises from the internal pudendal artery before its exit from the greater sciatic foramen[5]. The obturator and inferior epigastric arteries both supply branches to the back of the pubis. These pubic branches anastomose and the anastomotic channel is commonly (33%) so large that the obturator artery derives its blood from the inferior epigastric artery. This is known as an “accessory obturator artery”[6].

The obturator artery gives off a small branch to the periosteum on the back of the pubic bone, which anastomoses with the pubic branch of the inferior epigastric artery. In over a third of cases this anastomotic connection opens up and no obturator artery arises from the internal iliac artery. Such replacement by the branch from the inferior epigastric artery is named the “abnormal obturator artery”. The abnormal artery is present in a third of cases, when present it lies medial or lateral to the neck of the femoral hernia in a proportion of 1 to 10. That is to say, it is found on the free edge of the lacunar ligament in about 3% (1 in 30) of individuals, the same incidence as the thyroideaima artery. The middle rectal artery is ‘badly named’. It is characterized by three features: (1) It is often absent, especially in the female; (2) very little of its blood goes to the rectum and that only to the muscle coats there of and (3) most of its blood goes to the prostate. The vaginal artery, usually a separate branch of the internal iliac artery, nevertheless often branches from the uterine artery. It supplies the very vascular walls of the upper part of the vagina[7]. Inferior gluteal artery gives a long slender branch which runs on the surface of the sciatic nerve or in its substance called as the ‘companion artery of the sciatic nerve’. The inferior gluteal artery may, as in the foetus, constitute the main artery of the lower limb and become continuous with the popliteal artery, probably the normal companion artery of the sciatic nerve represents, this original vessel[8].

Bergman has reported that, internal iliac artery may be longer or shorter than usual. The branches may arise without the artery dividing into anterior and posterior division. Branches of the anterior and posterior divisions may exchange origins[9]. Variations of branches of the anterior division as follows:

Superior vesical artery : The number of superior vesicals varies from one to four. They commonly arise from the umbilical artery, but were also found arising from the uterine (6 of 66 sides), obturator (6 of 132 sides) and a large anastomosis

between the superior and inferior vescial arteries was found in 60 of 70 specimens.

Inferior vesical artery: Anastomoses between the inferior vesical and uterine arteries were found in 60 of 70 specimens.

Middle rectal artery: This artery is occasionally absent. It usually arises from the internal iliac; however, it has been reported as arising from the inferior vesical or internal pudendal.

Vaginal artery: This artery usually arises from the uterine artery, sometimes as several branches and sometimes from the internal iliac in common with the uterine artery. The vaginal artery may also arise from the middle rectal or superior vesical artery.

Obturator artery: This artery is variable in origin. It may arise from the common iliac, anterior division of the internal iliac (41.4%), inferior

epigastric (25% based on observations in 4044 bodies), superior gluteal (10%), inferior gluteal-internal pudendal trunk (10%), inferior gluteal (4.7%), internal pudendal (3.8%) or external iliac (1.1%). The obturator has also been found arising from the femoral artery adjacent to its profunda branch. In only 23% of cases is a similar origin found on both sides of the body.

Uterine artery: The uterine artery usually arises from the internal iliac but may arise in common with the vaginal artery or middle rectal artery. The artery may be doubled or composed of multiple parts.

Internal pudendal artery : This artery may arise in common with obturator or the umbilical. It may end as a perineal artery, with the artery to the penis arising from the internal iliac.

Inferior gluteal artery: This artery may form a common trunk with the superior gluteal[9].

According to Holub Z et al study ,Laparoscopic dissection of the uterine artery close to the origin of the uterine artery can be carried out safely in the most frequent types of surgicalclassification. The meticulous dissection of the uterine artery in cases in which the uterine artery does not arise typically from an unobliterated segment of the internal iliac artery was recommended[10].

Pick et al, have documented that the obturator artery arising from the posterior division of the internal iliac artery can occur in 3.28% of cases in western population. Although similar to the Pick et al's findings, observation of incidence of origin of left obturator artery is only 0.5% (one out of 316 pelvises). Further the exact site of origin has been documented in this study, which is at a distance of 8mm distal to the point of bifurcation of the internal iliac artery. This rare abnormality in Indian population may be due to different set of environmental or genetic factors. Thus influencing the development of pelvic vessels differently[11].

In cases of obstruction of the anterior division of internal iliac artery due to any cause, there will be sparing of obturator artery and its branches especially the branch to the head of femur. The parietal branches of obturator artery are important collaterals in aortoiliac and femoral arterial occlusive diseases. The increased length of the left obturator artery, owing to the origin from the posterior division of internal iliac, may have an additional advantage while grafting[12].

In study of Kawanishi Y et al, examination of 290 units of internal iliac arteries (IIA) in 145 patients showing repeated incomplete erectile response to intracavernosal injections with prostaglandin (E_1) was done. The pelvic arterial arrangement, evaluated by three dimensional computer tomographic angiography, was classified anatomically into five types as follows:

Type 1 (normal or basic type): in which the internal pudendal artery (IPA) originates from the anterior trunk at the level between the lineaterminalis and major ischial notch.

Type 2: the IPA originates from the anterior trunk of the IIA at the level of the major ischial notch or more distally.

Type 3: the IPA originates directly from the IIA at the level proximal to the linea terminalis.

Type 4: the IPA originates together with the superior and inferior gluteal artery within 1 cm of each other and

Type 5: the penile blood supply is dependent on arteries other than the IPA, such as the obturator artery.

Among the 290 units, eight could not be classified due to poor image quality. There was no statistically significant difference in blood

flow parameters among the types of IIAs, but there was a statistically significant difference in the IPA type at the age of onset of Erectile Dysfunction (ED). Type I (153 units or 53%) anatomy, was more common in patients who developed ED at an advanced age. Types 2, 3 and 4 were more common in patients with onset of ED at an early age. Compared with patients with the common type of IIAs bilaterally, patients with any of the variations bilaterally are at risk of early onset of ED. Congenital factors might contribute to the development of ED. If a man has bilateral variation from the common type (type 1), he might develop ED approximately 10 years earlier than those who are identical in every way except for their IPA (type 1) arrangements[13]. Anterior division internal iliac artery shows more variations in its branches and having more clinical importance because of its more clinical importance we have undertaken this work which is very helpful in pelvic surgery practice.

MATERIALS AND METHODS

50 formalin fixed adult human pelvic halves were procured from the Department of Anatomy, J.J.M. Medical College and S.S.Institute of Medical Sciences and Research Centre, Davangere. Specimens were collected during routine dissection practicals conducted by the Department of Anatomy, J.J.M. Medical College and S.S.Institute of Medical Sciences and Research Centre, Davangere. A horizontal section through the abdomen at the fourth lumbar vertebral level was taken. The pelvic specimen thus obtained was divided into two equal halves by cutting through the pubic symphysis, the sacrum and coccyx. The level of origin of internal iliac artery was noted. The individual branches (parietal, visceral) arising from the anterior and posterior divisions were dissected upto their terminations inside the pelvis.

RESULTS

The level of division of internal iliac artery took place above the greater sciatic foramen in 34 specimens (68%), at the upper border of greater sciatic foramen in 7 specimens (14%), and below the upper border of greater sciatic foramen in 9 specimens (18%). superior vesical artery were constant in their origin and course in all the specimens. The obturator artery presents considerable variation in its origin. It took origin most frequently from the anterior division of internal iliac artery in 36specimens (72%). Out of which, directly from anterior division in 20 specimens (40%), with ilio-lumbar artery in 5 specimens (10%), with inferior gluteal artery in 3 specimens (6%), with inferior vesical artery in 2 specimens (4%), with middle rectal artery in 1 specimen (2%), with internal pudendal artery in 4 specimens (8%) and with uterine artery in 1 specimen (2%).

FiG. 1: Internal iliac artery and its branches.

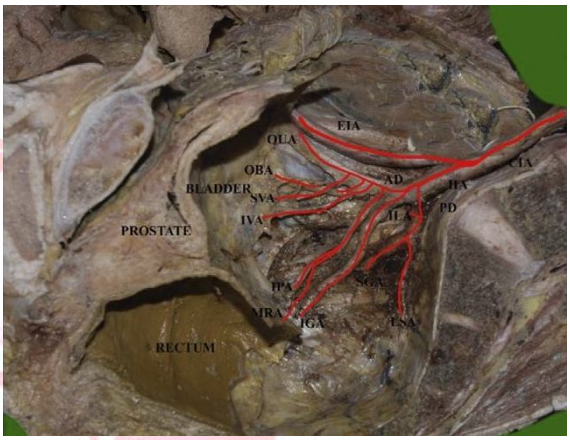

Table No. 1: Analysis of Figure 1.

Sex	Side	Origin	Length of the IIA	Level Of division
Male	Right	Between L4 & L5	6cm	2cm above greater sciatic foramen
BRANCHES FROM THE COMMON TRUNK : NIL				
BRANCHES FROM DIVISIONS :				
I) ANTERIOR DIVISION				
1) Obliterated umbilical artery	Present - normal			
2) Superior vesical artery	Present - normal			
3) Obturator artery	Present - normal			
4) Inferior vesical artery	Present - normal			
5) Middle rectal artery	Present			
6) Internal pudendal artery	Present			
7) Inferior gluteal artery	Present - normal			
II) POSTERIOR DIVISION				
1) Ilio-lumbar artery	Present - normal			
2) Superior gluteal artery	Present - normal			
3) Lateral sacral artery	Present - normal			
VARIATIONS : Length is long. Internal pudendal artery and middle rectal artery - common trunk from anterior division.				

The obturator artery took origin from the posterior division of internal iliac artery in 9 specimens (18%), from external iliac artery in 1 specimen (2%), from inferior epigastric artery in 3 specimens (6%) and was found to be absent in 1 specimen (2%).

Out of 33 specimens, the inferior vesical artery took origin from anterior division, alone in 14 specimens (42%), along with internal pudendal

artery in 9 specimens (28%), with obturator artery in 4 specimens (12%), with middle rectal artery in 2 specimens (6%) and double inferior vesical artery was found in 4 specimens (12%).

Out of 50 specimens, middle rectal artery took origin from anteriordivision, alone in 2 specimens(4%), with internal pudendal artery in 32specimens (64%), with inferior vesical artery in 3 specimens (6%), with obturator artery in 1 specimen (2%), with inferior gluteal artery in 4 specimens (8%) and was found to be absent in 8 specimens (16%).

Fig. 2: Internal iliac artery and its branches.

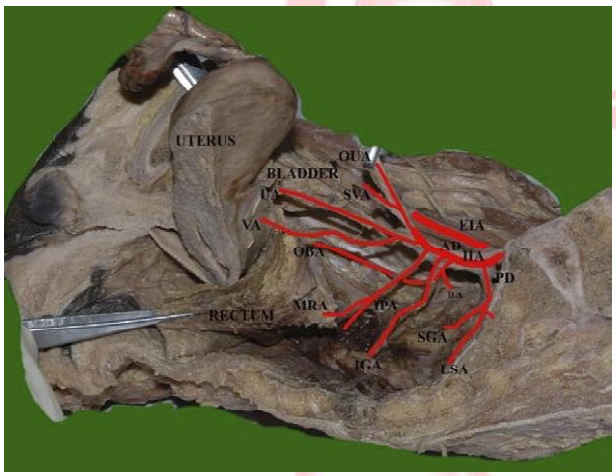

Table No. 2: Analysis of Figure 2.

Sex	Side	Origin	Length of the IIA	Level Of division
Female	Right	Between L5 & S1	5 cm	1cm below upper border of GSF
BRANCHES FROM THE COMMON TRUNK : NIL				
BRANCHES FROM DIVISIONS :				
I) ANTERIOR DIVISION				
1) Obliterated umbilical artery	Present - normal			
2) Superior vesical artery	Present - normal			
3) Obturator artery	Present			
4) Middle rectal artery	Present			
5) Internal pudendal artery	Present gives middle rectal artery			
6) Inferior gluteal artery	Present - normal			
7) Uterine artery	Present - normal			
8) Vaginal artery	Present - normal			
II) POSTERIOR DIVISION				
1) Ilio-lumbar artery	Present - from anterior division			
2) Superior gluteal artery	Present - normal			
3) Lateral sacral artery	Present - normal			
VARIATIONS : Length is long. Obturator artery and ilio-lumbar common trunk from anterior division. Internal pudendal artery gives middle rectal artery.				

The internal pudendal artery took origin from the anterior division, alone in 3 specimens (6%), along with middle rectal artery in 15 specimens (30%), with inferior gluteal artery in 25 specimens (50%), with obturator artery in 3 specimens (6%) and with inferior vesical artery in 4 specimens (8%). It made its exit from the pelvis through the greater sciatic foramen below the pyriformis muscle.

The inferior gluteal artery took origin both from anterior and posterior divisions of internal iliac artery. Anterior division gave rise to inferior gluteal artery directly in 11 specimens (22%), with internal pudendal artery in 24 specimens (48%), with ilio-lumbar artery in 1 specimen (2%), with obturator artery in 2 specimens (4%), with lateral sacral artery in 2 specimens (4%) and double inferior gluteal artery was found in 2 specimens (4%). Posterior division gave rise to inferior gluteal artery directly in 2 specimens (4%), with obturator artery in 1 specimen (2%) and the inferior gluteal artery was found to be absent in 5 specimens (10%). It made its exit from the pelvis through the greater sciatic foramen below the pyriformis muscle.

Out of 17 specimens, uterine artery took origin from anterior division directly in 15 specimens (88%) and double uterine artery was observed in 2 specimens (12%). Out of 17 specimens, vaginal artery took origin from anterior divisiondirectly in 15 specimens (88%) and with internal pudendal artery in 2 specimens (12%).

DISCUSSION & CONCLUSION

In the present study, obturator artery took origin directly from external iliac artery in 1specimen(2%). It correlate with the observations of Bergman(1.1%)[9], Braithwaite JL(1.1%)[2], Jakubowicz and Czerniawska - Grzesinska(1.3%)[14]. This is a low incidence when compared to the observations of Missankov (25%)[15].

In the present study, obturator artery took origin from inferior epigastric artery in 3 specimens (6%). This is a low incidence when compared with the observations of Bergman(25%)[9], Braithwaite JL(19.5%)[2], Jakubowicz and Czerniawska - Grzesinska(26%)[14]. Pai MM[16] observed the origin of obturator artery from external iliac artery and inferior epigastric artery in 19%.

In the present study, middle rectal artery took origin from anterior division directly in 2 specimens (4%), with internal pudendal artery

in 32 specimens (64%), with inferior vesical artery in 3 specimens (6%), with obturator artery in 1 specimen (2%) and with inferior gluteal artery in 4 specimens (8%). Middle rectal artery was found to be absent in 8 specimens (16%). It correlate with the observations of Lipshcutz[3] where this vessel was present in only 72% of the specimens and arises most frequently as a branch of the internal pudendal artery. It also correlate with the observations of Bergman[9], where the middle rectal artery is occasionally absent. It usually arises from internal iliac artery; however, it has been reported as arising from inferior vesical or internal pudendal artery.

In the present study, inferior gluteal artery took origin from anterior division in 42 specimens (84%), from posterior division in 3 specimens (6%) and was found to be absent in 5 specimens (10%). The absence of inferior gluteal artery was also observed by Reddy S[17].

In the present study, out of 17 specimens, uterine artery took origin from anterior division directly in 15 specimens (88%) and double uterine artery was found in 2 specimens (12%). This correlate with the observations of Bergman[9] in which, the uterine artery usually arises from the internal iliac artery. The artery may be doubled or composed of multiple parts.

In the present study, out of 17 specimens, vaginal artery took origin directly from anterior division in 15 specimens (88%), with internal pudendal artery in 2 specimens (12%). Bergman[9] states that, vaginal artery usually arises from the uterine artery, sometimes as several branches, and sometimes from the internal iliac in common with the uterine artery. The vaginal artery may also arise from the middle rectal or superior vesical artery. Middle rectal artery took origin from anterior division, most frequently with internal pudendal artery and was found to be absent significantly. Superior vesical artery, inferior vesical artery, uterine artery, vaginal artery, superior gluteal artery and lateral sacral artery were found to be fairly constant in their origin and course. The knowledge of anterior division of internal iliac artery very important in pelvic surgeries.

Conflicts of Interests: **None**

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How to cite this article: Pavan P Havaldar, Sameen Taz, Angadi A.V, Shaik Hussain Saheb. STUDY OF VARIATIONS IN ANTERIOR DIVISION OF INTERNAL ILIAC ARTERY. Int J Anat Res 2014;2(2):363-68.