Surgical anatomy for subfascial endoscopic perforating vein surgery of laterally located perforating veins

Piet A. R. de Rijcke, MD,[a] Tejo Schenk, MD,[b] Wijnand B. van Gent, MD,[a] Gert-Jan Kleinrensink, PhD,[b] and **Cees H. A. Wittens, MD, PhD,[a]** *Rotterdam, The Netherlands*

Objectives: **Endoscopic ligation of perforating veins is useful in treatment of perforating vein incompetence. Over the last few years the topic of interest has been the medial side of the lower leg; however, laterally located venous ulcers (10% of all) are of equal importance. Our poor results with lateral subfascial endoscopic perforating vein surgery (SEPS) procedures led us to study the anatomy of the perforating veins in the lateral leg. The presence of persistent insufficient perforating veins in our patients suggests that our procedure failed because of misinterpreted perforator anatomy.**

Methods and results: **Anatomic dissection was performed in 16 cadavers in two stages, subcutaneously and subfascially. Perforating veins were classified relative to the short saphenous vein and intermuscular septa, with coordinates. Three hundred fifty-one perforating veins were found, for an average of 21.9 perforating veins per leg. The results showed that there is alignment of the perforating veins according to the septa between the anterior and peroneal compartment and between the peroneal compartment and the superficial dorsal compartment. Most of the perforating veins did not correlate with the short saphenous vein.**

Conclusion: **Poor clinical results of lateral SEPS procedures might be improved after adjustment of the procedure for new anatomic information, which shows alignment of perforating veins along the intermuscular septa, obligating full septa dissection on the lateral side. (J Vasc Surg 2003;38:1349-52.)**

Extensive anatomic studies have been performed to define the location of the medial leg perforator veins. Mozes and Gloviczki[1] confirmed the presence of the Cockett II and III perforating veins and three groups of proximal paratibial perforating veins, including the "24-cm" perforator veins. They also showed that two thirds of medial direct perforator veins were accessible for endoscopic division from the superficial posterior compartment. This subfascial endoscopic perforating vein surgery veins (SEPS) is valuable in treatment of venous ulcer on the medial aspect of the lower leg. Although venous ulcerations tend to develop over the medial malleolus in 90% of cases, comparable venous ulcerations over the lateral malleolus are present, with the same clinical consequences. They are notoriously slow to heal, and generally recur if the underlying cause of venous hypertension is not removed. In our opinion, the primary goal is to relieve the high venous pressure in the skin. This can be achieved with ligation of the insufficient perforating veins with SEPS. We showed that lateral SEPS as performed until now does not contribute to ulcer healing.[2] We performed lateral SEPS in 13 patients, 3 of whom had previous deep venous thrombosis and nine with concomitant superficial venous reflux at the site of the saphenopopliteal junction. Our study showed a considerable difference between the results of SEPS on the medial side of the lower leg compared with the lateral side. SEPS on the lateral side of the lower leg does not contribute to ulcer healing or recurrence. Duplex scanning showed that a considerable number of perforating veins were missed during surgery, giving rise to persistent insufficient perforating veins postoperatively. The poor results of this study emphasize the need for adequate anatomic information to enable possible improvement in the surgical procedure.

Our study was designed to review the anatomy of perforating veins on the lateral aspect of the lower leg. We describe their location, and their relation to the lesser saphenous vein and the intermuscular septa. We believe better understanding of the anatomy could result in improved surgical technique and better clinical results.

MATERIAL AND METHODS

Sixteen limbs from 12 cadavers were examined. No limbs demonstrated macroscopic signs of venous disease. Dissection was performed in two stages, subcutaneously and subfascially (Fig 1). First the skin and subcuticular tissue were removed. The location of perforating veins was described, as well as their number, size (<1 mm, 1-2 mm, >2 mm), and relation to the short saphenous vein and the intermuscular septa. A perforating vein with direct relation to the short saphenous vein was defined as such when there were no divisions of the vein before entry in the fascia or muscle. If one or more divisions were present before entering the fascia or muscle, we defined the perforating vein as

From Department of Vascular Surgery, Sint Franciscus Gasthuis,[a] and Department of Anatomy, Erasmus University.[b]

Competition of interest: none.

Presented at the Inaugural Meeting of the European Venous Forum, Lyon, France, Jun 29-Jul 1, 2000.

Reprint requests: P. A. R. de Rijcke, MD, Department of Vascular Surgery, St Franciscus Gasthuis, Kleiweg 500, 3045 PM, Rotterdam, The Netherlands (e-mail: pderijcke@yahoo.com).

0741-5214/2003/$30.00 + 0

doi:10.1016/S0741-5214(03)01045-0

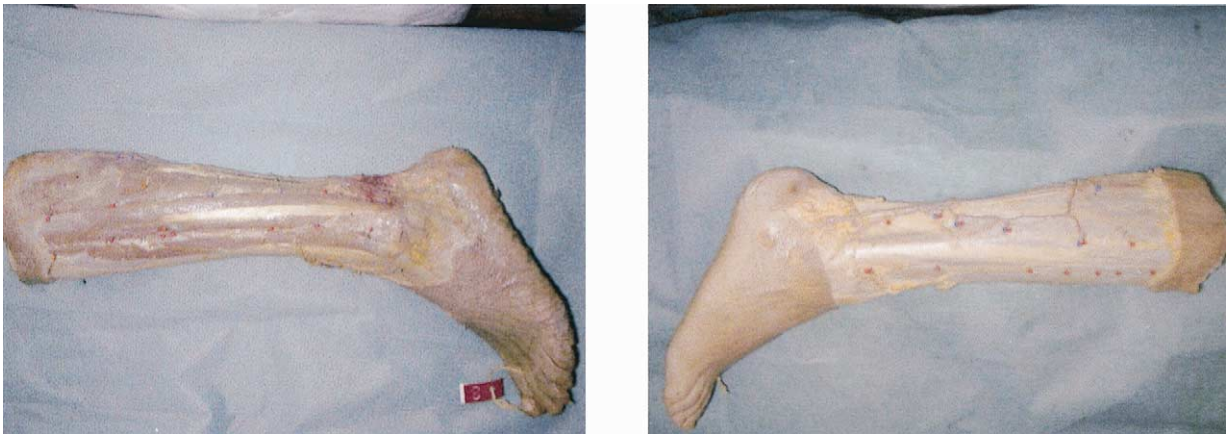

Fig 1. *Left,* Subcutaneous dissection; *right,* subfascial dissection.

having an indirect relation with the short saphenous vein. If the perforating vein did not relate to the short saphenous vein it was also recorded. All perforating veins found were marked with small colored pins. Different colors were assigned to perforating veins with a different relation with the short saphenous vein (direct, indirect, none). All data were recorded on data sheets.

The next stage involved removal of the fascia. The fascia of the anterior compartment was incised along a line halfway between the anterior margin of the tibia and the posterior midline. The point of entry in the muscle was marked with the same small pins used during subcutaneous dissection. The relation of the perforating veins to the intermuscular septa was recorded, as well as total number of perforating veins and their relation to the short saphenous vein. To classify the perforating veins we used a system of coordinates. Two coordinates were defined, A1 and A2, where A1 was the distance from the sole of the foot in centimeters, and A2 was the distance from the anterior margin of the tibia, noted as circumferential distance in centimeters. A1 measurements were corrected for differences in leg length with the formula: Corrected A1 = Measured A1 × (Mean leg length/Measured leg length). A2 measurements were corrected for differences in leg circumference with the formula: Corrected A2 = Measured A2 × (Mean leg circumference/Measured leg circumference). The various stages were recorded with digital photo equipment (Fig 1).

RESULTS

Macroscopically, there seemed to be alignment of the perforating veins along the lines of the intermuscular septum between the anterior compartment and the peroneal compartment and along the intermuscular septum of the peroneal compartment and the superficial dorsal compartment. After subcutaneous dissection 351 perforating veins were identified (mean, 22; range, 14-34). One hundred eighty-nine perforating veins (54%) were less than 1 mm in diameter, 123 perforating veins (35%) had a diameter of 1 to 2 mm, and 39 perforating veins (11%) were greater than 2 mm in diameter. Fifty-three perforating veins (15%) had a direct relationship with the short saphenous vein, 56 (16%) had an indirect relationship, and most, 244 perforating veins (69%), were unrelated to the short saphenous vein (Table). Most perforating veins with a direct relationship with the short saphenous vein were greater than 2 mm in diameter. Results of localization are shown in Fig 2.

Perforator vein relation to short saphenous vein

	Subcutaneous dissection (%)	*Subfascial dissection (%)*
Direct	15	18
Indirect	16	20
Not related	69	62

We expected alignment of the perforating veins along the intermuscular septa, and this proved correct after removal of the fascia. It was striking to see that this observation demonstrated great consistency; after studying just a few legs it became clear that there was little variation. It was clear that all perforating veins without a direct relation to the short saphenous vein were located near or in the intermuscular septa between the anterior and the peroneal compartments, and the peroneal and superficial dorsal compartments. The results of localization after the subfascial stage are shown in Fig 3. Alignment along the intermuscular septa is visible. Also visible is the diverging movement of these two lines. In contrast to general belief, we found that the two intermuscular septa on the lateral aspect of the lower leg diverge toward the distal end of the leg.

After subfascial dissection 306 perforating veins were identified (mean, 19; range, 11-29). This was fewer than the number found during subcutaneous dissection (n = 351), indicating that perforating veins combine subfascially before they enter the muscular tissue. This was proved during dissection. The opposite was also seen, that is,

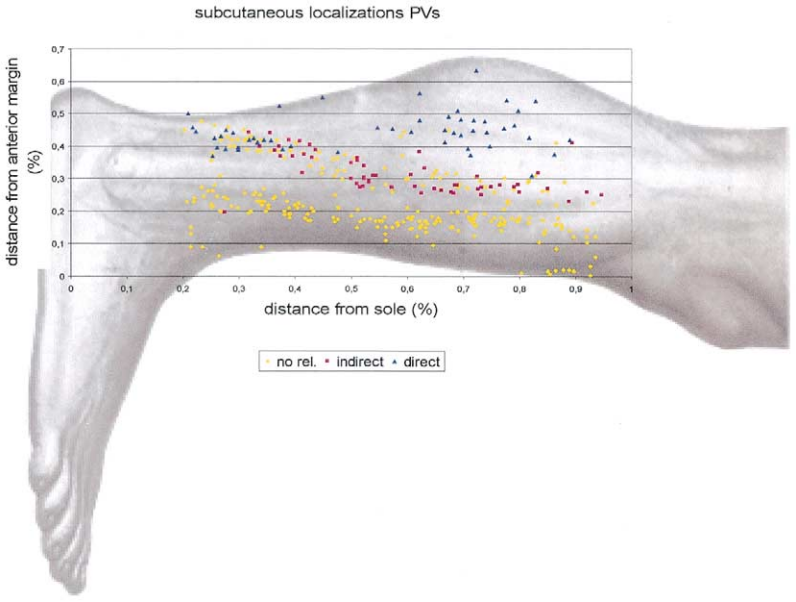

Fig 2. Location of perforating veins, as demonstrated at subcutaneous dissection.

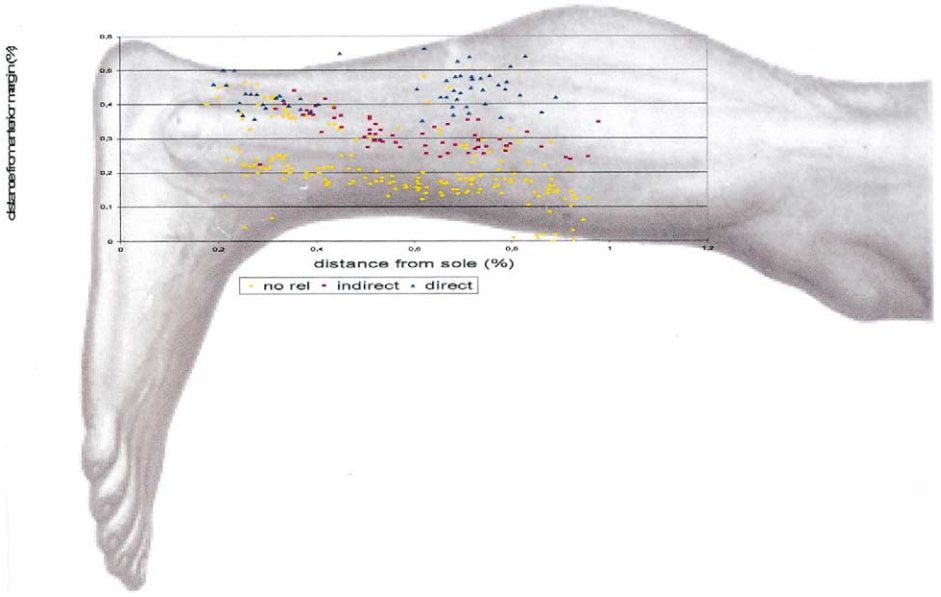

Fig 3. Location of perforating veins, as demonstrated at subfascial dissection.

subfascial division of the perforating veins, but overall this occurred less frequently. One hundred sixty-two perforating veins (53%) were less than 1 mm in diameter, 107 perforating veins (35%) were 1 to 2 mm in diameter, and 37 perforating veins (12%) were greater than 2 mm in diameter. Fifty-five perforating veins (18%) had a direct relationship with the short saphenous vein, 61 (20%) had an indirect relationship, and 190 perforating veins (62%) were not related to the short saphenous vein (Table).

DISCUSSION

Since Gay's Lettsomian Lectures in 1867 we have learned about perforating veins and their importance in chronic venous insufficiency. Although the role of perforating veins in contributing to chronic venous insufficiency has never been scientifically established, most authorities agree about their importance. However, other publications have questioned the role of perforating veins in chronic venous insufficiency.

Multiple studies have described the anatomy of the perforating veins on the medial aspect of the lower leg. In 1938 Linton performed 10 anatomic dissections, showing perforating veins at three different locations in the lower leg: distal third part, middle third part, and proximal third part. Ten years later Sherman examined a larger series of 92 anatomic dissections, giving the exact location of the perforating veins in centimeters measured from the sole. Since Cockett's 1953 series of 21 anatomic dissections we have known these clusters of perforating veins as the Cockett II, Cockett III, and proximal paratibial perforating veins. In 1977 O'Donnell et al[3] showed that 50% of incompetent perforating veins are located 10 to 15 cm from the lower edge of the medial malleolus. In contrast, Fischer in 1992 stated that there is random distribution of incompetent perforating veins. Finally, Mozes and Gloviczki[1] performed anatomic dissection of 40 limbs, confirming the presence and most frequent location of five groups of medial direct perforating veins, including the Cockett II and Cockett III perforating veins and three groups of more proximal paratibial perforating veins, as well as the "24-cm" perforator vein, and identified the importance of septum dissection in the medial aspect of the lower leg.

No description of the exact anatomic location of the lateral perforating veins has been published. We determined their position by measuring their distance from the sole, in contrast to Mozes and Gloviczki,[1] who measured their distance from the lower edge of the medial malleolus. The first striking finding was that there seemed to be alignment of the lateral perforating veins along the lines of the intermuscular septa. This is in sharp contrast to the clusterlike location of the medially located perforating veins. After removal of the fascia, our assumption was confirmed. With the exception of perforating veins with a direct relation with the short saphenous vein, all perforating veins found were located between the intermuscular septa, between the anterior and peroneal compartment and between the peroneal and superficial dorsal compartment. Furthermore, it became clear that most lateral perforating veins are not related to the short saphenous vein.

Until now, we performed lateral SEPS in 13 patients, with poor results. There were persistent insufficient perforating veins after lateral SEPS, mostly in the superficial dorsal compartment. This is understandable, because they are difficult to reach with an endoscope. Furthermore, it became clear that these persistent insufficient perforating veins are present only in patients with persistent or recurrent venous ulceration. It was striking to see that in all patients with persistent venous ulcers without concomitant incompetent perforating veins there was coexisting venous reflux at the site of the saphenopopliteal junction. This contributes to the belief that saphenopopliteal junction reflux has a role in the genesis of lateral leg ulcers. Satisfactory results in lateral venous ulcer healing after ligation and division of the saphenopopliteal junction have been described by Bass et al.[4] However, this study shows that most laterally located perforating veins (62%-69%) are not related to the short saphenous vein, indicating that additional SEPS could be helpful.

The poor results led us to conclude that our surgical technique was not quite optimal. With this new anatomic information, our technique can be improved. We suggest that full dissection of both intermuscular septa is required to obliterate all perforating veins located on the lateral side of the lower leg. Perhaps it is wise to start the procedure in the lateral peroneal compartment rather than the anterior tibial compartment; then no additional port sites will be necessary. Whether it is wise to perform full dissection of the intermuscular septa and all perforating veins, regardless of the presence of reflux, remains unclear. It could be that full dissection of the intermuscular septa is the only way to reach and obliterate all incompetent perforating veins, although this is a more invasive procedure. Therefore we believe that the procedure should be offered only to patients with an active ulcer (CEAP classification C6). Further studies will be necessary to provide additional information regarding this challenging problem.

CONCLUSION

Laterally located perforating veins are aligned along the lines of the intermuscular septa, and most (about 65%) perforating veins are not related to the short saphenous vein. Therefore full dissection of the lateral septa seems obligatory. The poor clinical results of lateral SEPS may be improved after adjustment of procedures according to this new anatomic information.

REFERENCES

1. Mozes G, Gloviczki P. Surgical anatomy for endoscopic subfascial division of perforating veins. J Vasc Surg 1996;24:800-8.
2. de Rijcke PAR, Wittens CHA. Subfascial endoscopic perforating vein surgery as treatment of lateral perforating vein incompetence and venous ulceration. J Vasc Surg 2003;38:799-803.
3. O'Donnel TF Jr, Burnand KG, Clemenson G, Thomas ML, Browse NL. Doppler examination vs clinical and phlebograpic detection of the location of incompetent perforating veins; a prospective study. Arch Surg 1977;112:31-5.
4. Bass A, Chayen D, Weinmann EE, Ziss M. Lateral venous ulcer and short saphenous vein insufficiency. J Vasc Surg 1997;25:654-7.

Submitted Mar 12, 2003; accepted May 8, 2003.