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Surgical anatomy of superior gluteal artery in relation to lumbosacral plexus – A cadaveric study in the Indian population

Anjali Shastry[1], Anu Francis[2]

[1]Assistant Professor, [2]Associate Professor, Department of Anatomy, PES University-Institute of Medical Science and Research, Bengaluru, Karnataka, India

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ABSTRACT

Background: The superior gluteal artery (SGA) passes in between branches of the lumbosacral plexus after arising from the internal iliac artery. Variations in the course of SGA from the internal iliac artery till it passes out of the pelvis through the greater sciatic foramen are very important during pelvic surgeries. Pseudoaneurysm of SGA caused by iatrogenic injuries can compress branches of the lumbosacral plexus, causing foot drops and sciatica. **Aims and Objectives:** The aim is to study the course of the SGA in relation to branches of the lumbosacral plexus. **Materials and Methods:** A cross-sectional observational study was done on 25 formalin-fixed human adult cadavers. Dissections were performed in the pelvic region and branches of the internal iliac artery and lumbosacral plexus were identified. SGA was traced on both sides from origin till passing out of the greater sciatic foramen and its relation to branches of lumbosacral plexus was recorded. **Results:** Three types of pathways taken by SGA were identified in relation to the lumbosacral plexus. The most common path taken by the SGA was between the lumbosacral trunk (LST) and the first sacral nerve. Thirty-five out of 50 were of this type (70%). Ten out of 50 had the second most common type which was between L4 and L5 branches of LST (20%). Five cadavers had SGA lateral to LST (10%). Ten cadavers out of 25 (40%) had side differences in the type of course taken by SGA in relation to the lumbosacral plexus. **Conclusion:** A surgeon must keep in mind variations in the path taken by SGA in relation to the lumbosacral plexus to prevent pseudoaneurysms of SGA, which in turn can compress branches of lumbosacral plexus, causing foot drop and sciatica.

Key words: Superior gluteal artery; Pseudoaneurysm; Lumbosacral plexus; Variations; Lumbosacral trunk

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INTRODUCTION

The superior gluteal artery (SGA) arises in the pelvis as a branch from the posterior division of the internal iliac artery. Most studies have concentrated on variations in branching patterns of the internal iliac artery. Even though variations are common in SGA, it has to pass through the lumbosacral plexus and then exit the pelvic cavity through the greater sciatic foramen superior to the piriformis muscle and divide into superficial and deep branches. As it passes through the lumbosacral plexus, there is a high chance of compression of underlying nerves, causing neurological symptoms such as foot drop and sciatica.[1] Pseudoaneurysms of SGA can occur due to blunt trauma, pelvic surgeries and interventional procedures, connective tissue disorders, vasculitis, and atherosclerosis.[2] Pseudo aneurysms of SGA even though rare, can compress the lumbosacral plexus. Location and relations of SGA are also important during horizontal sacroiliac screw placement following pelvic ring injuries.[3] Hence, the present study has attempted to analyze the relation between the lumbosacral plexus and SGA, which can help in better understanding of post-operative neurological deficits if there are iatrogenic aneurysms.

Address for Correspondence:
Dr. Anjali Shastry, Department of Anatomy, PES University-Institute of Medical Science and Research, Bengaluru, Karnataka, India.
Mobile: +91-9008735895. **E-mail:** anju_shas@yahoo.com

Aims and objectives

To study the relation between superior gluteal artery and branches of lumbosacral plexus in formalin fixed cadavers.

MATERIALS AND METHODS

Ethical clearance was obtained from the institutional ethics committee. Dissections were performed on 25 formalin-fixed human adult cadavers from the Department of Anatomy, St. John's Medical College, Bangalore. The study was done for a period of 1 year from August 2022 to August 2023. All cadavers were obtained as per a voluntary body donation program. Out of 25 cadavers, 13 were male and 12 were female cadavers' ages ranging from 35 to 70 years. Pelvic viscera were removed. Terminal branches of common iliac arteries – external and internal iliac arteries were identified on both sides. This was followed by the identification of the branches of the internal iliac artery. Hence 50 SGA (25 from each side) were identified arising from the internal iliac artery. The lumbosacral plexus was then cleaned with careful dissection on each side. The common iliac vein and its tributaries were ligated for proper visualization of SGA in relation to the lumbosacral plexus. Gender, side, and relation of SGA to lumbosacral plexus were recorded.

RESULTS

In the present study, SGA was identified to have taken three different pathways in relation to the lumbosacral plexus (Table 1). The most common path taken by the SGA was between the LST and the first sacral nerve (Figure 1). Thirty-five out of 50 were of this type (70%). Ten out of 50 had the second-most common type which was between L4 and L5 branches of LST (20%) (Figure 2). Five cadavers had SGA lateral to LST (10%). Ten cadavers out of 25 (40%) had side differences in the type of pathways taken by SGA in relation to the lumbosacral plexus (Table 2 and Figure 3).

DISCUSSION

The study of arteries in relation to peripheral nerve plexus is less commonly studied in the literature. Most of the studies are related to the axillary artery in relation to the brachial plexus.[4] There are many studies on variations in the branching pattern of the internal iliac artery.[5-10] However, variation in pathways of these branches if they are passing out of the pelvis is not available in Indian literature. Contemporary textbooks describe SGA as passing in between LST and the first sacral nerve.[11-14] However in the present study, there are variations in the position of SGA in relation to the lumbosacral plexus. In a similar study done by Anetai et al., on sixteen Japanese

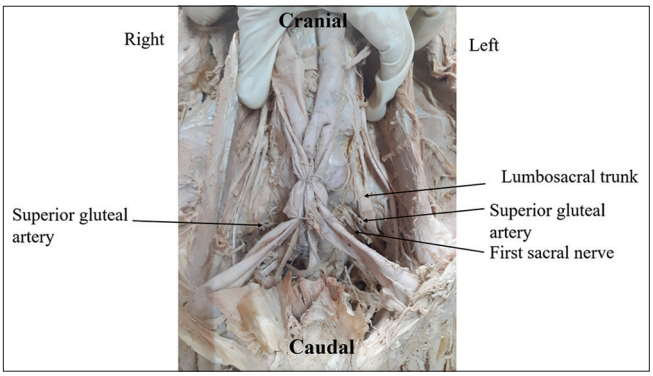

Figure 1: Cadaveric dissection showing stump of the superior gluteal artery between lumbosacral trunk and first sacral nerve on both sides in the same cadaver

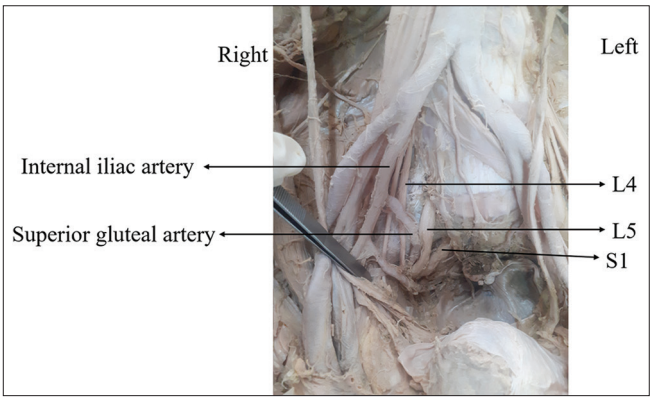

Figure 2: Cadaveric dissection showing superior gluteal artery between L4 and L5 on the right side

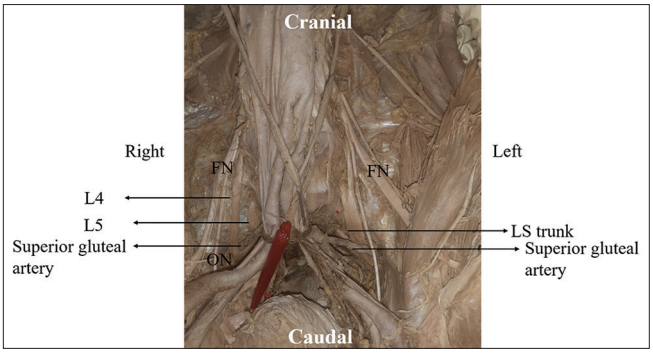

Figure 3: Cadaveric dissection showing superior gluteal artery between L4 and L5 on the right side and lateral to lumbosacral trunk on the left side in the same cadaver. FN: Femoral nerve, ON: Obturator nerve

cadavers, SGA has been categorized as type A, B, C, and D. Passage of SGA between L4 and L5 (type A), between L5 and S1 (type B), between S1 and S2 (type C), and between the obturator nerve and LST (type D) was identified. The authors concluded that differences in the course of the SGA suggest that the variations are caused by both arterial transformation and segmental deviation in the nervous system.[15] Cook dissected 112 adult formalin-fixed pelvic halves to study the relation of SGA with lumbosacral plexus.[16] He concluded that the

Table 1: Distribution of type of pathway taken by superior gluteal artery in relation to lumbosacral plexus

Gender	Superior gluteal artery between LST and S1	Superior gluteal artery between L4 and L5	Superior gluteal artery lateral to LST
Male (n=26)	19	5	2
Female (n=24)	16	5	3
Total (n=50)	35	10	5

LST: Lumbosacral trunk

Table 2: Side difference in the type of pathways taken by the superior gluteal artery in relation to lumbosacral plexus

Number of cadavers (10)	Right side	Left side
3	Superior gluteal artery between LST and S1	Superior gluteal artery between L4 and L5
3	Superior gluteal artery between L4 and L5	Superior gluteal artery between LST and S1
2	Superior gluteal artery lateral to LST	Superior gluteal artery between LST and S1
1	Superior gluteal artery between LST and S1	Superior gluteal artery lateral to LST
1	Superior gluteal artery between L4 and L5	Superior gluteal artery lateral to LST

LST: Lumbosacral trunk

most common pathway taken by the SGA through the lumbosacral plexus is between the LST and anterior ramus of spinal nerve S1 (67.9%), which was in correlation with our study. However, the second-most common pathway taken by SGA was lateral to the LST (20.5%), whereas in our study, the second-most common type was SGA passed in between L4 and L5. The fourth type of SGA passing between S1 and S2, identified by Cook and Anetai et al. was not observed in our study. Cook also reported a side difference in 18 out of 56 cadavers (32%). The possibility of embryological changes in the artery and nerve plexus on each side might be the cause for side differences. Furthermore, there are chances for significant variations in branching patterns and pathways of arteries among different populations. Further exploration through angiographic studies will aid in better visualization of the path of SGA through the lumbosacral plexus.

Limitations of the study

Study would we more clinically significant if it was combined with angiographic studies of superior gluteal artery and nerve conduction studies of lumbosacral plexus.

CONCLUSION

Knowledge of relation between superior gluteal artery and lumbosacral plexus plays an important role for operating surgeons. This can prevent iatrogenic injuries and pseudoaneurysms of superior gluteal artery.

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REFERENCES

1. Ge PS, Ng G, Ishaque BM, Gelabert H and De Virgilio C. Iatrogenic pseudoaneurysm of the superior gluteal artery presenting as pelvic mass with foot drop and sciatica: Case report and review of literature. Vasc Endovascular Surg. 2010;44(1):64-68.
https://doi.org/10.1177/1538574409351990
2. Taif S, Derweesh A and Talib M. Superior gluteal artery pseudoaneurysm presenting as a gluteal mass: Case report and review of literature. J Clin Imaging Sci. 2013;3:49.
https://doi.org/10.4103/2156-7514.120805
3. Zhao Y, You L, Lian W, Zou D, Dong S, Sun T, et al. Anatomical relation between S1 sacroiliac screws' entrance points and superior gluteal artery. J Orthop Surg Res. 2018;13(1):15.
https://doi.org/10.1186/s13018-018-0713-5
4. Aizawa Y, Otsuka K and Kumaki K. Examination of the courses of the arteries in the axillary region. II. The course of the axillary artery in the case of adachi's c-type brachial plexus. Kaibogaku Zasshi 1996;71(2):92-105.
5. Braithwaite JL. Variations in origin of the parietal branches of the internal iliac artery. J Anat. 1952;86(4):423-430.
6. Yamaki KI, Saga T, Doi Y, Aida K and Yoshizuka M. A statistical study of the branching of the human iliac artery. Kurume Med J. 1998;45(4):333-340.
https://doi.org/10.2739/kurumemedj.45.333
7. Fatu C, Puisoru M and Fatu IC. Morphometry of the internal iliac artery in different ethnic groups. Ann Anat. 2006;188(6):541-546.
https://doi.org/10.1016/j.aanat.2006.05.016
8. Bleich AT, Rahn DD, Wieslander CK, Wai CY, Roshanravan SM and Corton MM. Posterior division of the internal iliac artery: Anatomic variations and clinical applications. Am J Obstet Gynecol. 2007;197(6):658.e1-5.
https://doi.org/10.1016/j.ajog.2007.08.063
9. Bilhim T, Casal D, Furado A, Pais D, O'Neill JE and Pisco JM. Branching patterns of the male internal iliac artery: Imaging findings. Surg Radiol Anat. 2011;33(2):151-159.
https://doi.org/10.1007/s00276-010-0716-3
10. Tubbs RS, Shoja MM and Loukas M. Bergman's Comprehensive Encyclopedia of Human Anatomic Variation. 1st ed. New Jersey:

John Wiley and Sons; 2016. p. 694-740.

11. Tank PW. Grant's Dissector. 14th ed. United States: Lippincott Williams and Wilkins; 2009. p. 129-145.
12. Netter FH. Atlas of Human Anatomy. 5th ed. W.B. Saunders; 2010. p. 382.
13. Agur AM and Dalley AF. Grant's Atlas of Anatomy. 13th ed. United States: Lippincott Williams and Wilkins; 2013. p. 216-246.
14. Moore KL, Dalley AF and Agur AM. Moore Clinically Oriented Anatomy. 7th ed. Lippincott Williams and Wilkins; 2014. p. 354.
15. Anetai H, Tokita K, Kojima R, Aizawa Y, Kageyama I and Kumaki K. Variations in the course of the superior gluteal artery in relation to the lumbosacral plexus. Okajimas Folia Anat Jpn. 2017;94(2):45-54.

    https://doi.org/10.2535/ofaj.94.45
16. Cook M. The relationship between the superior gluteal artery and lumbosacral plexus. Austin J Anat. 2015;2(1):1030.

Author's Contribution:
AS- Definition of intellectual content, literature survey, prepared the first draft of the manuscript, implementation of the study protocol, data collection, data analysis, manuscript preparation, and submission of the article; **AF-** Definition of intellectual content, literature survey, prepared the first draft of the manuscript, implementation of the study protocol, data collection, data analysis, manuscript preparation, and submission of article.

Work attributed to:
Department of Anatomy, St. John's Medical College, Bangalore, Karnataka, India.

Orcid ID:
Anjali Shastry - https://orcid.org/0000-0002-8446-4659
Anu Francis - https://orcid.org/0009-0008-3451-8568

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