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An Egyptian Eye in the Leg - A Rare Inter – and Intra-fascial Course of the Great Saphenous Vein

Un Ojo Egipcio en la Pierna: Un Raro Trayecto Interfascial e Intrafascial de la Vena Safena Magna

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SUMMARY: The great saphenous vein (GSV), which has a long superficial course through the lower limb, is deemed as an important conduit of choice in coronary revascularization procedures. It is also a popular site for venous cannulation particularly in emergencies. Upon routine dissection of an 83-year-old Caucasian female cadaver, a rare unilateral unusual course of the left GSV was observed. A distal inter-fascial position of the left GSV was noted in the foot, followed by the occurrence of a thick fascial canal in the leg within which the GSV was lodged. It can be postulated that the presence of the fascial canal may aid venous return and prevent excessive dilatation of the vein during incompetencies of the venous valves. Moreover, knowledge of such variations of the GSV and its related fascial envelope are especially relevant for pre-operative protocols in peripheral vascular surgery.

KEY WORDS: Lower limb; Fascial canal; Great saphenous vein; Vascular surgery; Venous valves.

INTRODUCTION

Coronary artery bypass graft (CABG) is considered to be the most common and effective coronary revascularization procedure, with approximately 400,000 procedures performed annually (Bachar & Manna, 2023). Among the available venous conduits, the great saphenous vein (GSV), also known as the long saphenous vein, is the autologous conduit of choice in CABG procedures due to its lengthy distribution and ideal size, versatility, biological acceptance as well as its easily accessible superficial position that permits safe surgical removal (Portugal *et al*., 2014; Samano *et al*., 2021). The GSV is also a popular venous access site in hemodynamically unstable patients during emergency situations (Senevirathne *et al*., 2023).

As the principal vein of the superficial system of the lower limb, standard anatomy texts classically describe the GSV as a continuous single trunk that sports a lengthy course (Chen & Prasad, 2009; Senevirathne *et al*., 2023). According to Standring (2021), the GSV commences distally at the medial marginal vein of the foot and ascends anterior to the medial malleolus of the tibia at the ankle joint. It continues to ascend along the medial aspect of the leg alongside the saphenous nerve. In the leg, the GSV is often found to connect with deep veins via perforating veins as well as the short saphenous vein (Standring, 2021). Just distal to the knee joint, it also receives three large tributaries from the tibial malleolar region, and the anterior and posterior aspects of the leg (Standring, 2021). As it approaches the knee joint, the GSV ascends slightly posterior to the medial tibial margin to eventually come to lie posterior to the saphenous branch of the descending genicular artery at the knee joint. Accompanied by the anterior cutaneous branches of the femoral nerve, the GSV then ascends along the medial aspect of the thigh, receiving tributaries from the peri-inguinal, and large antero-lateral and postero-medial veins (Standring, 2021). It soon perforates the cribriform fascia of the oval saphenous opening and drains into the femoral vein, forming the saphenofemoral junction 3-4 cm infero-lateral to the pubic tubercle (Chen & Prasad, 2009; Chander & Monahan, 2015; Standring, 2021; Senevirathne *et al*., 2023). In fact, it is at this location that the GSV is often enclosed by a fascial envelope that is easily distinguished as it depicts a "Cleopatra's Eye" or "Egyptian Eye" on ultrasound imaging (Caggiati, 1999; Al-Adawi *et al*., 2021).

However, due to its complexity, the venous system of the lower limb, particularly the GSV, is reported to present

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with many anatomical variations (Chen & Prasad, 2009). Knowledge of variations of the GSV and its fascial envelope – the latter of which is not well-described anatomically - is surgically relevant as it may guide specific operative approaches in individuals such as in-situ bypass procedures (Al-Adawi *et al*., 2021). It may also prove beneficial in the therapeutic management of symptomatic venous disease as well as in the performance and interpretation of medical imaging (Chander & Monahan, 2015). Hence, this study aimed to describe an unusual presentation in the distal segment of the left GSV.

MATERIAL AND METHOD

During routine anatomical dissection of an 83-year-old Caucasian female cadaver at Mohammed Bin Rashid University of Medicine and Health Sciences, Dubai, United Arab Emirates, the distal segment of the left GSV was observed to have an unusual presentation (Figs. 1 and 2). The following anthropometric data was sourced from the cadaver records: Height: 162cm; Weight: 68kg; and BMI 25.5. The primary cause of death was acute-on-chronic respiratory failure. In addition, history of left hip replacement, right knee replacement and osteoporosis were also documented.

RESULTS

The superficial fascia of the dorsum of the left leg and foot was distinctly organized into a superficial fatty layer and a thickened, deeper membranous layer (Fig. 1). Although the left GSV exhibited a normal formation through the union of the medial marginal vein draining the great toe and the medial end of the dorsal venous arch, its formation and initial course in the foot were situated deep to the thickened, membranous layer of superficial fascia (Fig. 1).

While the arrangement of the subcutaneous tissue broadly resembled the arrangement of the Camper's and Scarpa's fascia of the lower anterior abdominal wall and proximal thigh, the deeper membranous layer in the foot and leg was unusually thicker and firmer, having a pseudo-resemblance to the typical deep fascia of the lower limb.

Soon after its formation in the foot, the GSV followed an inter-fascial course between the deep fascia of foot and the thickened membranous layer of superficial fascia. The deeper membranous layer of superficial fascia continued to be unusually thick and firm in the leg until approximately 9cm above the medial malleolus, at which point it became progressively thinner. In the upper part of the leg, at about 17 cm superior to the medial malleolus, the GSV pierced the deeper membranous layer, and underwent a brief course within an intra-fascial canal within the membranous layer before coming to lie entirely within the superficial fatty layer (Fig. 2). The remaining course of the GSV in the thigh appeared to be normal and uneventful. It passed a hand's breadth posterior to the knee joint and ascended along the medial aspect of the thigh to drain into the femoral vein.

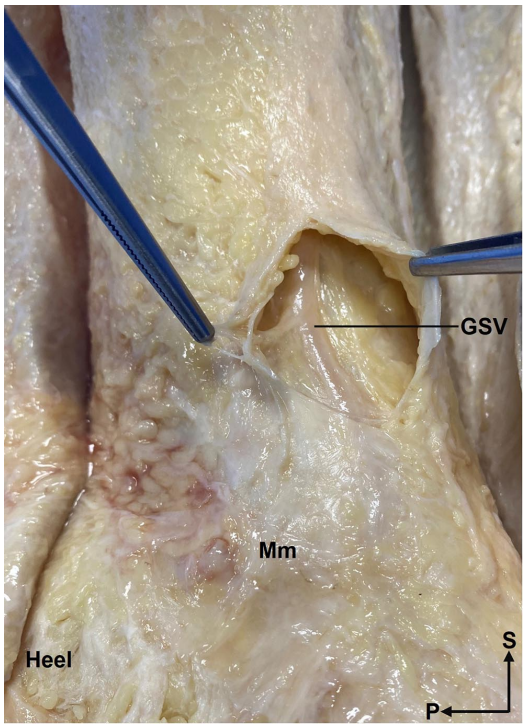

Fig. 1. The deeper membranous layer of the superficial fascia on the medial aspect of the left leg has been opened to visualize the left great saphenous vein. GSV. Great saphenous vein; Mm. Medial malleolus; P. Posterior; S. Superior.

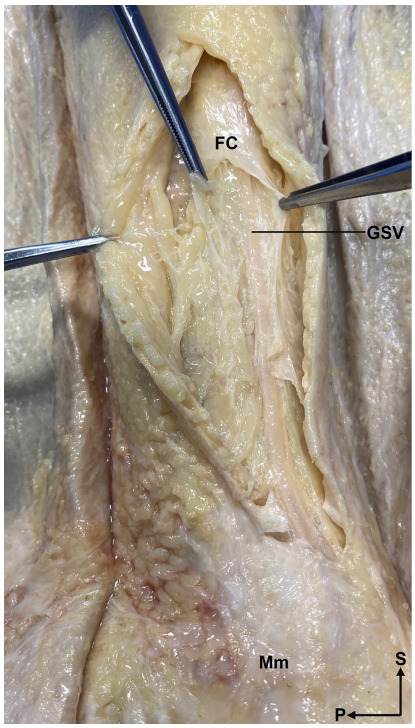

Fig. 2. The great saphenous vein is clearly seen to lie within an intra-fascial canal during its ascent in the left leg. FC. Fascial canal; GSV. Great saphenous vein; Mm. Medial malleolus; P. Posterior; S. Superior.

DISCUSSION

Although numerous authors report variations in the formation, termination and tributaries of the GSV, very few describe variations in the arrangement of the fascia related to it (Samuel & Stephen, 2015; Al-Adawi *et al*., 2021).

In the current study, the left GSV was observed to undertake an initial inter-fascial course between the deep fascia of foot and the membranous layer of superficial fascia. It then followed an intra-fascial course within a fascial canal in the upper leg formed entirely by the deeper membranous layer of the superficial fascia. The GSV eventually came to lie within the subcutaneous fatty layer of the thigh (Figs. 1 and 2). According to the literature reviewed, the earliest findings of a similar fascial canal lodging the GSV dates back to 1949 where the GSV was found to traverse through a slender fascial canal along the length of the leg, closely resembling our finding (Sherman, 1949). A similar report by Papadopoulos *et al*. (1981), observed the passage of the GSV through a fascial canal which was present in the upper leg and lower thigh regions. The same group also stated that histologically, this fascial canal was formed by contributions from the connective tissue laminae of the hypodermis and the deep fascia of the leg (Papadopoulos *et al*., 1981). In an ultrasonography study conducted by Chen & Prasad (2009), the GSV is described to lie within a fascial 'saphenous canal' or 'saphenous compartment' in the upper thigh, visible on ultrasound. This observation, seen on ultrasound, is comparable to our dissection finding, except that the fascial canal was noted to envelop the GSV in the leg itself. According to Samuel & Stephen (2015), this "incompleteness" of the saphenous fascia from the upper thigh to the ankle region is often seen and is of particular relevance to the vascular surgeon who relies on the "Egyptian Eye" sign (i.e., the classic combined appearance of the GSV within a fascial sheath) in this region to differentiate the GSV from adjacent venous tributaries during ultrasonography examination. Interestingly, a similar description of an inter-fascial disposition of the short saphenous vein has also been described by Caggiati (1999).

The rationale behind such variations is generally known to have an embryological basis (Yerolavi, 2015). The superficial venous system of the lower limb, a component of which is the GSV, develops during weeks 6-7 of intrauterine life (Mozes *et al*., 2000). An initial vascular framework consisting of an undifferentiated network of cells initially develops in the limb buds (Jean-François, 2015). Vascular endothelial growth factor (VEGF), secreted by the Schwann cells of developing nerves, then causes differentiation of this vascular network into the superficial veins of lower limb, as well as of the deep veins, arteries, and lymphatics. Superficial veins form along the pre- and post-axial margin of the developing lower limb buds and communicate with the deep venous system by the sixth month of intra-uterine life (Mozes *et al*., 2000). While variations and anomalous vessel formation occur due to molecular dysregulation and are more frequently reported in veins than arteries, they are rarely seen in the distal region of the GSV (Senevirathne *et al*., 2023). To date, there is no report describing the embryological basis for the development of such a fascial canal (as seen in this study) related to the GSV. Hence, we postulate that this variation may be due to an abnormal deviation in molecular regulation and/or a mutation in the gene encoding for the molecular regulating factor that governs the development of connective tissue sheathes that surround vascular structures (Yerolavi, 2015).

With the above in mind, it is noteworthy that the GSV is a popular site for emergency venous cannulation for rapid venous resuscitation, especially in those with visibly inconspicuous veins due to its constant relation to the medial malleolus, its thick wall, and wide calibre (Posner & Moore, 1985; Senevirathne *et al*., 2023). Therefore, a good understanding of the normal and variant venous anatomy and its relationship to the surrounding fascia is particularly imperative in vascular ultrasonography in the diagnosis and management of venous diseases of the lower limb, such as varicose veins, venous ulcers or deep vein thrombosis (Chen & Prasad, 2009). Finally, the saphenous fascia, within which the GSV sometimes lies, is thought to act as a mechanical shield to preserve the saphenous vein from excessive pathological dilatation.

CONCLUSION

In summary, we observed an unusual inter-fascial position of the GSV in the foot, followed by a rare and unconventional occurrence of a thick fascial canal, within which the GSV lodged in the leg. We postulate that the presence of this fascial canal may encourage venous return and prevent excessive pathological dilatation of the GSV during incompetencies of the venous valves.

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NAIDOO, N. & PRITHISHKUMAR, I. J. Un ojo egipcio en la pierna: Un raro trayecto interfascial e intrafascial de la vena safena magna. *Int. J. Morphol., 42(6)*:1504-1507, 2024.

RESUMEN: La vena safena magna (VSM), tiene un largo trayecto superficial a través del miembro inferior, y se considera una vena importante de elección en los procedimientos de revascularización coronaria. También es un sitio elegido para la canulación venosa, particularmente en emergencias. En una disección de rutina de un cadáver femenino caucásico de 83 años, se observó un trayecto inusual unilateral poco común de la VSM izquierda. Se notó una posición interfascial distal de la VSM en el pie, seguida de la aparición de un canal fascial grueso en la pierna dentro del cual se alojaba la VSM. Se puede postular que la presencia del canal fascial puede ayudar al retorno venoso y prevenir la dilatación excesiva de la vena durante las incompetencias de las válvulas venosas. Además, el conocimiento de dichas variaciones de la VSM y su envoltura fascial relacionada son especialmente relevantes para los protocolos preoperatorios en cirugía vascular periférica.

PALABRAS CLAVE: Miembro inferior; Canal fascial; Vena safena magna; Cirugía vascular; Válvulas venosas.

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