Anatomic Study of the Communicating Venous System of the Anteromedial Region of the Leg

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Key Words: *Anatomy, Veins, Legs*

Abstract

This study demonstrates that drainage, important for the anteromedial fasciocutaneous flap of the leg, the communicating veins that unite the superficial to the deep system of the accompanying veins of the posterior tibial artery, continually pass between the soleus and flexor longus muscles and that there are two communicating veins for each artery.

The major number of communicating vessels are found in the lower third of the leg up to ten cm above the medial maleolus. In addition, the more proximal the communicating vessels are to the anterior tuberosity of the tibia, the greater their diameter will be. No significant differences were encountered regarding the researched parameters, based on right or left side.

Introduction

The superficial venous system of the lower leg and the magna and parva saphenous veins are directly connected to the deep venous system by a series of communicating veins; these veins should not be confused with the perforating veins that pass through the deep fascia. The communicating branches are the main vessels that communicate directly with the deep veins, and are distributed along the intermuscular fascial plane of the external surface of the muscles.

The perforators are the vessels that pass through the deep fascia and unite with the superficial veins. The communicating veins normally have valves that permit the blood to pass from the superficial to the deep system, and if these valves become insufficient, the blood will flow in both directions. The latter condition is associated with varicose ulcer, Linton[8].

The first reference in the literature mentioning the inclusion of the deep fascia in flaps was described by Bowen & Meares[3]; Cormack & Lambert[4, 5], classified the fasciocutaneous flaps according to the various types of vascularization; Liu & colleagues[7] studied the communicating arteries of the posterior tibia and concluded that it was responsible for the blood supply of all the anteromedial surface of the leg, but do not mention studies regarding venous drainage of the region, which is the objective of this study.

Therefore, it was decided to investigate the venous circulation of the anteromedial surface of the leg, which is part of the leg's anteromedial fasciocutaneous flap, keeping in mind its morphological function and surgical significance, important currently because of its ability to restore skin losses to the lower limbs (see photos).

Material and Methods

Fifteen fresh adult male cadavers were utilized, from the "Serviço de Verificação de Óbitos da Univ. Federal de São Paulo - EPM" (Coroner's Office). Ages ranged from 32 to 75, both legs were dissected (total = 30 lower limbs).

Determination of the ethnic group was based on essential anthropological somatic features: skin color, hair, nose and lips. This characterization was somewhat difficult because of the high rate of miscegenation existing in Brazil, and the near absence of pure racial types, therefore including white and non-whites.

After identification, the cadaver was placed in horizontal

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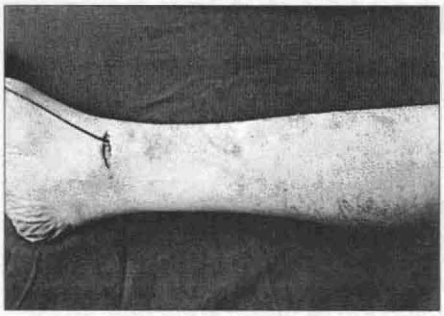


***Fig. 1** - Catheterization of the GSV.*
***Fig. 1** - Cateterização da veia safena magna.*

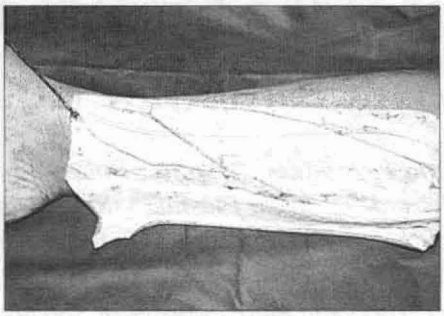


***Fig. 2** - Dyed GSV and branches.*
***Fig. 2** - Veia safena magna e colaterais coradas.*

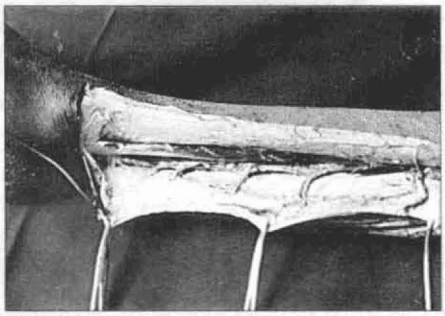


***Fig. 3** - Dissected and dyed communicating veins.*
***Fig. 3** - Veias comunicantes dissecadas e coradas.*

decubitus, with the lower limbs completely extended.

The length of the leg was determined by the distance separating the tibial tuberosity up to the midpoint of the medial maleolus.

A transverse incision over the medial maleolus through the skin and subcutaneous tissue exposed the great saphenous vein (GSV). With the help of a scalpel, the GSV was incised on the bias, and a polyethylene catheter introduced and fixed with a cotton suture. Clots were eliminated by rinsing with room temperature water. An Esmarch bandage was then placed from the distal third of the leg to the knee to prevent the dye's diffusion through the rest of the body. Blue neoprene latex (Artifix L-14) dye was slowly and continually injected (15-25 ml). An incision was made in the anteromedial region of the leg, along the body of the tibia, between its anterior tuberosity and the medial maleolus. The skin and the subcutaneous tissue were turned aside, exposing the GSV. The medial gastricnemus and soleus muscles were retracted and with the help of a 4 x magnifying lens, the communicating veins passing between the soleus and flexor longus muscles were dissected and measured.

The parameters studied are presented regarding the data of the superficial venous system and its communicating vessels, with the accompanying veins of the posterior tibial artery:

A) Limb length (cms);
B) Total number of communicating branches;
C) External diameter of the proximal segment of the GSV (mm);
D) External diameter of the distal segment of the GSV (mm)
E) External diameter of the communicating vessels (mm)
F) Graph showing the distribution of the communicating vessels (cm).

Table 1

Mean, Standard Deviation, Minimum and Maximum Values of the Length of Each Limb (cm)

	Right	Left
Mean	32.10	32.03
Standard Deviation	2.52	2.51
Minimum	28.00	28.00
Maximum	36.00	36.00

Wilcoxon's Test
(Right x Left)
Calculated T = 18.00 Critical T = 6

No significant differences between the right and left sides were observed.

Tabela 1

Média, Desvio Padrão, Valor Mínimo e Máximo do comprimento da perna em cm, segundo a lateralidade

	Direito	Esquerdo
Média	32,10	32,03
Desvio Padrão	2,52	2,51
Mínimo	28,00	28,00
Máximo	36,00	36,00

Teste de Wilcoxon
(direito x esquerdo)
T calculado = 18,00 T crítico = 6

Não observamos diferenças significativas segundo a lateralidade.

Results

Our results will be presented according to the aforementioned parameters:

A) Limb length;
B) Total number of communicating branches;
C) External diameter of the proximal segment of the GSV;
D) External diameter of the distal segment of the GSV;
E) External diameter of the communicating vessels;
F) Graph showing the distribution of the communicating vessels.

The results show that the diameter of the communicating veins on both sides is greater the closer they are to the anterior tuberosity of the tibia.

Discussion

The purpose of this anatomic study was to analyze the morphological aspects of the venous blood supply to the fasciocutaneous flap of the anteromedial region of the leg, with pedicle in the posterior tibial artery.

Contrary to Linton's studies[8], aimed at identifing the ligature of these communicating vessels, without giving due importance to the measurements of these branches, our study was directed at completing these data which were not stressed by the author.

After consulting a series of reports, we did not find sufficient data that could be compared to our results, from an anatomic point of view, and that could be applied clinically. Analyzing the various tables we note in tables 1,2,3 and 4 that there was no significant difference based on laterality, when the Wilcoxon test was applied.

Table 2 shows that the number of communicating branches displayed a mean of 3.60 and 3.27, respectively for the right and left sides. Nevertheless, we point out that the number of communicating veins varied from two to six for both sides, but the analysis of tables 3 and 4 evaluating the mean values of external diameter of the proximal and distal segments respectively of the GSV, did not demonstrate significant differences.

The analysis of table 5, shows that the external diameter of the communicating branches is proportional to their proximity to the anterior tibial tuberosity. Attention is called to the strange aspect that is the confluence of the two communicating veins in the respective accompanying veins of the posterior tibial artery, followed by a single artery, i.e., there are two veins for each artery.

The graph illustrating the concentration of the communicating branches shows that the majority of these vessels is distributed in the distal third of the limb, i.e., in the ten centimeters proximal to the medial maleolus. From a clinical point of view, this data permits the anteromedial fasciocutaneous flap of the leg to be sectioned proximally, thus maintaining its arterio-venous blood supply via the distal pedicle[1,2,6].

Conclusion

1. The communicating branches always pass between the soleus and flexor longus muscles.
2. The major number of communicating branches is situated in the lower third of the leg.
3. The diameter of the proximal communicating branches is greater than that of the distal ones.
4. There are two communicating veins for each artery.
5. There is no statistically significant difference regarding laterality.

Table 2

Mean, Standard Deviation, Minimum and Maximum Value of the Total Number of Communicating Branches

	Right	Left
Mean	3.60	3.27
Standard Deviation	0.99	1.16
Minimum	2.0	2.0
Maximum	6.0	6.0

Wilcoxon's Test
(Right x Left)
Calculated T = 15.00 Critical T = 8

Comparing individual sides, no significant differences were noted regarding the total number of communicating vessels.

Tabela 2

Média, Desvio Padrão, Valor Mínimo e Máximo do número de ramos comunicantes, segundo a lateralidade

	Direito	Esquerdo
Média	3,60	3,27
Desvio Padrão	0,99	1,16
Mínimo	2,0	2,0
Máximo	6,0	6,0

Teste de Wilcoxon
(direito x esquerdo)
T calculado = 15,00 T crítico = 8

Quando comparamos a lateralidade dos indivíduos não encontramos diferenças significativas em relação ao número total de comunicantes.

Table 3

Mean, Standard Deviation, Minimum and Maximum Value of the External Diameter of the Proximal Segment (mm) of the Great Saphenous Vein

	Right	Left
Mean	3.26	3.24
Standard Deviation	0.57	0.77
Minimum	2.4	2.3
Maximum	4.3	5.3

Wilcoxon's Test
(Right x Left)
Calculaled T = 51.00 Critical T = 21

There was no significant difference between the sides when the diameter of the external proximal segment of the Great Saphenous Vein was analyzed.

Tabela 3

Média, Desvio Padrão, Valor Mínimo e Máximo do diâmetro externo do segmento proximal, em mm, da veia safena magna, segundo a lateralidade

	Direito	Esquerdo
Média	3,26	3,24
Desvio Padrão	0,57	0,77
Mínimo	2,4	2,3
Máximo	4,3	5,3

Teste de Wilcoxon
(diretio x esquerdo)
T calculado = 51,00 T crítico = 21

Não houve diferenças significativas entre os lados quando analisamos o diâmetro externo do segmento proximal da veia safena magna.

Table 4

Mean, Standard Deviation, Minimum and Maximum Value of the External Diameter of the Distal Segment (mm) of the GSV

	Right	Left
Mean	3.21	3.16
Standard Deviation	0.59	0.76
Minimum	2.1	2.1
Maximum	4.2	4.8

Wilcoxon's Test
(Right x Left)
Calculated T = 51.00 Critical T = 25

No significant difference of the mean values of the external diameter of the distal segment of the GSV between the right and left side was noted.

Tabela 4

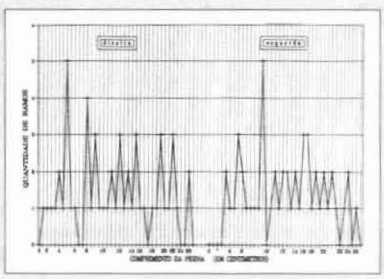
Média, Desvio Padrão, Valor Mínimo e Máximo do diâmetro externo do segmento distal, em mm, da veia safena magna, segundo a lateralidade

	Direito	Esquerdo
Média	3,21	3,16
Desvio Padrão	0,59	0,76
Mínimo	2,1	2,1
Máximo	4,2	4,8

Teste de Wilcoxon
(direito x esquerdo)
T calculado = 51,00 T crítico = 25

Não observamos diferenças significativas dos valores médios do diâmetro externo do segmento distal da veia safena magna, segundo a lateralidade.

Graph 1 - Gráfico 1 Concentration of the Communicating Branches / Concentração dos Ramos Comunicantes segundo a lateralidade



This graph shows that the major concentration of communicating branches is situated in the distal third of the leg on both sides, confirmed by the number of branches in the proximal ten centimeters of the medial maleolus.

Observa-se que a maior concentração de ramos comunicantes situa-se no terço distal da perna em ambos os lados, traduzida pelo número de ramos nos dez centímetros proximais ao maléolo medial.

Table 5

Mean, Standard Deviation, Minimum and Maximum Value of the External Diameter (mm) of the Communicating Vessels

					Right							
Comun	1	2	3	4	5	6	1b	2b	3b	4b	5b	6b
Mean	1.58	1.85	1.73	2.02	2.45	1.50	1.50	1.64	1.67	2.03	2.00	2.20
Standard Deviation	0.93	0.68	0.86	1.06	-	0.71	0.46	0.66	0.68	1.56	-	
Minimum	0.4	1.1	0.0	1.3	1.7	1.5	0.5	0.9	0.0	1.2	0.9	2.2
Maximum	3.9	3.4	3.2	3.1	3.2	1.5	3.0	2.3	3.1	3.0	3.1	2.2
					Left							
Comun	1a	2a	3a	4a	5a	6a	1b	2b	3b	4b	5b	6b
Mean	1.36	1.88	1.62	2.02	2.80	5.10	1.27	1.59	1.56	1.76	2.15	4.90
Standard Deviation	0.82	0.68	0.58	0.29	0.42	-	0.67	0.40	0.43	0.51	1.34	-
Minimum	0.1	0.8	0.7	1.6	2.5	5.1	0.1	0.9	0.8	0.9	1.2	4.9
Maximum	3.2	2.9	2.5	2.2	3.1	5.1	2.3	2.2	2.4	2.2	3.1	4.9

Tabela 5

Média, Desvio Padrão, Valor Mínimo e Máximo do diâmetro externo, em mm, das comunicantes, segundo a lateralidade

					Direito							
Comun.	1a	2a	3a	4a	5a	6a	1b	2b	3b	4b	5b	6b
Média	1,58	1,85	1,73	2,02	2,45	1,50	1,50	1,64	1,67	2,03	2,00	2,20
Desvio Padrão	0,93	0,68	0,86	0,64	1,06	0,71	0,46	0,66	0,68	1,56	-	
Mínimo	0,4	1,1	0,0	1,3	1,7	1,5	0,50	0,9	0,0	1,2	0,9	2,2
Máximo	3,9	3,4	3,2	3,1	3,2	1,5	3,0	2,3	3,1	3,0	3,1	2,2
					Esquerdo							
Comun.	1a	2a	3a	4a	5a	6a	1b	2b	3b	4b	5b	6b
Média	1,36	1,88	1,62	2,02	2,80	5,10	1,27	1,59	1,56	1,76	2,15	4,90
Desvio Padrão	0,82	0,68	0,58	0,29	0,42	-	0,67	0,40	0,43	0,51	1,34	-
Mínimo	0,1	0,8	0,7	1,6	2,5	5,1	0,1	0,9	0,8	0,9	1,2	4,9
Máximo	3,2	2,9	2,5	2,2	3,1	5,1	2,3	2,2	2,4	2,2	3,1	4,9

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