

Original Communication**BRANCHING PATTERN OF FETAL INTERNAL ILIAC ARTERY****Sumathilatha Sakthivelavan^{1*}, Sakthivelavan D Sendiladibban², Christilda Felicia¹**¹ *Department of Anatomy, Sri Ramachandra Medical College, Chennai, India*² *Department of Physiology, Hi-tech Medical College, Bhubaneswar, India.***RESUMEN**

Objetivo: Estudiar el patrón de ramificación de la arteria ilíaca interna del feto y que son equivalentes a la disposición de las ramas ilíacas internas en los adultos. Métodos: Veinticuatro mitades de pelvis fueron utilizados como muestras. Que se obtuvieron de fetos nacidos muertos, de 5 a 9 meses de edad gestacional. Resultados: la arteria ilíaca interna está en consonancia con la arteria ilíaca común y más grande que la arteria ilíaca externa. Tres tipos de ramificación se observaron sobre la base de las grandes ramas, a saber, la arteria glútea inferior, la arteria pudenda interna y la arteria glútea superior. Los resultados se correlacionaron con los patrones de ramificación descritos por Piersol (1930). Conclusión: La disposición más común, tenía dos grandes troncos procedentes de la arteria ilíaca interna, la posterior era la arteria glútea superior y la anterior se dividía en arterias pudenda y glútea inferior. Los otros patrones conducen variables en los adultos que son de importancia embriológica y quirúrgicos.

Palabras clave: *embriología, la arteria glútea inferior, la arteria glútea superior, la arteria pudenda interna.*

ABSTRACT

Objective: To study the branching pattern of fetal internal iliac artery and to correlate with the arrangement of the internal iliac branches in adults. Methods: Twenty four pelvic halves were used as specimens. They were obtained from the dead born fetuses of 5 to 9 months of gestational age. Results: Internal iliac artery was in line with the common iliac artery and larger than the external iliac artery. Three types of branching were observed based on the large branches namely inferior gluteal artery, internal pudendal artery and superior gluteal artery. The findings were correlated with the patterns of branching described by Piersol (1930). Conclusion: The most

common arrangement had two large trunks originating from internal iliac artery, the posterior one being superior gluteal artery and the anterior one divided into internal pudendal and inferior gluteal arteries. The other patterns lead to variable branching patterns in adults that are of embryological and surgical significance.

Key words: *embryology, inferior gluteal artery, superior gluteal artery, internal pudendal artery.*

INTRODUCTION

Internal iliac artery (IIA) is the prime artery of the pelvis. It is a smaller terminal branch of the common iliac artery while external iliac is the larger branch. It divides into anterior and posterior divisions giving rise to various parietal and visceral branches. There is usually no branch arising from the main stem of the IIA. Anterior division gives rise to the visceral branches namely superior vesical artery, inferior vesical artery, middle rectal artery and in females vaginal artery replaces inferior vesical and uterine artery in addition to the above said branches.

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The parietal branches arising from the anterior division are obturator artery, inferior gluteal artery and internal pudendal artery. All the branches from the posterior division are parietal namely superior gluteal artery, lateral sacral artery and iliolumbar artery (Standring, 2008). The branching patterns are quite variable. The branches may arise as “spray” of vessels with no distinct formation of anterior and posterior divisions (Skandalaki et al, 2004) Main arterial division into anterior and posterior trunks is brought into question now. In the fetus, the internal iliac artery appears different from that in the adult and serves a very important role, since it continues as the umbilical artery (Prabhu et al, 2001). The fetal branching pattern is also variable and that determines the pattern in adults. The

objective of this study is to correlate the fetal branching pattern with the adult pattern since it has significant surgical implications.

In the arrangement of branches of fetal IIA, four types were recognized by Piersol (1930) based on the three large branches namely inferior gluteal artery, superior gluteal artery and internal pudendal artery. Type I - two large trunks arise from the IIA, the posterior one being the superior gluteal artery and the anterior trunk divides into the internal pudendal and inferior gluteal arteries. Type II - the three vessels arise independently from the IIA. Type III – superior gluteal and inferior gluteal arteries arise by a common trunk from the IIA, the internal pudendal artery remaining distinct. Type IV - all three vessels arise from a common stem.

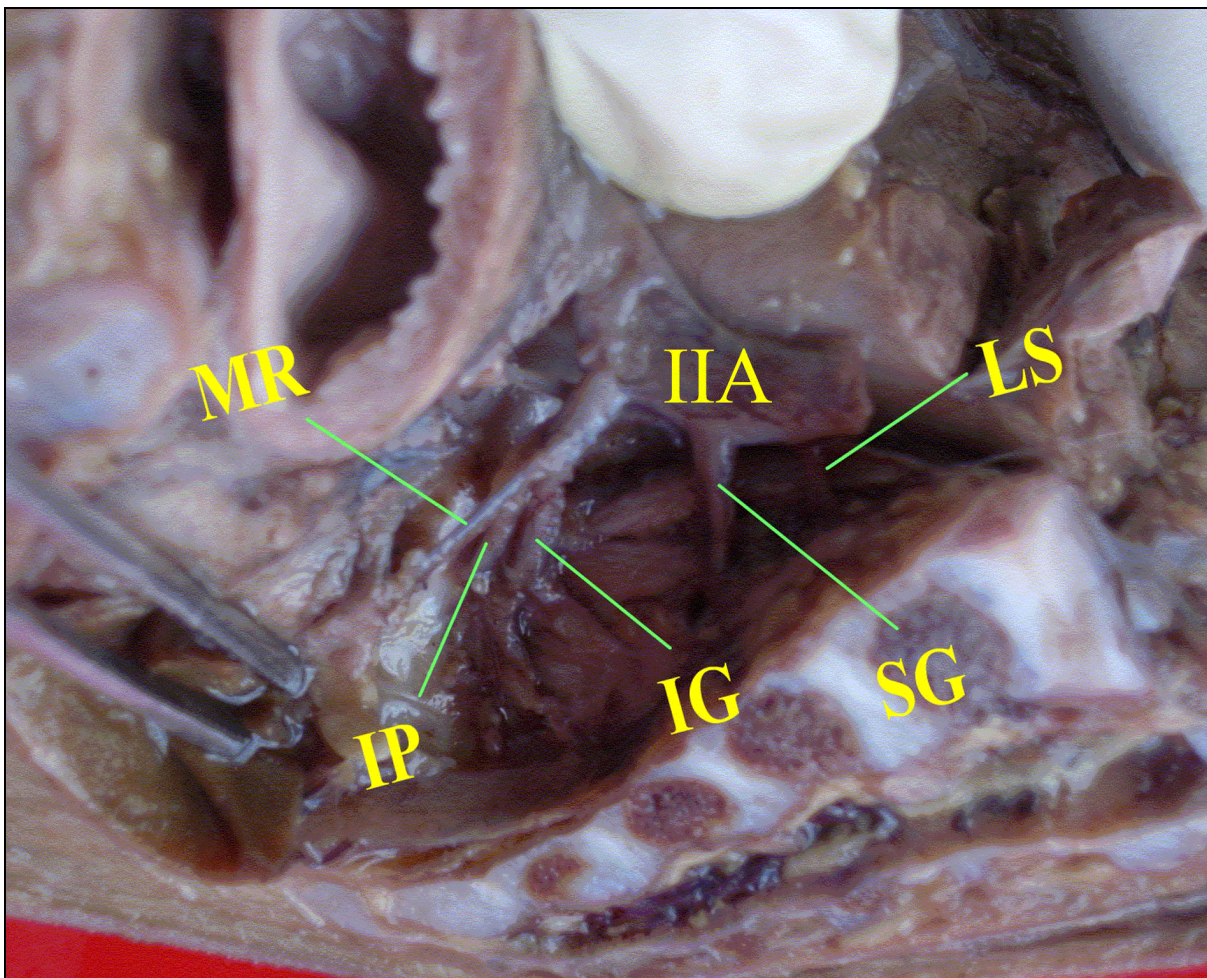


Figure 1. Right pelvic half showing the internal pudendal artery and inferior gluteal artery arising from the common trunk and superior gluteal artery separately from the internal iliac artery. IIA- Internal iliac artery; IG- Inferior gluteal artery; SG- Superior gluteal artery; IP- Internal pudendal artery. LS- Lateral sacral artery; MR- Middle rectal artery.

MATERIALS AND METHODS

Twenty four pelvic halves were used as specimens. They were obtained from 12 dead unclaimed fetuses composed of 8 male and 4 female fetuses, all belonging to 5 to 9 months of gestational age, from the Institute of Obstetrics and Gynecology, Chennai, India. Embalming was done and the fetuses were preserved. Then transverse sections were made at the level of upper border of iliac crest. Then the pelves were

bisected longitudinally in the midline. Lower limbs were not detached from the pelves to aid performing dissection.

Dissection of internal iliac artery in fetal specimens was a tedious procedure due to the extremely small branches in the fetus. Hence it was done with utmost gentleness and care and as many branches as possible were dissected and pictures were taken.

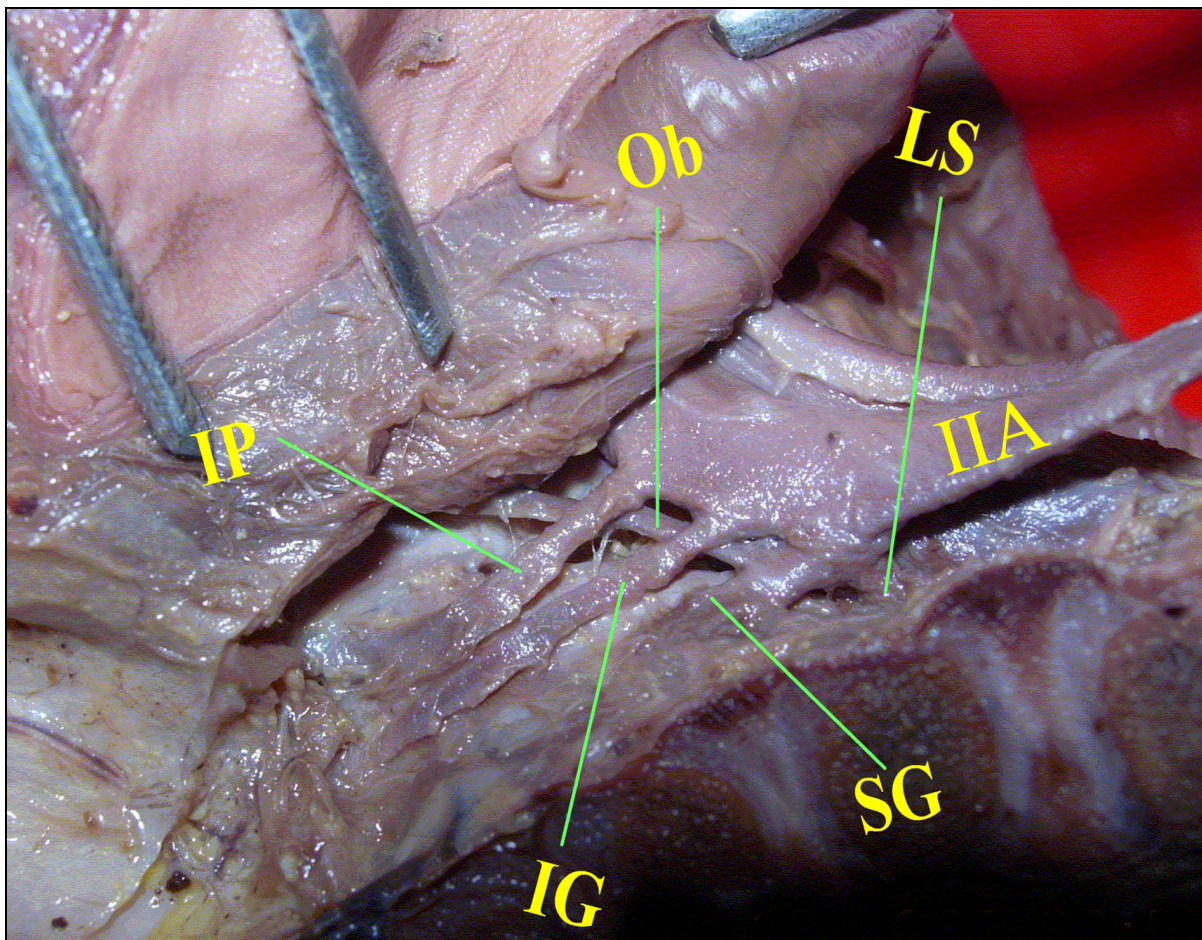


Figure 2. Right pelvic half showing the internal pudendal artery, inferior gluteal artery and superior gluteal artery arising directly from the internal iliac artery. IIA- Internal iliac artery; IG- Inferior gluteal artery; SG- Superior gluteal artery; IP- Internal pudendal artery. LS- Lateral sacral artery; Ob- Obturator artery.

RESULTS

Fetal internal iliac artery was in line with the common iliac artery and was larger than the external iliac artery, in contrast to that observed

in adult vessels. It continued as the umbilical artery which ascended along the sides and apex

of bladder to enter the anterior abdominal wall till it reached the umbilicus.

In 16 specimens (66.7%), two large trunks arose from internal iliac artery as described in the first type by Piersol. The posterior trunk continued as superior gluteal artery accompanied by two or three branches namely iliolumbar, lateral sacral artery and obturator artery. The anterior trunk gave off a common stem for internal pudendal artery and inferior gluteal artery. These two arteries are accompanied by the other smaller branches (figure 1). In 4 specimens, the division of the common trunk of internal pudendal artery and inferior gluteal artery occurs outside the pelvic cavity.

In 6 specimens (25%), there was no division into anterior and posterior trunks. All the three branches originated directly from the internal iliac artery. This was described as the second type by Piersol. Superior gluteal artery arose as the first branch from internal iliac artery. Inferior gluteal artery arose as the next branch. Internal pudendal artery was the third main branch (figure 2). The image shows the obturator artery arising in common with superior gluteal artery.

In two specimens (8.3%), inferior gluteal and superior gluteal artery arose from a common trunk and internal pudendal artery appears as a distinct branch as described in the third type by Piersol (figure 3).

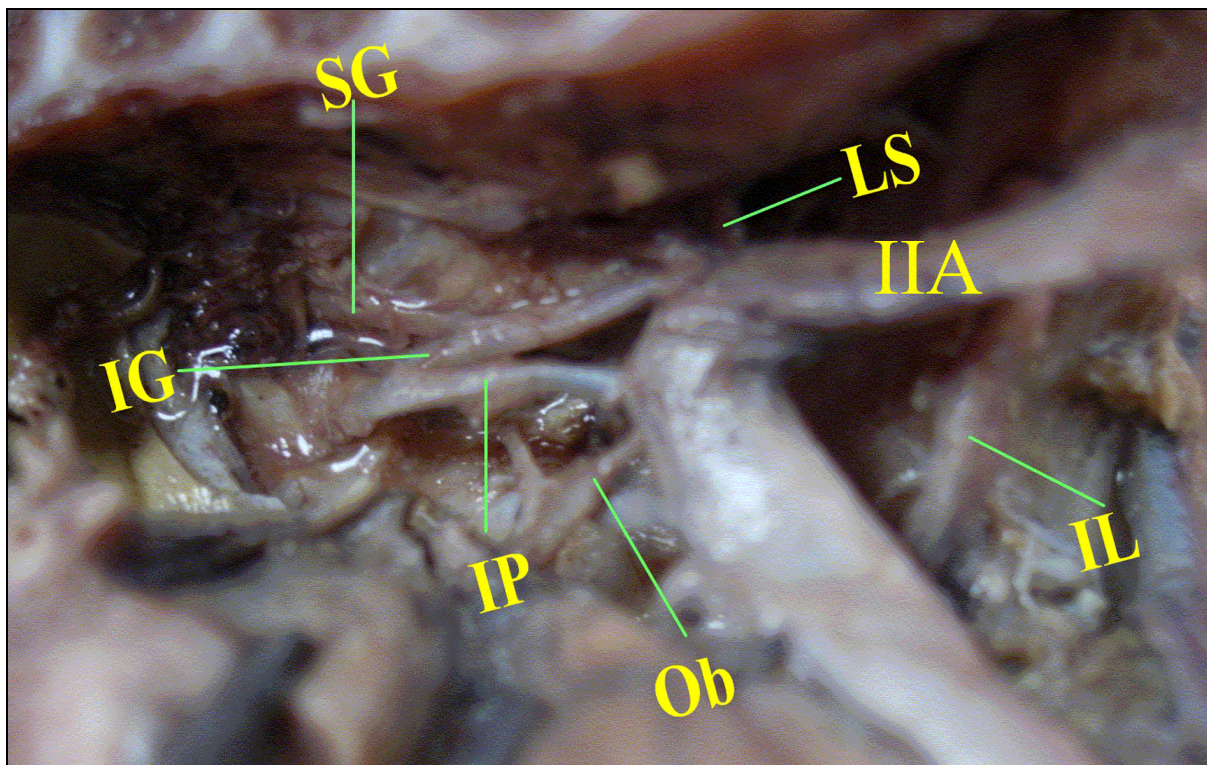


Figure 3. Left pelvic half showing the superior gluteal artery and inferior gluteal artery arising from the common trunk and internal pudendal artery separately from the internal iliac artery. IIA- Internal iliac artery; IG- Inferior gluteal artery; SG- Superior gluteal artery; IP- Internal pudendal artery. LS- Lateral sacral artery; Ob- Obturator artery; IL- Iliolumbar artery.

DISCUSSION

Piersol, (1930) has mentioned that in adults, the first type results in the typical description of internal iliac artery where, the main stem of the internal iliac divides into two divisions. Internal

pudendal artery and inferior gluteal artery are the terminal branches of the anterior division while superior gluteal artery originates from the posterior division. The second type leads to the

separation of the anterior division into its two terminal branches occurring higher. The third type leads to the anterior division giving rise to the internal pudendal, the inferior gluteal along with superior gluteal artery arising from the posterior division. The fourth type leads to the adult condition where there is no apparent separation of the adult internal iliac artery into an anterior and a posterior division. None of the specimens in this study revealed this type.

Embryologically, the umbilical arteries arise when the embryo is less than 1.5 mm long, about the level where, the fourth cervical mesodermal somite is developed at a later stage. They develop from the plexus formed, on the lateral walls of caudal part of the primitive gut, by anastomosis of some of the most caudally situated ventral or vitelline branches of the primitive dorsal aorta.

This origin of the arteries are gradually moved tail wards as the embryo grows, until eventually, they spring from primitive dorsal aorta opposite the 23rd body somite, which is the fourth lumbar segment. As each umbilical artery passes from its origin to its body stalk, it lies to the medial side of pronephric duct. The ventral origin is however, but temporary, as by the time embryo has attained a length of 5 cm, a new vessel has arisen on each side from the lateral part of the caudal end of the aorta. This new vessel passes ventrally to the lateral side of the mesonephric duct, and then unites on a plane ventral to the aorta, with the primitive umbilical artery of the same side (Grant, 1957). The umbilical artery, inferior gluteal artery, external iliac artery, common iliac artery and IIA are derived in adults as mentioned in table 1.

Artery	In fetus	After birth
UMB	Originates from aorta as a primary, then secondary root.	The greater part atrophies into medial umbilical ligament; but from the patent part, springs the superior vesical artery.
IG	Originates from UMB and is the primitive main artery of lower limb (sciatic artery).	The remnants of primitive axial artery present in the adult are IG, its sciatic branch, parts of popliteal and peroneal artery.
EIA	Originates as a small branch of UMB.	-Enlarges and exceeds the size of IIA. - Continues as the primary axial artery of lower limb.
CIA	Portion of UMB dorsal to the origin of EIA.	Appears to bifurcate into EIA and IIA.
IIA	Portion of UMB ventral to the origin of EIA.	Smaller terminal branch of CIA & continues as UMB.

Table 1. Embryology of the arteries of pelvis and lower limb. UMB- umbilical artery; IG- inferior gluteal artery; EIA- External iliac artery; CIA- Common iliac artery and IIA- Internal iliac artery.

In early fetal development, sciatic artery continues posteriorly as a large branch and anteriorly the internal iliac artery is large and dominant, the external iliac artery is a diminutive branch. The sciatic artery initially supplies the leg, but in time the femoral system, which develops de novo from the rete femoris in the upper thigh, takes over the supply. At 22 mm, the sciatic artery disappears and the femoral artery supplies blood to the leg. (Mooney et al, 2008). The adult pattern of vasculature is established by third month (Valentine et al, 2003)

In adults sciatic artery is usually present but hypoplastic. The persistence of the sciatic artery in the mature individual (the persistence of the internal iliac system as the circulation to the lower

extremity) although rare, is well described in the literature and leads to aneurysm formation (Shortell et al, 1998) and also atherosclerosis (McLellan et al, 1982) because of the persistence of immature vascular elements.

Extrinsic obstructions of the distal ureter because of aberrant or persistent umbilical artery traced in continuity from the internal iliac artery have been demonstrated in literature. The vessel was resected, and the ureter was reimplanted into the bladder (Gupta et al, 1999).

With the advent of fetal surgery, preoperative angiography with embolization and radio-frequency ablation or safe surgical resection of a large, vascular sacrococcygeal teratoma requires

adequate knowledge about the branching of fetal IIA (Cowles et al, 2006).

There are many reports of the vascular hazards of umbilical arterial catheterization such as renal artery thrombosis, superior mesenteric artery thrombosis and lower limb ischemia and infarction of iliac bone and gluteal region. The suggested sites for placement of the catheter tip are the lower abdominal aorta below the renal and mesenteric vessels or just above the diaphragm in the thoracic aorta. The blood supply to the skin of the upper thigh, buttock, and sciatic nerve is derived from the inferior gluteal artery. The superior gluteal artery supplies part of the lower back. These arteries may have been obstructed by thrombosis, embolism, or vasospasm caused by insertion of a catheter; alternatively the origins of these vessels might have been directly occluded by the catheter itself (Cumming et al, 1994 and Mann, 1980). A thorough knowledge of the branching pattern of IIA is necessary for radiological interpretation and avoidance of such mishaps.

The alteration from normal arterial anatomy in this region has its own obstetric, surgical and radiological implications in adult life while performing internal iliac ligation or angiographic embolisation.

The first type of fetal branching is the most common pattern observed and is the one which leads to the typical pattern of branching in adult life too. In the remaining there is a deviation from normal anatomy of internal iliac artery. The anatomical differences of fetal internal iliac artery from that of adult should be borne in mind while performing fetal surgeries.

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