DOI: 10.7860/IJARS/2021/48198:2685

Original Article

Anatomy Section

Anatomic Asymmetry of Iliolumbar Artery in Goan Population: A Cross-sectional Study

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ABSTRACT

Introduction: Haemorrhage is one of the most common complications in laparoscopic pelvic and para-aortic surgeries thus making variant anatomy of Iliolumbar Artery (ILA) important as it is one of the vessels leading to haemorrhage.

Aim: To study variant anatomy of ILA and its morphometric analysis.

Materials and Methods: A cross-sectional study was done over a period of five months from January 2020 to May 2020. Twenty-seven-formalin fixed human pelvises were dissected in iliolumbar region in the dissection hall of the Department of Anatomy, Goa Medical College, Bambolim, Goa, India. Point of origin of Iliolumbar Artery (ILA), its length before its branches, distance from the branching of Internal Iliac Artery (IIA) and Common Iliac Artery (CIA) trunk were evaluated. The length of these vessels was measured by using a thread and a vernier caliper (sensitive to 0.1 mm) by following their curves.

Results: The ILA was found to originate from IIA (trunk) in twenty-one (38.89%); from posterior division of the IIA in eight (14.81%); at the division of IIA in fifteen (27.78%); from CIA (trunk) in two (3.70%) and was not traceable (was not found branching from IIA) in eight (14.81%) specimen. Mean length of ILA when originating from posterior division of IIA was 1.36±0.44 cm; when originating from IIA (trunk) was 1.53±0.46 cm and when originating at the division of IIA was 1.64±0.67 cm. Mean distance of ILA from IIA if ILA originates from IIA (trunk) was 2.27±0.81 cm and if ILA originates from posterior division of IIA was 1.23±0.57 cm. Mean distance of ILA from CIA (trunk) if ILA originates from IIA (trunk) was 2.53±1.07 cm, if ILA originates from posterior division of IIA was 3.95±1.06 cm.

Conclusion: Knowledge of anatomy and variations of the ILA to the modern day laparoscopic surgeons, orthopaedic spine surgeons and vascular surgeons will immensely help in safe surgical outcomes.

Keywords: Anatomical variants, Haemorrhage, Internal iliac artery, Pelvic surgeries

INTRODUCTION

Laparoscopic pelvic and para-aortic surgeries, pelvic fractures due to high-energy trauma, injury to posterior pelvic segment and surgeries in the iliolumbar region can damage IIA and its branches, hence variant anatomy of the IIA is important for surgeons dealing with pelvic surgeries [1,2]. ILA classically arises as the first branch of the posterior division of the IIA. Thereafter, it laterally ascends running anterior to the sacroiliac joint and nerve trunk of the lumbosacral region. In relation to the obturator nerve and external iliac vessels, it lies posteriorly and upon reaching the medial border of the psoas major muscle, the ILA divides into iliac and lumbar branches behind this muscle [3].

Psoas major and quadratus lumborum is supplied by the lumbar branches of ILA and later it anastomoses with the fourth lumbar artery. It also supplies cauda equina by its spinal branches traversing through the intervertebral foramina. Iliac branches supply iliacus and anastomose with the iliac branches of the obturator artery. The branch from ILA forms the nutrient artery. Remaining branches are oriented around the iliac crest and anastomose with the neighbouring arteries [3].

According to a previous study on thirty human adult pelvic halves, the origin of ILA was classified as; level A-arising from the CIA (8.57%); level B-from CIA bifurcation (2.5%); level C-from IIA trunk (52.5%); level D- from IIA bifurcation (3.75%); level E-from posterior trunk of IIA (32.5%) [4]. Developmentally, the IIA passes through several stages of development and is derived from the umbilical artery. After birth the proximal part of the umbilical artery persists whereas the distal part gets obliterated [5].

Goa Medical College being the only medical college in the state of Goa and being the only government medical college where laparoscopic surgeries are undertaken, have encouraged us to take up this research work so as to help the young laparoscopic surgeons, orthopaedic spine surgeons and vascular surgeons to give them insight about the possible variations and asymmetry of ILA as found in Goan population and prepare them for their future surgeries.

MATERIALS AND METHODS

This cross-sectional study was conducted in the dissection hall of the Department of Anatomy, Goa Medical College, Bambolim, Goa, over a period of five months from January 2020 to May 2020; however, these specimens have been examined during an earlier study on aberrant obturator artery [6] and were collected over a period of five years for the same. Twenty-seven formalin-fixed pelvises (54 paired hemi pelvises) of adult cadavers were dissected, irrespective of sex. Institutional Ethics Committee (IEC) permission (GMC/IEC/2020/23) was taken for dissecting these formalin-fixed pelvises.

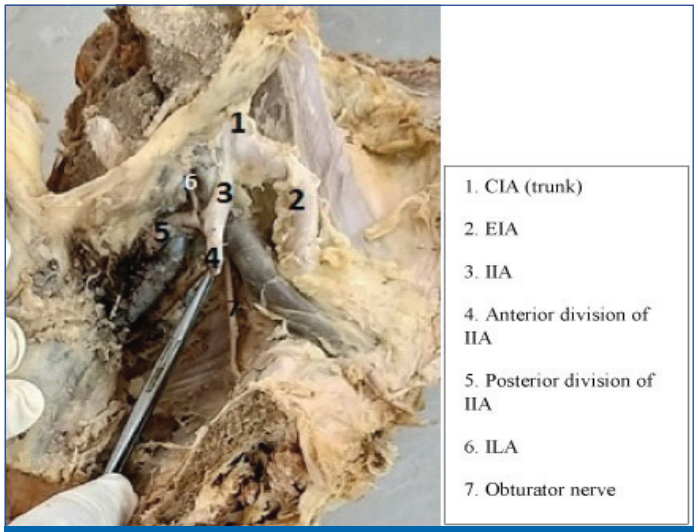
Inclusion criteria: Specimens from cadavers of Goan origin (verified origin as per records), having intact pelvic vasculature were selected for this study.

Exclusion criteria: Specimens showing gross carcinomatous changes, traumatised pelvises, any previous pelvic surgical manipulations which may affect the result of the study were excluded from the study.

Study Procedure

The fifty-four hemi pelvises were carefully examined for any of the above mentioned exclusion criteria. Dissection includes clearing of the dissection field by removal of all the tributaries of the Internal Iliac Vein (IIV) since it is typically plexiform. The next step was to identify the CIA and follow it distally till its bifurcation into IIA and EIA. Using blunt dissection, IIA was traced till the pelvis where it bifurcated into an anterior division and a posterior division. The ILA was identified arising from the posterior division of IIA. Its course was traced going

posteriorly and ascending between the lumbosacral trunk and the obturator nerve as can be seen in [Table/Fig-1] [7].



[Table/Fig-1]: Anterior and posterior divisions of ILA [7].
CIA: Common iliac artery trunk; EIA: External iliac artery; IIA: Internal iliac artery; ILA: Iliolumbar artery

After successful identification of the ILA from all the specimen, the morphological and morphometric parameters were studied, which included identification of the point of origin of the ILA, the measurement of its length before it gives off its branches and distance from the division of IIA and CIA. The lengths of these vessels were measured by using a thread and a vernier caliper (which was sensitive to 0.1 mm) by following their curves. Along with the ILA, CIA, EIA and IIA were also dissected. Photographs were taken using a sony alpha camera with the zoom lens.

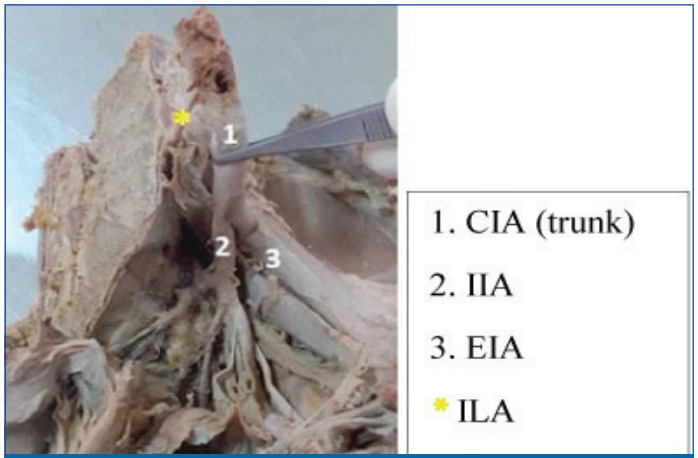
STATISTICAL ANALYSIS

Data was entered into Microsoft Excel spreadsheet, later the descriptive statistics including number and percentage for categorical data and mean±standard deviation for continuous data was analysed using statistical software SPSS version 22.0.

RESULTS

Taking into consideration [Table/Fig-2-5] the results were divided into four groups:

1. Arteries giving origin to the ILA.
2. Mean length of ILA.
3. Mean distance of ILA from IIA (origin).
4. Mean distance of ILA from CIA (origin).

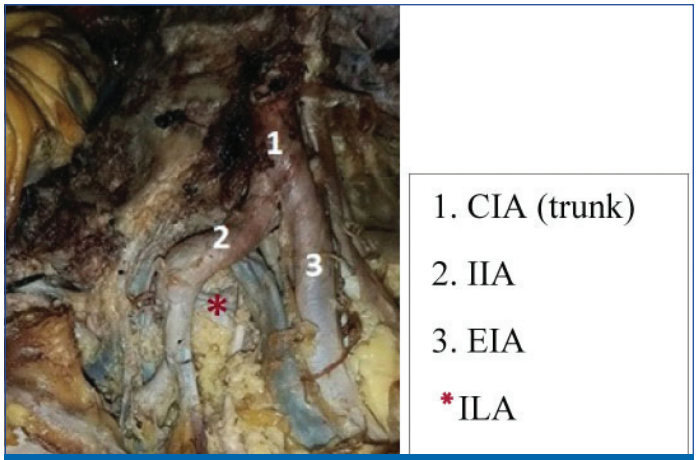


[Table/Fig-2]: Origin of ILA from the CIA (trunk).
CIA: Common iliac artery trunk; IIA: Internal iliac artery; EIA: External iliac artery; ILA: Iliolumbar artery

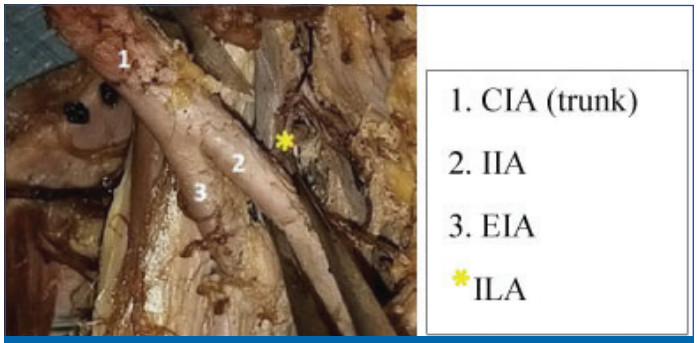
Arteries Giving Origin to ILA

In [Table/Fig-6] the various sites of origin of ILA, number of specimens showing the specific origin and the mean length of ILA from the artery of origin are tabulated. Origin of ILA was seen from IIA (trunk) [Table/Fig-4], posterior division of IIA [Table/Fig-5], at the division of IIA [Table/Fig-3], CIA (trunk) [Table/Fig-2] and in some specimens ILA was not traceable (was not found branching from IIA).

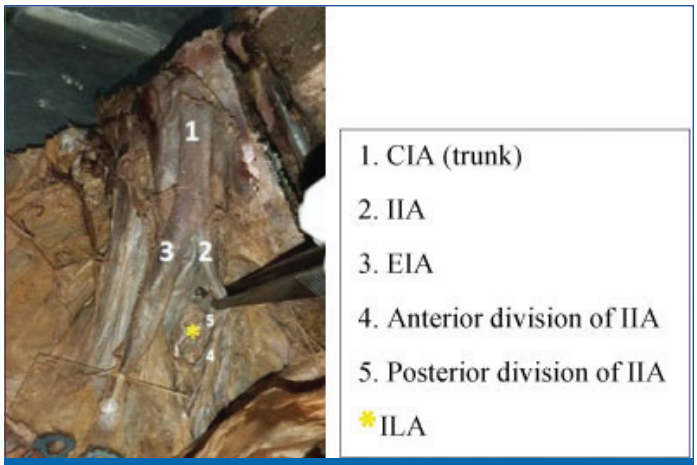
Out of fifty-four hemipelvises twenty-one hemipelvises (38.89%) had the origin of ILA from the IIA (trunk) and only two (3.71%) hemipelvises branched from CIA (trunk).



[Table/Fig-3]: Origin of ILA at the division of the IIA.
CIA: Common iliac artery trunk; IIA: Internal iliac artery; EIA: External iliac artery; ILA: Iliolumbar artery



[Table/Fig-4]: Origin of ILA from the trunk of IIA.
CIA: Common iliac artery trunk; IIA: Internal iliac artery; EIA: External iliac artery; ILA: Iliolumbar artery



[Table/Fig-5]: Origin of ILA from the posterior division of the IIA.
CIA: Common iliac artery trunk; IIA: Internal iliac artery; EIA: External iliac artery; ILA: Iliolumbar artery

Artery of origin	No. of samples (n)	Percentage	Mean length of ILA from the artery of origin (cm)
IIA (trunk)	21	38.89	1.53±0.46
Posterior division of IIA	8	14.81	1.36±0.44
At the division of IIA	15	27.78	1.64±0.67
CIA (trunk)	2	3.71	1.73±0.74
*Not traceable	8	14.81	-
Total	54	100	

[Table/Fig-6]: Incidence of origin and mean length from the artery of origin of ILA.
*was not found branching from IIA

Mean Length of ILA

Length of ILA from the artery of origin was found to vary between 1.36-1.73 cm. As seen in [Table/Fig-6].

Mean Distance of ILA from IIA (origin) and CIA (origin)

Mean distance of ILA (according to the artery of origin) from IIA (origin) and CIA (origin) is tabulated in [Table/Fig-7]. The distance was found to range in between 1.23-3.95 cm.

Table/Fig-8] represents the pattern of origin of ILA on either side of the pelvis.

Artery of origin	Mean distance from the IIA origin (cm)	Mean distance from the CIA origin (cm)
IIA (trunk)	2.27±0.81	2.53±1.07
Posterior division of IIA	1.23±0.57	3.95±1.06

[Table/Fig-7]: Mean distance of ILA (according to the artery of origin) from IIA (origin) and CIA (origin).

Artery of origin	Number of hemipelvises and percentage			
	Number of right hemipelvis (n)	Percentage	Number of left hemipelvis (n)	Percentage
IIA (trunk)	7	25.93	14	51.86
Posterior division of IIA	5	18.52	3	11.11
At the division of IIA	8	29.63	7	25.93
CIA (trunk)	1	3.70	1	3.70
Not traceable	6	22.22	2	7.40

[Table/Fig-8]: Incidence of asymmetry of ILA (N=54).

DISCUSSION

A successful surgery largely depends on thorough knowledge about the vascular system. In an earlier study on origin of the obturator artery in a Goan population, aberrant obturator artery was documented in 10% while 4% of arterial corona mortis was observed and the study concluded that knowledge of variant origin of the obturator artery and the presence of accessory or aberrant obturator arteries is of utmost importance to a laparoscopic surgeon while performing pelvic surgeries [6]. The amount of variation shown by the ILA in the present study is a reason enough to study more about the vascular system in detail.

Importance of ILA is significant due to the fact that it is situated in close proximity with the sacro-iliac joint, any trauma or fracture (open-book) due to high impact injuries may lead to laceration in the artery which may result in haemorrhage, can be encountered during anterior and anterolateral surgical procedures, in establishing collateral vasculature with deep circumflex iliac artery and lateral circumflex vessels, harvesting the free iliac bone flaps, laparoscopic common iliac and para aortic lymph node dissection and iatrogenic sciatica [8-10].

[Table/Fig-9] represents a comparison of the present study with previous studies by different authors. Absence of ILA was described in the studies conducted by Al Talawah W et al., Lipshutz B and Gadagi RS and Mulage SK, [Table/Fig-9] [9,11,12] in 5%, 4.7% and 26.67% of specimen, respectively. In the present study, it was found that 14.81% of specimen had a non-traceable ILA. In a recent study by Dzmitry V and Anastasiya B, [Table/Fig-9] [13]. ILA was found to be originating from IIA (trunk) and posterior division of IIA unlike in the present study where it originated from IIA (trunk), posterior division of IIA, CIA (trunk) and at the division of IIA.

Since the study included paired pelvises, it gave an opportunity to compare the pattern of the vasculature on either side. As stated above 74.07% of specimen showed bilateral asymmetry. This is an eye-opening fact especially concerning the bilateral surgeries of the pelvis. Hence, a surgeon should be prepared to discover different anatomy in the same surgery as it has been proved in the present study.

Authors	Origin sites of Iliolumbar Artery (ILA)				
	IIA (trunk)	Posterior division of IIA	At the division of IIA	CIA (trunk)	Not traceable/ Absent
Lipshutz B (1981) [11]	-	-	-	-	5%
Rusu MC et al., (2010) [4]	52.50%	32.50%	3.75%	8.80%	-
Kiray A et al., (2010) [14]	71.40%	19%	-	4.80%	-
Teli CG et al., (2013) [8]	20%	80%	-	-	-
Talalwah WA et al., (2015) [9]	13.80%	77.90%	-	2%	4.7%
Koc T et al., (2016) [15]	70.60%	-	-	29.40%	-
Gadagi RS and Mulage SK, (2018) [12]	36.67%	23.33%	-	13.33%	26.67%
Yuvaraj MF et al., (2018) [16]	75%	25%	-	-	-
Dzmitry V and Anastasiya B, (2020) [13]	16.6%	73.3%	-	-	-
Present study (2020)	38.88%	14.81%	27.77%	3.70%	14.81%

[Table/Fig-9]: Studies showing Incidence of origin of ILA [4,8,9,11-16].

Taking into consideration [Table/Fig-9] [4,8,9,11-16], it is clear that different researchers and specialists have found abundant variation in the origin of the ILA, hence importance should be given to variations found in the present study. The present study elaborates the possible variations in morphology and morphometry of ILA in formalin-fixed pelvic specimens and few variations which were rarely listed in the previous studies mentioned above, hence providing young surgeons as well as orthopaedic surgeons with a better knowledge of the variant anatomy of ILA.

Hence, knowledge of anatomy and variations of the ILA to the modern day laparoscopic surgeons, Orthopaedic spine surgeons and vascular surgeons will immensely help in safe surgical outcomes. This study provides an added advantage to young budding surgeons as they can visit the anatomy dissection hall to observe these vascular variations, and apply this knowledge in their surgical practice.

Limitation(s)

The availability of small number of cadaveric specimen for analysis, limited the present study.

CONCLUSION(S)

Anatomy of ILA is important for surgeons especially when there are vast variations. Variation includes point of origin of the ILA, its length before its branches, distance from the branching of IIA (trunk) and CIA (trunk). Even bilateral asymmetry as described in the present study is a noteworthy point to consider. As elaborated in the present study, most frequent origin of ILA was found to be from the IIA (trunk) followed by origin at the division of IIA; posterior division of IIA and CIA (trunk) in a decreasing order of incidence. In a few specimens, ILA was not traceable due to the reasons mentioned previously. This study even included vascular asymmetry with more specimens being bilaterally asymmetrical in their anatomy, which is vital in orthopaedics, obstetrics and gynaecology and general surgery.

Acknowledgement

The authors would like to extend their sincere regards to Dr. Professor Shivanand Bandekar, Dean of Goa Medical College and Hospitals, Goa, for giving permission to conduct the research work in the Department of Anatomy, Goa Medical College and Hospitals, Goa.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Jan 12, 2021
- Manual Googling: Apr 14, 2021
- iThenticate Software: May 07, 2021 (8%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? NA
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Jan 11, 2021**
Date of Peer Review: **Feb 11, 2021**
Date of Acceptance: **Apr 27, 2021**
Date of Publishing: **Oct 01, 2021**