Comparison between Clinical Examination, cw-Doppler Ultrasound and Colour-duplex Sonography in the Diagnosis of Incompetent Perforating Veins

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Objectives: This study was conducted to investigate the accuracy and agreement between clinical examination, continuous wave (cw)-Doppler ultrasound and colour-duplex sonography (CDS) in diagnosing incompetent perforating veins (ICPV).

Design: Observational cohort study.

Material and methods: Nineteen patients with chronic venous insufficiency (CVI) were examined clinically, by hand-held cw-Doppler ultrasound in combination with tourniquet compression and CDS.

Results: The low accuracy of the clinical examination and the diagnosis of ICPV by cw-Doppler were surprising. The specificity was 15 % and sensitivity 29 %, when CDS was taken as the “gold standard”. Furthermore the results show clearly that the application of a tourniquet cannot provide reliable results.

Conclusions: In patients with CVI, clinical and cw-Doppler cannot accurately diagnose ICPV when compared to CDS.

Key Words: Perforator; cw-Doppler; Varicose veins; Chronic venous insufficiency; Colour-coded duplex.

Introduction

The importance of recognising and locating incompetent perforating veins (ICPV) in the treatment of patients with varicose veins and venous ulcers is well established. Several methods of diagnosing ICPV have been evaluated in the past, however, none show satisfactory accuracy in predicting ICPV.

Clinical examination with digital palpation of fascial defects is widely used. These fascial clefts are generally thought to correspond to ICPV. Additional evidence is obtained when digital pressure relief on the defect leads to filling of superficial varicose veins or if a tourniquet applied beneath the defect prevents it. The bleed-back test during surgery was used in previous studies as the “gold standard” to diagnose ICPV. Several studies used continuous wave (cw)-Doppler ultrasound in combination with tourniquets and compression test to detect ICPV yielded an accuracy up to 62%.

Material and Methods

Patients

Nineteen patients (10 women, 9 men) with chronic venous insufficiency (CVI) were recruited for the study. Two patients had mild CVI with pitting oedema stage I according to Widmer et al. or class 3 according to the International Consensus Committee on Chronic Venous Disease; 14 patients had in addition trophic skin changes, hyperpigmentation and beginning lipo-
dermatosclerosis (stage II, and class 4, respectively) and three patients had healed venous ulcers (stage III, and class 5, respectively). The mean age of the women was 62.8 years (range 44–79 years) and of the men 56.3 years (range 32–76 years). Patients with open venous leg ulcers, peripheral arterial occlusive disease, manifest heart insufficiency, diabetes mellitus and nephropathy were excluded from the study. All patients were informed about the study and gave oral consent. The study was approved by the ethic committee of the Department of Medicine, University Hospital Zürich.

The study was conducted in a blinded and prospective design by two independent investigators. The clinical examination and cw-Doppler ultrasound study was performed by one medical doctor with great experience in venous disease and Doppler studies. The Duplex sonography examination was performed by a second medical doctor who did not know the results of the clinical and cw-Doppler studies.

Clinical examination

All patients had a complete vascular examination including assessment of the signs of CVI phlebectatica paraplantaris and ankle oedema (CVI stage I, and class 1 or 3, respectively), dermatosclerosis, induration, hyperpigmentation, white atrophy spots (CVI stage II, and class 4, respectively), or healed and open venous leg ulcers. Physical examination was performed with the patient standing. Both lower limbs were examined for fascial gaps by palpation. All fascial clefts were marked and their exact distance from the ground was measured. Photographical documentation was performed in every case. ICPV were

Fig. 1. Typical clinical feature of an incompetent perforating vein with “blow out”, where a gap in the fascia was palpable. Note the trophic skin changes distal from the varicose vein.

Fig. 2. Colour-duplex image of an incompetent perforating vein. The upper image demonstrates retrograde flow from the posterior tibial vein in the superficial venous system during distal (foot) compression. The second image shows the situation during proximal (calf) compression with reflux in the posterior tibial vein and through the incompetent perforating vein in the superficial vein. The arrows indicate direction of venous blood flow.

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diagnosed clinically when local tenderness on palpation and trophic skin changes, and/or “blow-outs” at the site of the fascial cleft (see Fig. 1) were present.

cw-Doppler ultrasound examination

All marked fascial gaps were examined by a hand-held bidirectional cw-Doppler (Parks Electronics Lab., Model 10110, Beaverton, OR, U.S.A.) with a 8.2 or 5.3 MHz pencil probe. With the patient standing the ultrasound probe was positioned on the marked fascial defect. Reflux was tested after proximal and distal manual compression in a distance of 3-5 cm from the fascial cleft. Then a rubber tourniquet was firmly applied 1-2 cm proximal of the measuring site to compress superficial veins. With this superficial vein compression tourniquet in place it was again tested for reflux with proximal compression. If reflux was present an incompetent perforating vein was diagnosed. In addition all patients had bilateral cw-Doppler ultrasound examination of the deep and superficial venous system.

Colour-duplex sonography

Colour-duplex sonography was performed with the patient in the standing position by a second medical doctor who was very experienced in CDS studies. Linear 5 and 7 MHz probes were used (Acuson 128 XP/10). The search focused on incompetent perforating veins along the medial aspects of the lower limb from the malleolar region up to the thigh using distal and proximal manual compression. The criterium for incompetence of a perforating vein was retrograde flow through perforators from the deep veins into the superficial veins detected both by the colour signal and by the Doppler velocity spectrum during compression (Fig. 2). Reflux was defined as reverse flow lasting 0.5 s or more. Each ICPV was marked and the distance from ground measured. Polaroid photographs were taken for documentation.

Results

Clinical examination

A total of 62 incompetent perforating veins were diagnosed on 19 lower limbs. The range per leg was one to seven ICPV, which were located along the medial aspect of the calf. Seventeen of 19 patients had varicose veins at the site of at least one fascial defect, 16 at the site of at least two and eight patients had a minimum of three ICPV. Local tenderness was found in 19 of the fascial clefts, trophic skin changes in 23 and “blow-outs” on 20 fascial defects (see Fig. 1). Simultaneous presence of tenderness and trophic skin changes occurred at only six sites, trophic skin changes and “blow-outs” at four sites and of tenderness and “blow-outs” at four sites. In one fascial cleft all three findings were present concomitantly.

cw-Doppler ultrasound examination

Incompetent perforating veins were diagnosed at 39 of the 62 fascial defects. Twenty-nine of these 39 sites were localised on clinically visible varicose veins. No venous velocity signals could be detected from three fascial defects. The deep venous system exhibited reflux at the popliteal vein level in 11 and at the posterior tibial vein in five out of 19 legs. Eight legs had no reflux in the deep veins. Eleven legs had reflux during Valsalva manoeuvre into the greater saphenous vein down to the knee level, in six without reflux in the deep veins.

Colour-duplex sonography

A total of 21 incompetent perforating veins could be detected by CDS in 14 of the 19 patients. Only six of these 21 incompetent perforating veins were also diagnosed by cw-Doppler ultrasound, whereas eight were diagnosed correctly by clinical examination. Of these eight fascial clefts, verified by CDS as incompetent perforating veins, two exhibited local tenderness, four trophic skin changes and two “blow-outs” at clinical examination, whereas three showed none of these clinical signs.

Of the 39 ICPV diagnosed by cw-Doppler ultrasound, six were verified as incompetent perforators by CDS and the rest as clefts in the fascia at the site of varicose veins without any perforating vein underneath. Of the 12 incompetent perforating veins found by CDS, which were neither diagnosed clinically nor by the cw-Doppler technique, eight were located in an area of indurated and trophically altered skin. Another four were located within 3 cm of a falsely diagnosed ICPV by cw-Doppler.
Discussion

The results of this study show that clinical diagnosis of incompetent perforating veins is inadequate. Only 13% (8/62) of palpated fascial gaps were verified to be incompetent perforating veins by CDS. Clinical signs like local tenderness, trophic skin changes and "blow-out" varicose veins demonstrated no better correlation to ICPV than to any fascial clefts. Palpable fascial gaps seem to correspond in the majority of the cases to varicose veins which run in the level of the fascia. Some fascial defects (3 in our study) are not associated with the venous system at all and are simple gaps in the fascia without underlying vascular structures. The positive predictive value of clinical examination was only 38%. This is lower than reported in other studies, however, our reference was CDS and not phlebography.

The low accuracy of the diagnosis of ICPV by cw-Doppler was surprising and does not confirm other reports.10,11 We found a specificity of 15% and a sensitivity of 29%, when CDS was taken as the "gold standard". The results show clearly that the application of a tourniquet cannot provide reliable results. This is caused mainly by varicose veins running in clefts of the fascia surrounded by indurated or lipodermatosclerotic tissue which makes it impossible for compression by tourniquets. As could be observed in CDS many varicose veins herniate through the fascia. Even in the presence of adequate tourniquet compression, flow and reflux in the varicosity may not be suppressed.

In this study, CDS has been shown to be far more sensitive than clinical examination and cw-Doppler ultrasound in the diagnosis of incompetent perforating veins. Colour-duplex sonography is sensitive even in indurated skin areas or regions with lipodermatosclerosis, where palpation is not useful and the handheld Doppler has its limitations. In our study 1.5 ICPV per leg were detected by duplex only along the medial and posterioromedial aspect of the lower leg. This corresponds to other studies, where 2.4 ICPV were found during surgery. Our results are supported by others showing that the accuracy of CDS is clearly superior to phlebography and comparable with careful exploration during operation. CDS studies of patients with chronic venous insufficiency are indicated (1) prior to venous surgery to provide the surgeons with accurate information about the localisation of the incompetent perforating veins and (2) before sclerotherapy of perforators.

Recent studies using duplex sonography have demonstrated the important heterogeneity of the sites of reflux and also the combined involvement of the deep and superficial veins and the perforating veins connecting both systems. It has to be emphasised that the criterium for incompetence of a perforating vein was a retrograde outward flow through the perforator from the deep veins into the superficial veins during compression. The definition was made according to the definition of venous valvular incompetence in the deep and superficial venous system.16-18 However, in a previous report it was shown that in patients with clinically normal limbs, blood flow can be in either direction. In our opinion incompetence of perforating veins is present when outward flow can be demonstrated during compression, and this pathologic condition can already exist in patients before the clinical signs of CVI develop.

In conclusion, in patients with chronic venous insufficiency clinical and cw-Doppler examinations cannot accurately diagnosis incompetent perforating veins. Colour-duplex sonography should be regarded as the "gold standard" for the diagnosis of incompetent perforating veins.

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References


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