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Case Report
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Variations of Saphenous Veins: Case Report and Literature Review

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ABSTRACT

Introduction: the superficial veins of the lower limbs, usually used as an autograft for arterial bypass surgery, can be affected by chronic venous insufficiency (CVI) and complications such as thrombosis, ulcers and thromboembolism. In addition to full knowledge of the anatomy, it is essential to consider anatomical variations and their clinical and surgical implications.

Case Report: this paper presents the atypical pattern of superficial veins in the right lower limb during the dissection of the intact formaldehyde-preserved cadaver of an adult man from Brazil. The great saphenous vein (GSV) extension does not course in a single trunk, but as an anastomotic network connected with the small saphenous vein (SSV). The elongated aspect of anterior cutaneous femoral vein (ACFV) which runs in the interfascial compartment from the knee to the right femoral triangle.

Review: a literature review on aspects related to the unusual path of superficial venous drainage of the lower limbs was carried out using the MeSH (Medical Subject Headings) terms: "Saphenous Vein" AND "embryology", "Saphenous Vein" AND "Anatomic Variation".

Conclusion: these morphological findings must be taken into account by clinicians because of the possible physiopathological implications of anatomical remodeling, flow by-passing and structural modifications related to variation of these veins.

Keywords: Saphenous Vein; Anatomy; Dissection.

Introduction

Anatomical dissection allows the observation of anatomical variations, which influence the success of surgical, clinical and treatment procedures[1]. The anatomical and functional knowledge of venous drainage of the lower limbs is of great importance in performing procedures[2]. Great saphenous vein (GSV) and small saphenous vein (SSV) are the major veins of the superficial venous system. It is connected to the deep venous system, which drains 90% of all blood out of the legs through the perforator veins[2]. The GSV originates with the junction of the dorsal venous arch of the foot and the dorsal vein of the hallux, passes anteriorly to the medial malleolus and follows in the medial region of the lower limb. Along this path, the GSV receives tributaries, including some pelvic veins (iliac circumflex vein, superficial epigastric vein, external pudendal vein)[3]. The SSV originates posterior to the lateral malleolus as a continuation of the lateral marginal vein of the foot, close to its companion nerve the sural nerve. SSV rises along the lateral border of the tendo calcaneus and then crosses to reach the middle of the posterior aspect of the leg. Running upwards, it perforates the deep fascia in the lower part of the popliteal fossa between the heads of the gastrocnemius muscle[4].

According to the angio-guiding nerves hypothesis, vessels develop following the pattern of nerve distribution. Three main axes are described for the lower limbs: 1) axial (or sciatic) nerve; 2) preaxial (or femoral); 3) postaxial (or posterior femoral cutaneous). These nerves guide the formation of three venous plexuses that form the vessels responsible for venous drainage of the lower limbs. Not only the blood flow, but also the production of mediators by the nervous tissue promotes the attraction and targeting of precursor tissues, originating three primitive venous plexuses[5,6]. Thus, the axial nerve induces organogenesis of veins of the thigh, the preaxial nerve induces organogenesis of the femoral vein and GSV, the postaxial nerve induces the organogenesis of the SSV and its postaxial networks induce the network that generates the popliteal vein. The venous plexuses can anastomose with each other, developing important connections for the drainage of the lower limbs[5-7]. The occurrence of the Giacomini vein, a crural venous branch that joins the SSV to the GSV, can be explained by the anastomosis between the preaxial and postaxial venous plexuses[5]. Formation of

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the superficial venous system occurs before the deep venous system. The first important superficial vein of the lower limb to form is the SSV, preceding the formation of the GSV. In the embryonic stage, cervical and lumbar intersegmental arteries and veins enter the buds of their respective limbs, which appear around the fourth week of development. Initially, the arteries pass through the center, while the veins run along the periphery. Thus, circulation depends on an arterial axis that develops in the center and on preaxial and postaxial veins, which promote circulation through the central and marginal vessels. During embryonic development, the lower limb appears in a lateral position, subsequently pelvic rotation occurs and there is relocation to the ventral position, together with the sciatic vessels that are predominant during this stage. The sciatic artery is a branch of the umbilical artery, the first artery to emerge, followed by the iliac artery. At the beginning of the embryonic phase, the vein that precedes the SSV, the marginal fibular vein, performs an anastomosis with the posterior cardinal vein, which later anastomoses with the ischial fibular vein. After pelvic rotation, the marginal fibular vein anastomosis with the external iliac vein. Several anatomical variations occur due to the various anastomoses described, and this is due to the great consensual variability regarding the termination of the small saphenous vein[8,9].

The GSV, together with the saphenous nerve, is located in the saphenous compartment, a neurovascular space limited by the membranous layer of the subcutaneous tissue and the deep muscle fascia. On the other hand, the surrounding tributaries have a more superficial path, which permeates the adipose tissue just below the skin and deepens where it flows into the GSV. Unlike the GSV, the tributary veins do not rest on the muscle fascia or accompany the main trunk of the saphenous nerve[10-12]. SSP follows the same stratigraphy. GSV is highly eligible as an autograft in certain vascular surgical procedures, such as arterial bypass surgery[12]. In addition, this vein is often associated with chronic lower limb venous insufficiency and its complications. This venous condition, usually known as varicose veins, occurs due to a primary valve insufficiency. More rarely, varicose veins are secondary to other pathologies, being more frequent in the elderly population[2,12].

Given the relevance of topographic knowledge of the venous drainage of the lower limbs, this report presents a case of anatomical variation in the path not only of the GSV and SSV, but also of the elongated aspect of the anterior cutaneous femoral vein (ACFV).

Materials and Methods

A male cadaver was fixed in the Human Anatomy Laboratory of the Federal University of Jataí, with immersion for two months in a formalin solution at 35 % (10 volumes). The skin of the lower limbs was removed for dissection of the superficial neurovasculature. After removing the subcutaneous tissue and cleaning the vessels, the anatomical variations were described and analyzed.

In the second part of this study, a literature review on aspects related to the unusual path of superficial venous drainage of the lower limbs was carried out using the MeSH (Medical Subject Headings) terms: "Saphenous Vein" AND "embryology", "Saphenous Vein" AND "Anatomic Variation". Only articles in English and Portuguese, published in Pubmed, Embase, Mendeley, and the Cochrane library were included. No date of publication was imposed as exclusion criteria.

Case Report

A male cadaver was fixed in the Human Anatomy Laboratory of the Federal University of Jataí. After removing the skin and subcutaneous tissue of the lower limbs, the superficial neurovasculature was dissected. An atypical pattern of superficial veins in the right lower limb of the cadaver was noted: right lower limb, GSV presents an anastomotic network interconnected with the SSV (figure 1 and 2); right lower limb, ACFV elongated with an ascending path, from the upper third of the leg to the femoral triangle. The left lower limb presents the superficial vessels with the usual aspect as shown on figures 1 and 2. GSV in a single main trunk and SSV perforating the deep muscular fascia in the upper third of the leg to reach the saphenopopliteal junction in the limb fossa.

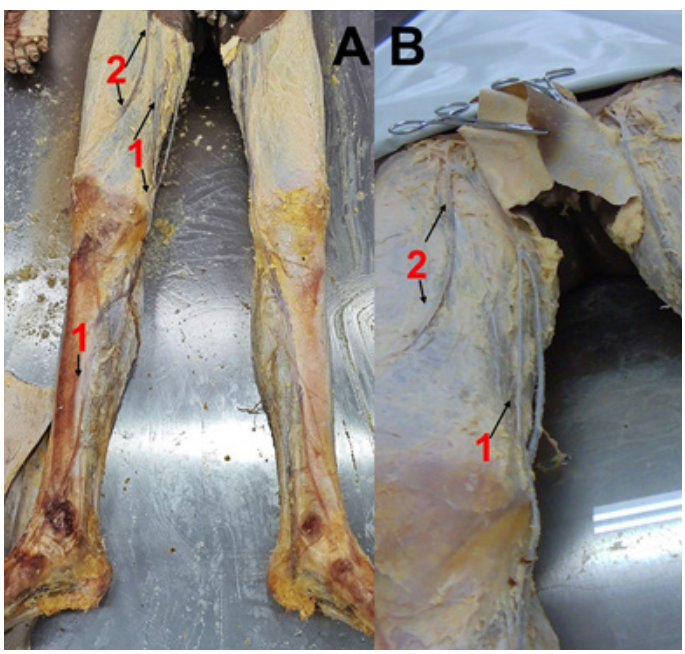
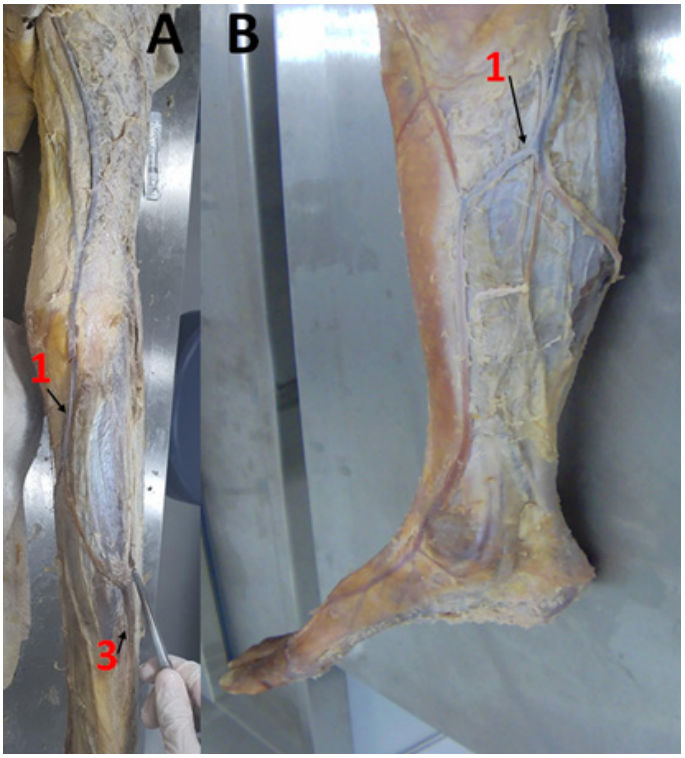


Figure 1. Corpse in anatomic position. A- Right and left lower limbs showing different patterns for great saphenous vein (1). B- Anterior cutaneous saphenous vein (2) elongated with an ascending path from the knee to the femoral triangle. Source: photographed by the authors.



Fugure 2. A) Corpse in prone position with small saphenous vein (3) connected with great saphenous vein (1). B) Corpse in anatomic position, vascular network of great saphenous vein (1).
Source: photographed by the authors.

Results and Discussion

The main superficial veins of the lower limbs are the GSV and SSV. The union of the dorsal vein of the hallux and the dorsal venous arch of the foot form the GSV. GSV runs anteriorly from the medial malleolus and follows posteriorly to the medial condyle of the femur, through the calf and thigh and receives several tributaries along this path, communicating in several sites with the SSV. The GSV flows into the femoral vein, through the saphenous-femoral junction. The SSV originates from the union of the dorsal vein of the fifth toe with the dorsal venous arch, ascends posteriorly to the lateral malleolus, passes between the heads of the gastrocnemius muscle and drains into the saphenopopliteal junction. Although the saphenous veins received several tributaries, their diameters remain reasonably constant during their route due to the fact that the blood received is continuously diverted to the deep veins of the lower limbs[4].

Reports on the prevalence of the Giacomini vein describe its presence in 92% in a sample of 50 cadavers (21 women and 29 men). It is an extension of the SSV that extends to the thigh region and occurs in different population groups around the world[13]. The analysis of the 50 cadavers led to the following result: 71 samples presented the SSV flowing into the popliteal vein; 8 samples showed endings of the SSV flowing into the popliteal vein without additional extension; 43 samples showed the SSV flowing into the popliteal vein with a branch anastomosing the GSV; 20 samples showed the SSV flowing into the popliteal vein having a proximal branch in the thigh; 16 samples showed the SSV ascending to the GSV; 13 samples showed the SSV ascending to the thigh, not flowing into the GSV[13].

Kurt (2014) presented a case of venous insufficiency in the lower limb of a 47-year-old woman whose GSV connected to the superficial femoral vein[14]. Rao and Chaudhuri (2006) presented the abnormal opening of the GSV into the femoral vein[12]. In this cadaver, the main trunk of the left GSV communicated with the femoral vein only through a small venous branch and its main trunk followed medially to the adductor great muscle, outside the femoral triangle, crossing the pubic symphysis and flowing into the contralateral femoral vein (right) along with the right GSV[12]. Usually, the SSV reaches the saphenopopliteal junction and forms an arch that flows into the popliteal vein. However, one possibility is that, after this terminal arch, which may be absent, the SSV continues as a venous branch that ascends deeply through the thigh, which may flow into the deep femoral vein and anastomoses with GSV[4]. The anatomical variations of the saphenous-femoral junction are described by Cirocchi (2016). The authors reported not only duplication of the saphenous-femoral junction, but also prevalence of separate junctions and ectasia[1].

Duplicated GSV can have an incidence of up to 52%. After analyzing the saphenograms of 103 patients (67 unilateral, 18 bilateral), 50 patients had some type of GSV duplication. Of these 50 patients, 24 presented duplication in the thigh with the closed circuit (anastomosis) in 14, with ramifications in nine limbs, and in only one there was complete duplication along the entire path in the thigh. Among these 50 lower limbs evaluated, 20 had duplication from the thigh to the calf, with the closed circuit (anastomosis) in 12, branched GSV in seven, and only one had complete duplication of the vein. Six examinations revealed duplication restricted to the calf, five of which had ramifications and only one had a closed venous circuit. The remaining three members had either a GSV tripling or a networked configuration. Among the 50 tests that showed duplication of the GSV, 41 demonstrated some connection of this superficial vein (and its branches or duplications) with deep veins through perforating veins in the calf, knee or thigh. Of these 41, in 21 cases these connections with the deep veins occurred with both superficial trunks and, in 10 only with accessory veins. Among the 18 people who underwent bilateral saphenogram, 10 had GSV duplication in both lower limbs, and only 1 had the same pattern and location in both lower limbs, which suggests a small influence of genetic factors on the anatomy of the veins. The anatomical patterns of duplication of the GSV and perforating veins that connect it to the deep veins, when not properly considered before surgical treatment, may be related to the recurrence of varicose veins after surgery[15].

Along its course, the GSV may have a heterogeneous diameter with narrow segments in length ranging from 4 to 30 cm or more. In these cases, large-caliber tributaries can be seen forming a collateral circulation pathway that supplies the reduced blood flow of the narrowed segment. In 17.6% of the limbs analyzed with ultrasonography, the saphenous vein had an absence of a segment. In this pattern, the vein had an abrupt termination distally, being continuous with a perforating vein or a tributary. It reappeared in the proximal third as a continuation of a large-caliber tributary that entered the saphenous compartment. In the cadaveric analysis of this study, the reduced caliber segment of the GSV was observed in 18.8% of the limbs, and there was an absence of any segment of the GSV in 15.6% of the limbs (superficial anatomy). The existence of a large-caliber collateral or tributary branch is considered a predisposing factor for varicose disease, since, outside the saphenous compartment, the vein does not have the same mechanical tissue support to maintain an efficient flow[11].

Conclusion

Thus, the anatomical distribution of the superficial and deep venous channels have crucial importance in the pathogenesis of chronic venous disorders of the lower extremities. Knowledge of anatomy and variations of lower extremity veins as well as their clinical implications would be beneficial to radiologists and practitioners, leading to a better treatment outcome.

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