

## Association between Insufficiency of Anterior Perforator Vein of the Knee and Great Saphenous Vein Insufficiency in Patients with Primary Varicose Veins of the Lower Limbs

Marcio Vinícius Lins Barros,<sup>1,2</sup> Gabriela Silva Lauer,<sup>1</sup> Jéssica Monteiro Machado,<sup>1</sup> Maria Cláudia Freitas Silva,<sup>1</sup> Taynara Andrade Capanema<sup>1</sup>

Faculdade de Saúde e Ecologia Humana,<sup>1</sup> Vespasiano, Minas Gerais; Clínica Especializada em Ultrassonografia,<sup>2</sup> Belo Horizonte, Minas Gerais – Brazil

### Abstract

**Background:** The accurate identification of reflux points in the study of primary varicose veins of the lower limbs is important in the therapeutic approach of these patients.

**Objective:** To evaluate the association between insufficiency of the anterior perforator vein of the knee and great saphenous vein insufficiency in patients with primary varicose veins of the lower limbs.

**Methods:** The study included 886 patients, corresponding to 1,772 lower limbs, in patients older than 18, of both sexes, undergoing superficial venous mapping using vascular ultrasound.

**Results:** The mean age of the patients was  $46.1 \pm 14.5$  and 81.7% were females. Great saphenous vein insufficiency was found in 38.8% of the cases. Insufficiency of the anterior perforator vein of the knee was found in 146 lower limbs (8.2%), with a mean diameter of  $1.7 \pm 0.15$  mm, prevailing in the infrapatellar area (86.4%). The anterior tributary vein of the great saphenous vein originated leg reflux in 34%, with a direct relation of this tributary vein with the anterior perforator vein of the knee in 79.4%. An association between the presence of anterior perforator vein of the knee and great saphenous vein insufficiency ( $p = 0.0001$ ) and male gender ( $p = 0.001$ ).

**Conclusion:** There was an association between insufficiency of the anterior perforator vein of the knee and great saphenous vein insufficiency in patients with primary varicose veins of the lower limbs at vascular ultrasound, and the accurate identification of this perforator vein may be important in the therapeutic approach of these patients. (Arq Bras Cardiol: Imagem cardiovasc. 2019;32(1):14-18)

**Keywords:** Varicose Veins/diagnostic Imaging Lower Extremity/surgery; Ultrasonography; Saphenous Vein/physiopathology; Venous Insufficiency/surgery.

### Introduction

Chronic venous insufficiency (CVI) of the lower limbs is the most prevalent disease among venous diseases, with a prevalence of 61% in women in the adult population.<sup>1</sup> It is defined as a venous system dysfunction that occurs because of venous hypertension, due to venous reflux, obstruction of the venous flow or the association of these two factors.<sup>2</sup> The varicose veins of the lower limbs are its main manifestation and the prevalence of these in Brazil varies from 41 to 63% in women, and from 14 to 38% in men.<sup>3</sup>

The perforator veins (PV) connect the superficial venous system to the deep venous system and are important in the

development of signs and symptoms in the chronic venous disease (CVD). There are about 150 perforator veins in each lower limb. Of these, about 40% are associated with venous incompetence, especially those that attach to the saphenous veins and tributary veins.<sup>4</sup> Besides, reflux in PV, compared to reflux in the Great Saphenous Vein (GSV), is relevant according to the severity of the clinical condition.<sup>4,5</sup>

Vascular ultrasound is the most useful tool for the diagnosis of venous diseases. It is a non-invasive test that allows anatomical and hemodynamic evaluation of the venous system.<sup>6-8</sup> The identification of these venous insufficiency points is important for the knowledge of the physiopathology of venous insufficiency, as well as for proper therapeutic planning.

Although the anterior PV of the knee have already been described in the literature, their importance in the physiopathology of primary varicose veins is not well established.

The purpose of this study was to evaluate the association between insufficiency of the anterior PV of the knee and GSV insufficiency using vascular ultrasound.

**Mailing Address:** Marcio Vinícius Lins Barros •  
Rua Padre Marinho, 214 B, Santa Efigência. Postal Code 30240-040,  
Belo Horizonte, MG – Brazil  
E-mail: marciovbarros@gmail.com  
Manuscript received July 8, 2018; revised August 20, 2018; accepted  
November 4, 2018.

## Methods

From 2016 to 2018, a cross-sectional study was carried out in a private clinic located in Belo Horizonte (MG).

The study included patients of both sexes older than 18, with clinical diagnosis of primary varicose veins of the lower limbs as found by vascular ultrasound. Those with a previous history of deep and/or superficial venous thrombosis and surgery for varicose veins were excluded.

All patients underwent vascular ultrasound scan of the lower limbs (LL) for the presence or absence of insufficiency of the PV of the knee and GSV (Figure 1).

Vascular ultrasound was performed with patients in the orthostatic position in order to examine the superficial venous system using multi-frequency linear transducers of 5 to 7 MHz, in two-dimensional mode, color and spectral Doppler, with special attention to evaluation of GSV insufficiency and origin of reflux points. The anterior perforator vein of the knee was evaluated by insonation of the anterior infra and suprapatellar area of the knee, mapping the presence of superficial venous segment perforating the fascia, characterizing perforator vein. The criterion for the definition of insufficiency was reflux time greater than 500 ms.

Descriptive statistics of the variables chosen resulted in the distribution of absolute and relative frequency of qualitative variables and the mean and standard deviation of the continuous quantitative variables. Then, proportions of independent and dependent variables of the groups were compared using the chi-square test for qualitative variables and Student's t test for quantitative variables. Statistical analyses

were performed using the software Statistical Package for Social Science (SPSS), version 20 (SPSS Inc., Chicago, Illinois, USA) and  $p < 0.05$  was considered statistically significant.

This study was submitted to the Ethics Committee of Faculdade de Saúde e Ecologia Humana. It was approved with CAAE number 66657017.5.0000.

## Results

The study evaluated 1,722 lower limbs of 886 patients with mean age of  $46.1 \pm 14.5$ , of which 81.7% were females. GSV insufficiency was found in 38.8% of the cases. The general characteristics of the study population are found in Table 1.

Insufficiency of the anterior perforator of the knee was found in 146 lower limbs (8.2%), with a mean diameter of  $1.7 \pm 0.15$  mm, predominantly in the infrapatellar area (86.4%). Table 2 shows an association between the presence of anterior perforator vein of the knee and GSV insufficiency ( $p = 0.0001$ ) and sex ( $p = 0.001$ ). No association was found between age and presence of anterior perforator vein of the knee ( $p = 0.46$ ).

The origin of reflux in the GSV, from an anterior perforator vein of the knee, stemmed from the confluence of an anterior tributary vein. The presence of GSV insufficiency in the leg occurred in 24% of the patients. Figure 2 shows the description of the origin of insufficiency (anterior tributary vein, posterior tributary vein and another perforator vein). The anterior tributary vein originated GSV reflux in 34% and the direct relationship of this tributary vein with a perforator vein occurred in 79.4% ( $p = 0.0001$ ).

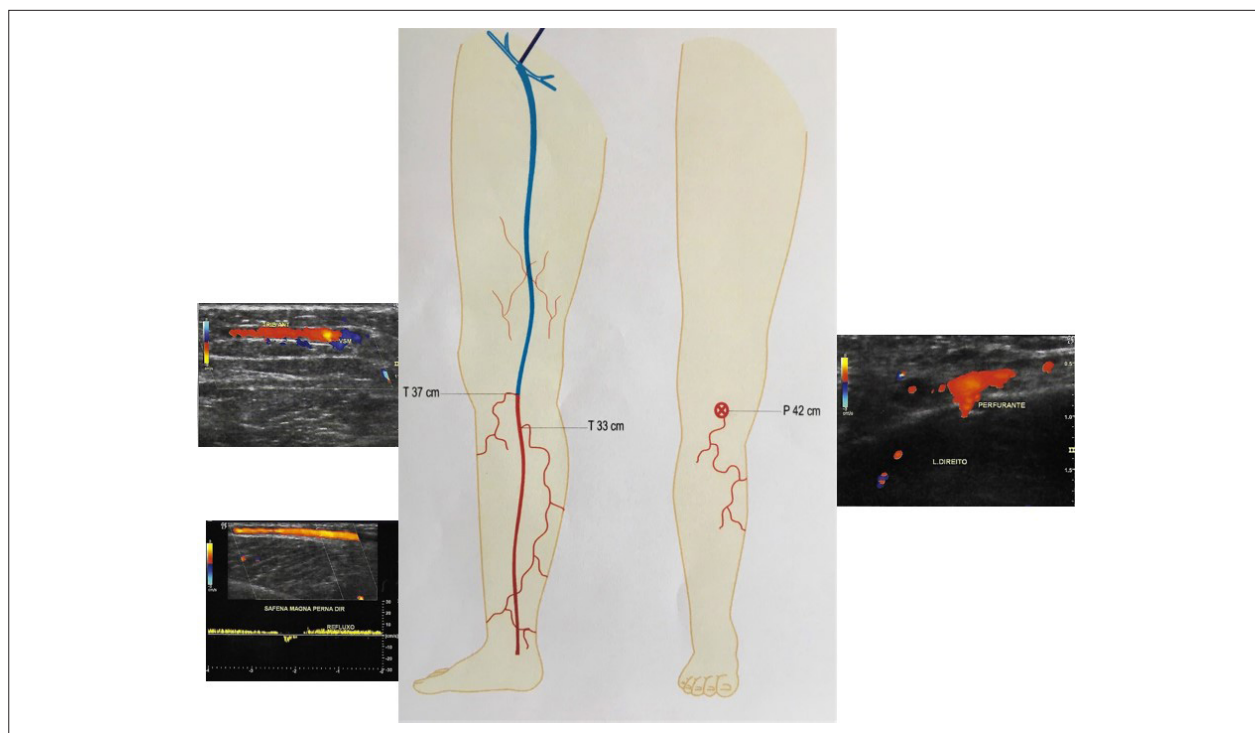


Figure 1 – Superficial venous mapping showing the anterior perforator vein of the knee and its relation with great saphenous vein insufficiency.

## Discussion

The study revealed an association between insufficiency of anterior perforator vein of the knee and GSV insufficiency in patients with primary varicose veins undergoing vascular ultrasound.

PVs connect the superficial and deep venous systems and most PVs have at least one unidirectional subfascial bicuspid valve connecting such systems. PV incompetence is often seen in patients with CVD. There are about 150 perforator veins in each lower limb with about 60 PVs in the thigh, eight in the popliteal fossa, 55 in the leg and 28 in the foot.<sup>4</sup> Due to the large number of PVs and the variation of their distribution, they can be classified according to their topography.<sup>9</sup> The PVs include the perforator veins of the knees, divided according to their location. Such perforator veins are designated as medial perforator of the knee, anterior suprapatellar, anterior

infrapatellar and lateral perforator of the popliteal fossa.<sup>5,9</sup> Although the location of the anterior perforator vein of the knee is described, there are no studies discussing the association of these with GSV insufficiency.

Vascular ultrasound allows to analyze the physiopathology of venous disorder and locate the specific venous segments with abnormalities, namely: deep and superficial systems, and perforator vein systems.<sup>10</sup> Besides, it allows to find the direction of the venous return circulation which, under physiological conditions, occurs in the proximal direction, but, in pathological situations, of valve incompetence, the flow is in the distal venous direction.<sup>11</sup>

Insufficiency of PVs may be related to the clinical severity of the CVI and its surgical approach may be necessary. The technique of subfascial endoscopic ligation of PV, developed in the past few years, aims to reduce surgical trauma, healing complications and relapse of varicose veins. Subfascial endoscopic surgery of insufficient PVs associated with radical variceal surgery is safe, presents a low rate of complications and should be recommended for patients classified with CEAP 4, 5 and 6.<sup>12</sup>

Individualized therapeutic approach in varicose diseases is better targeted by identifying specific reflux patterns. The onset of GSV insufficiency may occur at several areas, including at the sapheno-femoral junction, the tributary veins and the perforator veins. Engelhorn et al.<sup>13</sup> described the prevalence of the different possibilities of origin of GSV insufficiency. This analysis, by means of vascular ultrasound, showed the predominance of valvular insufficiency in the leg tributaries (44.78%), followed by thigh tributaries (25,30%), saphenous-femoral junction (15%), knee tributaries (9.54%), leg PV (3.81%), thigh PV (1.16%) and knee PV (0.41%).<sup>13</sup> In another study, which analyzed 1,684 lower limbs, insufficiency of the anterior PV of the knee was detected in

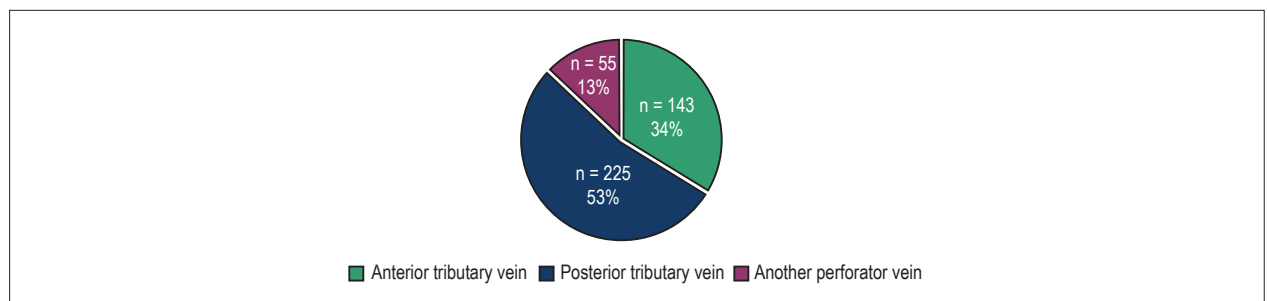
**Table 1 – General characteristics of 886 patients evaluated by vascular ultrasound**

Characteristics	n (%)
<b>Sex</b>	
Female	81.7
Male	18.3
Mean age (years)	46.1 ± 14.5
Great saphenous vein insufficiency	38.8
<b>Location</b>	
Thigh/leg	11.5
Thigh	9.4
Leg	17.9
Insufficiency of the anterior perforator vein of the knee	8.2

**Table 2 – Evaluation of insufficiency in anterior perforator veins of the knee in patients undergoing vascular ultrasound**

	No APV (n = 1.626)	Presence of APV (n = 146)	p value
Age	46.02 ± 14.75	47.03 ± 12.21	0.47
Male	281 (17.28)	43 (29.46)	0.001
GSV insufficiency	596 (36.68)	91 (62.33)	0.0001
GSV <sub>L</sub> insufficiency	286 (22.46)	77 (59.68)	0.0001

Results expressed as means ± standard deviation and n (%). APV: anterior perforator vein of the knee; GSV: great saphenous vein; GSV<sub>L</sub>: great saphenous vein in the leg.



**Figure 2 – Description of onset of great saphenous vein insufficiency in the leg.**

91 limbs (6.5%).<sup>14</sup> Reflux in these PV was related to great saphenous vein insufficiency in the calf in 36.7%, with varicosities in the anteromedial aspect in 79% and in the anterolateral aspect in 21%.

Krnic et al.<sup>15</sup> found that the extent of the great saphenous vein insufficiency is significantly related to the number of incompetent perforators and the mean diameter of the perforators. The number of insufficient perforators and the mean diameter of the perforators were larger the higher the CEAP grade. This study also found an increase in the prevalence of females compared to males, and increasing age was of significant relevance. Stuart et al., in an analysis of 308 limbs, also found that a worsening of the clinical grade of CEAP was significantly associated with the increasing proportion of PVs.<sup>16</sup>

Labropoulos et al. showed that the severity of chronic venous diseases increases with the number and diameter of incompetent PVs. In addition, PV insufficiency was more associated with reflux in the superficial veins (74%), followed by reflux in the superficial and deep veins (34.21%), and reflux in the deep veins alone (9.5%).<sup>4</sup>

Perforator vein insufficiency is present mainly in the medial and distal third of the medial calf, and more frequently in the middle third of the medial thigh and in the posterior calf. Delis et al.<sup>17</sup> found that perforator vein insufficiency increases significantly in the presence of deep venous insufficiency and it is important in determining the impact of surgery.<sup>17</sup> Engelhorn et al.,<sup>18</sup> in a recent study evaluating the prevalence of the location and hemodynamics of perforator veins not directly related to the great saphenous vein, reported a prevalence of 2.3% of perforator knee veins but only described the perforator veins on the posterior, lateral and medial aspects, not mentioning the perforators on the anterior aspect of the knee.<sup>18</sup> It is important to point out that the perforators of the anterior aspect of the knee have small calipers and their identification requires a careful mapping from varicose veins located on the anteromedial and anterolateral aspects of the leg.

The limitations of the study include the absence of the clinical description of the patients using the CEAP classification. This description was evaluated by the author in its first description in 2005, where it was found that most patients were in CEAP 1 to 3, as the characteristic of the sample comes from a private outpatient clinic. Inter- and intraobserver variability in vascular ultrasound evaluation was not assessed, nor do the findings reflect the experience of a single center.

## Conclusion

There was an association between insufficiency of the anterior perforator vein of the knee and great saphenous vein insufficiency. This finding may be useful in the correct mapping of varicose veins by vascular ultrasound, allowing a better therapeutic management of patients.

## Authors' contributions

Research creation and design: Barros MVL, Lauer GS, Machado JM, Silva MCF, Capanema TA; Data acquisition: Barros MVL, Lauer GS, Machado JM, Silva MCF, Capanema TA; Data analysis and interpretation: Barros MVL; Statistical analysis: Barros MVL; Manuscript writing: Barros MVL, Lauer GS, Machado JM, Silva MCF, Capanema TA; Critical revision of the manuscript as for important intellectual content: Barros MVL.

## Potential Conflicts of Interest

There are no relevant conflicts of interest.

## Sources of Funding

This study was self-funded.

## Academic Association

This study is not associated with any graduate programs.

## References

1. Chwala M, Szczeklik W, Szczeklik M, Aleksiejew-Kleszczynski T, Jagielska-Chwala. Varicose veins of lower extremities, hemodynamics and treatment methods. *Adv Clin Ex Med*. 2015;24(1):5-14.
2. Barros BCS, Araujo AL, Magalhães CEV, Barros RLS, Fiorelli SKA, Gatts RF. Efficacy of varicose vein surgery with preservation of the great saphenous vein. *Rev Col Bras Cir*. 2015;42(2):111-5.
3. Lins EM, Barros JW, Appolônio F, Lima EC, Junio MB, Anacleto E. Perfil epidemiológico de pacientes submetidos a tratamento cirúrgico de varizes de membros inferiores. *J Vasc Bras*. 2012;11(4):301-4.
4. Labropoulos N, Mansour MA, Kang SS, Gloviczki P, Baker WH. New Insights into Perforator Vein Incompetence. *Eur J Vasc Endovasc Sur*. 1999;18(3):228-34.
5. Andrade ART, Pitta GBB, Castro AA, Junio FM. Avaliação do refluxo venoso superficial ao mapeamento dúplex em portadores de varizes primárias de membros inferiores: correlação com a gravidade clínica da classificação CEAP. *J Vasc Bras*. 2009;8(1):14-20.
6. Baker SR., Burnand KG, Sommerville KM, Wilson NM, Browse NL, Thomas ML. Comparison of venous reflux assessed by duplex scanning and descending phlebography in chronic venous disease. *Lancet*. 1993;341(8842):400-3.
7. Magnusson M, Kålebo P, Lukes P, Sivertsson R, Risberg B. Colour Doppler ultrasound in diagnosing venous insufficiency a comparison to descending phlebography. *Eur J Vasc Endovasc Surg*. 1995;9(4):437-43.
8. Haenen JH, Langen H, Janssen MCH, Wollersheim H, Hof MA, Asten WNJC, et al. Venous duplex scanning of the leg: range, variability and reproducibility. *Clin Sci* 1999;96(3):271-7.
9. Caggiati MD, Bergan JJ, Gloviczki P, Jantet G, Wendell-Smith CP, Partsch H. Nomenclature of the veins of the lower limbs: an international interdisciplinary consensus statement. *J Vasc Surg*. 2002;36(2):416-22.
10. Blomgren L, Johansson G, Bergqvist D. Randomized clinical trial of routine preoperative duplex imaging before varicose vein surgery. *Br J Surg*. 2005;92(6):688-94.

11. Alves CP, Marques A. Varizes dos membros inferiores. Exame ecodoppler: classificação dos refluxos venosos e estratégia de tratamento cirúrgico. *Rev Port Cir* 2012,(22):41-54.
12. Aguiar ET, Lederman A, Farjallat MA, Rudner MA. Cirurgia endoscópica subfascial de veias perforante insuficientes (CESPI): experiência inicial. *Rev Col Bras Cir*. 2018,30(3):170-6.
13. Engelhorn A, Engelhorn AL, Cassou MF, Zanoni CC, Gosalan CJ, Ribas E. Classificação anatomofuncional da insuficiência das veias safenas baseada no eco-Doppler colorido dirigida para o planejamento da cirurgia de varizes. *J Vasc Br*. 2004,3(1):13-9.
14. Barros MVL, Labropoulos N, Tavares VMP, Machado FS. Knee perforating vein as a source of varicosities: prevalence and clinical relevance. In: 15th World Congress of Union Internationale de Phlebologie; 2005 October 2-7; Rio de Janeiro, RJ./ Torino: Edizioni Minerva Medica; 2005.
15. Krnic A, Vucic N, Susic Z. Correlation of Perforating Vein Incompetence with Extent of Great Saphenous Insufficiency: Cross Sectional Study. *Croat Med J* .2005;46(2):245-51.
16. Stuart WP, Lee AJ, Allan PL, Ruckley CV, Bradbury AW. Most incompetent calf perforating veins are found in association with superficial venous reflux. *J Vasc Surg*. 2001,34(5):774-8.
17. Delis KT, Husmann M, Kalodiki E, Wolfe JH, Nicolaidis AN. In situ hemodynamics of perforating veins in 20 chronic venous insufficiency. *J Vasc Surg*. 2001,33(4):773-82.
18. Engelhorn CA; Escorsin JKS, Costa KCO, Miyashiro L, Silvério MM, Costa RCG ,et al. Localização e papel hemodinâmico das veias perforantes independentes das veias safenas. *J Vasc Bras*. 2018;17(2):104-8.