ORIGINAL RESEARCH

Variations in the termination of Short Saphenous vein- A Cadaveric study

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ABSTRACT

Background: Variant anatomy of the superficial veins of the lower limb is clinically important in the management of chronic venous disease. Short saphenous vein is the superficial vein of the lower limb. Itterminates in the popliteal vein, in the popliteal fossa, 3-7.5 cm above knee joint. It may possess variable termination. The numerous modes of termination of SSV may contribute to recurrent varicose veins post operatively. The short saphenous vein can be the natural choice for coronary arterial bypass surgery, and also can be used in arterial reconstruction. **Material and Methods**: The present study was conducted in the department of Anatomy on 30 lower limbs belonging 15 formalin fixed cadavers. The cadavers with lower limb deformities or amputations were excluded from the study. The study was conducted over the period of 25 months (September 2012- October 2014). The data was entered in Microsoft excel sheet and expressed in count (percentage). **Results**: Ten specimens showed a variable level of termination of short saphenous vein. In the present study, 66.6% cases belonged to I a subtype, 16.6% were of type II b and 16.6% were of type III b. **Conclusion**: Detailed knowledge regarding the anatomical variations and unusual termination of the short saphenous vein is a prerequisite in the diagnosis and management of varicose veins. It is imperative to carefully explore the popliteal fossa and venous system of lower limb pre operatively in order to avoid undue complications.

Keywords: Short Saphenous vein, Variable termination, Varicose veins, Iatrogenic complications

INTRODUCTION

The Sort Saphenous vein (SSV) begins posterior to the lateral malleolus as a continuation of lateral marginal vein. In the lower third of the calf, it ascends lateral to the calcaneal tendon, lying on the deep fascia and covered only by superficial fascia and skin. Continuing its ascend, it passes between the heads of gastrocnemius, then terminates in the popliteal vein, in the popliteal fossa, 3-7.5 cm above knee joint. It has 7-13 valves.[1] It may possess variable termination; sometimes it joins the great saphenous vein in upper thigh directly or through the accessory saphenous vein, it may bifurcate, one joining the great saphenous vein and the other ending in the popliteal or the deep posterior vein of thigh and occasionally it may fail to reach the knee and may end in the great saphenous vein or deep veins of the leg.[2]Giacomini, in 1983, and Kosinski, in 1926, were the first researchers to provide detailed information- obtained through corpse dissections- about SSV termination.[3]Giacomini has reported the thigh extension of short saphenous vein which communicated with the great saphenous vein called as “Giacomini vein”.[4]The numerous modes of termination of SSV may contribute to recurrent varicose veins post operatively. The incidence of recurrence may vary from 14 to 44%, but it may reach up to 61% of cases due to residual stump or SSV. The numerous variations of termination of SSV alone in responsible for 10% of cases of post- operative recurrence.[5]Varicose veins of the lower limb are a well- known surgical entity.[6]The knowledge about the venous system is rapidly increasing and is now in a period of massive reconsideration.[7]

The SSV represents the post axial vein of the developing lower limb. Embryologically, a single axis artery supplies the lower limb and blood is returned to cardinal system by means of pre axial and post axial veins.[4]A thorough understanding of vascular system anatomy is a prerequisite for all vascular specialities. Venous embryology can explain many of the defects resulting in venous anomalies in later life. Early venous outfow from primitive lower limboccurs through lateral/ posterior fibular vein into posterior cardinal vein; this is the first embryonic vein of the lower limb.

The "primitive fibular vein" develops into two branches: The "anterior tibial vein" (ATV) and the "connecting branch". The ATV becomes main deep draining vein of the calf. The ATV and primitive fibular vein together now constitute the "sciatic vein"; which is the second embryonic vein. A part of primitive fibular vein distal to ATV evolutes to become SSV.[8]In quadrupedal mammals, ungulate and plantigrade animals, the SSV is the most important vein, whereas, in apesit becomes much smaller and less functional. The lower junction of SSV in popliteal fossa may be an adaptation to lower limb elongation. Embryological and phylogenetic regression of SSV may induce its functional regression. Actually, SSV dysfunction or reflux is a frequent disorder in human beings but has never been observed in animals.[9]

Variations in the mode of termination of the superficial veins are not uncommon. Aguinaldo de Oliveira et al have classified three types of termination of short saphenous vein.

- Type I - Termination in the popliteal vein. This type has two subtypes

I a: termination exclusively in the popliteal vein

I b: divided into two branches, one to the popliteal vein and the other to the greater saphenous vein

- Type II - Termination in thigh veins or in deep veins (femoral vein/veins of the posterior aspect of the thigh) and/or in the greater saphenous vein. It is further subdivided into:

II a: deep veins of the thigh

II b:both the deep veins of the thigh and the greater saphenous vein

II c: directly in the greater saphenous vein

- Type III- Termination in leg veins, without reaching the popliteal region. This type has two subtypes:

III a: termination in the greater saphenous vein

III b: termination in the gastrocnemius veins.[5]

A basic knowledge of vascular embryology; particularly, evolutional and involutional development of venous system involved in maturation of truncal vein is essential for recognition and interpretation of a number of venous anomalies.[10]

MATERIAL AND METHODS

The present study was conducted in the department of Anatomy on 30 lower limbs belonging to 15 formalin fixed cadavers. The dissection was carried out using Cunningham's manual of dissection. The cadavers with lower limb deformities or amputations were excluded from the study. The study was conducted over the period of 25 months (September 2012-October 2014). The data was entered in Microsoft excel sheet and expressed in count (percentage).

OBSERVATIONS

Ten specimens showed a variable level of termination of short saphenous vein. Five specimens showed a high termination of short saphenous vein. Here the short saphenous vein observed to terminate at the level of adductor hiatus.

In the present study, 66.6% cases belonged to I a subtype (Fig 1), 16.6% were of type II b (Fig 2) and 16.6% were of type III b.

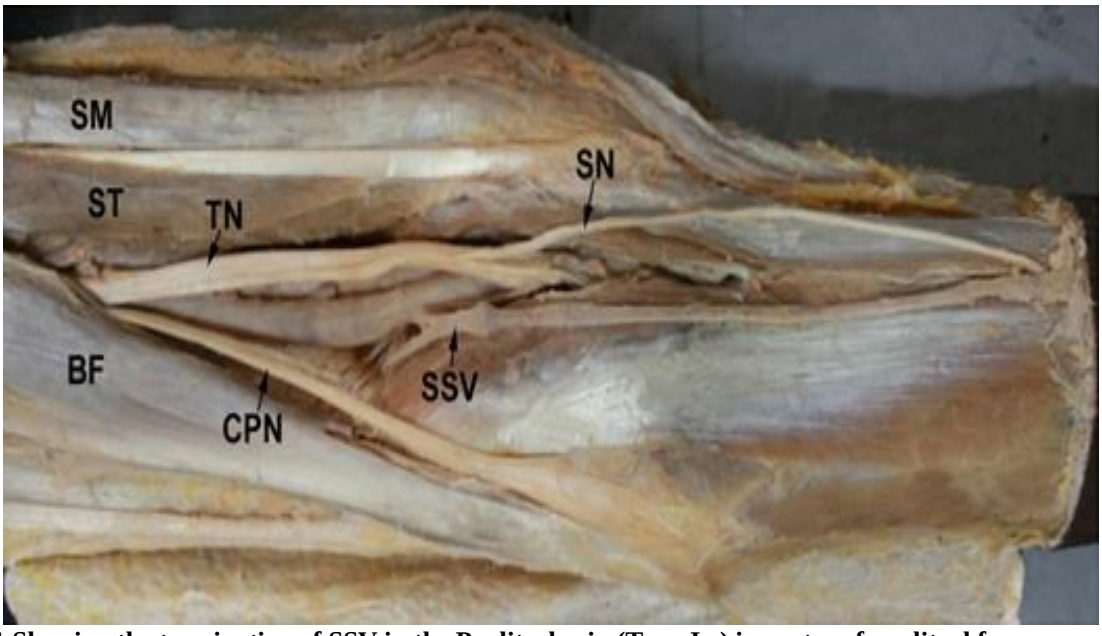

Fig 1 Showing the termination of SSV in the Popliteal vein (Type I a) in centre of popliteal fossa.

SM- Semimembranosus **SSV- Short Saphenous Vein**
ST- Semitendinosus **SN- Sural Nerve**
BF- Biceps Femoris **TN- Tibial Nerve**
CPN- Common Peroneal Nerve

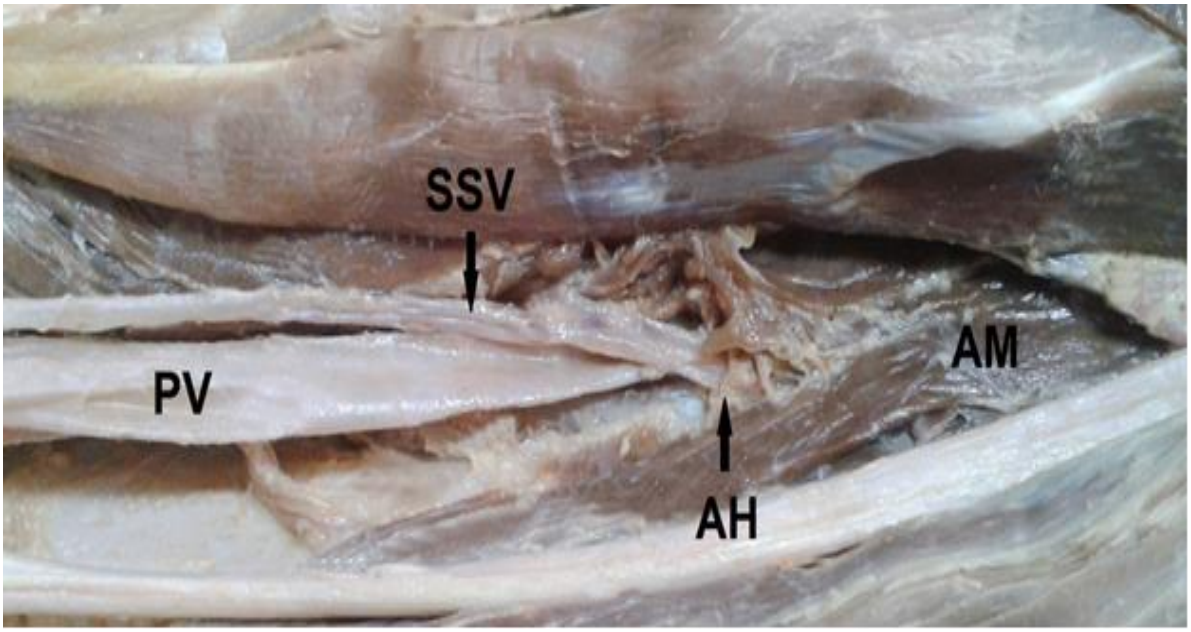

Fig 2 Showing termination of SSV in popliteal vein at the level of adductor hiatus (Type II b)
PV- Popliteal vein SSV- Short Saphenous vein
AM- Adductor magnus AH- Adductor hiatus

In one case, the SSV was seen to terminate into a plexus of veins which further drained into popliteal vein at the level of lower 1/3rdof the thigh. (Fig 3)

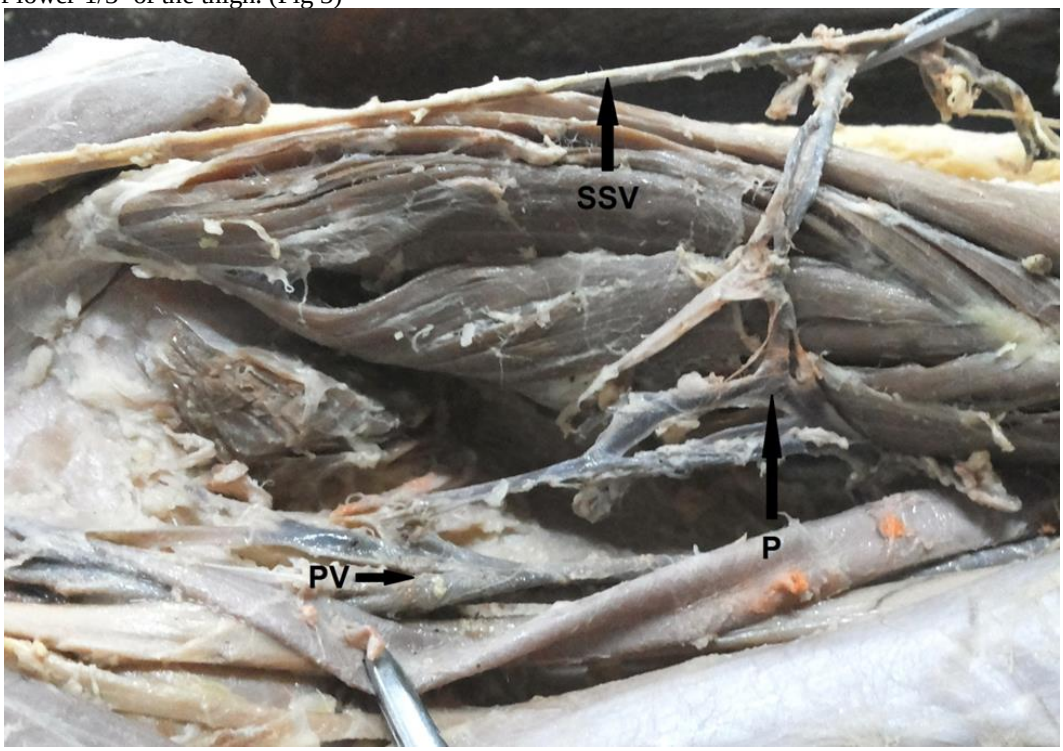

Fig 3 Showing termination of Short Saphenous Vein in plexus of deep veins of thigh.
SSV- Short Saphenous Vein
PV- Popliteal Vein
P- Plexus of veins (Deep veins of thigh)

In one case, partial duplication of SSV was observed. Both the veins reunited at the inferior angle of popliteal fossa and drained into popliteal vein. (Fig 4)

Fig 4 Showing partial duplication of Short Saphenous Vein.
SM- Semimembranosus SSV- Short Saphenous Vein
BF- Biceps FemorisMG- Medial head of Gastrocnemius LG- Lateral head of Gastrocnemius
Low termination of the short saphenous vein was seen in five specimens.

DISCUSSION

"Saphenous" is a term with ambiguous meaning derived from ancient history. In Greek, the term "Saphenous" is derived from "Safaina", meaning "evident"[11], whereas in Arabic history, the term "saphenous" is derived from "el safin" meaning "concealed".[4]Knowledge of the complex anatomy of the SSV is essential to improve the results of surgery for varicose veins.[12]Generally, the clinical assessment including tourniquet tests and Doppler ultrasound of primary varicose veins present no problem. However, in some patients, the information so obtained is inadequate for appropriate management and difficulties arise because of abnormal communication between the long and short saphenous veins.[2] It is important to emphasize one aspect: perhaps the major difficulty in determining the level and type of termination is related to its occurrence in deep veins of thigh. There is a consensus in the literature that the higher the distance in relation to popliteal crease, the higher the technical difficulty to determine the actual place of termination.[5]

Several authors have classified their findings on the bases of Kosinski's classification[13] for assessment of SSV termination. In type I- SSV termination in popliteal vein, Type II- SSV terminating in veins of thigh and type III- SSV terminating in veins of leg. Table 1 shows comparison of the same.

Table 1 Showing comparison of SSV termination by Color Doppler ultrasound based on Kosinski's classification.

Authors& Year	Number of limbs	Type I (%)	Type II (%)	Type III (%)
Kosinski (1926)[13]	124	57.3	33	9.7
Engel et al (1991)[14]	62	78	15.4	6.6
Engel et al (1994)[15]	104	52.4	46.6	1
Labrapoulos et al (1997)[3]	383	60.8	19.3	15.4

The findings of the present study were classified on the basis of classification given by Oliveira et al.[5] Table 2 shows the findings of the various authors based on the same.

Table 2 Showing comparison of variation in termination of SSV.

Author & Year	Type of study	Number of cases	Type I (%)		Type II (%)			Type III (%)	
			A	B	A	B	C	A	B
Oliveria et al (2004)[5]	Color Doppler Ultrasound	500	43.1	9.7	28.6	10.2	-	2	0.8
Anbumani et al (2016)[4]	Cadaveric	50	54	30	14	2	-	-	-
Present study (2014)	Cadaveric	30	66.6	-	-	16.6	-	-	16.6

Reviewing various anatomical series in literature, Creton e Kolher, cited by Garrido[16], it has been concluded that reflux is likely to occur in higher junctions, perhaps because of the obliquity of the junction or because of the protection exercised by the thigh muscles, in contrast to what occurs in popliteal fossa. However, according to these authors, the explanation for reflux is hemodynamic, not anatomical.[5] The hemodynamic difficulties are to the fact that popliteal fossa is the site of very intense pressure variations. Varicose veins is one of the commonest disease of the veins of lower limb. It may range in severity from undesirable appearance of venectasia to protuberant tortuous varicosities with or

without dermatitis. The cause of varicose veins is said to be multifactorial. It is also linked to FOXC2 gene.[17] Concerning clinical anatomy, the proximity of SSV to nerves must be kept in mind. Neural injury during varicose surgery is known common complication which is also the major reason for legal action against phlebologists.[18]

An important vein variant, often neglected in the classic textbooks, is the Giacomini vein The GV, which constitutes mainly an anastomotic branch between long saphenous vein and SSV, has been shown that could be affected by varicose disease with reflux, either upwards or downwards in the thigh.[19]This thigh extension of the SSV (Giacomini vein) can be the natural choice for coronary arterial bypass surgery, and also can be used in arterial reconstruction.[2]Various authors have reported GV in their studies which ranges from 82.2%- 92%.[13,20,21] However, Giaconimi vein was not observed in the present study.

Variant anatomy of the superficial veins of the lower limb is clinically important in the management of chronic venous disease.[22]Although surgical stripping is still considered the gold standard for saphenous vein ablation,[23] endovenous thermal ablation (EVA)endovenous laser therapy and radiofrequency ablation, hasbecome a more recognized alternative in common practice. Many complications of surgical stripping of the SSV have been described, along with damage to the sural nerve, tibial nerve and the common peroneal nerve.[24]The anatomic course of these nerves is also important because of extra risks caused by EVA coagulationtemperatures and the insertion of a needle when injecting tumescent anesthesia around the vein. Thermal damage to peripheral nerves is a known complication of EVA of the small saphenous. Therefore, the need for thorough research on complications, recurrence rates, and relevant anatomy becomes greater.[25]

The main limitation of the study was the small sample size. Also, the present study is cadaveric. Its findings should be complimented with the data obtained from radiological studies to make it more significant.

Nevertheless, in the light of highly variable termination of SSV, it is imperative to carefully explore the popliteal fossa and venous system of lower limb pre operatively in order to avoid undue complications.

CONFLICTS OF INTEREST

None

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