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Distribution of saphenous vein valves and its pratical importance

Distribuição das válvulas da veia safena magna e sua importância prática

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Abstract

Objective: **Among the veins used as a graft in myocardial revascularizations and ends, great saphenous vein is the most used. Knowing the presence and location of valves has great importance when evaluating the surgical anatomy of the great saphenous vein. Despite major surgical application and many works involving great saphenous vein, the number of valves present in it from the saphenous hiatus to the medial epicondyle of the femur is still described inaccurately. The objective of this study is to quantify the valves of the great saphenous vein from the saphenous hiatus to the medial epicondyle of the femur to determine the best portion of the great saphenous vein to perform revascularization surgeries.**

Methods: **This is a crosssectional observational study in which it was analyzed great saphenous vein extracted from 30 cadavers. It was measured the length of the veins; (diameter) at its proximal, middle and distal, quantifying the number of valves in each one and the total number of valves at the great saphenous vein.**

Results: **The frequency of valves in the great saphenous vein taken from the medial epicondyle of the femur to the saphenous hiatus was 4.82, ranging between 2 and 9. Moreover, there is a significant difference in the number of valves in the proximal and distal relative to the average.**

Conclusion: **the median and distal portions of the saphenous vein in the thigh, are the best options for the realization of bridges due to the fact that these portions have fewer valves which therefore would tend to decrease the risk of complications connected with the valves in these grafts.**

Descriptors: **Venous Valves. Saphenous Vein. Myocardial Revascularization.**

Resumo

Objetivo: **Dentre as veias empregadas para revascularizações do miocárdio e de extremidades, a veia safena magna é a mais utilizada. Conhecer a presença e localização de válvulas é de grande importância quando se avalia a anatomia cirúrgica da veia safena magna. Apesar de grande aplicação cirúrgica e de muitos trabalhos envolvendo a veia safena magna, o número de válvulas presente nela desde o hiato safeno até o epicôndilo medial do fêmur ainda é descrito de forma imprecisa. O objetivo**

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Abbreviations, acronyms & symbols	
CPB	Cardiopulmonary bypass
DM	Mean diameter
GSV	Great Saphenous Vein
LCS	Left coronary system
LITA	Left internal thoracic artery
MAA	Without ascending aorta
UNCISAL	State University of Health Sciences of Alagoas

do presente trabalho é quantificar as válvulas da veia safena magna desde o hiato safeno até o epicôndilo medial do fêmur para determinar a melhor porção da veia safena magna para a realização de cirurgias de revascularização.

Métodos: **Este é um estudo transversal e observacional em que foram analisadas veias safena magna extraídas de 30 cadáveres. Foram realizadas as medidas das variáveis do comprimento das veias; (diâmetro) em suas porções proximal, média e distal; quantificação do número de válvulas nestas e número de válvulas total na veia safena magna.**

Resultados: **A frequência de válvulas da veia safena contadas desde o epicôndilo medial do fêmur até o hiato safeno foi de 4,82, podendo variar entre 2 e 9. Além disso, houve diferença significante do número de válvulas da porção proximal em relação à média e distal.**

Conclusão: **As porções média e distal da veia safena magna na coxa são as melhores opções para a realização de pontes em decorrência do fato destas porções terem menor quantidade de válvulas o que, portanto, tenderia a diminuir o risco de complicações relacionadas as válvulas nestes enxertos.**

Descritores: **Válvulas Venosas. Revascularização Miocárdica. Veia Safena.**

INTRODUCTION

Among the materials used for revascularization, the veins can be used in various parts of the body. Among them, the great saphenous vein (GSV) is the first choice. Its use as an implant during coronary artery bypass surgery and lack of being affected by varicose disease has aroused the interest of researchers. This vessel remains an essential component in strategies for coronary artery bypass grafting in humans. The vessel is used alone or in combination with arterial grafts and has the advantage of being available autologous vascular tissue in most patients in need of such surgeries[1]. Its use in composite graft with the left internal thoracic artery (LITA) could allow complete revascularization of the left coronary system (LCS) without a cardiopulmonary bypass (CPB) and without ascending aorta (MAA) in order to reduce some risks and complications in the immediate postoperative period. The autologous saphenous vein also remains a nearly ideal prosthetic element be low the inguinal ligament. That, depending on the outcome of patients in the progression of atherosclerotic disease especially in the revascularization of the tibia arteries, because they tolerate more flow limit[2].

Knowledge of the presence and location of valves is of great importance when assessing the surgical anatomy of the GSV. Generally, the valves are located along the vein and immediately below the mouth of major tributaries. Almost always, one or two valves are present in its termination or mouth. The GSV has often an ostial or ostial valve and a subostial valve. Knowledge of the presence of these valves makes us better understand the pathophysiology of trunk varicose veins of the GSV, since insufficient ostia valves can cause the appearance of these anomalies[3]. Another important role of valves, the saphenofemoral junction, for example, is to prevent the flow of popliteal[4], or femoral veins.

This vein begins above the medial malleolus, ascends obliquely, and passes postero - medially to the medial condyle of the tibia and femur and along the medial aspect of the thigh through the saphenous gap[5]. It has numerous valves that are irregularly distributed throughout its length[6]. The GSV has 10 to 12 valves, which are more numerous than the leg at the thigh. These valves are usually located just below the veins sections[7]. The blood drained by the venous system of the lower limbs flows back to the heart through the thick veins and is maintained by unidirectional valves, usually bicuspid, which close as its contents move toward the center vein[8].

Despite extensive surgical application and many works involving the GSV, the number of existing valves from the saphenous hiatus to the medial epicondyle of the femur is further described inaccurately. The objective of this study is to quantify the valves of the GSV from the saphenous hiatus until the medial epicondyle of the femur, dividing the GSV into three regions, comparing the number of valves between them and indicating the portion with fewer valves, thus determining the best portion GSV for performing CABG surgeries.

METHODS

In the transversal method and observational study, great saphenous veins were taken from 30 cadavers during autopsies at Alagoas Services and analyzed. These veins were excluded from the corpses with disorders that brought certainty to the study, namely anemia, varicose veins, previous surgery, deformities, obesity and mellitus diabetes. After approval from the Ethics Committee in Research of the Universidade

Estadual de Ciências da Saúde de Alagoas (UNCISAL), and the signing of consent from the statutory bodies responsible, we measured the lengths of the thighs and their diameters in their proximal, middle and distal portions. After this, the dissection of the GSV by traditional techniques was performed by making a long single incision along the venous path from the saphenous hiatus to the medial epicondyle of the femur (Figure 1). The ends of the veins were labeled with cotton thread at the proximal long and short on the distal. They were then identified and stored in a refrigerator.

Fig. 1 – Dissected great saphenous vein.

At The Laboratory of Descriptive and Topographic Anatomy of UNCISAL - Maceió (AL), the measurements of the variables of the length of the veins were performed; (diameter) at its proximal, middle and distal portions; quantification of the number of these valves and the total number of valves in the VSM. The measurements were made with the aid of tape measure and caliper manual mechanical METRICA®.

RESULTS

The average number of valves of the saphenous vein taken from the medial epicondyle of the femur to the saphenous hiatus is 4.82, and 4.77 in the left leg and 4.87 in the right. The analysis of the total number of valves in the GSV was performed by quantitative descriptive analysis with a sample of 60 veins, this being 30 from the right leg and 30 from the left, from 30 adult cadavers of both sexes. Of these cadavers, 21 were male and 9 female. All valves were observed to be bicuspid. The minimum amount found was 2 valves and maximum of 9. The average was 4.8167 with a maximum standard deviation of 1.6518 and minimum standard deviation 0.2132. The median of each portion is shown in Table 1. The value of the number of valves that occurred in more proximal portions was 2 and in other portions, 1. Comparing the mean diameter (DM) of the portions, it was found that the MD of the proximal portion of the left saphenous vein was 4.96 millimeters (mm) and 4.78 mm from the right, the left middle portion was 4.05 mm right and 3.86 mm, DM left distal portion is 3.42 mm and 3.23 mm from the right.

Analysis of the distribution of valves between the portions of the veins was performed by ANOVA with Tukey post-test. In both the left and the right, there was no significant difference in the number of valves between the middle and distal portions. However, there was significant difference in the number of valves in the proximal and distal relative to the average.

Analysis of the distribution of valves between the left and right proximal portions was made by the student's t test and no significant result (*P* (bilateral)=0.64) with a confidence interval (95%) 0.33 to 0.53. The sample size is 30 for each side.

Analysis of the distribution of valves between the mean left and right portions was made by the student's t test, with no significant result (*P* (bilateral)=0.88) with a confidence interval (95%) 0.42 to 0.48.

Analysis of the distribution valve between the left and right distal portions and was performed by the student's t test showed no significant result (*P* (bilateral)=0.1966) with a confidence interval (95%) 0.59 to 0.12.

A linear regression analysis of the number of valve relative to the thigh length, diameter, length of the thigh vein and vein diameter were not significant (*P*=0.08), with the multiple correlation coefficient 0.32. No statistical significance was related to gender (Table 2). The sample size was 21 saphenous veins in males and 9 in females, with 95 % confidence interval (Diff between averages): 1.37 to 1.66. The length of the saphenous vein from the medial epicondyle of the femur to the saphenous hiatus divided by the number of valves 68 mm in males and 59 mm in females.

Sample distribution and number of valves per age group are shown in Table 3. The analysis of the distribution valves for age was performed using Pearson correlation. No significance was found between age and distribution of valves in both GSV left (r(Pearson)=0.2651, (*P*)=0.1567) and in the right (r (Pearson)=0.0806, (*P*)=0.6719).

Table 1. The amount allocated between the portions of the GSV.

GSV	Portions			*P*-value
	Proximal Median (ID)	Medial Median (ID)	Distal Median (ID)	
Left	2.00 (1.7500)[a]	1.00 (1.0000)[b]	1.00 (1.0000)[b]	0.0004
Right	2.00 (0.0000)[c]	1.00 (1.0000)[d]	1.50 (1.0000)[d]	0.0016

GSV=Great saphenous vein; ID=Interqualitic Deviation

Table 2. Distribution of the valves in relation to sex.

GSV	Gender		*P*-value
	Male Average (ID)	Female Average (ID)	
Left	5.00 (3.0000)	4.00 (3.0000)	0.84
Right	5.00 (2.0000)	5.00 (2.0000)	0.95

GSV=Great saphenous vein; ID=Interqualitic Deviation

Table 3. Distribution of, and the number of, valves per age group.

Age range	MP	n	Percent	Median (ID)
14.0 |— 36.0	25.0	4	13.33 %	4.00 (3.0000)
36.0 |— 58.0	47.0	6	20.00%	4.00 (2.2500)
58.0 |— 80.0	69.0	9	30.00%	4.00 (2.5000)
80.0|—102.0	91.0	11	36.67 %	5.00 (1.7500)

MP=Midpoint of the sample; n=Frequency; ID=Interqualitic deviation (DIQ) of the sample

DISCUSSION

The consensus is that the best graft for myocardial revascularization is the Magna Saphenous Vein. Among these, the most used is the left internal thoracic artery. As a second option, this is widely used for bypass surgeries. The presence of valves in this vein has not been a deterrent for utilization[1-4]. The widespread use of the autologous Saphenous Vein for direct myocardial revascularization procedures is mainly attributed to its easy and safe surgical removal, its almost ideal size and versatility, as well as their biological acceptance[9].

The use of GSV in myocardial revascularization has become a well established method of acceptance in the treatment of refractory angina and improved prognosis. GSV grafts remain potent for about 10 years. However, 15% of the first block and the constant presence of year[10] valves in this vein has not been a hindrance to use[1-4].

The permeability of the greater saphenous vein in the short and long term depends on several factors, such as high blood pressure, "distal coronary circulation" intramural ischemia, and progressive graft atherosclerosis. The human saphenous vein wall has a thin inner layer, separated from the support by a rudimentary internal elastic membrane. The wall consists of two distinct layers of muscle cells: a longitudinal inner layer mixed with collagen bundles and a circular outer layer.

The adventitia is composed mainly of collagen bundles with scattered longitudinal fascicles of smooth muscle cells. Near the locations of the venous valves, the longitudinal layer muscle usually becomes thicker. The main finding in the histopathological study of GSV grafts is the intimal fibrosis layer, while in communication; only the longitudinal muscle layer was surrounded by sclerotic process. Although these lesions are generally considered to be an aging process, statistical analysis reveals that neither the inner or medial sclerosis is correlated to the age of patients[9]. Experimental evidence has shown that intact valves in veins, when reversed, can cause luminal narrowing, serve as a source of strength, and generate significant hemodynamic effects in coronary artery bypass grafts. Indeed, in a recent study, reversed arterialized vein grafts in an animal model of atherosclerosis. After 8 weeks, a significant thickening was observed in the gr afted distal wall of valves when compared with grafts without valves[11]. Spray & Roberts[6] reported subendothelial proliferation within a single valve when reviewing pathological changes in aortal-coronary grafts. Many of the studies cited in the study showed fibrosis of the venous valve as a cause of late segmental occlusion of venous grafts[5].

Considering the characteristics of GSV, Sarzaeem et al.[10] created a scoring system that takes into account the ramifications, varicosity, diameter and wall thickness of the GSV. Regarding the number of branches, which are directly related to the number of valves, GSV were classified as follows: [None, when there are no significant branches (1 point); Few, if there are three or less branches (2 points) or multiple, when more than three branches (3 points)]. In relation to the diameter when a vein segment is continuous, has an internal diameter of 3 mm to 5 mm, and progressively increases in proximal size is classified as normal (1 point). A vein segment with an internal diameter of more than 5 mm is classified as dilated (2 points). A vein segment with a lower inner diameter of 3 mm is classified as small (3 points).

Three distinct described pathologic processes are well known to influence early or late failure of revascularization with GSV. During the first 30 days after surgery, up to 12 % of the grafts can become clogged, which is referred to as acute graft failure. Between one month and one year, neointimal hyperplasia (the accumulation of smooth muscle cells and extracellular matrix in the intimal compartment) can occur. Although this condition rarely leads to a clinically significant stenosis, it may provide the basis for developing atherosclerotic graft. After the first postoperative year, graft failure is delayed and can occur in the form of graft vascular disease (accelerated atherosclerosis), which is present in 17% of grafts after 6 years and in 46% of grafts after 11 years. In this study, 87.7 % of the grafts were potent at 1 year, similar percentages reported in other studies[10].

The GSV has 10 to 12 valves, which are more numerous in the leg than in relation to the thigh and are usually located just below the perforated veins[7]. The number of valves in the saphenous vein has been reported to be 8 to 20, with many being below the knee[8]. Other studies claim that there are between 7 and 9 valves in the saphenous vein with an average of 3.5 (when above the knee) and 4 on average are located below the knee[12]. Some authors found between 5 and 11 valves in the saphenous vein with an average of 5.2 above the knee and 3.8 below the knee[13]. The latter feature also results closer to those observed in the results of our research.

The average number of valves in the saphenous vein taken from the medial epicondyle of the femur to the saphenous nerve gap is 4.82 valves, but may vary between 2 and 9.

CONCLUSION

We conclude that it is extremely important to know the segments with the highest number of valves in the saphenous vein allowing surgeons, when possible, to have an option to choose the most appropriate segments; in the average or distal portion of the saphenous magna vein in the thigh, due to the smaller amount of valves, therefore, tend to decrease the risk of complications related to these structures in grafts.

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Authors' roles & responsibilities	
IBMP	Participation in all phases of the experiment, since the dissection to the writing of article
ILR	Participation in all phases of the experiment, since the dissection to the writing of article
CFSR	Participation in all phases of the experiment, since the dissection to the writing of article
RFMB	Participation in all phases of the experiment, since the dissection to the writing of article
ACR	Participation in all phases of the experiment, since the dissection to the writing of article

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