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CASE REPORT

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Branching pattern of the internal iliac artery accompanied by a venous anastomosis: rare vascular variations

M. Kula[1], Ł. Olewnik[1], K. Ruzik[1], R.S. Tubbs[2–7], A. Balcerzak[1], N. Zielinska[1]

[1]*Department of Anatomical Dissection and Donation, Medical University of Lodz, Poland*
[2]*Department of Anatomical Sciences, St. George's University, Grenada, West Indies*
[3]*Department of Neurosurgery, Tulane University School of Medicine, New Orleans, Louisiana, United States*
[4]*Department of Neurology, Tulane University School of Medicine, New Orleans, Louisiana, United States*
[5]*Department of Structural and Cellular Biology, Tulane University School of Medicine, New Orleans, Louisiana, United States*
[6]*Department of Surgery, Tulane University School of Medicine, New Orleans, Louisiana, United States*
[7]*Department of Neurosurgery, Ochsner Medical Centre, New Orleans, Louisiana, United States*

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The ability to navigate the complex and often deceptive branching patterns of the internal iliac artery can be decisive in planning and performing surgeries within the lesser pelvis. The following case report presents a peculiar quadruple division of the internal iliac artery, accompanied by a venous anastomotic structure. Apart from the posterior and anterior trunks, the superior vesicle and iliolumbar arteries arose independently from the internal iliac artery. The division was surrounded by a venous oval, compressing certain branches and potentially complicating surgical access. Due to the uncommon course of the internal iliac artery and the presence of the anastomosis, a possible nerve root compression has been identified. Both clinical significance and classification method of the case are discussed. Knowledge of this anatomical variation is valuable for both diagnosis and surgery, especially within the specialties of urology, gynaecology and general surgery. (Folia Morphol 2023; 82, 4: 943–947)

Key words: anatomical variations, internal iliac artery, case report

INTRODUCTION

The internal iliac artery (IIA), also known as the hypogastric artery, is the main blood vessel supplying the walls and organs of the pelvis, the reproductive organs, buttocks, muscles of the lumbar region and the medial section of the thigh. About 3–4 cm long, it is significantly smaller than the external iliac artery [7]. The IIA arises at the bifurcation of the common iliac artery, anterior to the pelvic brim, at the level of the L5-S1 intervertebral disc [16]. It descends posteriorly to the upper margin of the sciatic foramen, where it divides into two branches, the posterior and anterior trunks (AT).

The posterior trunk (PT) bends posteriorly and passes towards the greater sciatic foramen, exiting the pelvis above the piriformis muscle. It most commonly gives off three parietal branches, the iliolumbar, lateral sacral and superior gluteal arteries, the last-named being its termination. The AT passes proximally to the piriformis muscle and the sacral plexus until it reaches the lower section of the sciatic foramen. It gives rise to six visceral branches: the umbilical, superior vesi-

Address for correspondence: Ł. Olewnik, MD, PhD, Department of Anatomical Dissection and Donation, Chair of Anatomy and Histology, Medical University of Lodz, ul. Żeligowskiego 7/9, 90–410 Łódź, Poland, e-mail: lukasz.olewnik@umed.lodz.pl

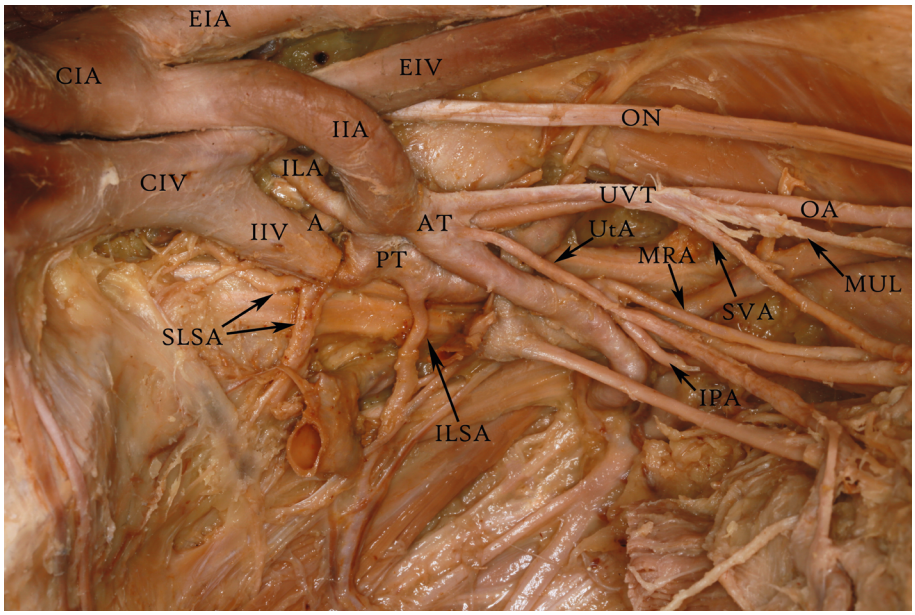

Figure 1. Branching point of a left internal iliac artery seen from the medial perspective. Section of a left internal iliac vein has been resected for better exposure; A — point of anastomosis of the EIV (beginning of the venous circle); AT — anterior trunk of internal iliac artery; CIA — common iliac artery; CIV — common iliac vein; EIA — external iliac artery; EIV — external iliac vein; IIA — internal iliac artery; IIV — internal iliac vein; ILA — iliolumbar artery; ILSA — inferior lateral sacral artery; IPA — interior pudendal artery; MRA — medial rectal artery; MUL — median umbilical ligament; OA — obturator artery; ON — obturator nerve; PT — posterior trunk of internal iliac artery; SLSA — superior lateral sacral artery; SVA — superior vesical artery; UtA — uterine artery; UVT — umbilico-vesical trunk.

cal, inferior vesical and middle rectal arteries and, in females, the vaginal and uterine arteries. It also gives off two parietal branches, the obturator and inferior gluteal arteries, the latter being its termination.

The following case study describes an unusual branching pattern of the IIA. Instead of giving rise to two main trunks that further divided into its terminations, the IIA divided into four lower calibre branches, the iliolumbar and superior vesical arteries arised directly from its main trunk. The division was encircled by a venous anastomotic structure derived from the internal iliac vein. The anastomosis passed between the posterior and AT of the IIA, surrounding the artery's division and coming back beneath the iliolumbar artery (ILA) before ending its course, reaching the external iliac artery.

Understanding the elusive branching pattern of the IIA is invaluable for clinicians, especially gynaecologists [9]. This knowledge is likely to prove essential during surgical procedures in which a certain part of the artery needs to be ligated in order to control pelvic haemorrhage.

CASE REPORT

A female cadaver 75 years old at death was subjected to routine anatomical dissection for research and educational purposes at the Department of Anatomical Dissection and Donation, Medical University of Lodz, Poland. During a routine assessment of the lumbosacral plexus, an anomaly of IIA branching was identified (Fig. 1).

The lengths and widths of the branches were measured using a digital calliper. A detailed analysis of the branching pattern revealed an unusual division, which has not previously been described to our knowledge. Additionally, a venous anastomotic structure surrounding the division was exposed (Fig. 2).

The IIA begins its course at the bifurcation of the common iliac artery. It is 38.6 mm long and its diameter is 7.21 mm. After branching out of the common iliac artery, it descends medially alongside the posterior pelvic wall towards the external iliac vein (EIV). Upon passing the EIV it descends towards the pelvic floor for approximately 16 mm before giving rise to its 5 branches: the ILA, the superior lateral sacral artery, the PT, the AT, and the superior vesical artery (SVA) from which the medial umbilical ligament arises. Immediately after branching from the IIA, the ILA (7.94 mm) bends upwards and runs on top of the anastomosis of the internal iliac vein, then passes beneath the EIV and divides into its terminations, the iliac and lumbar branches. The uterine artery (UtA) begins at the AT 3.12 mm below the origin

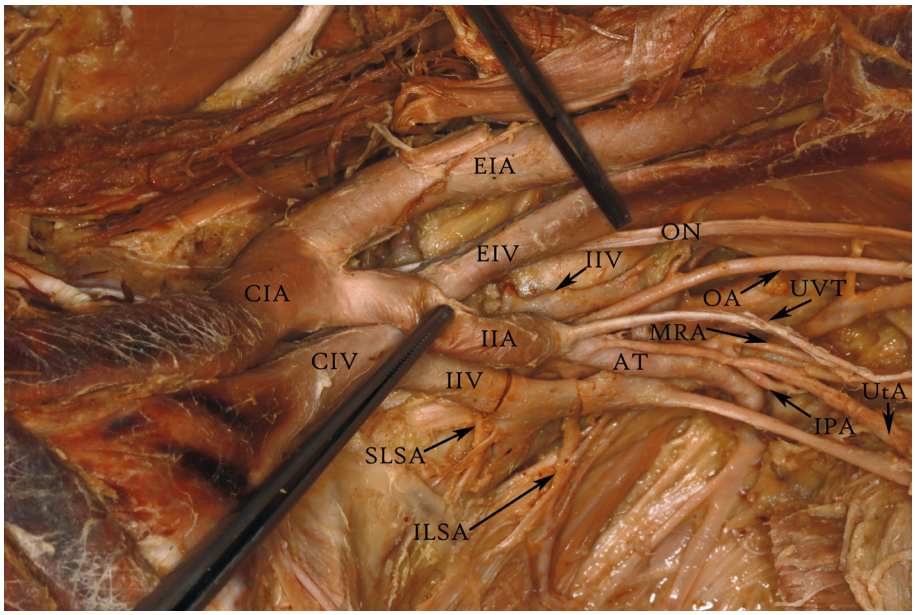

Figure 2. Branching of the internal iliac artery surrounded by a venous anastomosis originating from the internal iliac vein. Top-down perspective; AT — anterior trunk of internal iliac artery; CIA — common iliac artery; CIV — common iliac vein; EIA — external iliac artery; EIV — external iliac vein; IIA — internal iliac artery; IIV — internal iliac vein; ILA — iliolumbar artery; ILSA — inferior lateral sacral artery; IPA — interior pudendal artery; MRA — medial rectal artery; OA — obturator artery; ON — obturator nerve; SLSA — superior lateral sacral artery; UtA — uterine artery; UVT — umbilico-vesical trunk.

of the umbilico-vesical trunk and descends towards the uterus. The internal pudendal artery and the middle rectal artery share a short (6.09 mm) common trunk, which begins at the AT 20 mm below the beginning of the UtA and almost immediately bifurcates, creating points of origin for the aforementioned vessels. After giving off the internal pudendal artery and the middle rectal artery, the AT passes anteriorly for 18 mm and then bends posteriorly, exiting the lesser pelvic cavity between the L5 and S1 spinal nerves and below the piriformis muscle to become the inferior gluteal artery. Further dissection and assessment of the inferior gluteal artery ruled out the presence of a sciatic artery. The PT arises from the IIA below the AT and descends anteriorly. Before exiting the pelvic cavity above the piriformis muscle and becoming the superior gluteal artery, it gives off the inferior lateral sacral artery 7 mm below the superior lateral sacral artery, and the obturator artery, which arises from the PT directly opposite the inferior lateral sacral artery. Further dissection and analysis of the obturator artery and the inferior epigastric artery ruled out the presence of a "corona mortis" anastomosis [2]. The PT is 4.43 mm in diameter.

The venous anastomotic structure originates from the internal iliac vein and is oval. The anastomosis is 9.48 mm wide and 19.76 mm long and encircles the division of the IIA. The PT of the IIA passes through the venous circle and descends towards the pelvic floor, whereas the AT runs anteriorly, resting on top of the anastomosis, pressing it down against the PT. Applied pressure forces the PT down, causing it to rest on the L5 root of the sciatic nerve (Table 1).

Table 1. Measurements of the structures of interest

Structure	Length [mm]	Width [mm]
Internal iliac artery	38.6	7.21
Anterior trunk	41.97	3.97
Posterior trunk	22	4.43
Iliolumbar artery	7.94	3.12
Uterine artery	84.41	2.22
Umbilico-vesical trunk	27	2
Umbilical ligament	90	1.34
Vesical artery	79.4	1.47
Obturator artery	47.3	1.67
Middle rectal artery	29	1.22
Internal pudendal artery	19.4	1.25
Internal iliac vein anastomosis	19.76	9.48

Ethical approval

The cadavers belonged to the Department of Anatomical Dissection and Donation, Medical University of Lodz, Poland.

DISCUSSION

Since the pelvic vascularisation is intricate, it is essential for a wide range of specialists such as gynaecologists, urologists, proctologists and general surgeons to understand the possible anatomical variations of the IIA to maximise the efficiency of certain procedures [3, 5, 11, 14]. Especially in laparoscopic surgery, there is a huge demand for precise descriptions of pelvic vascularisation to help preclude iatrogenic injuries [10, 13, 18].

The branching pattern described here resembles type III in the Balcerzak classification [1] because three main branches (AT, PT, ILA) exit the common trunk. However, certain nuances such as a SVA arising directly from the IIA instead of the AT, and two sacral lateral arteries, distinguish it significantly since none of them are considered in Balcerzak's system [1]. The artery described in the present article has a further uncommon anatomical variation: the obturator artery branches out of the posterior division of the IIA. Pai et al. [15] estimated the prevalence of a similar variant at 8–10%. This has some clinical value: during procedures such as embolization or ligation of the obturator artery, it is vital for the operator to be aware of the possible points of origins of the vessel. Such knowledge can reduce the duration of the procedure and thereby minimise potential complications [20].

Since the IIA provides the main blood supply to the uterus, it is also crucial in the development of a range of uterine pathologies such as adenomyosis [17] and uterine fibroids [12]. Both those conditions are exacerbated by an excessive blood supply from the UtA, which is why UtA embolisation provides effective treatment. During this procedure, a catheter is inserted through the femoral or radial artery into the IIA and then into the UtA. It is therefore important for the surgeon to have a good understanding of the highly variable branching pattern of IIA in order to avoid dire complications. For instance, in the case presented here, the procedure could prove difficult because of the close proximity (3.12 mm) of the UtA to the SVA and the difference in vessel diameters: UtA: 1.72 mm, SVA: 2.2 mm. This could lead to accidental insertion of the catheter into the SVA; or puncture of the AT, inevitably causing profuse haemorrhage.

Because the IIA follows a sinuous course and is close to major nerves, anatomical variations often correlate directly with compression syndromes. Conditions such as aneurysms involving a drastic increase of the artery's diameter are the most common causes of such pathologies. In a recent case study, de Bruijn et al. [6] described a type IA (Balcerzak, 2021) IIA containing an aneurysm located between the L5 and S1 nerve roots. The location of the aneurysm combined with the artery's branching pattern elicited buttock ischaemia and neurological symptoms such as impairment of active knee and plantar foot flexion, absent dorsal flexion, and sensitivity disorders below the knee, all caused by nerve root compression [6]. In the case presented here, owing to the venous anastomosis, the PT of the IIA applied considerable pressure on the L5 nerve, causing it to deform. It is unclear whether this caused any discomfort during life, but it certainly aggravated or increased the risk of closely-related conditions such as wallet neuritis, lotus neuropathy or piriformis syndrome.

Rupture of the IIA and its branches is a rare but potentially lethal complication that can occur during pregnancy [4, 19]. In a case report describing three instances of utero-ovarian ruptures, Ginsburg et al. [8] estimate the initial overall mortality at up to 49%. However, owing to the rapid development of intensive intraoperative and postoperative treatments, a decline to 3.6% has been noted (Table 2) [8].

Table 2. The 2021 Balcerzak classification. "Main vessels" include the superior gluteal, inferior gluteal, internal pudendal and sciatic arteries (in group V)

Type	Description
Group I	Main vessels have two points of origin: the first is a single branch, the second a common trunk
Subgroup A: Common trunk divides inside the pelvic cavity Subgroup B: Common trunk divides outside the pelvic cavity	
Group II	Main vessels have two points of origin: the first is a common trunk, the second a single branch
Subgroup A: Common trunk divides inside the pelvic cavity Subgroup B: Common trunk divides outside the pelvic cavity	
Group III	Main vessels have three points of origin; order of origin is irrelevant
Group IV	Main vessels have one point of origin; order of origin is irrelevant
Group V	Main vessels have four points of origin; additionally includes the sciatic artery

CONCLUSIONS

In conclusion, variations of the IIA are common and it is nearly impossible to classify them comprehensively. This underlines the importance of supplementing existing classifications with case studies like the present one. Preoperative knowledge of anatom-

ical variants and their relationships to neighbouring structures is crucial in planning and performing surgical procedures on the IIA and in its vicinity.

Conflict of interest: None declared

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