

## VARIATIONS IN ORIGIN OF THE PARIETAL BRANCHES OF THE INTERNAL ILIAC ARTERY

By J. L. BRAITHWAITE

*Department of Anatomy, University of Liverpool*

The first attempt to group the variations in the origin of the parietal branches of the internal iliac artery into definite patterns was undertaken by Jastschinski (1891*a*). In an extensive study of the internal iliac artery in Polish subjects he classified the vessels into three categories:

- (1) Those of large calibre (superior gluteal, inferior gluteal and internal pudendal arteries).
- (2) Those of medium calibre (obturator artery).
- (3) Those of small calibre (iliolumbar and lateral sacral arteries).

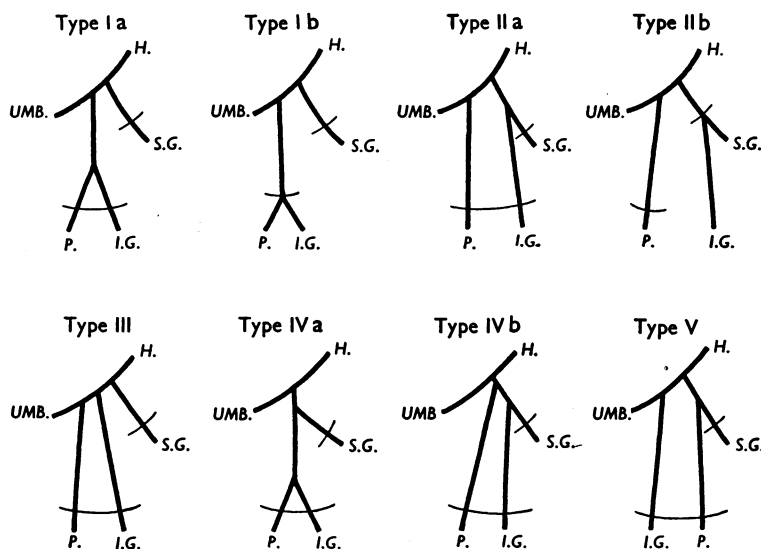


Fig. 1. Adachi's types. *H.* internal iliac artery; *I.G.* inferior gluteal artery; *P.* internal pudendal artery; *S.G.* superior gluteal artery; *UMB.* umbilical artery.

Jastschinski (1891*a*) found that only the vessels in the first category showed sufficient regularity in origin to enable them to be grouped into definite *Types*, of which he described four. Adachi (1928) modified the method slightly, adding a fifth type of variation and included certain subtypes, in a study of the internal iliac artery and its branches in Japanese subjects. His scheme is as follows (Fig. 1):

*Type I.* The superior gluteal artery arises separately from the internal iliac artery, and the inferior gluteal and internal pudendal vessels are given off by a common trunk. If the latter divides within the pelvis it is considered to be *Type Ia*, whereas if the bifurcation occurs below the pelvic floor it is classified 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, as in the previous one, two subtypes are described. *Type IIa* includes those specimens in which the trunk common to the two gluteal arteries divides within the pelvis, and *Type IIb* those in which the division occurs outside the pelvis.

*Type III. The three branches arise separately from the internal iliac artery.*

*Type IV. The three arteries arise by a common trunk.* The subtyping in this group is based on the sites of origin of the superior gluteal and the internal pudendal arteries from the parent stem. In *Type IVa* the trunk first gives rise to the superior gluteal artery before bifurcating into the other two branches; in *Type IVb* the internal pudendal is the first vessel to spring from the common trunk, which then divides into superior and inferior gluteal arteries.

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

Ashley & Anson (1941), who carried out a similar investigation to that of Lipshutz (1918) in American subjects (Whites and Negroes), employed the umbilical artery in addition to the three large parietal trunks for 'typing' and the obturator artery for 'subtyping' the internal iliac variations.

Since the variations in origin of the parietal branches of the internal iliac artery are of great surgical importance, but have not been previously investigated in a large series of British subjects, it was decided to undertake this extensive study.

On account of the marked variations in origin of the obturator artery the findings for this vessel will be described separately from those pertaining to the superior gluteal, inferior gluteal and internal pudendal arteries, and the latter will be classified according to Adachi's method. The existing arterial variations can be as well appreciated by this approach as by employing the obturator artery as an additional factor in 'subtyping', as in the classifications of Lipshutz (1918) and Ashley & Anson (1941).

#### MATERIAL AND METHODS

A total of 169 pelvic halves have been studied, of which seventy-four pelves were examined completely (i.e. 148 pelvic halves), the remaining twenty-one being single sides. Of these sixty-one were female (twenty-seven adult and thirty-four infant pelvic halves), and 108 (ninety-one adult and seventeen infant) were male.

The adult material consisted of subjects from the post-mortem and dissecting rooms, between the ages of thirty-two and eighty-nine. The post-mortem room pelves were injected with a carmine gelatine preparation through one internal iliac artery, to display more clearly the pelvic arteries, indian ink ('Raven' brand) being employed for the injection of all the infant material.

Photographs or drawings were made after displaying the branches of the internal iliac artery. Their sites of origin from the parent trunk, their destinations and any abnormalities found were carefully recorded.

FINDINGS

(1) Superior gluteal, inferior gluteal and internal pudendal arteries

The findings in 169 observations are given in Table 1, and examples of some of the variations noted in the present series are depicted in Figs. 2-5.

Table 1. Internal iliac types

Types	Female		Male		Total	
	No.	%	No.	%	No.	%
I a	25	40.9	57	52.7	82	48.5
I b	5	8.2	12	11.1	17	10.0
II a	11	18.0	9	8.3	20	11.8
II b	4	6.5	2	1.8	6	3.5
III	18	21.3	25	23.1	38	22.5
IV a	2	3.2	2	1.8	4	2.4
IV b	1	1.6	1	0.9	2	1.2
V	—	—	—	—	—	—
Totals	61	99.7	108	99.7	169	99.9

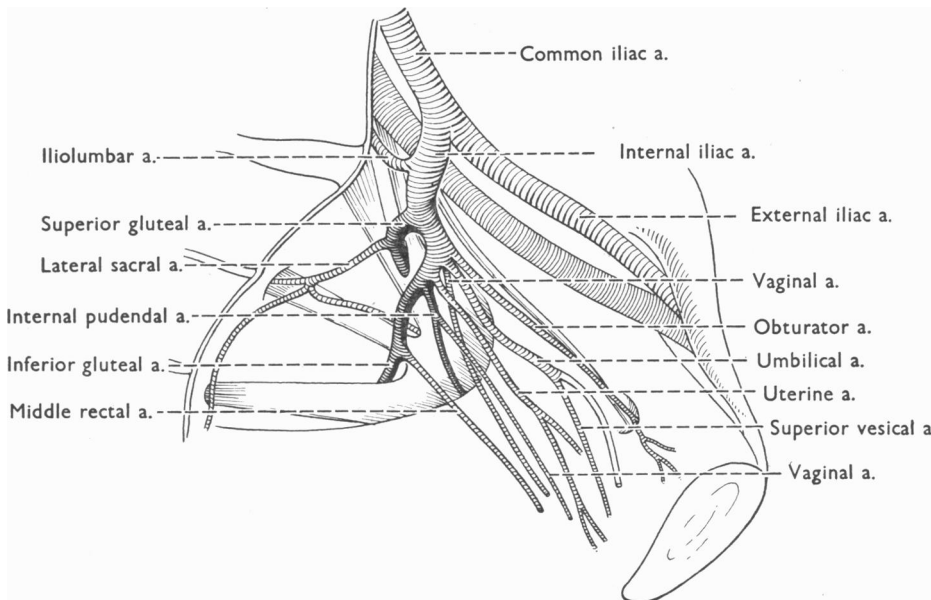
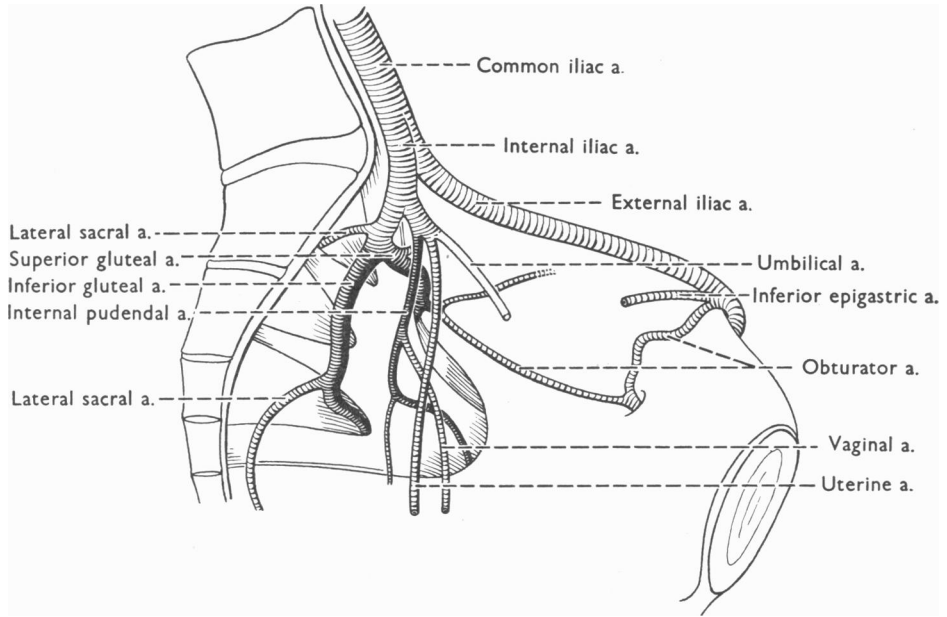
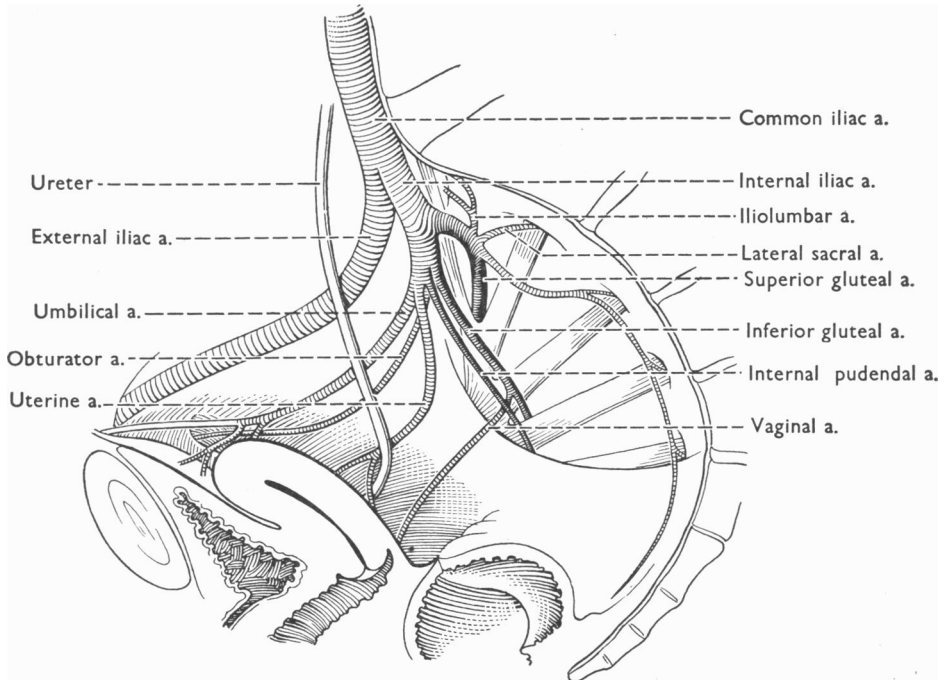


Fig. 2. Internal iliac artery—Type Ia.

A Type I arrangement is the most frequent finding, accounting for 58.5 % of all specimens; the common stem for the inferior gluteal and internal pudendal arteries divides proximal to the pelvic floor in 48.5 % of instances, whilst in 10 % the division occurs outside the pelvis. Type III is found in 22.5 % and a Type II arrangement in 15.3 %; in the latter the trunk common to the two gluteal arteries divides proximal to the pelvic floor in 11.8 % of instances and below this level in 3.5 %. The pattern conforming to Type IV is comparatively rare, being present in only 3.6 % of specimens. A Type V arrangement is not found in this series.



**Fig. 3. Internal iliac artery—Type IIa.**



**Fig. 4. Internal iliac artery—Type III.**

The main difference between the female and male series is in the proportion of Type II arteries, only 10.1% of the male specimens being in this category as compared with 24.5% of female.

Thirty-nine of the seventy-four complete pelves examined (52.7%) exhibit a similar origin of the three parietal arteries on both sides (twenty-seven out of forty-nine male pelves (55%) and twelve out of twenty-five female pelves (48%).

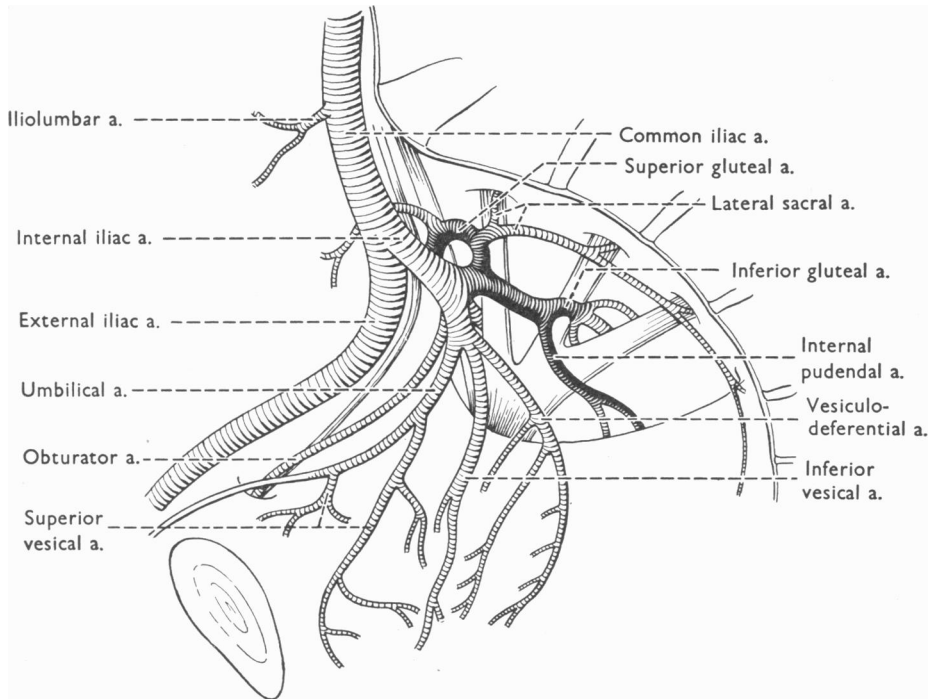


Fig. 5. Internal iliac artery—Type IV a.

### (2) Obturator artery

The findings in 169 observations are given in Table 2, and represented diagrammatically in order of frequency in Fig. 6.

The obturator artery is most frequently a direct branch of the anterior division of the internal iliac artery, in 41.4% of instances, and arises from the inferior epigastric artery in 19.5%. There is a similarity of incidence of origin (10% of cases) of the obturator artery from the superior gluteal and inferior gluteal-internal pudendal arteries. In 6.5% of instances the obturator artery arises by a bifid root, one from an internal iliac source and the other from the external iliac artery. Less frequently, it is given off by the inferior gluteal artery (4.7%), the internal pudendal artery (3.8%), and as a direct branch from the external iliac artery in 1.1%. The main difference between the two sexes is in the incidence of a superior gluteal origin; this occurs in 16.4% of the female specimens as compared with 6.4% of male. Of the seventy-four complete pelves examined, the obturator artery exhibits a similar origin on both sides in only 23%.

Table 2. *Origins of obturator artery*

Origin	Female		Male		Total	
	No.	%	No.	%	No.	%
A. From internal iliac artery:						
(i) Direct branch from anterior division	24	39.3	46	42.6	70	41.4
(ii) Inferior gluteal-internal pudental trunk	5	8.2	12	11.1	17	10.0
(iii) Inferior gluteal artery	2	3.2	6	5.5	8	4.7
(iv) Internal pudental artery	2	3.2	4	3.7	6	3.8
(v) Superior gluteal artery	10	16.4	7	6.4	17	10.0
(vi) Iliolumbar artery	3	4.9	2	1.8	5	3.5
B. From external iliac artery:						
(i) Direct branch	1	1.6	1	0.9	2	1.1
(ii) Inferior epigastric artery	10	16.4	23	21.3	33	19.5
C. From internal and external iliac arteries:						
By double origin	4	6.4	7	6.4	11	6.5
Totals	61	99.6	108	99.7	169	99.5

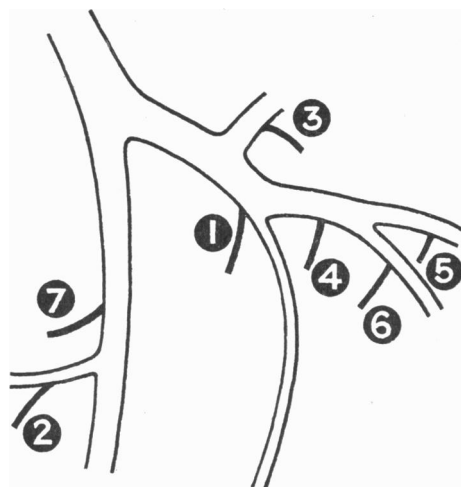


Fig. 6. *Origins of the obturator artery* (in order of frequency). 1, from anterior division of internal iliac artery—41.4%; 2, from inferior epigastric artery—19.5%; 3, from superior gluteal artery—10%; 4, from inferior gluteal-internal pudental trunk—10%; 5, from inferior gluteal artery—4.7%; 6, from internal pudental artery—3.8%; 7, from external iliac artery—1.1%.

#### DISCUSSION

Although the mode of origin of the three large parietal vessels conforms to one of four types in the present investigation, an arrangement in which the superior gluteal artery arises proximal to the common trunk for the inferior gluteal and internal pudental arteries is comparatively constant (58.5%). This finding is in agreement with Adachi (1928) and Ashley & Anson (1941). Jastschinski (1891*a*), however, notes a Type I incidence in only 38% of his specimens. The obturator artery is much more variable. All investigators are agreed that the most common site of origin of this vessel is from the anterior division of the internal iliac artery as a direct branch; present findings, however, differ from those of previous observers

in the comparatively low incidence of an obturator artery arising from the inferior epigastric artery (19.5%), and the high incidence of a vessel with a double origin (6.5%).

The incidence of an origin from the inferior epigastric artery varies from 20 to 30% in most series (Jastschinski, 1891*b*; Quain, 1844; Levi, 1901; Pick, Anson & Ashley, 1942). Most observers describe the obturator vessel as having a double origin in about 1% of cases (Quain, 1844; Dwight, 1895; Pick *et al.* 1942). Adachi (1928) pointed out that an obturator artery with two roots probably occurs more frequently than previous findings have indicated, this discrepancy being due to the difficulty of recognizing one of the roots when of very small size. In such instances, the larger root, which generally arises from the inferior epigastric artery, would probably be regarded as an obturator artery arising by a single stem.

In the present investigation, many of the pelvic arteries were injected in fresh material prior to dissection; this enabled the fine vessels to be followed more accurately than is possible in uninjected dissecting room material, from which earlier investigators have obtained their results.

It is suggested, therefore, that the technique adopted may account for the recognition of a greater number of obturator arteries with a double origin compared with other findings and, consequently, a lower incidence of single obturator vessels of inferior epigastric origin.

#### SUMMARY

1. The sites of origin of the superior gluteal, inferior gluteal, internal pudendal and obturator arteries have been investigated in 169 specimens (108 male and sixty-one female).

2. The superior gluteal, inferior gluteal and internal pudendal arteries are comparatively constant in their origins, conforming to a Type I arrangement on the Adachi scale in 58.5% of cases, a Type III pattern being found in 22.5% and Type II in 15.3%. Type IV is less frequent and occurs in 3.6% of specimens. In 52.7% of instances, a similar origin of vessels is noted on both sides.

3. The obturator artery is more variable and arises as a direct branch from the anterior division of the internal iliac artery in 41.4% of instances, from the inferior 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 origin in 6.4%. In only 23% of instances is a similar origin noted on both sides.

4. The present findings show a lower incidence from the inferior epigastric artery and a higher rate of occurrence of a vessel with a double origin than previous series. Reasons are suggested to explain these differences.

I wish to thank Prof. R. G. Harrison for his helpful criticism of this work, also Prof. G. A. G. Mitchell of Manchester University, in whose Department the greater part of this study was carried out, for allowing me all facilities.

## REFERENCES

- ADACHI, B. (1928). *Das Arteriensystem der Japaner*, Bd. II. Kyoto. Supp. to *Acta Scholae Medicinalis Universitatis Imperialis in Kioto*, 9 (1926-7).
- ASHLEY, F. L. & ANSON, B. J. (1941). The hypogastric artery in American Whites and Negroes. *Amer. J. phys. Anthropol.* 28, 381-391.
- DWIGHT, T. (1895). Statistics of variations with remarks on the use of this method in anthropology. 1. Origin of the obturator artery. *Anat. Anz.* 10, 209-215.
- JASTSCHINSKI, S. (1891a). Die typischen Verzweigungsformen der Arteria hypogastrica. *Int. Mschr. Anat. Physiol.* 8, 111-127.
- JASTSCHINSKI, S. (1891b). Die Abweichungen der Arteria obturatoria nebst Erklärung ihres Entstehens. *Int. Mschr. Anat. Physiol.* 8, 366-379.
- LEVI, G. (1901). Osservazioni sulle variazioni delle arterie iliache. *Monit. zool. ital.*, 12, no. II, 332-341.
- LIPSHUTZ, B. (1918). A composite study of the hypogastric artery and its branches. *Ann. Surg.* 67, 584-608.
- PICK, J. W., ANSON, B. J. & ASHLEY, F. L. (1942). The origin of the obturator artery; study of 640 body halves. *Amer. J. Anat.* 70, 317-343.
- QUAIN, R. (1844). *The Anatomy of the Arteries of the Human Body*. London: Taylor and Walton.