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Origin of median sacral artery with fourth pair of lumbar artery — an alert for spine surgeons and interventionalists: A case report and mini literature review

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Abstract: The median sacral artery (MSA) is the single unpaired dorsal branch of the abdominal aorta. The present case describes the relatively unusual origin of the median sacral artery in common with the fourth pair of lumbar arteries via a common trunk in a 74-year-old male cadaver. Unusual common trunk is prone for iatrogenic injury in surgeries of the lumbar and pelvic region. Owing to the deep seated nature of MSA close to the periosteum of lumbar vertebrae and sacrum, detection of accidental rupture of MSA and ligation thereof becomes a difficult task. MSA is also increasingly being utilized for intra-arterial embolization of pelvic tumours. The proximal portion of the common origin may at times undergo cone shaped dilatation which is referred to as infundibulum or infundibular dilatation and can also transform into aneurysm later. Knowledge of this variation is imperative for spine and pelvic surgeons to avoid unwanted complications.

Keywords: lumbar artery, lumbar spine, median sacral artery.

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Introduction

The median sacral artery (MSA) is the unpaired dorsal branch of the abdominal aorta just before aortic bifurcation that provides several parietal and visceral branches to the lumbosacral region [1]. Embryologically the MSA is derived from the primitive caudal aorta. The MSA descends approximately in the midline anterior to the bodies of the L4, L5 vertebrae, then passes posterior

to the iliocaval junction and traverses the pre-sacral space running anterior to the sacrum and coccyx and finally anastomoses with the branches of lateral sacral arteries [1]. It has several anastomotic connections with the lumbar, iliolumbar and lateral sacral arteries and also provides few posterior rectal branches [2, 3]. The MSA is closely related to the lower lumbar vertebrae, sacrum and coccyx and therefore vulnerable for iatrogenic injuries during interventions in and around the lumbar spine and during various gynaecologic and urologic surgeries. Anatomical variation in the origin, course and anastomotic channels of the MSA are reported in the literature [3]. The fifth lumbar artery when present often arises from the MSA [1]. Here, we describe a unique cadaveric case of common origin of MSA with fourth lumbar arteries.

Case report

This present case was observed in November, 2022 during routine dissection performed for undergraduate teaching in a 74-year-old male cadaver at All India Institute of Medical Sciences, New Delhi, India. Institutional guidelines for use of human cadaver for teaching and research were strictly followed. The dissection was carried out employing standard dissection methods. The cadaver did not present any gross deformity in the lumbosacral region. The retroperitoneal structures in the posterior abdomino-pelvic wall were dissected out. Measurements pertaining to the origin of MSA were taken with digital Vernier callipers. The course of the artery and its communications were carefully noted down and relevant photographs were obtained. The MSA originated in common with the fourth pair of lumbar arteries via a common trunk from the dorsal aspect of the aorta 0.6 cm proximal to the aortic bifurcation (Fig. 1 A & B). At the origin with the fourth pair of lumbar arteries via the common trunk at the lower margin of L4 vertebra, the external diameter of MSA was 1.45 mm and thereafter the artery gradually tapered distally. The distance of MSA from its aortic origin to the lower margin of the body of the L5 vertebra was 1.32 cm. At L5 vertebral level, the MSA was seen posterior to the left common iliac vein.

Discussion

Usually the MSA arises as a single artery and follows its normal course. The most frequent site of origin of MSA is nearer the upper border of body of the L5 vertebra (approximately observed in 95%) slightly on the left side and the least frequent site is at L4 vertebral level (approximately observed in 2%) [2]. The present case describes a common origin of MSA with the fourth pair of lumbar arteries which is not frequently encountered. Few studies have highlighted about the common origin of MSA with fourth pair of lumbar arteries with variable incidences [4, 5]. Identification of the common origin is crucial in the region as the lumbar disc herniation at L4–L5 is the most common site often requiring surgical intervention. Thomas R. *et al.*, 2018 first identified *infundibulum* (a conical dilatation at an arterial branching point) at the common origin of MSA with fourth pair of lumbar arteries as incidental findings during CT angiography [4] and recommended a yearly follow up vascular imaging for the individual to look for aneurysm occurrence at the site of infundibulum. The present case however did not present any such enlargement at the three vessel commencement site.

The MSA itself is very relevant clinically from various aspects. Early in 1984, studies suggested the benefit of selective MSA arteriography in the clinical management of sacral tumours [6]. The lower lumbar vertebrae are commonly affected by degenerative diseases requiring surgical

intervention such as anterior spinal interbody fusion. Minimally invasive spine surgeries via lateral trans psoas approach are also gaining popularity these days which involves less disruption of para spinal tissue [5, 7]. The newer laparoscopic and minimally invasive surgical procedures are relatively complication free but are very prone for iatrogenic vascular injuries. During posterior approach to the lower lumbar spine, the risk of injury to the branches of abdominal aorta near aortic bifurcation including MSA increases if not carefully dissected and mobilized. Unanticipated haemorrhage when occurs may require huge volume blood transfusion and emergency exploratory laparotomy before detecting the artery and arresting bleeding [8]. MSA has a potential role in the management of sacrococcygeal teratoma and tumours of the sacroccygeal region. Laparoscopic ligation of the MSA prior to surgical excision of the sacrococcygeal teratoma minimises significant haemorrhage [9, 10]. Furthermore, rectal vascularisation from the MSA should be considered as well which gets often ignored in resection-anastomosis of the colorectal region [11]. Rectal perfusion by MSA though relatively insignificant and limited to the posterior wall of the anorectal region, can be a cause of much concern during intraoperative injuries of the MSA. In the normal course, MSA runs posterior to iliocaval junction and left common iliac vein. But MSA passing anterior to the left common iliac vein and iliocaval junction has been reported [12]. A brief literature review detailing the important anatomical variations of the MSA and other relevant clinical aspects has been tabulated in Table 1. Therefore, many different anatomical variations are possible for MSA in its origin, relation, course, anastomosis etc. Some uncommon variants such as common origin with a pair of lumbar arteries are less explored, and are definitely difficult to be identified during surgery. The iliocaval junction can be considered as a common readily identifiable vascular landmark for guiding intraoperative MSA identification and safe mobilization.

Knowledge of uncommon anatomic variation of median sacral artery originating from a common trunk along with fourth pair of lumbar arteries is critical for preventing intraoperative bleeding, achieving haemostasis and for successful catheterization of median sacral artery for chemoembolization procedures. It will help in making adequate preoperative planning in lumbar spine surgeries and avoid hazardous consequences.

Declaration for consent and ethics

The present study was carried out on cadaver. The cadaver used in this case study was donated to the department with written and informed consent for carrying out whole body dissection for education and research purpose. All norms related to use of human cadavers in teaching and research were followed strictly as per the institutional guidelines.

Table 1. Reported anatomic variations and other notable clinico-surgical anatomy of median sacral artery.

Authors	Study type	Population & sample size	Findings
Sae-Jung S. *et al.*, 2014 [2]	Autopsy	Thai, 54 cases	Detailed study of the anatomy of MSA at the lumbosacral region
Chenin L. *et al.*, 2018 [3]	Autopsy	France, single case	MSA was located ventral to the left common iliac vein
Thomas R. *et al.*, 2018 [4]	CT angiography	American, single case	Described infundibulum of the common trunk of origin of MSA with fourth pair of lumbar arteries
Pinho A.R. *et al.*, 2022 [5]	Autopsy	Portuguese, 20 cases	MSA was found originating via a common trunk with fourth pair of lumbar arteries in 15% of cases
Kudo S. *et al.*, 1984 [6]	Radiographic	American, 8 cases	Common trunk providing origin to MSA with either fourth or fifth pair of lumbar arteries
Zilberlicht A. *et al.*, 2017 [7]	Radiographic	Jewish, 60 cases	Aberrant positioning of the MSA in relation to the right ureter
Vig A. *et al.*, 2019 [9]	Clinical	Indian, single case	Laparoscopic MSA ligation before sacrococcygeal teratoma excision reduces intraoperative haemorrhage
Osei H. *et al.*, 2019 [10]	Clinical	American, 2 cases	Laparoscopic MSA ligation before sacrococcygeal teratoma excision reduces intraoperative haemorrhage
Dimov I. *et al.*, 2021 [11]	Autopsy	Canadian, 19 cases	MSA provides a significant contribution to rectal blood supply.
Bax N.M.A. *et al.*, 1998 [12]	Clinical	Dutch, single case	Laparoscopic ligation of MSA in very large sacrococcygeal teratomas
Kostov S. *et al.*, 2021 [13]	Autopsy	Bulgarian, 2 cases	MSA was anterior to the left common iliac vein
Pearl M.S. *et al.*, 2014 [14]	Angiographic	American, 2 cases	Superior rectal artery took origin from MSA
Colak T. *et al.*, 2016 [15]	Histological	Turkish, 30 cases	MSA in female exhibit greater external diameter and thick tunica media
Meignan P. *et al.*, 2018 [16]	Micro CT	France, single fetus of 22 weeks gestation	22 weeks of gestation is a critical period for MSA development
Beveridge T.S. *et al.*, 2015 [17]	Autopsy and CT angiography	Canadian, 63 cases	Common origin of MSA with fourth pair of lumbar arteries was found in 33% cases.

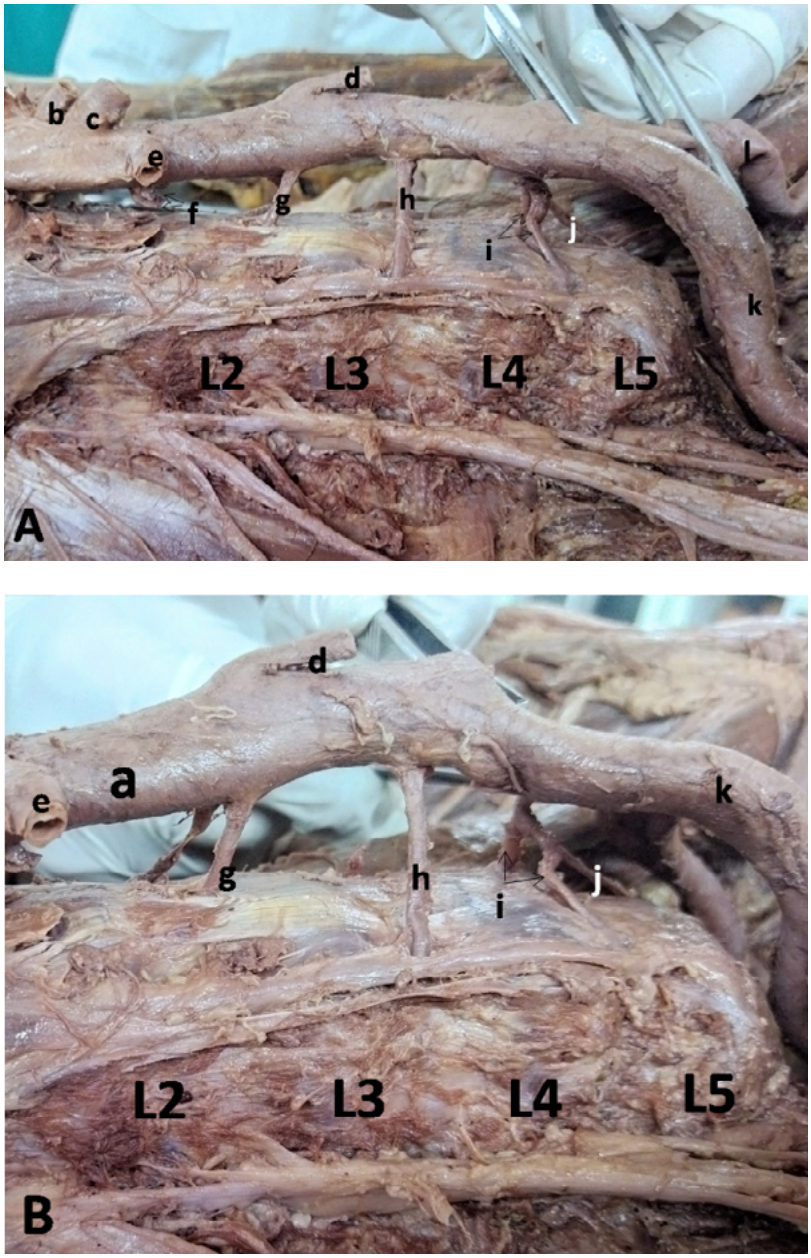

Fig. 1. A. Dissected posterior abdominal wall in the lumbar region showing common origin of the median sacral artery with the fourth pair of lumbar arteries. B. Magnified view of the region: a — abdominal aorta, b — celiac trunk, c — superior mesenteric artery, d — inferior mesenteric artery, e — right renal artery, f — 1st pair of lumbar arteries, g — 2nd pair of lumbar arteries, h — 3rd pair of lumbar arteries, I — 4th pair of lumbar arteries, j — median sacral artery, k — right common iliac artery, l — left common iliac artery, L2–L5 indicates the second to fifth lumbar vertebrae.

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