Study of Great Saphenous Vein and its Tributaries at the Saphenofemoral Junction and its Variations

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ABSTRACT

BACKGROUND
Great saphenous vein is the largest and thickest walled superficial vein of the lower limb. It ascends on the medial border of the tibia to the posteromedial surface of the knee and inclines anteriorly over the thigh to enter the femoral vein through the saphenous opening. The centre of the opening is 2.5-3.5 cms inferolateral to the pubic tubercle. Among various venous anatomical variations in lower limbs, most important and significant variations occur at the saphenofemoral junction. The study was focussed on the tributaries of great saphenous vein at the saphenofemoral junction and its variations.

METHODS
The study was conducted on 80 surgical cases who underwent Trendelenburg surgery and in 30 cadavers from the Department of Anatomy. The specimens were dissected according to the steps in Cunningham's Manual of Practical Anatomy. Saphenofemoral junction was studied in detail with emphasis on number of tributaries, variation in the drainage pattern of tributaries and duplication of great saphenous vein. Data obtained were consolidated, statistically evaluated using SPSS Version 16 and results obtained were represented using charts and tables.

RESULTS
According to our study, varicosity of the great saphenous vein was more prevalent in the age group 41-50 years (25%) and there was a male predominance. The number of tributaries at the SFJ varied from 1-7 with highest frequency of three tributaries in 57% of cases. Distance of saphenofemoral junction from pubic tubercle varied from 2.60 to 4.20 cms. Duplication of great saphenous vein was noted in 16.7 % of cadavers. In 66.7 % of cases draining pattern was normal.

CONCLUSIONS
In the present study, we found a significant variation of tributaries at the saphenofemoral junction. Although knowledge in venous anatomy and variations may not be necessary in conservative approach, interventional treatment modalities may necessitate expertise. Hence if important anatomical variations are not recognised, surgical or less invasive procedures might result in incomplete saphenofemoral junction surgery. Consequently, the knowledge and identification of anatomical variations play an important role in increasing the success and efficacy of surgical treatments and in decreasing recurrence rates of varicose veins.

KEY WORDS
Great Saphenous Vein, Saphenofemoral Junction, Varicose Veins

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BACKGROUND

Great saphenous vein is the largest and thickest superficial vein of the lower limb. It begins on the medial side of the dorsum of the foot and runs upwards and backwards anterior to the medial malleolus and then on the medial surface of the distal third of the tibia. It then ascends on the medial border of the tibia to the posteromedial surface of the knee and inclines anteriorly over the thigh to enter the femoral vein through the saphenous opening.[1] The centre of the opening is often said to be 2.5- 3.5 cm inferolateral to the pubic tubercle. However, the saphenous opening varies greatly in size and disposition so that this centre is not a reliable surface marking for the saphenofemoral junction.[2]

Saphenofemoral junction is a sophisticated structure comprising of the arch of great saphenous vein, terminal and pre- terminal valves plus a number of tributaries.[3] In the thigh near the saphenofemoral junction, the great saphenous vein receives posteromedial and anterolateral veins. The deep external pudendal vein, superficial epigastric vein, superficial circumflex iliac vein and superficial external pudendal vein enter the great saphenous vein at the fossa ovalis.[4]

Ligation of saphenofemoral junction in flush with the femoral vein after ligating and dividing the known and unknown tributaries (Trendelenburg's procedure) is a time-tested method of treating saphenofemoral incompetence in primary varicose veins. Among various venous anatomical variations in lower limbs, most important and significant variations occur at the saphenofemoral junction. The junction is identified 2.5 cm inferior and 4 cm lateral to pubic tubercle. An incision made at this point however fails to accurately reach the saphenofemoral junction frequently, thereby chance of injury to femoral vessels and failure in flush ligation results in recurrence.[5]

A complete knowledge about anatomical variation in SFJ and variations in tributaries of great saphenous vein is important during surgery ensuring that the junction is safely managed in the least aggressive and most effective way. The major causes of recurrences of varicose veins were identification of GSV stump with non-ligated tributaries, a completely intact SFJ, nonidentification of bifid system and presence of non-ligated junctional tributaries.[6]

We wanted to assess the tributaries of great saphenous vein at the saphenofemoral junction and the variations of tributaries at the saphenofemoral junction.

METHODS

This is a descriptive study conducted in the Department of General Surgery, and the Department of Anatomy, Govt. Medical College, Thiruvananthapuram over a period of two years after approval by the Human Ethics Committee, Govt. Medical College, Thiruvananthapuram.

Sampling Method
Census type of sampling

Sample Size
Sample size was calculated by the formula n= z∝pq/d2
z∝=3.84, p=78.3 (according to the study by Carolina Vas et al)
q=100-p, d=10% of p
n= 3.84 x 78.3 x 21.7/7.82^2 =108

Sample size was 110, out of which 80 samples were taken from Department of Surgery and 30 samples were taken from cadavers of Dept. of Anatomy.

Statistical Analysis
Data obtained were consolidated, statistically evaluated using SPSS software version 16 and results obtained were represented using charts and tables.

Study Sample
The study was undertaken on 80 patients undergoing Trendelenburg surgery in the Dept. of Surgery, Govt. Medical College, Thiruvananthapuram and 30 specimens were obtained from the cadavers of Dept. of Anatomy, Govt. Medical College, and Thiruvananthapuram.

Inclusion Criteria
1. Patients undergoing Trendelenburg surgery in the department of General Surgery, Govt. Medical College, Thiruvananthapuram.
2. Cadavers from Department of Anatomy, Govt. Medical College, Thiruvananthapuram.

Exclusion Criteria
1. Patients with previous history of surgical procedures at groin.
2. Patients undergoing surgery for recurrent varicose veins.
3. Cadavers with traumatic lesion, pathological lesion and surgical intervention at the groin.

Study Procedure
A skin crease incision was made in the groin below and parallel to inguinal ligament at the site of saphenofemoral junction (below and lateral to pubic tubercle). The incision was carried down through the subcutaneous tissues so that great saphenous vein was identified. The first five centimeters of great saphenous vein were explored and thoroughly studied. The tributaries at the saphenofemoral junction was ligated and Trendelenburg surgery was performed.

RESULTS

Age Distribution
Out of 80 cases, 23.8% belonged to the age group 40 and less, 25% belonged to the age group 41-50 years, 22.5% belonged to 51-60 years, 20% belonged to the age group 61-70 years and 8.8% belonged to the age group 71 and above years of age. Highest frequency belonged to the age group 41-50 years of age.

Gender Distribution
Out of the 110 samples, 62.73% were obtained from the males and 37.27% were obtained from the females.

Number of Tributaries

The number of tributaries draining at the saphenofemoral junction were noted in cadavers as well as patients undergoing Trendelenburg surgery. In both samples, the maximum number of tributaries identified was seven and minimum number was one. In 57% of surgical patients, three junctional tributaries were identified.

Number	Frequency	Percent
1	2	6.7
2	5	16.7
3	16	53.3
4	2	6.7
5	3	10.0
6	1	3.3
7	1	3.3
Total	**30**	**100.0**

Table 1. Number of Tributaries in Cadavers

Pattern of Drainage	Frequency	%
Draining directly into SFJ	55	68.8
Superficial epigastric & superficial circumflex iliac vein forming a common trunk to drain into SFJ	9	11.3
Anterolateral vein & superficial circumflex iliac vein forming a common trunk to drain into SFJ	5	6.3
Superficial epigastric & superficial external pudendal vein forming a common trunk to drain into SFJ	6	7.5
Superficial circumflex iliac vein & superficial external pudendal vein forming a common trunk to drain into SFJ	3	3.8
Superficial epigastric, superficial circumflex iliac & anterolateral vein forming a common trunk to drain into SFJ	2	2.5
Total	**80**	**100.0**

Table 2. Draining Pattern of Tributaries at the Saphenofemoral Junction

DISCUSSION

Variations and abnormalities are more frequently reported in veins than arteries. The variations are more common in the upper segment of the great saphenous vein in its tributaries where it ends into the femoral vein.[4] Embryological source of this variation may be explained as an abnormal deviation from the normal process of embryonic development of vascular process.[7]

Age Distribution

In the study done by Thrisuli. P. B et al, prevalence of varicose veins was more among the age group 40-50 years (38.3%).[5] Kshitij et al found that 66% of the study group belonged to less than 50 years of age and 34% belonged to the age group above 50 years.[6] Hemmatti et al in their study showed that the mean age of the patients with varicose vein was 45 years and the range was 17 to 81 years of age.[8] In our study, highest frequency (53%) belonged to the age group 41-50 years of age which was in correspondence with most of the previous studies.

Gender Distribution

In the study done by Thrisuli et al, prevalence was more common in males with 93.3% which may be due to more male patients admitted. Hence the prevalence in hospital admitted cases is more in male population.[5] Kshitij et al found that the male: female ratio was 57:1.2.[6] In the study done by Hemmatti et al, out of 228 patients, 146 (64%) were male and 82 (36%) were female.[8] Carolina Vaz et al observed that the prevalence of variations at saphenofemoral junction was more in women (75%) than in males.[9] In our study 62.73% of the samples were obtained from the males and 37.27% were obtained from the females which was consistent with the study done by Hemmatti et al. There is no consistency in the literatures as to gender differences in prevalence of varicose veins.

Number of Tributaries at the Saphenofemoral Junction

In the study conducted by Kshitij et al, the number of tributaries at the saphenofemoral junction varied from 2 (2%) to 6 (2%). Most frequent number of tributaries was 3 in 42% cases.[6] Pourhasssan et al identified 3 junctional tributaries in 57.4% cases.[10] The number of tributaries as noted by H. G. Kluess et al varied from 2 to 8[11] and that of Donelly M varied from 1 to 10.[12] In the present study, number of tributaries varied from one to seven. The mean was found to be 3.20 with a standard deviation of 1.324. This finding corresponds to most of the findings in the previous studies. The variation in the number of tributaries may be either due to racial differences or due to different ways of counting the tributaries ie, some surgeons tend to count all the tributaries on a single trunk as one at the saphenofemoral junction.

Right and Left Side Variation at the Saphenofemoral Junction

In 48.7% of surgical patients of our study, variation of the saphenofemoral junction was detected on the right side and in 51.3% of the cases, it was detected on the left side. In the study done by Thrisuli et al variation at the saphenofemoral junction was reported on right side in 37 cases out of 60 cases studied and on left side in 23 cases.[5] In the study done by Carolina Vaz et al 189 consecutive operative procedures were performed at the saphenofemoral junction: 103 cases on right side and 86 cases on left side.[9] There were not much studies done on sidewise variation of the saphenofemoral junction to compare our data.

Distance of Saphenofemoral Junction from the Pubic Tubercle

In our study, distance of saphenofemoral junction from the pubic tubercle was measured. It varied from 2.60 cm to 4.20 cm on the right side and 2.70 cm to 3.90 cm on the left side. Our finding was in accordance with most of the previous studies quoted below. Thrisuli et al reported the ultrasound guided location of saphenofemoral junction was at mean distance of 3.641 cm below and lateral to pubic tubercle.[5] Study done by Mirjalili stated that the centre of saphenofemoral junction was 2.4+/- 0.6 cm below and lateral to pubic tubercle (range: 2.5-4.0)[13] while the distance reported by Kshitij et al was 3.77 +/- 0.61 cm.[6]

Duplication of Great Saphenous Vein

Present Study	16.7 % of Cadavers & 12.5 % of Surgical Cases
Glasser	3% of anatomical dissections
Allen & colleagues	18% of anatomical dissections
Capuano and colleagues (1975)	12.5%) of cases
Burnand and colleagues	16% cases of vascular surgery
Dhiraj M Shah	35% of cases
Chandler et al	35% of cases
Mark H Meissner	8% of cases
Donnelly M et al	18.1% of study population

Table 3. Duplication of Great Saphenous Vein

The earliest study was done by Glasser in 1942. He performed anatomical dissection on 100 limbs and found duplicated saphenous vein in 3 limbs.[14] Allen & colleagues found duplication of GSV in 18% of anatomical dissections,[15] Capuano and colleagues in 12.5% of cases,[16] Burnand et al in 16% cases of vascular surgery[17] and Donelly M et al in 18% of study population.[12]

Pattern of Drainage of Tributaries at the Saphenofemoral Junction

In 66.7% of cases in our study, draining pattern was normal while in other cases, the tributaries joined to form a common trunk. According to the study done by K Udhaya et al, out of 70 specimens (30%) showed a normal pattern of superficial circumflex iliac vein, superficial epigastric and superficial external pudendal vein draining directly at saphenofemoral junction. The posteromedian vein drained along with superficial external pudendal vein in 5.7% of cases. The posteromedian vein drained directly into great saphenous vein at fossa ovalis in 7.14% cases. In 24.2% specimens, anterolateral vein drained with superficial circumflex iliac vein and superficial epigastric vein. In 7.14% cases anterolateral vein drained directly at saphenofemoral junction, in 2.85% it drained along with superficial circumflex iliac vein.[4] M.H Chung et al reported that the postero median vein joined to form a common trunk with superficial external pudendal vein at an incidence of 14.1% or with superficial epigastric vein and superficial external pudendal vein in a 3.6% incidence and directly in 82.3% cases. The anterolateral vein drained directly in 38.6% incidence. Superficial epigastric and superficial external pudendal vein joined to form a common trunk in 12.5% cases, superficial epigastric and superficial circumflex iliac vein in 0.8%, superficial epigastric and anterolateral vein in 9.2% cases. The superficial circumflex iliac vein drained directly in 56.6% cases or formed a common trunk by joining with superficial epigastric vein (0.8%). The superficial external pudendal vein and superficial epigastric vein drained directly at the saphenofemoral junction in 61.95% and 45% incidence.[18]

CONCLUSIONS

The knowledge and identification of anatomical variations of saphenofemoral junction play an important role in increasing the success and efficacy of surgical treatments in varicose veins and in decreasing recurrence rates. Pre-operative knowledge of each individual's saphenous vein is important for several reasons. It permits accurate placement of skin incisions and minimises a major source of frustration during the operative procedure. Recurrent varicose veins after surgery is a common problem which has different causes such as inadequate assessment for the presence of DVT, anatomical variation at saphenofemoral junction, post-operative neovascularisation etc. Failure to ligate the major tributary veins would not be surprising considering the anatomical complexity and has been attributed to the efforts of less experienced surgeons. A double saphenous vein can be an explanation for recurrent incompetence of the great saphenous vein due to a persistently duplicated trunk.

There have been revolutionary developments in the diagnosis and treatment of chronic venous insufficiency in recent years. The treatment options of varicose veins include conservative approach, sclerotherapy, ultrasound guided sclerotherapy and junctional ligation with or without stripping. Although expertise in venous anatomy and variations may not be necessary in conservative approach, interventional treatment modalities may necessitate expertise. Hence if important anatomical variations are not recognised, surgical or less invasive procedures might result in incomplete saphenofemoral junction surgery.

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