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Original Research Article

Assessment of the iliolumbar artery: its structural variations and applied aspect

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ABSTRACT

Background: The Iliolumbar artery normally arises from the posterior division of Internal iliac artery. The main artery and its two branches supply the iliacus and lumbar region and other vital structures in that area. However, various studies conducted depict the differences in the pattern of its origin and course. Thus, the goal of this study was to discover the various origins of the iliolumbar artery, as well as its relationships with other surgically significant anatomical structures; the importance of which can prevent any intraoperative hemorrhages during surgery.
Methods: The study was conducted in Department of Anatomy Lady Hardinge Medical College between 2019-2021. Pelvis of 12 formalin fixed adult cadavers (8 females, 4 males) were dissected to observe the iliolumbar artery. Its origin, caliber and course were measured using a digital vernier caliper. The relationship of iliolumbar artery was established with obturator nerve, lumbosacral trunk and sympathetic chain.
Results: Iliolumbar artery was originating from trunk of internal iliac artery in 70.83% cases in which the mean distance of origin and mean caliber was more on right side. In the remaining 29.17% cases where the Iliolumbar artery was arising from posterior division of internal iliac artery, the mean distance of origin and mean caliber was higher on left side. The truncal origin of iliolumbar artery was predominant in females.
Conclusions: The variant origin of the iliolumbar artery and its clinic-anatomical relationships have been highlighted to reduce iatrogenic artery trauma during surgery.

Keywords: Hemorrhage, Iliolumbar artery, Obturator nerve, Variation

INTRODUCTION

The iliolumbar artery (ILA) is a branch of the posterior division (PD) of the internal iliac artery (IIA). It ascends behind the external iliac vessels anterior to the sacroiliac joint to enter behind the psoas major, where it splits into lumbar and iliac branches.[1] Hemorrhage during pelvic surgery is one of the leading causes of mortality in India. The iliolumbar artery and its twigs can be injured iatrogenically during anterior approaches to the sacroiliac joint for arthrodesis or internal fixation, resulting in intraoperative hemorrhages.[2] Since it is very close to the sacroiliac joint, the iliolumbar artery is often at risk of damage in posterior pelvic fractures (open book or shearing fractures).[3,4] Consequently, the diverse knowledge of position and variations of iliolumbar artery will be useful for Surgeons, Orthopaedicians, Obstetricians and Gynecologists and an Anatomists for research purposes. Since there is dearth of literature about iliolumbar artery variations, the present study has been conducted.

METHODS

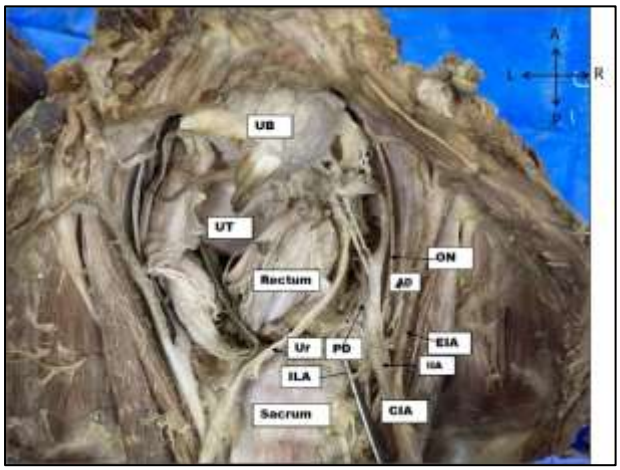
Pelvis of 12 formalin-fixed adult cadavers (8 females, 4 males) were dissected in Department of Anatomy, Lady Hardinge Medical College, between 2019-2021. The external iliac artery, the internal iliac artery, and the

common iliac artery were all dissected. The iliolumbar artery was observed and traced. Its relation to the obturator nerve, lumbosacral trunk and sympathetic chain was assessed. The origin as well as direction of the artery was observed and caliber of the iliolumbar artery measured bilaterally using a digital vernier caliper.

The origin of the iliolumbar artery (normally it is from posterior division of internal iliac artery) was measured from the point of bifurcation of internal iliac artery into anterior and posterior division. The data containing maximum, minimum, mean and standard deviation values of origin of artery and its caliber were then tabulated (Table 1) and analyzed statistically using Statistical package for social sciences (SPSS) 21.0 version; $p<0.05$ was considered statistically significant.

RESULTS

Iliolumbar artery was found originating singly from the trunk of Internal Iliac Artery in 16 pelvic halves (8 right and 8 left) as shown in figure 1 and figure 2 and from posterior division of internal iliac artery in 7 pelvic halves (3 right and 4 left). In one of the pelvic halves, the 1st lateral sacral artery (LSA) and the iliolumbar artery had a common origin from the trunk of right internal iliac artery as shown in figure 3.



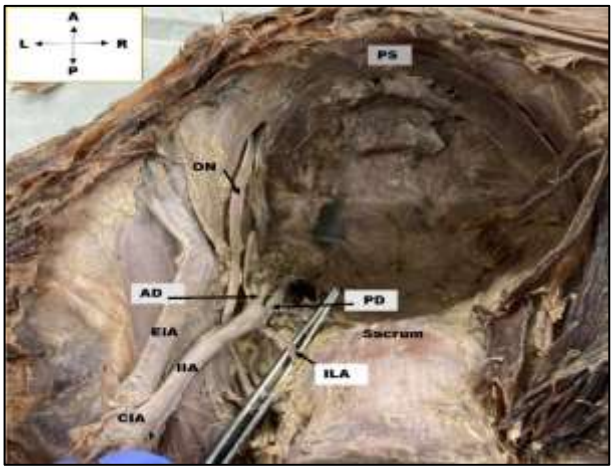
CIA- Common iliac artery, EIA-External iliac artery, IIA-Internal iliac artery, ILA- Iliolumbar artery, AD-Anterior Division, PD- Posterior Division, ON- Obturator nerve, Ur-Ureter, UT- Uterus, UB-Urinary bladder

Figure 1: Origin of iliolumbar artery on right side from trunk of internal iliac artery.

The average distance of origin of those iliolumbar arteries which were arising from the trunk of internal iliac artery when measured from its bifurcation into anterior and posterior division was 28.03±3.93 mm on left side and 29.7±1.74 mm on right side whereas the average distance of origin of iliolumbar artery, budding from the posterior division of internal iliac artery was 27.6±3.39 mm on left side and 27.45±3.05 mm on right side. The distance of origin of Iliolumbar artery when arising as a common stump with 1st lateral sacral artery from trunk of IIA was 29.5 mm (Table 1). Accordingly, we have classified the origin of ILA into three types as shown in Figure 4.

Type 1- normal type (when ILA is originating from posterior division of IIA, type 2- purely truncal type (when ILA is arising from trunk of IIA), type 3- iliosacral type (when ILA and 1st lateral sacral artery are arising as a common stump from the trunk of IIA)

Out of the total, predominant cases were females falling under type 2 category.



CIA- Common iliac artery, EIA-External iliac artery, IIA-Internal iliac artery, ILA- Iliolumbar artery, AD-Anterior Division, PD- Posterior Division, ON- Obturator nerve

Figure 2: Origin of iliolumbar artery on left side from trunk of internal iliac artery.

CIA- Common iliac artery, EIA-External iliac artery, IIA-Internal iliac artery, ILA- Iliolumbar artery, LSA- Lateral sacral artery, A-Anterior Division, P- Posterior Division, ON-Obturator nerve, LST- Lumbosacral trunk, ST- Sympathetic trunk

Figure 3: Origin of iliolumbar artery from common origin along with 1st lateral sacral artery from the trunk of right internal iliac artery.

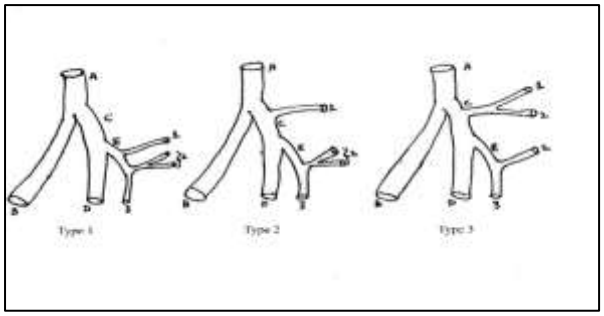


Figure 4: Schematic representation of variable origin of iliolumbar artery into three types.

Mean caliber of the iliolumbar artery when originating from trunk of internal iliac artery was 2.06±1.06 mm on left side and 2.3±0.77 mm on the right. Similarly, the mean caliber of the iliolumbar artery when originating from posterior division of internal iliac artery was 3.5±0.14 mm on left side and 2.9±0.15 mm on right side. The caliber of third variant in which the Iliolumbar artery was arising as a common stump with 1st LSA was 3.1 mm (Table 1)

Although the ILA had different source of origin but it followed the normal course of distribution. Even the relation of iliolumbar artery to obturator nerve, lumbosacral trunk and sympathetic chain was normal.

Table 1: Maximum, minimum and mean values of length and caliber of iliolumbar artery.

Iliolumbar artery	Number of specimen(n)		Maximum (in mm)		Minimum (in mm)		Mean		Standard Deviation	
Origin (from Internal Iliac Artery)	Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
***From Trunk**	8	8	34	32	24.1	27	28.03	29.7	3.93	1.74
***From Posterior Division**	4	3	30	30.5	25.2	24.4	27.6	27.45	3.39	3.05
***As common trunk with 1st lateral sacral artery**	0	1	Length- 29.5mm				-	-	-	-
Caliber										
***When originating from trunk**	8	8	4.2	3.8	1.4	1.2	2.06	2.3	1.06	0.77
***When originating from posterior division**	4	3	3.6	3	3.4	2.8	3.5	2.9	0.14	0.15
***When originating as common trunk with 1st lateral sacral artery**	0	1	Caliber- 3.1mm				-	-	-	-

DISCUSSION

In 3.7-11.25% cases, ILA may arise from the common iliac artery as per different studies. IIA has been confirmed to be the source of origin of iliolumbar artery in 28.3-96.3% cases in different studies. In addition, ILA has been stated to stem from posterior division (PD) in 32.5-44% cases.[5-10] In our study, ILA originated from trunk of internal iliac artery in 70.83% cases and from posterior division in 29.17 % cases.

The caliber of the ILA during its course on the medial side of the psoas major was estimated by Harrington to be 3-4 mm.[2] Chen et al reported a diameter of 2.7± 0.6 mm, and Kiray et al reported a diameter of 3.7±0.7 mm for ILA at its origin.[5,6] Our findings show the caliber of the artery to be almost same as that of Harrington et al and Kiray et al.

In has been documented earlier that the ILA arose from the lumbar, middle sacral, and lateral sacral arteries.[11] In addition, the ILA originated in 0.7 and 2% of cases, respectively, from the common and external iliac arteries. In 0.7 percent of cases, it came from the inferior gluteal artery, as well as the sciatic artery.[12] In our study we have found ILA to be originating from either trunk of IIA or from PD. There were no branches coming from the common iliac or gluteal arteries (Figure 1,2,3).

Several authors have classified the origin of ILA diversely, Rusu et al classified the ILA origin into different levels; Level A: ILA from the CIA. Level B: ILA from the CIA bifurcation. Level C: ILA from the main trunk of the IIA. Level D: ILA from the origin of the posterior division of the IIA. Level E: ILA from the posterior division of the IIA.[8] In our study, type 1 corresponds to level E category whereas type 2 corresponds to level C category. The atypical type 3 did not correspond to any of the above Rusu et al levels of classification.

Several factors such as genetics, race and tissue vascular demand may have been the cause of such variability. Embryologically, the inconsistent origin of ILA may be

due to flaw in either the growth or regression of the primitive ILA (plexus).[12] The medial umbilical ligament (superior vesical artery) and the inferior gluteal artery were the two main trunks of IIA during development. The two trunks and the intersection between them are the source of the majority of the branches and any variation in its pattern.[13-15] Surgeons must be aware of variant origin, course and branching pattern of ILA divisions.

During lumbosacral spinal surgery, anterior approaches to the sacroiliac joint, and posterior pelvis fractures, iliolumbar artery is vulnerable to injury. The iliolumbar artery may be accidentally injured during L5-S1 far-lateral disc excision, according to Harrington, who also stressed the importance of its variations at this stage.[2] During anterior approaches to the sacroiliac joint for internal fixation, Ebraheim et al found that the iliolumbar artery and a branch supplying the ilium that emerges from the ILA are at risk of injury.[3] Since ILA lies in loose connective tissue, and has sufficient length and diameter, the iliolumbar artery and its branches can be used in bone reconstructions and especially in lumbar spinal surgery as supplying pedicles.[6,16] Iliolumbar artery variations can be found at the edges of extraforaminal intervertebral disc exposures as suggested by Harrington due to which magnetic resonance imaging scans may be needed for this arterial system.[2] It was biomechanically shown that the bicortical screw purchase to the sacrum increases the pull-out strength.[17] This theory may be adapted to other cancellous bones such as pelvis and sacroiliac joint. The tip of the screws or pins may penetrate the inner cortex of pelvic bones and may damage the vascular structures.[18]

In 1894, Kelly was the first to characterize ligation of the internal iliac artery (IIA) as a measure to prevent hemorrhages during pelvic surgery.[19] In today's obstetrics and gynaecology, the use of IIA ligation is debatable. The procedure's efficacy in controlling obstetrical hemorrhage has been stated to be between 42 and 75 %.[20] Thus, knowing about variations of iliolumbar artery becomes all the more important.

The tendency of origin of ILA from trunk of IIA was found to be greater in females in our study. Various literature has also demonstrated that numeric measures are consistent across studies and that there is no significant difference in measurement between people of different ethnic backgrounds.

One of the study's shortcomings is that the number of male cadavers available were limited. As a result of the small number of male cadavers, the impact of gender variations on artery measures gave predominance to tendency of variation being more in females.

CONCLUSION

The ILA may have distinct and important patterns that are important to be identified during surgical procedures. Acute hemorrhages or postoperative hematoma may occur if the iliolumbar artery is injured during surgery. The iliolumbar artery's anatomical variations may be significant when gathering the vascular iliac bone graft. The surgeon should keep in mind that the variant origin of ILA can make anterior lumbosacral junction exposure and posterior sacroiliac fixations more difficult. The branching and distribution patterns along with sexual differences will be further strengthened with future studies in a greater number of subjects.

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