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Is color Doppler ultrasound-assisted perforating vein ligation with a mini-incision still a viable alternative?

Renkli Doppler eşliğinde mini insizyon ile perforan ven ligasyonu halen geçerli bir alternatif mi?

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ABSTRACT

Background: This study aims to emphasize the clinical significance of perforating vein insufficiency and to share our diagnosis and treatment experience for lower extremity perforating veins with insufficiency.

Methods: Thirty-six patients (19 males, 17 females; mean age 40.7±11.3 years; range 20 to 68 years) who underwent colored Doppler ultrasound (CDUS) assisted perforating vein ligation with mini-incision due to perforating vein insufficiency between December 2012 and December 2014 were retrospectively analyzed. Symptomatic patients having at least 350 milliseconds of venous reflux during Valsalva maneuver or perforating vein diameter greater than 4 mm in the erect position were included in the study. All affected limbs were classified according to the Clinical-Etiological-Anatomical-Pathophysiological classification system. According to Clinical-Etiological-Anatomical-Pathophysiological classification, 24 patients (66.7%) were C4 (Clinical class 4), five patients (13.9%) were C5, and seven patients (19.4%) were C6. Preoperative and postoperative venous clinical severity scores (VCSS) were calculated and compared. Patients were evaluated with CDUS at postoperative first week and third month.

Results: Mean perforating vein diameter was 4.43±0.35 mm (range 4.0 to 5.1 mm). No intraoperative complications occurred. No severe complications including infection, deep vein thrombosis, paresis, or paresthesia were observed postoperatively. While mean preoperative VCSS score was 12.25±3.6, postoperative VCSS score was 2.25±0.8 with a significant statistical difference ($p \leq 0.05$). Venous ulcer was detected in seven patients (19.4%). Mean diameter of venous ulcers was 30±15.2 mm (range 15 to 50 mm). All ulcers were healed postoperatively with a mean healing duration of 2.43±1.2 months.

Conclusion: Colored Doppler ultrasound guided perforating vein ligation with mini-incision is an efficient, simple, and feasible procedure. Thus, it can be a safe alternative to current endovenous thermo-ablative techniques.

Keywords: Ligation; perforating vein; ultrasound; venous insufficiency.

ÖZ

Amaç: Bu çalışmada perforan ven yetmezliğinin klinik önemi vurgulandı ve yetmezlik bulunan alt ekstremite perforan venlerine yönelik tanı ve tedavi deneyimimiz paylaşıldı.

Çalışma planı: Aralık 2012 - Aralık 2014 tarihleri arasında perforan ven yetmezliği nedeniyle renkli Doppler ultrason (RDUS) eşliğinde mini insizyonla perforan ven ligasyonu yapılan 36 hasta (19 erkek, 17 kadın; ort. yaş 40.7±11.3 yıl; dağılım 20-68 yıl) retrospektif olarak incelendi. Valsalva manevrası sırasında en az 350 milisaniye venöz reflüsü olan veya ayakta ölçülen perforan ven çapı 4 mm'nin üzerinde olan semptomatik hastalar çalışmaya dahil edildi. Tüm etkilenen ekstremiteler Klinik, Etyolojik, Anatomik, Patofizyolojik sınıflama sistemine göre sınıflandırıldı. Klinik, Etyolojik, Anatomik, Patofizyolojik sınıflamasına göre, 24 hasta (%66.7) C4 (Klinik sınıf 4), beş hasta (%13.9) C5 ve yedi hasta (%19.4) C6 idi. Ameliyat öncesi ve sonrası venöz klinik önem skorları (VKÖS) hesaplandı ve karşılaştırıldı. Hastalar ameliyat sonrası birinci hafta ve üçüncü ayda RDUS ile değerlendirildi.

Bulgular: Ortalama perforan ven çapı 4.43±0.35 mm (dağılım 4.0-5.1 mm) idi. Ameliyat sırası komplikasyon gelişmedi. Ameliyat sonrası enfeksiyon, derin ven trombozu, parezi ya da parestezi gibi ciddi komplikasyonlar görülmedi. Ameliyat öncesi ortalama VKÖS skoru 12.25±3.6 iken, ameliyat sonrası VKÖS skoru istatistiksel olarak anlamlı şekilde 2.25±0.8 idi ($p \leq 0.05$). Yedi hastada (%19.4) venöz ülser tespit edildi. Venöz ülserlerin ortalama çapı 30±15.2 mm (dağılım 15-50 mm) idi. Ameliyat sonrasında tüm ülserler ortalama 2.43±1.2 aylık iyileşme süresiyle iyileşti.

Sonuç: Renkli Doppler ultrason eşliğinde mini insizyon ile perforan ven ligasyonu etkin, basit ve uygulanabilir bir işlemdir. Dolayısıyla, güncel endovenöz termal ablasyon tekniklerine güvenli bir alternatif olabilir.

Anahtar sözcükler: Ligasyon; perforan ven; ultrason; venöz yetmezlik.

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Chronic venous insufficiency (CVI) and the leg ulcers associated with it are common causes of morbidity.[1] During a physical examination, the lesser saphenous vein (LSV) and the perforating veins (PVs) of the leg should at least be evaluated along with the greater saphenous vein (GSV) because those veins might be entirely responsible for the lower extremity venous ulcers.[2] For this reason, color Doppler ultrasound (CDUS) plays a crucial role in investigating the venous pathology before a diagnosis can be firmly established.

The PVs of the leg (Cockett's perforators) connect the posterior tibial vein with the posterior arch vein (Leonardo's vein) and are not connected to the GSV.[1] Hence, symptoms due to venous insufficiency do not adequately recover if only the GSV is treated because this does not address the existing PV reflux. Currently, medical treatment, subfascial endoscopic ligation of PVs, percutaneous ablation of the perforators, and CDUS-enhanced ligation with mini incisions are the preferred methods of treatment for this condition.[2-8]

In this manuscript, we present patients with symptomatic venous insufficiency due to PV incompetence who underwent surgery via CDUS-assisted ligation with mini incisions. This proved to be a simple, feasible, and efficient method of treatment.

PATIENTS AND METHODS

We performed CDUS-guided PV ligation with mini-incisions in 36 patients (19 males, 17 females; mean age 40.7±11.3 years; range 20 to 68 years) between December 2012 and December 2014 (Table 1). The inclusion criteria were a venous reflux of at least 350 milliseconds and a PV diameter of greater than 4 mm. Both measurements were achieved with CDUS during the Valsalva maneuver in the erect position. Those with active infected venous ulcers, deep vein thrombosis (DVT), or a PV diameter of less than 2 mm were excluded from the study. All of the affected limbs were classified using the Clinical-Etiology-Anatomy-Pathophysiology (CEAP) classification system, and based on this, 24 patients (66.7%) were categorized as C4 (Clinical class 4), five (13.9%) as C5, and seven (19.4%) as C6 (Table 2). In addition, the pre- and postoperative venous clinical severity scores (VCSS) were calculated and compared with each other, with 0 representing the absence of venous disease, 1 mild venous disease, 2 moderate venous disease, and 3 severe venous disease (Table 3),[9] and we also evaluated the presence of DVT, infection, nerve injury, and reflux. In addition, the patients were scheduled to be followed up at one week and three months postoperatively.

All procedures were performed under the guidance of CDUS in which the straight section of the PV at the level of the fascia was identified. Under local anesthesia, a small incision was made with a No. 11 scalpel, and the PV was explored and gently pulled with the help of a hook. It was then ligated with free silk sutures and dissected. All of the patients were discharged on the postoperative first day and were advised to wear compression stockings and walk at least twice a day for 30 minutes. Furthermore, a non-steroid anti-inflammatory drug (NSAID) was prescribed for one week after surgery to combat analgesia.

Statistical analysis

The data was analyzed via the SPSS for Windows version 15.0 software program (SPSS Inc., Chicago, IL, USA). The one-sample Kolmogorov-Smirnov test was used to assess the normality of the continuous variables, and the statistics for these variables were given as mean ± standard deviation (SD) or median (minimum-maximum). The categorical variables were shown as the number of cases and percentages. In addition, the Wilcoxon test was used to evaluate the significance of the differences for the two dependent variables, and the Kruskal-Wallis test was used to determine the significance between the three independent variables that were not normally distributed. The Spearman test was also used to determine any correlations between the two groups. The results were considered to be statistically significant with a p value of ≤0.05.

RESULTS

Perforating vein ligation was combined with the GSV and venous pack interruption in 16 patients (44.4%)

Table 1. Descriptive statistics

	n	Minimum	Maximum	Mean±SD
Age (years)	36	20	68	40.8±11.4
Perforating vein diameter (mm)	36	4.0	5.1	4.43±0.35
Venous clinical severity score preoperative	36	8	22	12.25±3.6
Venous clinical severity score postoperative	36	1	4	2.25±0.8

SD: Standard deviation.

Table 2. Frequency table

	Frequency	Percent	Cumulative percent
Gender			
Male	19	52.8	52.8
Female	17	47.2	100.0
Total	36	100.0	
Number of perforating veins			
1	4	11.1	11.1
2	27	75.0	86.1
3	5	13.9	100.0
Total	36	100.0	100.0
Clinical-Etiological-Anatomical-Pathophysiological			
Class 4	24	66.7	66.7
Class 5	5	13.9	80.6
Class 6	7	19.4	100.0
Total	36	100.0	
Operation			
Isolated perforating vein	13	36.1	36.1
Perforating vein + greater saphenous vein + pack	16	44.4	80.6
Perforating vein + lesser saphenous vein + pack	7	19.4	100.0
Total	36	100.0	
Presence of ulcer			
No	29	80.6	80.6
Yes	7	19.4	100.0
Total	36	100.0	

(spinal anesthesia) and with the LSV and venous pack interruption in seven others (19.4%) (spinal anesthesia). In addition, isolated PV surgery was performed on 13 patients (36.1%) (local anesthesia). The mean VCSS scores of the patients with combined LSV-PV incompetence (16.1±4.2) were higher than those with GSV-PV incompetence (11.1±2.1) and isolated PV incompetence (11.4±3.4) ($p \leq 0.05$). Moreover, the mean PV diameter was 4.43±0.35 mm (range 4.0-5.1 mm), and there was no significant correlation between this diameter and the VCSS scores. Furthermore, the mean preoperative VCSS score was 12.25±3.6 while the postoperative VCSS score was 2.25±0.8, which represented a significant statistical difference ($p \leq 0.05$) (Table 1). No intraoperative complications were noted, and we encountered no postoperative infection, DVT, paresis, or paresthesia. However, ulcers were seen in seven patients (19.4%), and the mean diameter in these cases was 30±15.2 mm (range 15-50 mm). All of the ulcers eventually healed, with an average postoperative healing time of 2.43±1.2 months.

DISCUSSION

The PVs act as a collateral route for blood flow in case the superficial veins are obstructed, which can occur because of thrombophlebitis or be precipitated by a

Table 3. Venous clinical severity scores

Attribute	Absent (0)	Mild (1)	Moderate (2)	Severe (3)
Pain	None	Occasional	Daily	Daily/medicine
Varicose vein	None	Few	Multiple	Extensive
Venous edema	None	Evening	Afternoon	Morning
Pigmentation	None	Limited	Diffuse	Wider (recent)
Inflammation	None	Mild	Moderate	Severe
Induration	None	Focal	Less than lower third of the leg	Entire lower third of the leg
Ulcer number	None	1	2	>2
Ulcer size	None	<20 mm	20-60 mm	>60 mm
Ulcer duration	None	<3 months	3-12 months	>12 months
Compression	None	Intermittant	Most days	Every day

Table 4. Indications for the interruption of perforating vein insufficiency

	Indications for interruption
1.	Promotion of ulcer healing in extremities with CEAP clinical class C6
2.	Prevention of ulcer recurrence in extremities with clinical classes C5 and C6
3.	Diminished severity of CVD and resolution of symptoms in C2 to C5 extremities
4.	Prevention of progression to more advanced stages in C2 to C4 extremities.

CEAP: Clinical-Etiological-Anatomical-Pathophysiological; CVD: Cardiovascular disease.

postural mechanism such as sitting or crossing the legs. Most of the PVs have a one-way valve mechanism that directs the blood to flow from the superficial to the deep veins. Critical reflux from the deep to the superficial veins is known as PV incompetence and has been seen in 20% of the cases that also have superficial CVI. However, isolated PV incompetence is rare (5%).[10,11] Furthermore, approximately 56-63% of the patients with venous ulcers due to CVI have also demonstrated PV incompetence.[12] We similarly observed that if there was also LSV insufficiency, the PV insufficiency significantly increased the VCSS scores in the affected patients.

The numbers and sizes of incompetent PVs are correlated with the severity of CVI since with greater severity, the diameter of the PVs becomes wider. This dilatation can be attributed to the elevated venous pressure.[13] Interestingly, in our study, there was no correlation between the VCSS scores and PV diameter, and the close approximation of the range values with respect to the diameter might have been responsible for this debatable outcome. Reducing superficial venous hypertension (HT) leads to more rapid ulcer healing and lower recurrence rates, and this reduction can be achieved by treating the incompetent PVs in CVI.[12] Regarding the CEAP class 4, 5, and 6 patients, the addition of the surgical treatment to treat the incompetent PVs has recently been recognized as being particularly beneficial, and this surgery also keeps 80-90% of the patients free from any ulcer recurrence. However, this ratio decreases to 50% in post-thrombotic syndrome patients.[11] In this study, all of the patients presented as CEAP 4, 5, or 6, and none had this syndrome.

Identifying the PV is easily accomplished via palpation of the fascial defect over the vein. However, CDUS should always be performed after a physical examination by the surgeon to confirm its presence. A cut-off point time of 0.35 seconds and the use of the PV diameter have been suggested as possible criteria for PV incompetence. The clinical importance of the PVs of less than 2 mm is arguable for the diagnosis of reflux even when the reversed flow through them exceeds the cut-off point. Moreover, the technical difficulty of intervention with these PVs is a common problem. Perforating veins that are larger than 4 mm in diameter are always clinically significant and may be identified as incompetent even when the reversed flow through them does not exceed the cut-off point for reflux. However, PVs measuring 2-4 mm in diameter should be considered to be incompetent only when they meet the appropriate hemodynamic criteria.[14-16] In this study, all of the PV diameters were more than 4 mm, and the reflux time was at least 0.35 seconds. The four indications for the interruption of PV insufficiency are presented in Table 4, and only one is needed to indicate the need for treatment.[8]

Bed rest, leg elevation, local treatment, and compression bandages make up the conservative medical treatment that is usually prescribed for this condition. Although this provides good healing rates in mixed patient groups (C2-C6), the recurrence rates with this type of treatment can be as high as 55-100%.[2] However, the simultaneous surgical treatment of incompetent superficial veins and PVs has been shown to improve recovery and decrease the chance of recurrence compared with the nonsurgical approach in venous ulcer patients. For example, in one critical study, the healing rates were 83% in the surgically treated group and 73% for the patients who received the more conservative course of treatment.[2] Our findings suggest that a combination of medical and surgical therapy is preferable to increase the odds of healing.

Current intervention methods for incompetent PVs include standard open surgery, subfascial endoscopic perforator surgery (SEPS), and percutaneous thermal ablation. Linton's surgery used to be the preferred form of intervention, but it was abandoned. Currently, CDUS-enhanced PV ligation using a mini-incision via a vein hook is preferable because it is less invasive and very efficient. In addition, it requires no hospitalization. The success rate for this procedure is 95%, and the recurrence rate is only 32% during the first three postoperative years.[3] In our study, the sharp decrease in the VCSS scores after surgery also indicated the success of this technique.

Subfascial endoscopic perforator surgery is minimally invasive and safe. Plus, it has an ulcer healing rate of 88% during the first postoperative year and an ulcer recurrence rate of just 28% after two years.[4] In addition, the patients can be discharged after only a few hours. However, SEPS is considered to be ineffective, especially for retro-malleolar and lateral perforators and for patients with post-thrombotic limbs (46% recurrence rate).[4] There is also a risk of injury for the posterior tibial vessels and tibial nerve, and complications such as DVT (1%), superficial thrombophlebitis (3%), and saphenous neuralgia (7%) have been reported.[13] In addition, wound infection, paresthesia, and subfascial space hematoma have been seen.[8] This method is also expensive and requires a complicated learning curve compared with open surgery techniques. Furthermore, complications such as DVT, superficial thrombophlebitis, and neuralgia are seen more frequently with SEPS.[8]

Thermal and chemical ablation of the saphenous veins can provide a significant reduction in patient discomfort, fewer complications, and an earlier return to work. There is also no need for sedation or anesthesia with this procedure, and it can be performed in the doctor's office. The occlusion rate for the endovenous laser ablations is reported to be approximately 90%, and complications such as pain (50%), paresthesias (16%), hyperpigmentation (8%), and phlebitis (4%) may be seen along with ecchymosis and induration.[5,17] Radiofrequency ablation is another treatment option. It has an occlusion rate of greater than 90%, and skin burns are very rare with this approach.[6] Sclerotherapy can also be used for PVs with a diameter ranging from 4-7 mm. Contraindications for this type of therapy include allergies to sclerotherapy agents, pregnancy, and patients with prothrombotic tendencies, arterial occlusive disease, or active vasculitis. Sclerotherapy has a 90% occlusion rate,[6] and significantly improved VCSS scores have been noted with this procedure. However, superficial skin necrosis may also occur (1.5%), and the recurrence rate is high (23%).[7] Moreover, anaphylactic shock is a rare and severe complication of sclerotherapy.[7,8] Furthermore, since the PVs usually are accompanied by the perforating arteries (PAs), extra care should be taken to prevent the accidental injection of the sclerosing agents into these arteries.[18]

Conclusion

With respect to patients with venous ulcers, underlying PV-LSV insufficiency is often overlooked, and the treatment usually concentrates solely on GSV insufficiency. However, PV insufficiency significantly reduces the quality of life (QoL), as noted by the increased VCSS scores in affected patients, especially if LSV insufficiency is also present. Perforating veins may be treated with various interventional methods, but we prefer using CDUS-enhanced PV ligation with a mini-incision because it is simple to perform, easy to use, and safe. Furthermore, the interruption of insufficient PV via this method prevents the progression of the CVI, varicose vein recurrence, and venous ulcers. Moreover, this technique also decreases venous HT through the veins and promotes ulcer healing that would not otherwise be possible without PV interruption. Finally, CDUS-assisted PV ligation using the mini-incision technique can be used as an alternative to the current endovenous thermal or chemical ablation devices. While further studies are needed to confirm our results, we believe that our findings clearly indicate that this technique should be the current treatment of choice for this condition.

Declaration of conflicting interests

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REFERENCES

1. Karla M, Gloviczki P. Endoscopic subfascial ligation of perforating veins. In: Ascher E, editor. Haimovici's vascular surgery. 5th ed. New York: Wiley-Blackwell; 2003. p. 1115-29.
2. van Gent WB, Hop WC, van Praag MC, Mackaay AJ, de Boer EM, Wittens CH. Conservative versus surgical treatment of venous leg ulcers: a prospective, randomized, multicenter trial. J Vasc Surg 2006;44:563-71.
3. van Rij AM, Hill G, Gray C, Christie R, Macfarlane J, Thomson I. A prospective study of the fate of venous leg perforators after varicose vein surgery. J Vasc Surg 2005;42:1156-62.
4. Gloviczki P, Bergan JJ, Rhodes JM, Canton LG, Harmsen S, Ilstrup DM. Mid-term results of endoscopic perforator vein interruption for chronic venous insufficiency: lessons learned from the North American subfascial endoscopic perforator surgery registry. The North American Study Group. J Vasc Surg 1999;29:489-502.
5. Proebstle TM, Herdemann S. Early results and feasibility of incompetent perforator vein ablation by endovenous laser treatment. Dermatol Surg 2007;33:162-8.
6. Eklof B, Kessler D, Kistner RL. Can Duplex-guided sclerotherapy replace SEPS in the treatment of incompetent perforating veins? J Vasc Surg 2003;37:545-51.
7. Guex JJ. Ultrasound guided sclerotherapy (USGS) for perforating veins (PV). Hawaii Med J 2000;59:261-2.

8. Lurie F, Puggioni A. Treatment of perforator vein insufficiency. In: Cronenwett JL, Johnstin KW, editors. Rutherford vascular surgery. 7th ed. Philadelphia: Sounders Company; 2010. p. 1386-99.
9. Vasquez MA, Rabe E, McLafferty RB, Shortell CK, Marston WA, Gillespie D, et al. Revision of the venous clinical severity score: venous outcomes consensus statement: special communication of the American Venous Forum Ad Hoc Outcomes Working Group. J Vasc Surg 2010;52:1387-96.
10. Labropoulos N, Tassiopoulos AK, Bhatti AF, Leon L. Development of reflux in the perforator veins in limbs with primary venous disease. J Vasc Surg 2006;43:558-62.
11. Hissink RJ, Bruins RM, Erkens R, Castellanos Nuijts ML, van den Berg M. Innovative treatments in chronic venous insufficiency: endovenous laser ablation of perforating veins: a prospective short-term analysis of 58 cases. Eur J Vasc Endovasc Surg 2010;40:403-6.
12. Iriz E, Ereren E, Oktar S, Oktar L, Halit V, Ilhan V. Perforan venöz yetmezlikte miniflebektomi ile ligasyon. Turk Gogus Kalp Dama 2009;17:101-5.
13. Gloviczki P. The rationale for the treatment of perforating veins in advanced chronic venous insufficiency. Dis Mon 2010;56:658-62.
14. Labropoulos N, Tassiopoulos AK, Bhatti AF, Leon L. Development of reflux in the perforator veins in limbs with primary venous disease. J Vasc Surg 2006;43:558-62.
15. Mendes RR, Marston WA, Farber MA, Keagy BA. Treatment of superficial and perforator venous incompetence without deep venous insufficiency: is routine perforator ligation necessary? J Vasc Surg 2003;38:891-5.
16. Hastaoglu IO, Tokoz H, Yurdakul I, Bilgen F. Doppler ultrason ile işaretlenmiş perforan venlerin subfasiyal açık ligasyonunun yeri: Orta-geç dönem sonuçlarımız. Damar Cer Derg 2013;22:136-41.
17. Black CM, Hatch D, Brown D. An endovenous approach to symptomatic perforator ablation. J Vasc Interv Radiol 2007;18 (Suppl 2):S23.
18. Lurie F, Kessler D, Puggioni A. Blood flow in perforating arteries can change after ablation of incompetent perforating veins-preliminary ultrasound observations. Praktika Flebologie 2005;14:55-6.