

## ORIGINAL PAPER

# The anomalous origin and branches of the obturator artery with its clinical implications

A. R. JUSOH, NURZARINA ABD RAHMAN, AZIAN ABD LATIFF,  
FAIZAH OTHMAN, S. DAS, NORZANA ABD GHAFAR,  
FARIHAH HAJI SUHAIMI, FARIDA HUSSAN,  
ISRAA MAATOQ SULAIMAN

*Department of Anatomy,  
Faculty of Medicine, Universiti Kebangsaan Malaysia,  
Jalan Raja Muda Abdul Aziz, Kuala Lumpur, Malaysia*

### Abstract

The obturator artery (OA) originates from the internal iliac artery. Variation in the origin of the OA may be asymptomatic in individuals and occasionally be detected during routine cadaveric dissections or autopsies. In the present study, we observed the origin and the branching pattern of the OA on 34 lower limbs (17 right sides and 17 left sides) irrespective of sex. The bifurcation of the common iliac artery into internal and external iliac from the sacral ala varied between 4.3–5.3 cm. The distance of the origin of the anterior division of internal iliac artery from the bifurcation of common iliac artery varied between 1–6 cm. The distance of the origin of the posterior division of the internal iliac artery from the point of bifurcation of the common iliac artery varied between 0–6 cm. Out of 34 lower limbs studied, two specimens (5.8%) showed anomalous origin of the OA originating from the posterior division of the internal iliac artery. Of these two, one limb belonged to the right side while the other was from the left side. The anomalous OA gave off an inferior vesical branch to the prostate in both the specimens. No other associated anomalies regarding the origin or branching pattern of the OA were observed. Prior knowledge of the anatomical variations may be beneficial for vascular surgeons ligating the internal iliac artery or its branches and the radiologists interpreting angiograms of the pelvic region.

**Keywords:** artery, anatomy, branches, internal iliac, obturator, inferior vesical, anomalies, variations.

### Introduction

Normally, the internal iliac artery originates from the common iliac artery at the level of sacroiliac joint [1, 2]. The internal iliac artery descends posterior to the greater sciatic foramen thereby dividing into anterior and posterior divisions [1–3]. On each side, the anterior division gives rise to the superior vesical artery, inferior vesical artery, middle rectal artery, vaginal artery, obturator artery, internal pudendal artery and the inferior gluteal artery [1–3]. The posterior division of the internal iliac artery is known to give rise to three main branches i.e. iliolumbar artery, lateral sacral artery and the superior gluteal artery [1–3].

As per standard anatomy textbook description, the OA inclines antero-inferiorly on the lateral pelvic wall and leaves the pelvic cavity by passing through the obturator foramen [2, 3]. Standard anatomy textbook also describes that the OA may give off an iliac branch, a pubic branch and a vesical branch [2]. The OA has been reported to originate from all the neighboring arteries which includes even the common iliac or any of the branches of the internal iliac artery [4]. Interestingly, the ratio of the frequency of the OA originating from the internal iliac artery to those originating from epigastric and external iliac artery has been reported to be 3:1 [5]. The origin of the OA from the posterior division of the

internal iliac artery has been also been reported by past researchers [6].

In the present study, the clinical implications of anomalous origin of the OA from the posterior division of internal iliac artery and the inferior vesical artery originating from the anomalous OA are being discussed.

### Material and Methods

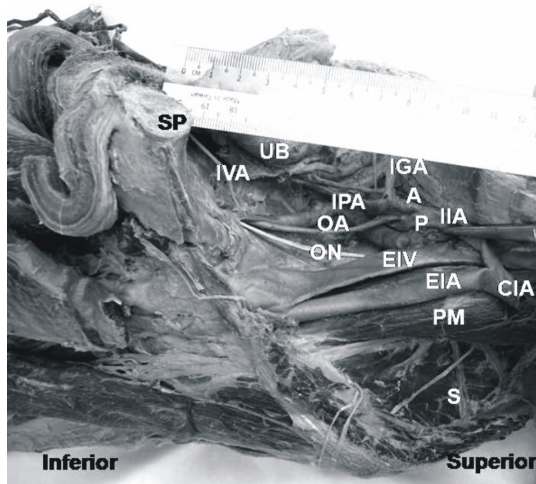
The study was performed as per Institutional ethical rules and regulations. The present study was performed on both sides of 17 (n=34) cadavers in the Department of Anatomy, Universiti Kebangsaan Malaysia. All the cadavers were of unclaimed origin, so no proper history of the cadavers was available. No particular emphasis was given if the limb belonged to male or the female sex. We admit humbly that due to extreme shortage of cadavers, we conducted the study only on the available 34 specimens.

The region of the pelvis was dissected in all the specimens. No particular method was employed for the dissection but care was taken to expose the branches of the common iliac artery. The common iliac artery along with its anterior and posterior divisions and its further subdivisions, were carefully delineated by separating it from the surrounding structures. The OA was carefully dissected to study its origin and branches. Morphometric

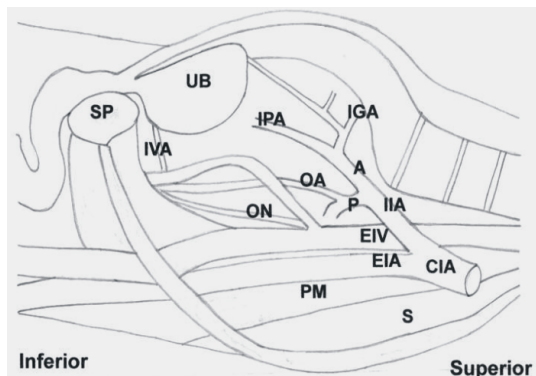
measurements were taken and the specimens were photographed (Figures 1–3). The distances were measured using steel wires fixed between two points. To avoid bias, all the measurements were taken by two different authors. A line diagram was also drawn for better understanding (Figure 2).

## Results

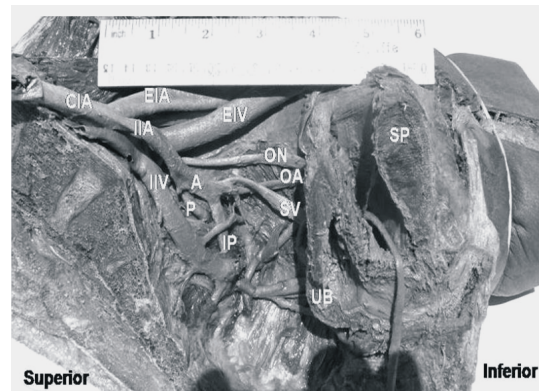
The distance of the bifurcation of the common iliac artery into internal and external iliac from the sacral ala ranged between 4.3–5.3 cm. The distance of the origin of the anterior division of internal iliac artery from the bifurcation of common iliac artery ranged between 1–6 cm. The distance of the origin of the posterior division of the common iliac artery ranged between 0–6 cm. All the specimens exhibited the division of the common iliac artery into anterior and posterior divisions ('A' & 'P' in Figures 1–3).



**Figure 1** – Photograph of the anomalous dissected specimen (left side) showing: A – anterior division of the internal iliac artery; P – posterior division of the internal iliac artery; UB – bladder; CIA – common iliac artery; EIA – external iliac artery; EIV – external iliac vein; IGA – inferior gluteal artery; IIA – internal iliac artery; IPA – internal pudendal artery; IVA – inferior vesical artery; OA – obturator artery; ON – obturator nerve; PM – psoas major muscle; S – superior surface of iliacus muscle; SP – symphysis pubis.



**Figure 2** – A line diagram for anomalous dissected specimen (left side) exactly representing Figure 1 with similar legend.



**Figure 3** – Photograph of the normal dissected specimen (left side) showing: A – anterior division of the internal iliac artery; P – posterior division of the internal iliac artery; UB – bladder; CIA – common iliac artery; EIA – external iliac artery; EIV – external iliac vein; IIA – internal iliac artery; IP – internal pudendal artery; OA – obturator artery; ON – obturator nerve; S – sacrum; SP – symphysis pubis; SV – superior vesical artery.

Out of 34 lower limbs studied, only two specimens (5.8%) showed anomalous origin of the obturator artery originating from the posterior division of the internal iliac artery ('OA' in Figures 1–3). Of these two, one limb belonged to the right side while the other was from the left side. The anomalous OA gave off an inferior vesical branch innervating the prostate gland. The anomalous origin of the inferior vesical artery from the anomalous OA (IVA in Figure 1) was observed in two specimens (5.8%). The IVA originated from the anterior division of the internal iliac artery in 32 cases (94.1%). The inferior vesical artery was observed to supply the prostate gland. No significant statistical analysis on the results was performed.

No other associated anomalies regarding the origin or branching pattern of the obturator artery was observed.

## Discussion

Accidental hemorrhage is common during erroneous interpretation of anomalous blood vessels. Alarming, hemorrhage has been considered the leading cause of obstetrical mortality in the United States of America and the leading cause of maternal deaths in all the developing countries of the world [7]. Thus, a thorough knowledge of the normal and the abnormal anatomy of the branches of the internal iliac artery is essential for obstetric surgeons. Concurrent presence of OA originating from the posterior division of the internal iliac artery with an inferior vesical branch arising from the anomalous OA is a rare entity.

The OA has been reported to originate commonly from the internal iliac artery [8]. The common origin of the inferior epigastric and the OA has been reported to be present in 20–30% cases [5]. The OA has also been reported to originate from the anterior division of the internal iliac arteries and the inferior epigastric arteries in 41.4% and 19.5% cases, respectively [9].

The OA has also been reported to originate from the external iliac artery [10–12]. The OA may originate

from the posterior division of the internal iliac artery [6]. Interestingly, the inferior vesical artery has also been reported to originate from the OA [2]. Thus, the origin of the OA from the posterior division of the internal iliac artery and the origin of the inferior vesical artery from the OA is not uncommon as evident from past records but there is paucity of data on the concurrent existence of anomalous origin of the OA from the posterior division of the internal iliac artery and the inferior vesical artery originating from the OA as observed in the present study.

Embryologically, the anomaly may be explained on certain factors. As per description by previous researchers, OBA has been reported to arise late in the development [13]. Unusual selection of channels from the primary capillaries is thought to account for the anomalies affecting the arterial patterns in the lower limb [4]. A simple view is that the most appropriate channels enlarge with the others retracting or disappearing, which may result in the final arterial pattern [14]. In the later period, the persistence of the arterial channels near the posterior division may have resulted in the anomalous origin of the OA from the posterior division of the internal iliac artery while the anterior channels may have disappeared [13].

As early as in 1894, Kelly HA described the ligation of the internal iliac artery to control hemorrhage during pelvic surgeries [15]. Recent reports depict that the efficacy of the internal iliac artery ligation during any obstetrics and gynecology surgery may vary between 42–75% [16, 17]. Thus, for any successful ligation of the internal iliac artery the operating surgeon should be cognizant of the anatomy of the anterior and the posterior divisions of the internal iliac artery. Ideally, one would ligate the internal iliac artery distal to its posterior division because proximal ligation has been associated with buttock claudication and necrosis [18]. Obviously, an anomalous OA originating from the posterior division as seen in the present study would make the case more complicated.

A past study had described that the posterior division of the internal iliac artery may be observed at a distance of 3.2 cm from the bifurcation of the common iliac artery [19]. In the present study, we observed the posterior division to originate even at a distance of 6 cm from the bifurcation of the common iliac artery. While the past study was conducted in United States, our study mainly focused on the Malaysian cadavers. Therefore, there is a chance of racial and geographical variation, which may have accounted for the difference in the numerical values.

A past research study has highlighted the fact that in women undergoing pelvic surgery, the ligation of the internal iliac artery or its branches, post operative angiograms show collateral channels functioning and these may be important for surgeons and radiologists [19]. In the event of OA arising from the posterior division of the OA as seen in the present study, any ligation of the OA would result in erroneous interpretation of angiograms.

The OA is known to supply the head of the femur and in the event of the OA arising from the posterior

division of the internal iliac artery; it may be spared during any injury to the anterior division. Past research studies have focused on the parietal branches of the OA, which are important collaterals in the aorticoiliac and the femoral arterial occlusive diseases and this may be kept in mind during any possible bypass grafting in cases of ischemic necrosis of the head of the femur [6].

Normally, the prostate is supplied by the inferior vesical arteries originating from the anterior division of the internal iliac artery [1]. In case of the inferior vesical artery originating from the OA as seen in the present study, it would require proper knowledge and care by operating surgeons who wish to ligate the vessel.

## ☐ Conclusions

The present study highlighted the presence of anomalous OA originating from the posterior division thereby giving rise to inferior vesical artery supplying the prostate. Awareness of such variation may be beneficial for operating surgeons and radiologists in day-to-day clinical practice.

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**Corresponding author**

Srijit Das, Senior Lecturer, MBBS, MD, Department of Anatomy, Faculty of Medicine, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Kuala Lumpur, Malaysia; Phone 006–03–92897263 Ext 7874, Fax 006–03–26989506, e-mail: das\_srijit23@rediffmail.com

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