Long saphenous vein and its anatomical variations

Suzi Su-Hsin Chen and Shri Kumar Prasad

Vascular Laboratory, Department of Vascular Sciences and Medicine, Dandenong Hospital, Dandenong, Victoria 3175, Australia.

Correspondence to Dr Suzi Chen. Email suzi.chen@med.monash.edu.au

Abstract

Vascular ultrasonography has an important role in the diagnosis and management of venous disease. The venous system, however, is more complex and variable compared to the arterial system due to its frequent anatomical variations. This often becomes quite challenging for sonographers. This paper discusses the anatomy of the long saphenous vein and its anatomical variations accompanied by sonograms and illustrations.

Fig. 1: In a transverse view, the saphenous eye or “Egyptian” eye is featured with the LSV located between the superficial and aponeurotic deep fasciae.

Fig. 2: A large subcutaneous tributary pierces the superficial fascia to join the LSV in the thigh region.

Introduction

The venous system is more variable compared to the arterial system due to its frequent anatomical variations. A good understanding of the venous anatomy is very important for sonographers. In the UK alone 60,000 lower limb varicose vein operations are performed every year¹. Clearly, vascular ultrasonography plays an important role in the diagnosis and management of venous disease. Part of an educational series, this paper focuses on the long saphenous vein and its anatomical variations accompanied by sonograms and illustrations. Perforators, however, are beyond the scope of this paper. In writing this paper we hope to simplify and clarify some of the confusions and difficulties associated with imaging the long saphenous vein.

Complexity started with the name

The long saphenous vein (LSV) is also known as the internal, great or greater saphenous vein. Although a consensus meeting held in 2001 as part of the Union Internationale de Phlebologie suggested “great saphenous vein” to be used², Australia has yet to adopt the nomenclature. Thus, “the long saphenous vein” will be used throughout this paper.

Long saphenous vein and its eye

The LSV is the longest vein in the body. It originates from the anterior aspect of the medial malleolus and runs along the tibial aspect of the medial calf before crossing the knee.

The LSV then continues its course along the medial thigh before joining the femoral vein forming the saphenofemoral junction at the level of the groin skin crease.

The LSV is easily identified particularly in the proximal to mid thigh region due to its typical ultrasound appearance known as the saphenous eye. First described by Bailly in 1993³, the saphenous eye shows that the LSV, in a transverse view, is located within the saphenous compartment outlined by the superficial and aponeurotic deep fasciae. This transverse arrangement gives an appearance of an “Egyptian eye” (Fig. 1) and helps the LSV to be distinguished from other tributaries.

Long saphenous vein and its anatomical variations in the thigh

Five anatomical LSV variations have been reported⁴ in the thigh region. The unique “Egyptian eye” appearance of the saphenous compartment allows the identification and differentiation of these anatomical patterns as listed below.

- 1 Single LSV located within the saphenous compartment with no large parallel tributary in sight (Fig. 1).
- 2 A single LSV found in the saphenous compartment with a large subcutaneous tributary which pierces the superficial fascia to join the LSV at a variable level in the thigh (Fig. 2).
- 3 A slight variation to the previous one in that the LSV lies within the proximal saphenous compartment while

Fig. 3: The LSV and the anterior accessory saphenous vein in their own saphenous compartment (A). The anterior accessory saphenous vein then joins the LSV before entering the saphenofemoral junction (B).

Fig. 4: Duplication of the LSV and its confluences.

a large subcutaneous tributary is found distally with no other substantial veins visible in the saphenous compartment. Once again, this tributary pierces the saphenous fascia at a variable level in the thigh to join the LSV.

- 4 The LSV is found with the anterior accessory saphenous vein, which runs the lateral aspect of the thigh. Distally located in separate saphenous compartments, these two veins then join and lie within one saphenous compartment before entering the saphenofemoral junction (Figs. 3a and 3b).
- 5 A rare anatomical variation which consists of duplication of the LSV can be found in the thigh region. Two criteria make this variation so rare that it only exists in about 1% of the population⁵. The two LSVs will lie in the same plane, parallel to the skin and run along the aponeurotic deep fascia. These two LSVs will also have the same caliber draining a common cutaneous territory. An accessory saphenous vein is often mistaken as a duplication of the LSV, but the accessory saphenous vein is usually smaller in size and does not drain the same cutaneous territory as the LSV⁶⁻⁷. The duplication of the LSV can be described in three types based on its relationship with the femoral vein (Fig. 4)⁶⁻⁷.

Long saphenous vein and its anatomical variations at the knee

The space in the knee region is concise and contains numerous

Fig. 5: The tibio-gastrocnemius angle sign shows that the LSV at the knee region is bordered by the tibia and the medial gastrocnemius muscle.

subcutaneous tributaries and perforators. It may be difficult to identify the “Egyptian eye” appearance of the saphenous compartment in this area. Instead of the saphenous compartment, the LSV can be identified using the tibio-gastrocnemius angle sign (Fig. 5). The LSV is located within a triangle bordered by the tibia, medial gastrocnemius muscle and fascial sheet between the distal third of thigh and proximal third of calf⁸. This technique is particularly useful in determining if the LSV is absent due to anatomical variations, which can be found in approximately 29% of the patients⁸. According to Ricci and Caavezzi⁸, there are five LSV patterns at the knee region.

- 1 The LSV is seen at the level of knee skin crease without any large tributaries found (Fig. 5).
 - 2 The LSV is seen with one or more tributaries below the knee (Fig. 6a and 6b).
 - 3 The LSV is seen with a large tributary located above the knee (Fig. 7a and 7b).
- In some cases, the middle portion of the LSV can be absent or barely visible.
- 4 A portion of the LSV is not visible above or below the knee. The LSV then returns by piercing the saphenous fascia at the level of mid-calf to become a subcutaneous tributary. The tributary then courses upwardly and crosses the knee before joining the LSV in its saphenous compartment at the distal thigh (Fig. 8a and 8b).
 - 5 This variation is similar to the previous one except that the non-visible portion of the LSV is very short and

Fig. 6a: Anatomical variation of the LSV below the knee. The LSV and its tributary are seen below the knee (A and B).

Fig. 6b.

Fig. 7a: Anatomical variation of the LSV above the knee. The LSV and its tributary are seen above the knee (A and B).

Fig. 7b.

Fig. 8a: Anatomical variation of the LSV at the knee region. Missing portion of the LSV at the knee region can be identified using the tibio-gastrocnemius angle sign. A tributary is seen subcutaneously without the presence of the LSV (A). The missing portion of the LSV can be above the knee (B) or below the knee (C).

is usually located below, rather than across the knee (Fig. 8c). This can be easily identified (Fig. 8a) using the tibio-gastrocnemius angle sign (Fig. 5).

In addition to these five most commonly found LSV patterns at the knee region, it is important to note that this classification did not describe 3% of the cases reported⁸. It is possible that both the LSV and the usually observed tributary are not visible at the knee region (Fig. 9). The tributary may rejoin the LSV from the lateral aspect of the thigh prior to the entry to the saphenofemoral junction.

Fig. 8b.

Fig. 8c.

Fig. 9: Anatomical variation of the LSV at the knee region. Both the LSV and its tributary are missing at the knee region.

Fig. 10: The LSV is accompanied by a subcutaneous tributary in the distal calf.

Long saphenous vein and its anatomical variations in the leg

The LSV is almost always present between the medial malleolus and the level of the mid-calf paratibial perforator. In the leg region, the LSV is often accompanied by one or more subcutaneous tributaries which are parallel to the LSV in the distal calf (Fig. 10). In some cases, the tributaries in the leg region can appear quite large and are easily mistaken for the LSV itself or duplication of the LSV. Since the true LSV duplication is rare (1%)⁵, careful ultrasound imaging usually reveals that these tributaries are subcutaneous and may enter the saphenous compartment by piercing the superficial fascia.

Conclusions

The LSV is the longest vein in the body originating from the medial malleolus to the level of groin skin crease. The LSV can be identified easily by its typical ultrasound appearance known as the saphenous eye or “Egyptian” eye in the thigh and the tibio-gastrocnemius angle sign at the knee. The LSV is often accompanied by its tributaries and at times tributaries can be confused with the LSV or be mistaken for LSV duplication. In addition to its tributaries, the LSV also presents with several anatomical patterns both in the thigh and at the knee. Thus, a good understanding of the typical ultrasound appearance of the LSV, its relationship to the saphenous compartment and fasciae is critical in performing a successful venous scan.

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