Association between Anatomical Variation of the Great Saphenous Vein and Venous Failure in Patients Undergoing Vascular Ultrasound of the Lower Limbs

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Summary

Introduction: **Venous anatomy may present significant variability, with a wide incidence of venous tributaries, duplicate or accessory veins related to saphenous veins. The recognition and identification of these variations are important in the therapeutic management of these patients, and vascular ultrasonography is the method of choice in the evaluation of the peripheral venous system.**

Objectives: **To evaluate the association between anatomic variance of the great saphenous vein (VSM) and venous insufficiency of the lower limbs in patients with primary varicose veins of the lower limbs.**

Methods: **Patients with varicose veins were consecutively evaluated in the period from 2014 to 2015, excluding patients with a history of previous surgery and deep venous thrombosis. Vascular ultrasound was performed to examine the superficial venous system, in particular to the VSM study, determining the different patterns of anatomical variation of this vessel and its association with the presence of venous insufficiency and CEAP classification.**

Results: **422 lower limbs of 211 patients, aged between 21 and 86 years, mean age of 45.7 years, 81% female, with a predominance of APC 1 (43.8%) and 2 (46.2% %). Reflux in the VSM was found in 35.1%. The presence of anatomical variation was found in 8.8% of the patients, being more frequent in the distal third of the thigh and proximal of the leg (27.3%). No association was found between the anatomical variation of MSV and CEAP ($p = 0.25$). There was a statistically significant association between no anatomic variation and the presence of VSM insufficiency ($p = 0.03$).**

Conclusion: **in the present study, anatomic variation of the great saphenous vein was observed in about 9% of the patients, with a significant association between insufficiency of the great saphenous vein and no anatomical variation. (Arq Bras Cardiol: Imagem cardiovasc. 2018;31(2):90-94)**

Keywords: **Saphenous Vein/physiopathology; Saphena/anatomy & histology; Venous Insufficiency/physiopathology; Connective Tissue; Fascia; Varicose Veins/diagnostic imaging; Lower Extremity.**

Introduction

The great saphenous vein (GSV) plays an important role in the pathophysiology of varicose veins of the lower limbs. It is commonly found in a deep plane of the hypodermis, directly above the muscular fascia, with all its extension covered by a hypodermic connective tissue fascia called "saphenous fascia." This fascia fuses with the muscular fascia, causing the formation of the saphenous compartment (Figure 1), through which the saphenous vein and the saphenous nerve pass through. These anatomical findings may play a significant role in both clinical practice and in the pathophysiology of varicose disease. Correct recognition of the saphenous compartment allows identifying and differentiating the anatomical patterns related to the GSV, and vascular ultrasound (VSA) is the method of choice in this identification. The presence of venous tract outside the saphenous compartment and alterations in the saphenous vein thickness (hypoplasia and aplasia) are considered anatomical variations.[1,2]

The presence GSV with segmental hypoplasia in patients who clinically present varicose veins suggests a possible role of this phenomenon in the pathogenesis of varicose veins. This could be explained by the hemodynamic overload of the accessory saphenous vein that occurs at the level of the segments with hypoplasia. The accessory saphenous vein wall is thinner and contains fewer muscle cells than the GSV. In addition, these veins are surrounded by a single layer of fat, which cannot withstand the dilatation of vessels.[1,2]

In limbs predisposed to varicose disease, the overload in the accessory saphenous veins is greater and results in dilatation and tortuosity, which are larger, occur earlier and are clinically more evident than those occurring in the incompetent GSV.[1]

In the last decade, several modalities have been developed for the treatment of varicose veins. The recognition and identification of anatomical variations of GSV are important in the therapeutic management of patients. VUS is the main propaedeutic method

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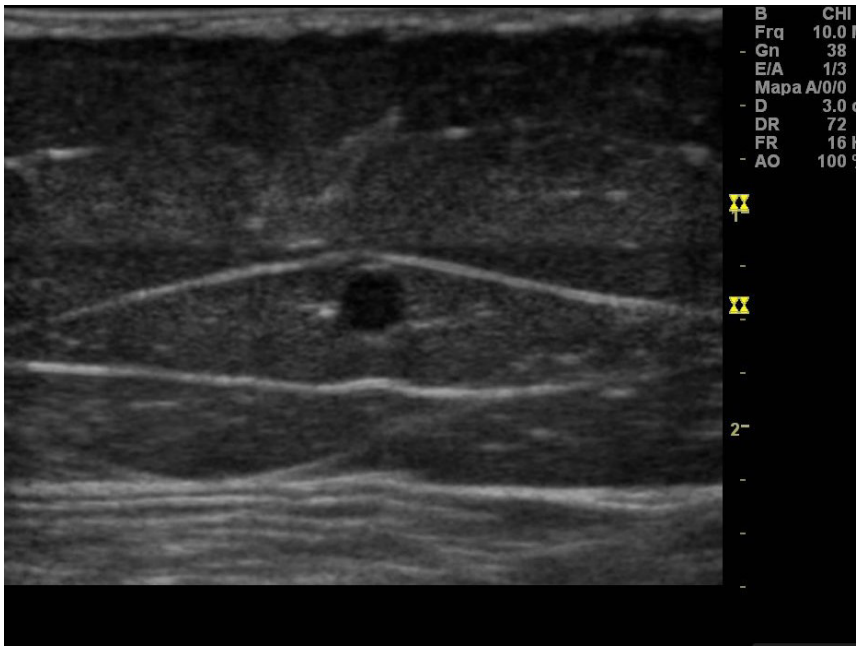

Figure 1 – *The saphenous compartment or "Egyptian eye" is characterized by cross-sectional great saphenous vein located between the superficial and the aponeurotic fascia.*

for the morpho-functional evaluation of varicose veins in the lower limbs, including the GSV. The correct evaluation of the venous system through this method is important for the management of the disease.[2] Although studies have shown an association between the presence of GSV anatomical variation and failure,[2] other studies do not corroborate these findings,[3,4] making the issue even more controversial.

The main objective of this study was to determine the prevalence of anatomical variations of the great saphenous vein and its relationship with the presence of reflux in patients with varicose veins of the lower limbs, as well as to evaluate the association between the presence of GSV anatomical variation and failure and clinical repercussion in these patients.

Methods

Adult patients assisted at a private clinic to perform vascular echography to map varicose veins of the lower limbs in the years 2014 and 2015 were included in the study. Exclusion criteria were history of variceal surgery and history of deep or superficial venous thrombosis. Examination of the superficial venous system, especially the GSV study, was performed in an orthostatic position using 5 to 12 MHz multifrequency linear transducers. GSV scanning was performed in a cross-sectional view from the sapheno-femoral junction to the malleolar region in two-dimensional mode to evaluate its course. GSV aplasia was considered when it was not inside the saphenous compartment. In the segments where GSV aplasia was present, the presence of a vein outside the saphenous compartment was considered as an anatomical variation. The presence of varicose veins in different sites of the lower limb, related or not to the GSV, were analyzed. The criterion for defining valvular failure was reflux time by spectral analysis greater than 500 ms.[1] For the evaluation of the GSV pathway by VUS, six types of anatomical variation were considered: Type I – one that presented aplasia only in the thigh segment; Type II – aplasia in the leg segment; Type III – aplasia in the distal segment of the thigh and proximal segment of the leg; Type IV – vein in the saphenous compartment in the thigh and aplasia of the entire leg segment; Type V – vein in the saphenous compartment only in the short proximal thigh segment; and Type VI – vein with short segment in the saphenous compartment only in the distal leg.[1] For clinical evaluation, the CEAP classification was adopted.[5]

This study was approved by the research ethics of FASEH.

The statistical analysis considered the distribution of absolute and relative frequency of the qualitative variables and the mean and standard deviation of the continuous quantitative variables. The proportions of independent and group-dependent variables were compared using the chi-square test for qualitative variables. The software SPSS (version 20, SPSS Inc., Chicago, Illinois) was used and $p < 0.05$ was considered statistically significant.

Results

The study included the examination of 422 lower limbs of 211 patients, aged between 21 and 86 years, mean age 45.7 years, with a predominance of females (81%). The CEAP classification showed a predominance of CEAP 1 (43.8%) and 2 (46.2%), and no cases of CEAP 5 and 6 were found.

Anatomical variation was found in 8.8% of the patients. Anatomical variation was more frequent between the distal third of the thigh and the proximal third of the leg, according to Chart 1. The segments with GSV variation were: 3 proximal thighs (0.7%), 21 medium thighs (5.0%), 32 distal thighs (7.6%), 31 knees (7.3%), 37 proximal legs (8.8%), 17 medium legs (4.0%), 1 distal leg (0.2%).

There was an association between the anatomic variation of the GSV and the presence of reflux ($p = 0.03$). Patients without anatomical variation developed more venous failure than those with anatomical variation, as shown in Table 2.

No association between the anatomical variation of the GSV and the CEAP classification ($p = 0.25$) was observed, as shown in Table 1.

Discussion

This study analyzed 422 lower limbs and their results showed a prevalence of GSV anatomical variation of 8.8%. The absence of GSV anatomical variation was associated with GSV failure ($p = 0.03$).

There is no definition as to the etiology of the anatomical variations of the GSV, which may be related to a developmental defect where the vessels with hemodynamically favorable conditions prevail over others, who undergo atrophy.[6] Variability in the venous anatomy is due not only to the individual physiological variations, but may also be associated with embryogenesis, potentially determinant of variations that is subject to the actions of biochemical and genetic factors that are not very clear yet. These embryogenesis abnormalities determine the onset of abrupt reductions in the caliber of GSV segments, which receive different names according to size. Aplasias are narrowing processes that usually affect the GSV, leaving it with a diameter smaller than 1 mm – visible only under the microscope, and hypoplasias are narrowing processes larger than 1 mm in diameter, visible to the naked eye. The presence of GSV with segmental hypoplasia in patients who clinically present varicose veins suggests a possible role of this phenomenon in the pathogenesis of varicose veins, related to hemodynamic overload. Therefore, anatomical variations may interfere with the venous flows.[7]

In a study conducted by Caggiati and Mendonza,[2] in which 996 members were analyzed by vascular echography, the prevalence of anatomical variation of GSV was 16.4%, of which 12% was in controls and 25% in patients with GSV with ostial failure. There was also an association between GSV ostial failure and aplasia ($p > 0.001$) in this study.

Oğuzkurt et al.,[6] in turn, found, in the sample groups, segmental aplasia in 34% of those with GSV failure and 31% of those with normal GSV. In this study, there was no significant difference in the frequency of aplasia in the left and right limbs or in patients with or without valve failure.

In a sample of 1408 patients, in which 2,665 lower limbs were examined, Seidel et al.[4] reported GSV aplasia in 61.8% in the non-varicose group and 38.2% in limbs with varicose veins. The result of this study showed that in the group with varicose veins there was a higher incidence of limbs with association of valve failure and GSV aplasia compared to the non-varicose group. In the non-varicose group, there was a higher number of limbs with segmental aplasia of the GSV.

Compared to the other studies, our sample showed a lower prevalence of anatomical variation of the GSV, and the association between anatomical variation and GSV failure was not found in the study of Caggiati and Ricci.[7]

Conflicting findings reported in the studies may be related to differences in the samples as well as the degree of venous failure. In the study by Caggiati and Ricci,[7] for

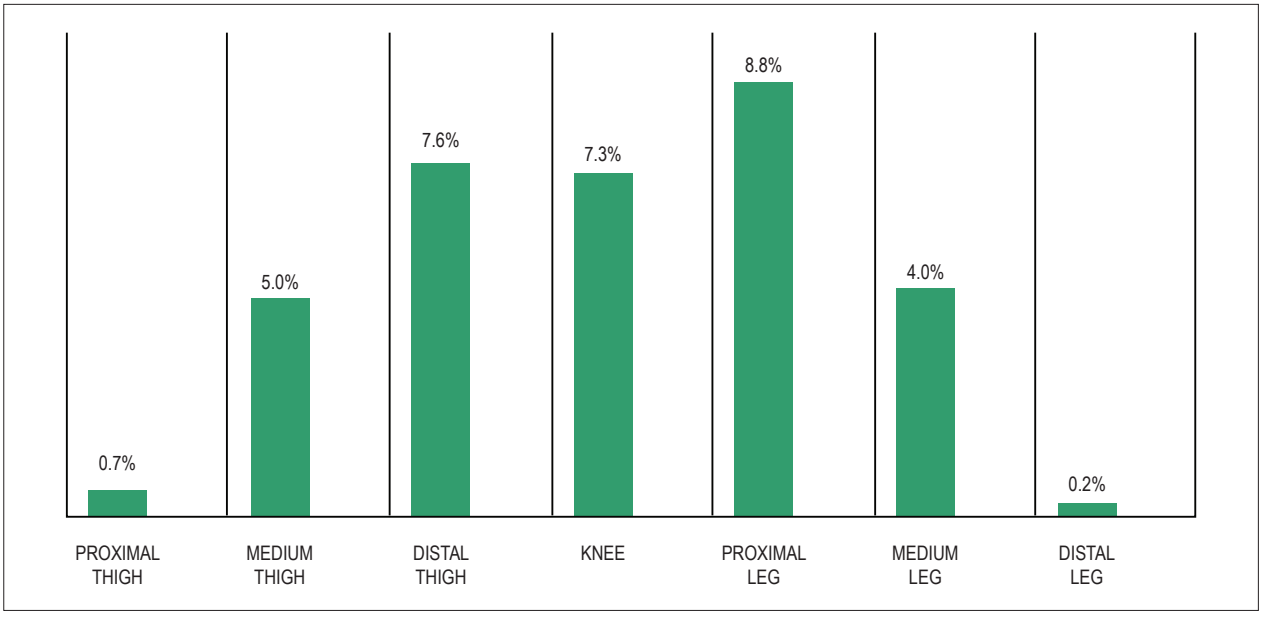

Chart 1 – *Distribution of the presence of anatomical variation according to different topographies of the lower limb.*

Table 1 – Distribution between anatomical variation and CEAP classification in 422 lower limbs

CEAP	Anatomical variation		Total
	No	Yes	
0	12	2	14
1	169	16	185
2	179	16	195
3	15	0	15
4	10	3	13
Total	385	37	422

p = 0.25

Table 2 – Distribution between anatomical variation of the great saphenous vein and reflux

GSV REFLUX	Anatomical variation		Total
	No	Yes	
No	244	30	274
Yes	141	7	148
Total	385	37	422

p = 0.03

example, only patients with ostial failure of the GSV were evaluated, which was not the characteristic of the other samples. Comparative analysis with other studies, therefore, is compromised by the difference between the samples as to the patients' characteristics, making the studies not comparable. The limitations of this study include the experience of a single center for data collection and the failure to use inter and intraobserver variability in VUS studies.

In conclusion, this study reported anatomical variation of the great saphenous vein in about 9% of the patients, showing no association between the presence of greater prevalence of failure and anatomical variation of the GSV. These findings demonstrate the importance of careful mapping of the GSV in the diagnosis of anatomical variation of this vessel to better manage these patients.

Authors' contributions

Research creation and design: Albricker ACL, Andrade AGF, Almeida DS, Almeida GS, Andrade JMM, Santos PS, Barros MVL; Data acquisition: Albricker ACL, Andrade AGF, Almeida DS, Almeida GS, Andrade JMM, Santos PS, Barros MVL; Data analysis and interpretation: Albricker ACL, Andrade AGF, Almeida DS, Almeida GS, Andrade JMM, Santos PS, Barros MVL; Manuscript drafting: Albricker ACL, Andrade AGF, Almeida DS, Almeida GS, Andrade JMM, Santos PS, Barros MVL; Critical revision of the manuscript for important intellectual content: Albricker ACL, Barros MVL.

Potential Conflicts of Interest

There are no relevant conflicts of interest.

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Academic Association

This study is not associated with any graduate program.

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