Eur J Vasc Endovasc Surg **25**, 552–555 (2003)
doi:10.1053/ejvs.2002.1878, available online at http://www.sciencedirect.com on SCIENCE DIRECT®

Accessibility of Calf Perforating Veins from the Superficial Posterior Compartment: an Anatomic Dissection Study

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Objectives: *to determine the anatomic location of medial perforating veins (PVs) and their course within the compartments of the leg.*
Materials and Methods: *the lower extremity veins of 15 cadavers were filled with coloured latex solution. Medial PVs between the ankle and the knee were dissected out.*
Results: *in total 95 direct PVs (mean 6.3 per extremity, range 3–9) were identified and classifed as Cockett I, II, or III, proximal and distal paratibial and Boyd. Cockett PVs were present in more than half of the cases, of which the majority (except Cockett I) were located in the superficial posterior compartment. Whereas the vast majority of Cockett PVs originate from the posterior arch vein, the other perforators originate from the greater saphenous vein.*
Conclusions: *only 62% of all PVs pass through the superficial posterior compartment. As a result, during subfascial endoscopic perforating vein surgery (SEPS), at least one third of patients require a paratibial fasciotomy in order to reach and ligate the PVs.*

Key Words: Perforating veins; Calf; Venous insufficiency; SEPS.

Introduction

Robert Linton was the first to study and recommend the ligation of perforating veins (PVs) in the management of chronic venous insufficiency.[1–4] Successful venous surgery depends upon a sound knowledge of anatomy and pathophysiology. The aim of our study is to reveal the anatomic location of medial PVs and their courses within leg compartments so as to shed light on the treatment of varicose veins and CVI.

Material and Methods

In 15 cadavers without any venous disease, approximately 40 ml of coloured latex solution was injected into the greater and lesser saphenous veins before fixation with formaldehyde.[5] PVs that directly connect superficial to deep veins were dissected in three steps. In step 1 skin and subcutaneous tissue were dissected from the lower tip of the medial malleolus up to upper edge of patella to reveal the greater saphenous and posterior arch veins (Fig. 1). In step 2, the venous origin of PVs connecting these superficial veins to posterior tibial and popliteal veins were recorded in terms of D1 (distance from lower tip of the medial malleolus) and D2 (distance from medial edge of the tibia). In step 3, the fascia cruris was divided from ankle to tibial tuberosity through Linton's line. PVs were dissected and photographed up to the deep

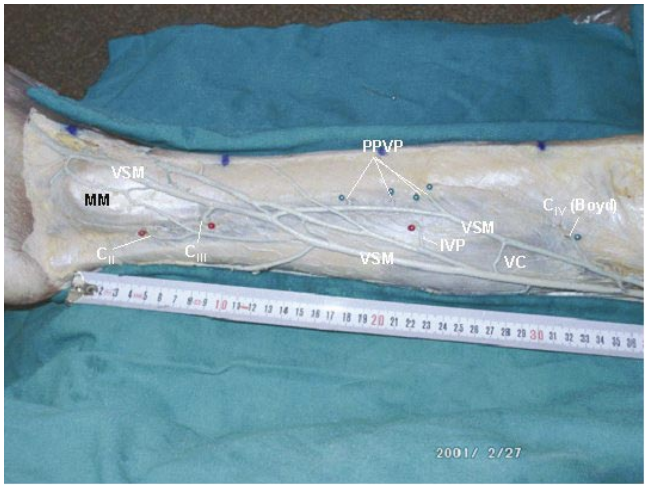


Fig. 1. The appearance of the superficial and some of medial PVs. MM: medial malleolus GSV: great saphenous vein, CII: Cockett II, CIII: Cockett III, PTPVs: paratibial perforating veins.

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veins through the superficial and the deep posterior compartments (Fig. 2).

Results

There were a total of 95 PVs (mean 6.3, range 3–9 per leg). In 60% of legs there was at least one Cockett I PV, all of which were inaccessible from the superficial posterior compartment and all of which connected the posterior arch to the posterior tibial vein (Fig. 3, Tables 1 and 2). Cockett II PV all originated from the posterior arch vein, connected to the posterior tibial vein, were 5–8 cm from the medial malleolus, were within 1–3 cm of the medial edge of the tibia. Overall, 78% of Cockett II PVs were accessible from the superficial posterior compartment. Cockett III were at 10–11 cm from the medial malleolus, 1–2 cm from the medial edge of the tibia. Overall, 89% originated from the posterior arch and the rest from the greater saphenous vein and all were accessible from the superficial posterior compartment. The paratibial PVs were defined as distal and proximal because of their location at 13–16 and 18–28 cm from the medial malleolus, respectively (Fig. 3). Ninty-three percent of distal paratibial perforators were present in the superficial posterior compartment. Only 7% of these PVs were inaccessible from the superficial posterior compartment. Fifty-eight percent of these PVs originated from the posterior arch vein, the rest (42%) from the greater saphenous vein. The proximal paratibial perforators originated mostly (88%) from the greater saphenous vein. Only 12% of these PVs originated from the posterior arch vein. Forty-five percent of proximal paratibial perforators were inaccessible from the superficial posterior compartment. The sixth group (Boyd perforators) were located at 33–35 cm from the medial malleolus, at 1 cm from the medial edge of the tibia. Thirty-three percent of these PVs seperated from the posterior arch vein. Sixty-seven percent of these PVs were accessible from the superficial posterior compartment. According to our findings, 62% of all PVs were located in the superficial posterior compartment. The rest (38%) of them were located in the deep posterior compartment. They were inaccessible from the superficial posterior compartment.

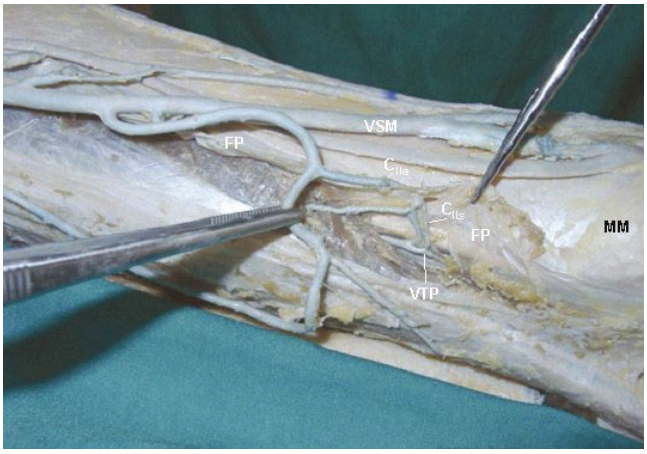


Fig. 2. The figure shows the prefascial and subfascial course of a Cockett II perforating vein, and its connection to posterior tibial vein in the deep posterior compartment. PTV: posterior tibial vein, MM: medial malleolus, CII: Cockett II, GSV: greater saphenous vein.

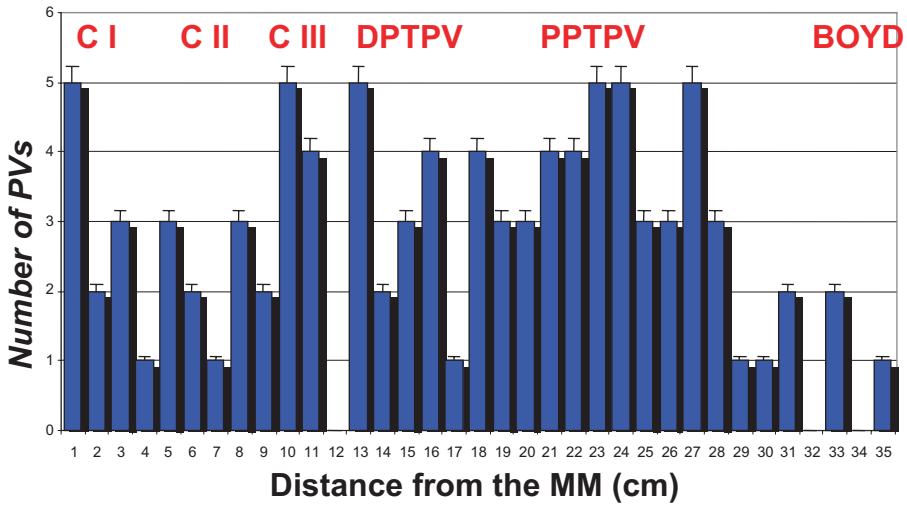


Fig. 3. The number of perforating veins and their distance from MM. MM: medial malleolus, CI: Cockett I, CII: Cockett II, CIII: Cockett III, DPTPV: distal paratibial perforating vein, PPTPV: proximal paratibial perforating vein.

Table 1. The occurrence of PVs and their accessibility from the superficial posterior compartment.

	Cockett I (0–3 cm)	Cockett II (5–8 cm)	Cockett III (10–11 cm)	DPTPV (13–16 cm)	PPTPV (18–28 cm)	Boyd (33–35 cm)
Occurrence (%)	60	53	53	73	100	20
Accessibility from the SPC (%)	0	78	100	93	55	67

SPC: superficial posterior compartment, DPTPV: distal paratibial perforating vein, PPTPV: proximal paratibial perforating vein.

Table 2. The origin of the medial calf PVs.

	Cockett I	Cockett II	Cockett III	DPTPV	PPTPV	Boyd
Origin from PAV (%)	100	100	89	58	12	33
Origin from GSV (%)	0	0	11	42	88	67

PAV: posterior arch vein, DPTPV: distal paratibial perforating vein, PPTPV: proximal paratibial perforating vein.

Discussion

PVs that connect the superficial and deep veins of the leg have been classified as foot, medial and lateral calf, and thigh. The clinically most important PVs are located in the medial calf. Direct PVs connect the superficial veins to deep veins whereas indirect PVs connect the superficial veins to veins of leg muscles. Many studies showed that direct medial PVs have a relatively constant location.[6–10] In this study, medial calf PVs were dissected in the legs of 15 cadavers free of venous disease following the injection of coloured latex solution. There were 95 direct medial calf PVs, an average of 6.3 per limb; 33% in the distal, 45% in the middle and 22% in the proximal third of leg. Mozes dissected 40 limbs in 24 cadavers to reveal an average of 13.8 medial calf PVs (range 7–22). Of 552 such PVs, 52% were direct and 63% accessible from superficial posterior compartment. However, 68% Cockett II, 16% of Cockett III and 75% of the proximal paratibial PVs were inaccessible.[10] Our study revealed that the majority of non-I Cockett PVs (except Cockett I) were located in the superficial posterior compartment. The vast majority of Cockett PVs originated from the posterior arch vein but proximal paratibial and Boyd PVs mostly originated from the greater saphenous vein.

The relationship between the presence of calf perforating veins and clinical status of CVI has been established by many groups. These studies showed that patients with CEAP classes 4–6 have increased diameter and number of insufficient perforating veins permitting pathological outward flow. Eradication of saphenous reflux mostly corrects incompetent PVs (IPV) where reflux is confined to the superficial system and if deep venous system is normal. However, in patients with severe CVI according to CEAP Classes 4, 5, and 6, standart saphenous surgery fails to correct IPV reflux. In these circumstances, the patients may need the interruption of PVs[11–16] and the SEPS procedure is now the method of choice.[17–19] Our study revealed that 62% of all PVs were accessible from the superficial posterior compartment where during SEPS procedure the endoscope is inserted. The rest are inaccessible and located either in deep compartment or within intermuscular septum, a duplication of deep crural fascia, that is present in about 30% of cases.[20] The fascia of deep compartment (paratibial fasciotomy) or the intermuscular septum have to be incised to dissect and to divide these PVs.[10,17] We believe that it is unnecessary to use the exploration of DPC in every case because this may result in the injury of posterior tibial neurovascular bundle. Rather, the decision to explore the deep posterior compartment can be made pre-operatively by using duplex mapping.[17,19]

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Accepted 13 January 2003