

Original Research Article

Variations of great saphenous vein: a cadaveric study in central Indian population

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Received: 31 May 2017

Accepted: 03 June 2017

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ABSTRACT

Background: Variations are more commonly seen in venous system as compared to arterial system. Varicosities are more commonly seen in the superficial veins of lower limbs.

Methods: In the present study, thirty lower limbs were dissected superficially to study the course, tributaries and perforators of great saphenous vein. After exposing the vein, we took various measurements from saphenofemoral junction to the origin of various tributaries and perforators. Pattern of duplications were also reported.

Results: The mean distance of tributaries and perforators were compared with the previous literature available. Patterns of duplication were also reported.

Conclusions: Study of variations of great saphenous vein would be of immense help in planning varicose vein treatment and coronary artery bypass procedures where it is used as autograft. Therefore, the study will be helpful for surgeons, cardiologist and interventional radiologist.

Keywords: Cadaver, Duplication, Graft, Great saphenous vein, Varicose vein

INTRODUCTION

Venous drainage of lower limb is governed mainly by sets of veins i.e. superficial veins which include great and small saphenous vein, deep vein which consists of tibial, peroneal, popliteal and femoral vein and lastly perforators which communicate superficial veins with deep veins. All these sets of veins are provided with numerous valves for unidirectional flow of blood to the heart.

Great (long) saphenous vein (GSV) is the longest vein in the body commencing from the medial end of dorsal venous arch of the foot and supplemented by medial marginal vein. It passes in front of medial malleolus straight up to the postero-medial aspect of knee joint being one hand breadth posterior to patella and finally ascends to saphenous opening and ends by joining femoral vein. Great saphenous vein is closely associated

with the saphenous nerve being anterior to vein at ankle but posterior to it at knee.

Many tributaries join the Great saphenous vein. Below the knee GSV is joined by posterior arch vein and anterior leg vein. In the thigh GSV receives the posteromedial (also called accessory saphenous vein) and anterolateral vein just before piercing cribriform fascia. External pudendal, inferior epigastric and circumflex iliac vein form the main tributaries of GSV.

A fairly constant number of perforating vessels connect the tributaries of GSV with the deep veins namely perforator in adductor canal, knee perforator connecting GSV with tibial vein, 3 medial ankle perforators connecting GSV with posterior tibial vein and one lateral ankle perforator connecting small saphenous vein with peroneal vein. Perforators have valves at each end for unidirectional blood flow from superficial to deep veins.

Venous drainage of lower limb varies considerably in its arrangements from subject to subject and even from limb to limb. Hence knowledge of these variations is of great significance.¹ Few reports mention the incidence and patterns of duplication or have drawn attention to the possible role of this variation as a source of recurrent varicose vein.²⁻⁵ The GSV is often duplicated especially distal to the knee. The incidence of duplication has been reported to be between 1 and 52 percent.⁶ In addition, the saphenous vein is usually chosen when obstructive coronary heart disease is surgically treated with grafts of autogenous veins anastomosed between aorta and coronary arteries.⁷

Several authors have reported the variations possible in tributaries and course of great saphenous vein. However, no light has been focussed on the possible measurements of GSV in relation to saphenofemoral junction. Understanding venous anatomy will be of great help to surgeons, cardiologist, radiologist and would help in diagnosis management of venous disorder. The aim of the study was to find the variations of GSV in central Indian population.

METHODS

Thirty formalin fixed adult lower limbs were dissected (15 right side and 15 left side) in the Department of Anatomy, L.N. Medical college and Research center, Bhopal, Madhya Pradesh, India. Lower limbs which were having damaged veins were excluded from the study.

The skin is reflected from the medial side of the lower limb to lateral side and a superficial dissection of the course of GSV was traced from its formation in front of medial malleolus at ankle to its termination into femoral vein at saphenofemoral junction. The tributaries and perforators were identified and dissected.

After exposing the GSV and its tributaries and perforators, the vein was studied with reference an important landmark. i.e. from saphenofemoral junction. Various measurements were taken by using thread and measuring tape. Variations of the GSV were noted and photographs were taken. A total of 13 parameters were taken for each lower limb. The measurements were repeatedly taken to ensure the accuracy.

The following parameters will be measured:

- Limb Length (LL)- Distance from Anterior superior iliac spine (ASIS) to great toe
- Great saphenous vein length (GSV L)- Distance from the formation of GSV i.e. from the commencement of marginal vein with dorsal venous arch till its termination into femoral vein at saphenofemoral junction

- Midpoint of Inguinal ligament (MIP) to saphenofemoral junction (SF in)- Distance from mid of inguinal ligament to saphenofemoral junction where GSV is draining into Femoral vein.

Tributaries of GSV

- Antero-lateral (AL)- Distance from saphenofemoral junction (SF in) to the origin of antero-lateral tributary
- Postero-medial (PM)- Distance from saphenofemoral junction (SF in) to the origin of postero- medial tributary
- Genicular (G)- Distance from saphenofemoral junction (SF in) to the origin of genicular tributary
- Anterior arch vein (ARV)- Distance from saphenofemoral junction (SF in) to the origin of Anterior arch vein
- Posterior arch vein (ARV)- Distance from saphenofemoral junction (SF in) to the origin of Posterior arch vein.

Perforators of GSV

- Adductor canal perforator (Add P)- Distance from saphenofemoral junction (SF in) to the origin of Adductor canal perforator
- Knee Perforator (KP)- Distance from saphenofemoral junction (SF in) to the origin of knee perforator
- Medial Ankle Perforator 1st (MAP 1)- Distance from saphenofemoral junction (SF in) to the origin of 1st Ankle perforator
- Medial Ankle Perforator 2st (MAP 2)- Distance from saphenofemoral junction (SF in) to the origin of 2st Ankle perforator
- Medial Ankle Perforator 3st (MAP 3)- Distance from saphenofemoral junction (SF in) to the origin of 3st Ankle perforator
- All the measurements will be taken in centimetres(cms). Observations were tabulated and analysed.

RESULTS

In the present study, out of 30 lower limbs (15 right and 15 left), some form of duplication of GSV was seen in 40% cases i.e. 12 limbs out of 30. Maximum frequency of duplication was seen in the ankle region i.e. 58.33% (out of 12 limbs) followed by saphenofemoral junction in the thigh region i.e. 33.33% (out of 12 limbs) and least in knee region i.e. 8.56 % (1 limb out of 12).

The mean distance and the range of origin of tributaries and perforators of GSV from saphenofemoral junction is shown in Table 1 and Table 2.

Table 1: Mean and range of distance of origin of various tributaries of great saphenous vein from saphenofemoral junction.

Parameters	Right lower limb		Left lower limb	
	Mean (cms)	Range (cms)	Mean (cms)	Range (cms)
LL	94.5	86-105	94.06	86-105
GSV L	90	87-101	90	80-101
MIP to SF jt	3.12	2-4	3.23	2-4.5
AL	10.6	3-24	16.36	3-42
PM	14.56	12.5-16.5	14.6	7-23
G	40.7	30-46	41.9	38-44.5
ARV	43.58	36-50	44.1	41-49.5
PAV	42.5	32.5-49.5	42.2	39-47

(LL-Lower limb, GSV L-Great saphenous vein length, MIP to SF jt-Midpoint of inguinal ligament to saphenofemoral junction, AL-Antero-lateral tributary, PM-Postero-medial tributary, G-Genicular tributary, ARV-Anterior arch vein, PAV- Posterior arch vein).

Table 2: Mean and range of distance of origin of various perforators of great saphenous vein from saphenofemoral junction.

Parameters	Right lower limb		Left lower limb	
	Mean (cms)	Range (cms)	Mean (cms)	Range (cms)
LL	94.5	86-105	94.06	86-105
GSV L	90	87-101	90	80-101
Add P	25.23	17-33	24.2	14-29
KP	38.18	32-46	34.5	26-44
MAP 1	85.06	75-91	81.73	79-93
MAP 2	85.82	79.5-93	83.06	76.5-92
MAP 3	86.32	80-94	79.08	75-92.5

(LL-Lower limb, GSV L-Great saphenous vein length, Add P-Adductor canal perforator, KP-Knee perforator, MAP1-Ankle perforator 1, MAP 2-Ankle perforator 2, MAP 3-Ankle perforator 3).



Figure 1: Formation of great saphenous vein along with its medial ankle perforators.

DISCUSSION

A study in which all the three aspects of GSV i.e. its Duplication, Tributaries and Perforators was studied is rarely seen in previous articles. The present study is a pioneer cadaveric study of GSV and would be great help to other researchers in a single research article.

In previous articles, all the parameters were taken from bony prominences like medial malleolus or pubic

tubercle or from medial border of patella but in this study, we have used saphenofemoral junction as the landmark for measurement.

In the present study, duplication was found to be 40 % in central Indian population which was more on right side than left side. As compared to Motwani et al who reported 8.9 % incidence of duplication of vein in North Indian population while the incidence of duplication was noted to be 20 % in Iraq population by Haythem and sayigh.^{8,9} Duplication in present study, was found maximum towards the ankle i.e. 58.33% and the frequency of duplication was found to be least in knee region i.e. 8.33 %. At saphenofemoral junction the frequency was found to be intermediate i.e. 40%.

Since the present study was cadaveric study and there are very few cadaveric studies on GSV, maximum researchers have used saphenogram or USG for the study of veins.

In the Salgado et al study, the above knee perforators were measured from medial epicondyle.¹⁰ In 20 limbs (50%) perforators were found at 6-8 cms from the medial epicondyle and in 24 limbs (60%) at 10-13 cm and in 28 limbs (70 %) at 14-17 cms.

But in the present study instead of medial malleolus all the measurements were taken from saphenofemoral junction. According to which, the origin of adductor canal perforator was found to be in the range of 32 - 46 cms on right side and 26-44 cms on left side. The deep perforators which were found as below knee perforators from the medial malleolus at 5-9 cm, 10-14 cms, 20-24 cm are compatible with the cockett 1, cockett 2, cockett 3 and “24 cm perforator” described in available literature.^{11,12} In Salgado et al study, deep perforators were found to be in the range of 15-19 cms in 30% cases.¹⁰

In the present study, knee perforators are found to be in the range of 32-46 cms on right side and on left side it is 26-44 cms. Ankle perforators are measured from saphenofemoral junction i.e 1st, 2nd and 3rd perforator at 75-91cms, 79.5-93 cms and 80-94 cms on right side and from 79-93 cms, 76.5-92 cms and 75-92.5 cms on left side.

Several authors have studied various variations in the formation, course and tributaries of the saphenous vein but no studies have been done on the measurements of the origin of tributaries of GSV.^{13,14} In the present study, we have taken saphenofemoral junction as a landmark and the origin of various tributaries were found to be i.e. of antero-lateral tributary, postero-medial tributary, genicular tributary, anterior and posterior arch vein tributaries in the range of 3-24cms, 12.5-16.5 cms, 30-46 cms, 36-50 cms and 32.5-49.5 cms on right side and 3-42 cms, 7 -23 cms, 38-44.3 cms, 41-49.5 cms and 39-47 cms on the left side as observed in Table 2. However, comparison of the data could not be done cause no such cadaveric studies are available on the origin of tributaries of GSV.

Variations in the pattern of duplication of GSV would be of great help in planning varicose vein treatment and consequent operative interventions. Since, GSV is used as an autograft for coronary artery bypass procedures. Therefore, a knowledge of duplication of GSV and the various measurements that of origin of tributaries and perforators of GSV that we have done from saphenofemoral junction will be helpful for surgeons, cardiologists and interventional radiologists.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Rai N, Nair S, Thanduri N, Joshi R. Variations of great saphenous vein-a cadaveric study in central Indian population. Int J Res Med Sci 2017;5:2883-6.