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# Relationship between the diameter of great saphenous vein and body mass index

*Relação entre o diâmetro da veia safena magna e o índice de massa corporal*

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## Abstract

**Objective:** This study has been designed to correlate the diameter of the greater saphenous vein in different levels of the lower limbs with the body mass index of each individual to determine a possible relation between them.

**Methods:** Fifty-two lower limbs in 26 volunteers (six males and 20 females) without a chronic venous disease record, aged 21-68 were evaluated. Prior to color-flow duplex scanning the body mass index was defined. The deep and superficial venous systems and perforator veins were assessed as described in the literature. The diameter of the greater saphenous vein was measured with ultrasound longitudinal imaging in seven different levels. For the statistical analysis, Student *t* test for paired data and Spearman test were used.

**Results:** The difference observed in saphenous venous in the second and third levels when compared to the lower right and left limbs was not considered significant and a single group was formed to correlate with body mass index. The correlation was considered statistically irrelevant.

**Conclusion:** By correlating the diameters of the greater saphenous vein with the body mass index of each individual it was noted that the relation between them is not significant, therefore it can be assumed that tall thin individuals can have greater saphenous vein with similar diameter as short fat individuals.

**Key words:** saphenous vein, color Doppler ultrasonography, veins.

## Resumo

**Objetivo:** Este estudo teve o objetivo de comparar o diâmetro da veia safena magna em diferentes níveis dos membros inferiores e o índice de massa corporal dos sujeitos para determinar uma possível relação entre esses fatores.

**Métodos:** Cinquenta e dois membros inferiores de 26 voluntários (seis homens e 20 mulheres) sem registro de doença venosa crônica, com idades entre 21 e 68 anos, foram avaliados. O índice de massa corporal foi definido antes do eco-Doppler colorido. Os sistemas venosos superficial e profundo e as veias perforantes foram avaliados de acordo com a literatura. O diâmetro da veia safena magna foi medido através de imagem ultra-sonográfica longitudinal em sete níveis diferentes. Para a análise estatística, foram utilizados o teste *t* de Student para dados pareados e o teste de Spearman.

**Resultados:** A diferença observada na veia safena no segundo e terceiro níveis, quando comparada aos membros inferiores direito e esquerdo, não foi considerada significativa, e somente um grupo foi formado para a comparação com o índice de massa corporal. A correlação foi considerada estatisticamente irrelevante.

**Conclusão:** Através da comparação dos diâmetros da veia safena magna com o índice de massa corporal dos sujeitos, percebeu-se que a relação entre esses dois fatores não é significativa e, portanto, pode-se concluir que indivíduos altos e magros podem ter veias safenas magras com diâmetros similares aos de indivíduos baixos e gordos.

**Palavras-chave:** veia safena, ultra-sonografia Doppler, veias.

The anatomy of the greater saphenous venous system in current standard texts is usually described as a continuous single trunk in the medial and lateral

accessory branches finishing in the groin. Below the knee there is a posterior accessory branch that invariably rejoins the main trunk above the ankle.<sup>1</sup>

The details of the surgical anatomy of the saphenous venous system are particularly relevant and have recently become even more significant because of the resurgence of interest in this vein as an approach to each *in situ* bypass procedure; hence, accurate knowledge of this system has provided a major advance in the simplification of such procedure. However, even when the saphenous vein requires excision for free grafting, knowledge of such anatomy will provide the efficient selection and dissection of the optimal venous conduit to be used.<sup>1</sup>

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Also, in patients with chronic venous disease (CVD) there is a major importance regarding the clinical findings and the detection of greater saphenous vein (GSV) reflux. The diameter of the vein therefore represents important information to be considered for the surgical planning of each extremity with varicose veins.<sup>2</sup>

Clinical examination is of limited usefulness in evaluation of the GSV in the thigh and in patients with a substantial amount of subcutaneous fat. Color-flow duplex scanning provides anatomic information about the GSV, including size, patency, course, varicosities, double segments and tributaries.<sup>3</sup>

This study has been designed to correlate the diameter of the GSV in different levels of the lower limbs with the body mass index (BMI) of each individual in order to define whether they are dependant on each other.

### Patients and methods

Fifty-two limbs were examined in 26 volunteers who did not present any signs or symptoms of CVD and were found not to have the condition at all after proper examination. Therefore, no patients were excluded from this study. There were six males and 20 females aged between 21 and 68 years and the mean age was 40.2 years.

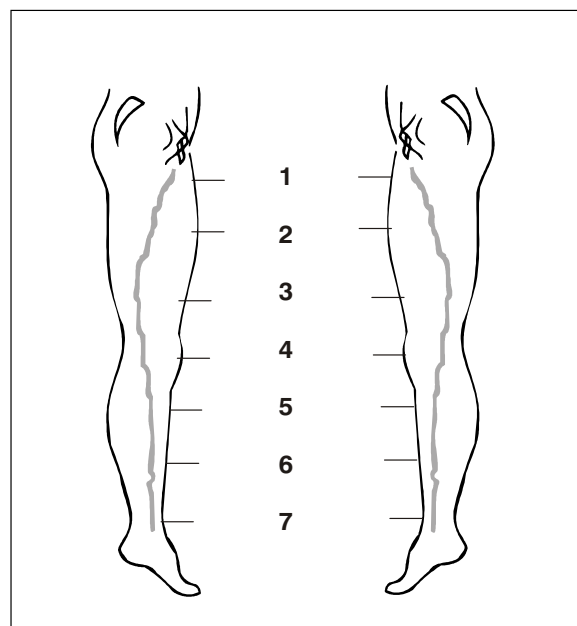
These individuals were seen at Med Imagem Laboratory in the city of Maringá (PR), Brazil, between 8 a.m. and 11 a.m. Prior to color-flow duplex scanning of the GSV they were weighed and measured to calculate the BMI [BMI = weight kg/(height cm)<sup>2</sup>].

In this study imaging was performed using a Hewlett-Packard Image Point (Hewlett-Packard Co., Andover, Mass., USA) in B-mode and graphic representation of blood flow was analyzed by color-flow duplex imaging. Most images were performed with 5-7 MHz linear transducer, but for fat patients, the 3-5 MHz convex transducer was used.

Patients were scanned in the supine position and in 45 degrees of reversed Trendelenburg to discard the possibility of thrombosis or reflux in any veins in this system as described by many other authors.<sup>4-6</sup> Following that, with the patient standing on a two-step ladder holding himself in the upright position, assessment of the superficial venous system and perforator veins was made as described in the literature,<sup>4,5,7</sup> as well as the diameter of the GSV.

The GSV in the right lower limb (RLL) and left lower limb (LLL) were analyzed in detail from the dorsomedial area of the foot to its junction with common femoral vein in the groin with the B-mode and spectral curve of ultrasound.

This vein was measured in millimeter and in different levels with ultrasound longitudinal image. The first level to be studied was in the inguinal area, 2 cm from the saphenofemoral junction where the vein was visible without any curvature. The fourth level was marked in the medial face of the knee in the interarticular level, the second and third levels located in the thigh equally distant from the first and fourth levels. The seventh level was together with the dorsomedial area of the foot, the fifth and sixth levels were located in the leg and also equally distant from the levels mentioned above (Figure 1).



**Figure 1** - Mapping of the venous system of the lower limbs

The Student *t* test for paired data was used to analyze these data by comparing the diameters obtained in the different levels of the RLL and LLL. The Spearman test was likewise used to study the correlation between the diameters of the GSV and BMI of each individual.

The nullity hypothesis rejection level was set at 0.05 or 5% ( $P \leq 0.05$ ) and the significant values were marked with an asterisk.

## Results

The weight (kg), height (cm) and BMI ( $\text{kg/m}^2$ ) averages of the individuals were 65.3 kg, 1.64 cm, and  $25 \text{ kg/m}^2$ , respectively.

When evaluating the GSV diameter and considering the different levels given, the averages obtained in the RLL and LLL were: first level = 4.2/4.1 mm, second level = 3.0/3.2 mm, third level = 3.0/3.2 mm, fourth level = 3.0/3.1 mm, fifth level = 2.7/2.7 mm, sixth level = 2.4/2.4 mm, and seventh level = 2.3/2.3 mm. There was a progressive increase in the proximal diameter and a variability of the diameter of the GSV, between 1.6 and 5.7 mm.

In the statistical analysis it was observed that although the RLL and LLL showed different diameters in the second and third levels, this was not considered significant, since it was too small and therefore one single group was formed for correlation with BMI (Table 1).

In the analysis of the diameters and BMI the explanation factor ( $r^2$ ) of Spearman test was applied and a very weak correlation between these values was

observed. Thus, it did not represent any statistical relevance (Table 2).

## Discussion

As the techniques for diagnosing and treating varicosities in the lower limbs evolve, vascular surgeons will need anatomical and functional information about the superficial venous system for an adequate therapeutic planning.<sup>8</sup> Changes that cannot be detected in clinical examination such as solear and gastrocnemius vein dilation, anatomical

**Table 2 -** Diameters (mm) of the great saphenous vein in the different levels related with the body mass index. Spearman correlation

Level	Correlation	Explanation factor
1st	$r = 0.68$	$r^2 = 0.46$
2nd	$r = 0.35$	$r^2 = 0.12$
3rd	$r = 0.43$	$r^2 = 0.18$
4th	$r = 0.40$	$r^2 = 0.16$
5th	$r = 0.36$	$r^2 = 0.13$
6th	$r = 0.29$	$r^2 = 0.08$
7th	$r = 0.56$	$r^2 = 0.31$

**Table 1 -** Diameter (mm) of the great saphenous vein of the right and left lower limb in the different levels. Student *t* test for paired data

Level	Member	Mean	SD	$t_{\text{calculated}}$	Significance
1st	R	4.20	0.70	0.78	NS
	L	4.11	0.71		
2nd	R	3.08	0.48	2.20	$P < 0.05$
	L	3.28	0.59		
3rd	R	3.03	0.54	2.11	$P < 0.05$
	L	3.24	0.65		
4th	R	3.01	0.62	1.65	NS
	L	3.19	0.63		
5th	R	2.71	0.38	0.05	NS
	L	2.71	0.39		
6th	R	2.35	0.29	0.75	NS
	L	2.40	0.30		
7th	R	2.34	0.35	0.25	NS
	L	2.32	0.28		

variation of the course and venous junction, presence of tributaries of the pudenda veins, Giacomini veins, presence of dilation and segmental reflux can be detected with color-flow duplex scanning, allowing an approach for each situation to be determined.<sup>2</sup> They also provide anatomical information about the GSV including size, patency, course, varicosities, double segments, and tributaries.<sup>3</sup>

The use of the GSV in the revascularization of the myocardium and peripheral arteries, despite being performed with their full exposition, can be previously evaluated, which will help the procedures and provide information about the degree of success of the surgery.<sup>1,2,9</sup> A study carried out with the use of color-flow duplex scanning reported the importance in assessing the GSV prior to the realization of infrainguinal revascularization as it would help the access to the vein and its use as a graft.<sup>3</sup> Shah et al., although phlebography was used to evaluate the vein in the pre-operative of revascularization, agreed that previously knowing the venous anatomy is very important.<sup>1</sup>

In the study undertaken by Caggiati & Ricci in order to analyze the anatomy of GSV, it was published that the caliber of the GSV was constant in 59.3% of the assessed limbs. Only a mild and progressive increase in caliber could be observed from the leg to the thigh (mean caliber  $2.82 \pm 0.35$  mm at leg,  $3.64 \pm 0.52$  mm at thigh). In these limbs, the mean caliber of the GSV showed a great individual variability, ranging from 1.8 to 6.2 mm (mean value:  $2.83 \pm 1.22$ ).<sup>9</sup> The result of the present study was similar to the one mentioned above by the progressive increase of the proximal diameter and also by the variability of the diameter of the GSV.

Other studies show that the analysis of the diameter of the GSV and perforator veins is necessary to determine the probability of reflux and description of its standards referring to the diameter as an absolute number.<sup>2,9-11</sup>

The diameter of the GSV must be considered in the surgical planning of patients with venous reflux, when there is the necessity for an arterial graft and revascularization of the myocardium, although in the study performed by Shah et al. to evaluate the anatomy of the GSV of patients who would undergo vascular graft surgery with phlebography and confirmation of the results in the surgery, the diameter of the veins was frequently underestimated (in 80% by  $1.1 \pm 0.4$  mm) and hence could not be used as an index of vein adequacy.<sup>1</sup>

Engelhorn et al. published data showing that the average diameter of incompetent GSV was 2 mm wider than that of competent saphenous veins at the femoral junction (7.7 vs. 5.7 mm) and midthigh (5.5 vs. 3.3 mm) and 1 mm wider at midcalf (3.5 vs. 2.5 mm). These authors also indicated that a GSV diameter wider than 8 mm, 6 mm, and 4 mm at the femoral junction, midthigh, and midcalf, respectively, was more likely to be predictive of reflux. On the other side of the spectrum, diameters smaller than 5 mm, 3 mm, and 2 mm were associated with lack of reflux at the same three respective levels. These guidelines may be used to help make the decision for stripping or segmental preservation of the GSV.<sup>10</sup>

Luccas et al., using color-flow duplex scanning in 117 limbs in 75 patients with suspected CVD, classified the pattern of GSV reflux in five types and registered the variation and mean diameter of the vein in each pattern described. Whenever signs of reflux were absent, the diameter varied from 3 to 6 mm with an average of 4.3 mm. The authors do not cite the levels in which the measurements were taken.<sup>2</sup>

Therefore, by correlating the values obtained with the BMI of each individual it was observed that the statistical relation amongst them was not significant and thus it can be assumed that tall thin individuals might have GSV with a diameter similar to short fat ones.

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