

# The thigh extension of the lesser saphenous vein: From Giacomini's observations to ultrasound scan imaging

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**Background:** Giacomini described a vein that now bears his name almost 130 years ago. Subsequent anatomic studies detail his findings but receive inadequate attention in clinical and surgical textbooks. The purpose of this study was to present a summary of the original observations by Giacomini, present our ultrasound scan findings, and review later anatomic, venographic, and ultrasound scan studies.

**Methods:** The study was a literature review and experience with duplex ultrasound scanning from units in Italy and Australia.

**Results:** Giacomini described a thigh extension from the lesser saphenous vein that passed to join with the greater saphenous vein, which since then bears his name, and described also the other destinations of the thigh extension to deep veins through perforators or an end as multiple tributaries in the superficial tissues or muscles. Duplex ultrasound scanning shows that the vein can be affected by varicose disease with reflux either upwards or downwards in the thigh to the greater or lesser saphenous veins respectively.

**Conclusion:** Ultrasound scan imaging has brought the vein of Giacomini from the realm of anatomic dissection to an important structure to be considered in the clinical management of chronic venous disease. (*J Vasc Surg* 2003;37:558-63.)

## GIACOMINI'S ORIGINAL DESCRIPTION

In 1873, Carlo Giacomini (Fig 1) described a vein that now bears his name but receives little attention in clinical and surgical textbooks. This paper presents a summary of Giacomini's original description and a review of later anatomic, venographic, and ultrasound scan studies and discusses the topics in the light of our own ultrasound scan findings.

Giacomini published his observations, on the basis of dissections of 51 limbs, under the title "Anatomical observations to serve the study of the venous circulation of the lower limbs".<sup>1</sup> In a section concerning "the superficial veins of the abdominal limb and principally the external saphenous," he described different patterns of proximal thigh extension (TE) and termination of the external or lesser saphenous vein (LSV), including connections to the internal or greater saphenous vein (GSV). His unique description was apparently ignored until recent discovery of his original paper in the University Library in Bologna, Italy. A complete English-language translation has been pub-

lished,<sup>2</sup> and this presentation is a summary under the following five headings.

### "Superior anastomotic branch of the external saphenous vein with the internal saphenous"

"This ascending branch originates at the angle that the external saphenous vein forms, passing out from a vertical to oblique direction always sub-aponeurotic. It goes up, following the primitive direction of the external saphenous vein, adherent to the deep face of the aponeurosis and reaching beyond the back of the thigh it again becomes subcutaneous, and bends internally. . . to finish into the internal saphenous. It therefore presents two distinct portions, one inferior sub-aponeurotic, the other superior subcutaneous.

"In all cases in which the external saphenous does not give any branch to the popliteal and precedes undivided upward, the communications in the leg between the external saphenous and the internal and to deep inter and intramuscular vessels are more abundant than in the normal state. The latter does not precede undivided from the popliteal cavity to the internal saphenous, but gives branches that go to other secondary veins and principally to the perforators, or then proceed into the superficial or deep femoral vein, or both.

"At other times, the external saphenous arriving sub-aponeurotic at the popliteal fossa bends anteriorly as if about to join the popliteal vein, but adheres quite closely to the internal side of the popliteal artery and becomes a popliteal collateral, and goes to terminate further up into the popliteal vein or into the femoral vein. The anastomotic branch between the external saphenous and the internal

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Competition of interest: none.

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generally has a calibre that equals one third of the original external saphenous, but sometimes its diameter can increase so that the connection with the popliteal is reduced to an extremely tiny thread and sometimes even this thread does not exist, and then all the external saphenous goes into the internal saphenous.

“In its thigh portion, one sometimes encounters valves in its sub-aponeurotic part, and constantly two or three pairs in the subcutaneous part close to the junction with the internal saphenous. All these valves are arranged in a way to prevent reflux of blood from the internal saphenous to the external.”

**Comment.** The anastomotic branch between the LSV and GSV, which since then has been widely known as the vein of Giacomini, was found in 72% of the limbs (37/51). In 27 limbs (53%), there was a saphenopopliteal junction; in seven limbs (14%), there was no saphenopopliteal junction and the LSV terminated directly into the GSV; and in the remaining three limbs (6%), the Giacomini vein had other terminations, particularly into the biceps muscle.

#### “Vein of the small ischiatic nerve or femoro-popliteal”

“The external saphenous vein terminated into the popliteal vein and the anastomotic branch was absent, with a well evident vein of the small ischiatic nerve or femoro-popliteal. This branch having the same point of departure from the external saphenous vein as the anastomotic branch described above, and following the same relationship with the small ischiatic nerve, instead of becoming subcutaneous to pass anteriorly into the internal saphenous vein, exhausted itself in the cellular-adipose sub-aponeurotic tissue in the posterior and superior part of the thigh. This branch obviously carried blood into the external saphenous vein, since there was a pair of valves that were arranged to prevent blood from flowing upward in this vein in opposition to what I had previously observed.”

**Comment.** This type of termination was found in 14% of the limbs (7/51), and the saphenopopliteal junction was also present in all cases.

#### “Termination of the external saphenous vein into the perforating veins”

“The anastomotic branch of the external saphenous vein gave branches to the perforating veins along its long course along the posterior part of the thigh and mainly to the IIIrd and IIInd. These branches may become voluminous and constitute the only termination of the external saphenous. In those cases the external saphenous continued into the deep femoral passing between the arches that the great adductor muscle presents at its insertion.”

**Comment.** This high LSV termination was found in 6% of the limbs (3/51).

#### “Branch of the external saphenous to the short portion of the biceps muscle”

“It is not rare to find that some of these collateral branches, which come from the external saphenous in cases where the latter does not have a normal course and termination, instead of proceeding as indicated above, terminate



**Fig 1.** Portrait of Carlo Giacomini. Reprinted by permission of Edizioni Minerva Medica from *Int Angiol* 2001;20:225-33.

in the body of the short part of the biceps muscle of the thigh. The form of the external saphenous that behaves in this way can be of small calibre or constitute the only termination.”

**Comment.** This termination was found in 8% of the limbs (4/51).

#### “The external saphenous vein terminated entirely into the popliteal vein without any anastomotic branch”

**Comment.** This is the “classic” LSV termination. It was found in 6% of the limbs (3/51) as the only termination.

The types of termination that Giacomini described are shown in Table I and are illustrated in Fig 2. The descriptions appear to show the main terminations and not the only ones. In most cases, the TE divides and terminates with more than one branch, besides giving tiny anastomotic branches to other superficial veins.

**Table I.** Summary of Giacomoni's synoptic description of proximal termination of LSV

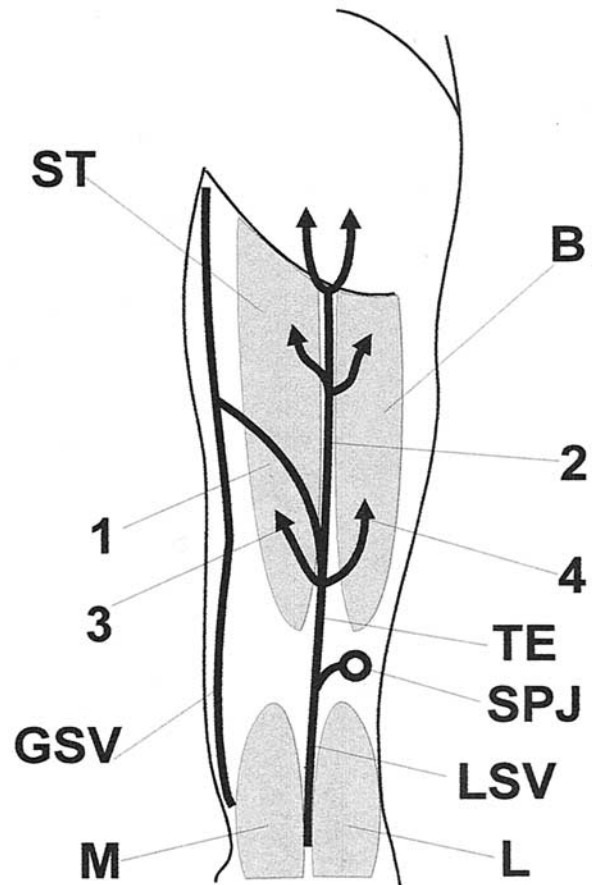
Description	No.
LSV terminated into popliteal vein and had anastomotic branch with GSV	27
LSV terminated into popliteal vein and had large branch communicating with third perforator	1
LSV terminated into popliteal vein with well-evident vein of small ischiatic nerve or femoropopliteal	7
LSV terminated entirely into GSV following direction of anastomotic branch	7
LSV terminated essentially into flesh of short head of biceps and had anastomotic branches with GSV	3
LSV terminated entirely into flesh of short head of biceps	1
LSV terminated essentially into perforators with various anastomotic branches	2
LSV terminated entirely into popliteal vein without any anastomotic branch	3
Total	51

### DUPLEX ULTRASOUND SCAN FINDINGS

We have observed that duplex scanning can show some details not described by Giacomini. The intersaphenous anastomosis, so-called vein of Giacomini or TE, typically presents not two sections, the distal subfascial and proximal subcutaneous, but three sections, a distal and proximal sections deep to the fascia and a middle section that is subcutaneous. This is not a surprise because both the GSV and the LSV are covered by fascia and lie in what has been recently called the "saphenous compartment."<sup>3,4</sup> The TE is detected on a transverse scan of the posterior thigh in a groove between the semitendinosus muscle medially and the long head of biceps muscle laterally (Fig 3).<sup>5</sup>

A recent study by one author (MG) described an illustrative series of patients with enlarged TE.<sup>5</sup> The findings confirm the various terminations described by Giacomini and show that the TE may be enlarged in two different clinical situations. The first is when the TE is involved in varicose vein disease because the TE may then transmit proximal reflux from the GSV, perforators, or pelvic anastomoses to the LSV and its varicose collaterals or be involved by reflux in the opposite direction from the leg, LSV, or saphenopopliteal junction into the GSV and its varicose tributaries. The second is when the TE is enlarged but competent and functions as a major outflow channel in limbs with deep popliteal vein obstruction.

Another author (KAM) studied 1226 limbs in 1000 consecutive patients where there was GSV or LSV reflux shown with duplex scanning. There were intersaphenous thigh anastomoses as described by Giacomini affected by varicose disease with reflux in 76 limbs (6.2%; Table II). This affected 5.3% of limbs with primary varicose veins and 9.6% of limbs with recurrent varicose veins after previous greater saphenous surgery. Varicose involvement of the TE was observed in 0.7% of limbs with GSV reflux only, 16.7% of limbs with LSV reflux only, and 28.3% of limbs with both GSV and LSV reflux. Flow was towards the LSV in 53 limbs

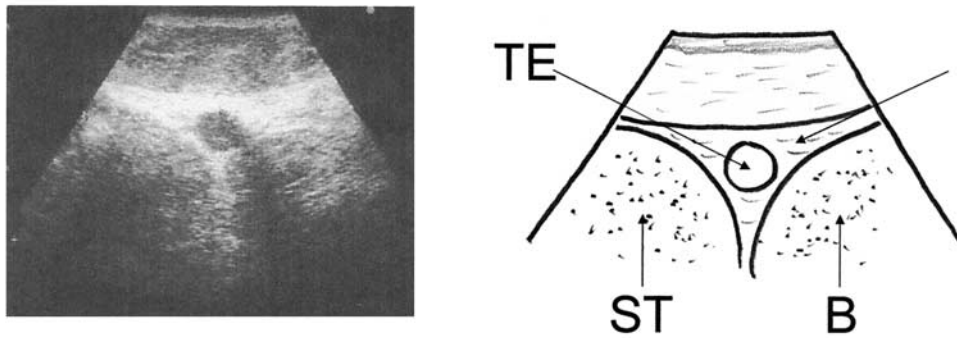


**Fig 2.** Posterior aspect of right lower limb shows various proximal terminations of TE of LSV. TE, TE of LSV; SPJ, saphenopopliteal junction; M, medial gastrocnemius muscle; L, lateral gastrocnemius muscle; ST, semitendinosus muscle; B, biceps muscle (long head); I, intersaphenous anastomosis; 2, vein of small ischiatic nerve or femoropopliteal, going up into gluteal area; 3, posterior thigh perforator; 4, termination into short head of biceps muscle.

(70%) from the GSV, deep veins, or pelvic veins and from the LSV in 23 limbs (30%) to the GSV or other veins (Table III; Fig 4).

### DISCUSSION

**Giacomini's contributions.** Several 19th century anatomists described some of the TE patterns before Giacomini, but they considered these to be anomalies, failed to describe their relationship to the surrounding fascial layers, and generically described them as "superficial veins."<sup>1</sup> Giacomini's original contributions appear to be to describe new types of termination, such as the one into the biceps muscle, to describe the relationship of the TE with the fascial layers of the thigh, which clearly show that the TE and the LSV are the same vein, and to conclude that the "ascending branch that comes out from the external saphenous instead of being considered an anomaly, because of its



**Fig 3.** Transverse ultrasound scan of TE. TE, TE of LSV; I, interfascial compartment; ST, semitendinosus muscle; B, biceps muscle.

extreme frequency should be regarded as the ‘normal state.’”

Another original contribution was the discovery in the vein of two opposite valve arrangements, the first allowing only upward flow when there is an intersaphenous anastomosis and the second allowing only downward flow toward the saphenopopliteal junction when the TE ends in many small branches in the tissues of the posterior and upper thigh. In the latter case, the TE behaves not as an “extension” of the LSV but as a tributary from the proximal thigh passing to the saphenopopliteal junction, much the same as the proximal tributaries at the saphenofemoral junction. Therefore, both saphenous junctions collect blood from proximal and distal parts of the limb.

**Subsequent anatomic developments.** The TE of the LSV was included in the 1936 official Anatomical Terminology (Jenaer Nomina Anatomica) under the name “vena femoropoplitea” but was dropped from later Nomina Anatomica editions, where the term “vena subcutanea femoris posterior” appeared first, to be replaced later by the term “vena marginalis medialis,” both indicating superficial veins with no reference to the LSV.<sup>6</sup> Several European anatomists interested in venous anatomy were able to confirm Giacomini’s observations.<sup>7</sup> In one study, the LSV was found to extend into the thigh without connection to the popliteal vein in 33% of 120 dissections.<sup>8</sup> In another series of 50 dissections, the TE was found in 28 limbs (56%), and there was no connection with the popliteal vein in 20 (40%), and the saphenopopliteal junction was also present in eight (16%).<sup>9</sup> In a recent anatomic publication, the veins described by Giacomini are grouped under the name of “post-axial extension of the LSV” and are illustrated in detail with their embryologic development and various terminations.<sup>3</sup> The author stresses that the LSV and its TE are the same vein because they develop from the same primitive vessel following the course of the accompanying nerve and run into the same interfascial compartment.

**Subsequent observations from venography.** From the early 1940s, venography remained the only practical method for imaging veins. Perhaps this is why the TE remained a vein of pure anatomic interest, “diagnosed” in

**Table II.** Prevalence of TE involvement in 1226 limbs with varicose veins and GSV or LSV reflux with study with duplex ultrasound scanning

Sites of saphenous reflux	Total no. of limbs	No. of limbs with TE reflux	Percent with TE reflux
GSV	922	6	0.7%
LSV	138	23	16.7%
GSV and LSV	166	47	28.3%
All veins	1226	76	6.2%

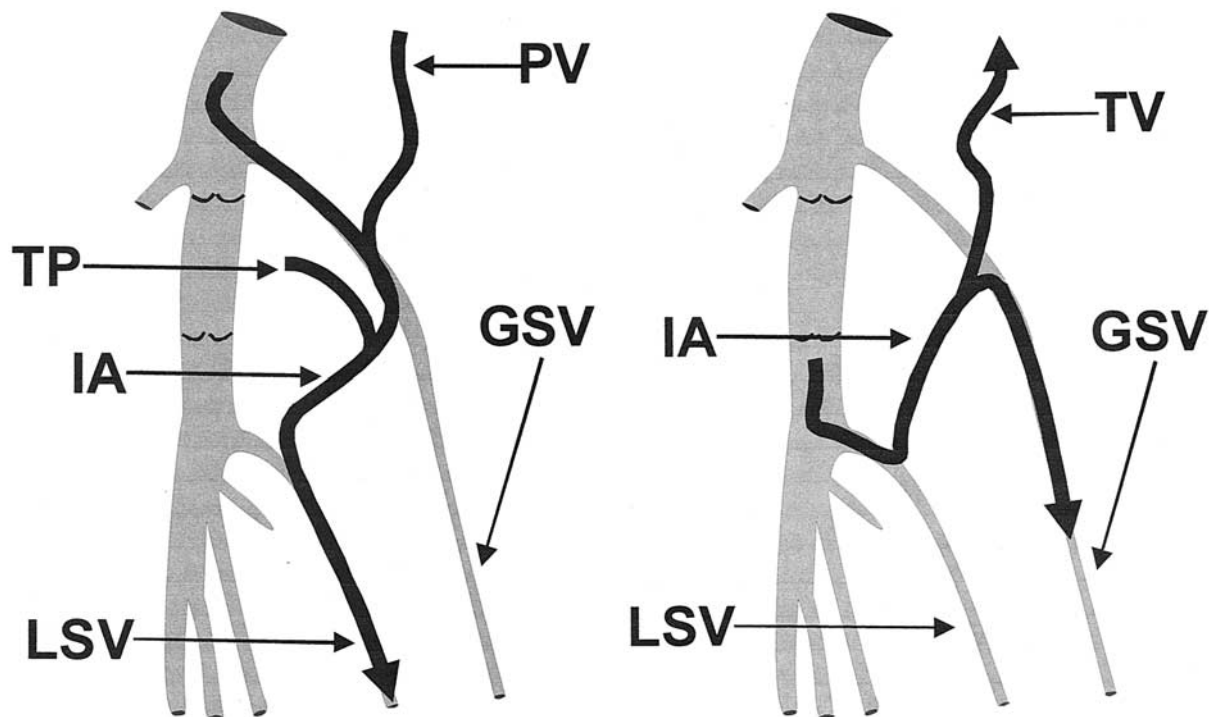
**Table III.** Sites of origin and destination for TE reflux in limbs affected by varicose disease as shown with study of 1226 limbs with duplex ultrasound scanning

Source	Destination	No. of limbs with TE reflux	Percent with TE reflux
GSV	LSV	15	19.7%
Thigh veins	LSV	18	23.7%
Pelvic veins	LSV	20	26.3%
LSV	GSV	18	23.7%
LSV	Thigh veins	5	6.6%

cadavers but not in patients and barely mentioned in clinical or surgical textbooks. It is possible to show the TE on lateral views from venograms,<sup>10</sup> and indeed it was found in 36% of 8000 venograms by one group,<sup>11,12</sup> in 60% of 500 venograms by another,<sup>13</sup> and in 33% of 100 preoperative venograms.<sup>10</sup> The author of one of these studies considered that the LSV and TE are the same vein and proposed that it be called the “vena saphena parva proximalis.”<sup>13</sup>

Despite these studies, contrast venography did not help to raise awareness to the existence of the TE. It is not even mentioned in a 1982 monograph on venography, which is probably the only one in the English language.<sup>14</sup> Possible reasons for this could be that the technique is selective and will rarely show what is not being looked for and that venography does not show soft tissue structures, such as





**Fig 4.** Involvement of Giacomini's thigh intersaphenous anastomosis (IA) in varicose disease. **A**, Dilated and incompetent IA transmits reflux from GSV or thigh perforators (TP) and pelvic veins (PV) to LSV; **B**, Dilated IA transmits reflux from saphenopopliteal junction to GSV or thigh varicose veins (TV).

muscle and fascia, so as to miss precise anatomic definition of the veins that are seen.

**Findings from duplex ultrasound scanning.** Things were not to change until ultrasound scan imaging, and in particular, high frequency duplex scanning became an established technique for examining patients with venous disease and detecting and recognizing the TE. This is not only because of the well-known advantages of ultrasound scan—that it is noninvasive, inexpensive, and repeatable—but also because the duplex scan shows both the vein and its relation to surrounding anatomic structures, in particular to muscles and fascial layers. This allows the TE to be precisely identified and distinguished from adjacent subcutaneous tributaries. It becomes possible both to verify data obtained from anatomic dissections and to study the involvement of the TE in venous pathology of the lower limb. One group performed 1060 duplex scans and found the TE in 22% of limbs.<sup>15</sup>

The middle subcutaneous (extrafascial) portion of the TE is easily identified and is of surgical interest because it is here that the TE is easily hooked through stab incision for surgical excision<sup>5</sup> or is punctured for ultrasound scan-guided echosclerotherapy. Removal of the TE through stab incisions with local anesthesia is made more simple with duplex scanning for both diagnosis and preoperative vein marking.<sup>16</sup>

Duplex scanning also allows a deeper insight into another original description by Giacomini, namely the situa-

tion where the TE physiologically drains blood from the thigh downwards to the saphenopopliteal junction. In such case, the TE does not have an adequate proximal outlet but is a tributary of the saphenopopliteal junction and may become varicose when valves that normally prevent upward flow from the junction become incompetent. This may give rise to a particular "paradoxical" varicose vein pattern, where varicose veins of the thigh are filled with antigravitational upward reflux from the saphenopopliteal junction.<sup>16</sup>

## CONCLUSION

In 1873, on the basis of anatomic dissections, Giacomini described the thigh intersaphenous anastomosis (a TE of the LSV that joins the GSV), which since then is referred to as "Giacomini's vein," and also described a series of alternative destinations of the TE of the LSV. Although it is currently recommended to discourage the use of personal names for anatomic structures, it is probable that the thigh intersaphenous anastomosis will keep the name of "Giacomini's vein."

Combined clinical examination and venography largely fails to identify the TE and diagnose its involvement in lower limb venous pathology. For almost 130 years, this kept the TE in the realm of anatomic dissection. With the introduction of duplex scanning, the veins described by Giacomini finally entered into clinical and surgical practice, and it is now evident that these are frequently involved in varicose vein disease. This is one of several reasons why we

consider that duplex scanning for routine examination of patients with venous pathology and for preoperative vein marking improves diagnosis and treatment.

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