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ARAŞTIRMA / RESEARCH

Sonographic identification of isolated incompetent perforating veins and their correlation with age, sex, body mass index and CEAP classification

İzole inkompetan perforan venlerin sonografik değerlendirilmesi ve yaş, cinsiyet, vücut kitle indeksi, CEAP sınıflandırması ile korelasyonu

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Abstract

Purpose: Isolated incompetent perforating veins (IPVs) are poorly discussed in the literature and their importance and prevalence is unknown. This study aims to assess the prevalence and their relation with several factors; age, sex, location and body mass index (BMI).

Materials and Methods: A total of 803 limbs of 485 patients were evaluated with duplex ultrasonography. The clinical severity of the affected limbs were assessed according to CEAP classification. Incompetent perforating veins were considered isolated if neither superficial nor deep venous system reflux were associated.

Results: 617 legs were classified as CEAP 0-2, 186 legs were classified as CEAP 3 or higher. There was a significant correlation with age, sex, BMI, incompetent perforating veins and CEAP stage. 22 of 803 legs (2.7%) have been shown to have isolated incompetent perforating veins. Total of 25 isolated incompetent perforating veins were detected in these 22 legs (19 patients; 14 females, 5 males). All patients with isolated incompetent perforating veins had CEAP stage 0-2. The mean BMI of these patients was lower than the whole patients groups.

Conclusion: The results of this study show that isolated IPVs may also be a cause of venous insufficiency. It may be inferred that the increase in the patients' weights or BMIs does not lead to development of isolated incompetent perforating veins because the BMI of the patients with isolated incompetent perforating veins are found to be lower.

Key words: perforating, vein,incompetent

Öz

Amaç: Bu çalışmada izole inkompetan perforan venlerin prevalansının belirlenmesi ve çeşitli faktörlerle (yaş, cinsiyet, lokasyon ve vücut kitle indeksi) ilişkisinin araştırılması amaçlanmıştır.

Gereç ve Yöntem: Toplam 485 hastaya ait 803 bacak dupleks ultrasonografi ile değerlendirilmiştir. Venöz yetmezliğin klinik ciddiyeti CEAP sınıflandırması ile yapılmıştır. Yüzeyel ve derin venöz yetmezliğin eşlik etmediği perforan venler, izole inkompetan perforan ven olarak tanımlanmıştır.

Bulgular: 617 bacak CEAP 0-2, 186 bacak CEAP 3 ve üzeri olarak sınıflandırıldı. Yaş, cinsiyet, vücut kitle indeksi ve inkompetan perforan venler ile CEAP sınıflaması arasında anlamlı korelasyon mevcuttu. 803 bacaktan 22'sinde (%2.7) izole inkompetan perforan ven tespit edildi. Bu 22 bacakta toplam 25 adet izole inkompetan perforan ven vardı. Olguların 14'ü kadın, 5'i erkekti. Bu olguların tamamı CEAP 0-2 arasında sınıflandı. Olguların vücut kitle indeksi tüm hasta grubuna göre daha düşük bulundu.

Sonuç: Bu çalışmanın sonuçları izole inkompetan perforan venlerin de venöz yetmezliğe yol açabileceğini göstermektedir. Vücut kitle indeksi, izole inkompetan perforan ven izlenen grupta daha düşük bulunmuştur. Bu nedenle hasta kilosunda yada vücut kitle indeksindeki artışın, izole perforan ven yetmezliği gelişimine anlamlı yatkınlık oluşturmadığı sonucuna varılabilir.

Anahtar kelimeler: perforan, ven, inkompetan

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INTRODUCTION

The increasing concern about chronic venous insufficiency (CVI) is related to the high number of people affected and debilitated due to this disease and its socioeconomic consequences on healthcare resources[1-4]. Lower extremity CVI affects nearly 20-40% of the population according to the literature[3,5,6]. The venous structures of the lower extremity are divided into a superficial and deep venous system. Deep venous system (DVS) lies beneath the muscular fascia and serves as collecting veins for the outflow from the extremity. The DVS consists of the popliteal vein, the superficial femoral vein, the profunda femoris (or deep femoral) vein, the common femoral and the external iliac vein. Superficial venous system (SVS) lies above the muscular fascia layer. It consists of a network that connects the veins to each other and truncal superficial veins that enable the blood to return into the DVS.

Major superficial veins are the vena saphena parva (VSP) and vena saphena magna (VSM). Posterior arch, lateral accessory saphenous, and vein of Giacomini are the other superficial veins that can cause CVI. As far as we know, perforating veins (PVs) of the lower extremity take over the function of incompetent saphenofemoral junction or saphenopopliteal junction and help to transfer venous blood from superficial veins to deep venous system in upright position. CVI may be due to the valvular incompetence of superficial, deep or PVs, venous obstruction or muscle pump dysfunction[1].

A lot of PVs have been described in the lower limb[7]. Studies have shown that in patients with severe CVI, deep venous reflux often accompanies incompetent perforating veins (IPVs)[3,4,8,9]. However, there are also studies that show IPVs are particularly occurring with incompetent superficial veins[4,10]. As the number of IPVs increase, the clinical severity of CVI which is determined according to CEAP (clinical, etiological, anatomical and pathological) classification also increases[7,8].

Isolated IPVs (IIPVs) are poorly discussed in the literature and their importance and prevalence is unknown[11-14]. This study aims to assess the prevalence and their relation with several factors (age, sex, location and body mass index).

MATERIALS AND METHODS

Patients with the signs and symptoms of lower extremity venous insufficiency were referred to us for duplex sonography after a detailed physical examination in vascular surgery unit. Ultrasonographic evaluation was performed by a single radiologist experienced in Doppler ultrasonography. This prospective study was approved by the ethics committee (17.12.2012, numbered 06/15) of our institution and written consent was obtained from each patient.

A total of 803 limbs of 485 patients were included in this prospective study during October 2012-April 2013. The height and weight of the patients were noted to calculate body mass index (BMI). The clinical severity of the affected limbs were assessed according to CEAP classification[15]. The classification was as follows: C0: no signs or symptoms of chronic venous disease; C1: telangiectasias; C2: varicose veins; C3: varicose veins and edema; C4: skin changes; C5: healed ulcer; C6: active ulcer; 617 legs were classified as CEAP 0-2, 186 legs were classified as CEAP 3 or higher.

The CEAP classification of the patients were carried out by the clinician or the vascular surgeon before the Doppler ultrasound. Patients with history of varicose vein surgery, sclerotherapy, venous malformations, orthopedic procedures for fractures were not included in the study.

Ultrasonographic evaluation

The duplex sonography studies were performed with ESAOTE (MyLab 60) duplex scanner. First a standard evaluation of DVS was done in every patient to rule out the deep venous thrombosis including common femoral vein, saphenofemoral junction, superficial femoral vein, deep femoral vein, popliteal vein and crural veins with 7 MHz linear and 3MHz convex probes. Patients who had deep venous thrombosis of any stage were also excluded from the study. A history of previous venous thrombosis was also another exclusion criteria in our study. After completing DVS scan for thrombosis, the legs were evaluated for venous insufficiency.

Patients who were not able to stand up were not included in the study. Duplex sonography examination of common femoral vein and saphenofemoral junction were performed with the

patient in supine position on examining couch with augmentation maneuver. Augmentation maneuvers include Valsalva maneuver for common femoral vein and saphenofemoral junction and use of manual compression/release placed distal to the point of examination for lower extremity veins below the femoral junction.

Anteromedial and anterolateral perforator veins of calf and tibial portion (below the knee) of VSM were examined while the patient was sitting on a high examining couch facing the sonographer. Femoral portion (above the knee) of VSM, superficial femoral vein, deep femoral vein, posteromedial and posterolateral calf perforators, posteromedial and posterolateral thigh, saphenopopliteal junction, and small saphenous vein were evaluated while the patient was in upright position with distal manual compression and release. Popliteal veins were analyzed to evaluate DVS insufficiency in above and below the knee crease while the patient in upright position[16,17]. Reflux lasting ≥1 second for femoral and popliteal veins and ≥0.5 second for VSM, VSP, tibial veins, deep femoral vein, and PVs was considered abnormal and were taken as venous insufficiency[3,8,16,18,19]. (Figure 1,2). PVs are defined as venous insufficiency when directional flow is from deep to superficial, valve closure time is ≥0.5 second, vein diameter exceeds 3.5 mm[19]. Venous incompetence was classified as superficial, deep and perforator. Thigh and calf were anatomically subdivided into four regions as; anteromedial, anterolateral, posteromedial and posterolateral and all IPVs were documented and marked in these eight anatomic sites. IPVs were considered isolated if neither SVS nor DVS reflux were associated.

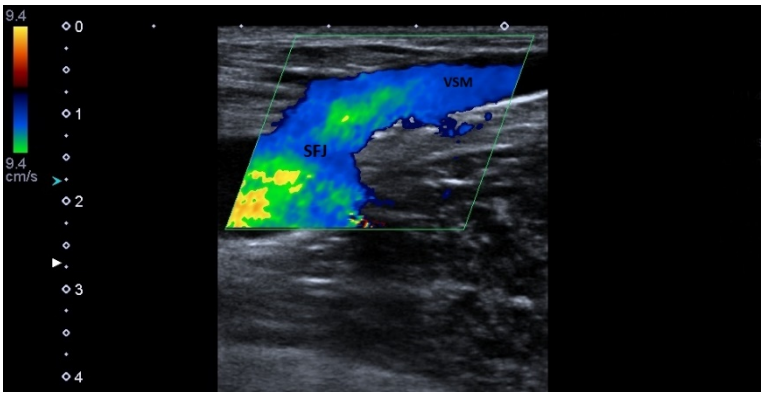

Figure 1. Doppler image of saphenofemoral junction (SFJ) and vena saphena magna (VSM)

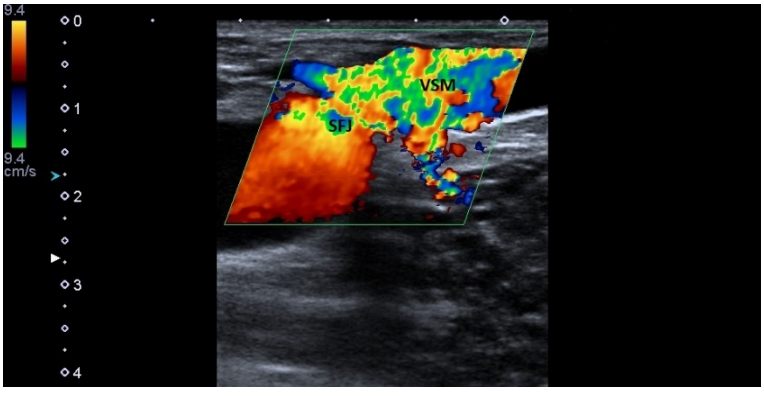

Figure 2. Aliasing due to reflux, venous insufficiency (SFJ; saphenofemoral junction, VSM; vena saphena magna)

Statistical analysis

Data were analyzed using the IBM Statistical Package for Social Sciences v.20.0 (SPSS Inc., Chicago, IL, USA). Patients are grouped according to CEAP classification and correlation between increase in CEAP level and BMI, age and sex is investigated by Chi-square test. Chi-square tests were used to determine whether there is a significant difference between the patient groups. A p value of 0.05 or less was considered statistically significant.

RESULTS

540 legs of patients under the age of 50 and 263 legs of patients aged 50 and over were evaluated. The mean age of the patients was 45 (age range 20-65). The mean BMI of the patients was 28.1. There was a significant correlation with age, sex, BMI, IPVs and CEAP stage. Older subjects (50 and over), and male subjects tended to have higher CEAP stages (CEAP 3-6). There was also a positive correlation with BMI, the presence of IPVs and CEAP stage. Subjects with higher BMI and subjects with IPVs also tended to have higher CEAP stages (Table 1). In this study 22 of 803 legs (2.7%) have been shown to have IIPVs. Total of 25 IIPVs were detected in these 22 legs (19 patients; 14 females, 5 males). 10 IIPVs were detected in anteromedial calf of right legs, 10 IIPVs were detected in anteromedial calf of left legs, 4 IIPVs were detected in posteromedial calf of right legs and 1 IIPV was detected in posteromedial calf of left leg. The locations where IIPVs are encountered are shown schematically in figure 3.

Mean age of female subjects with IIPVs was 43.9 and mean age of male subjects with IIPVs was 39.6. All patients with IIPVs had CEAP stage 0-2. 3 female patients (age 36, 60 and 60) had IIPVs in her both legs. Measured diameters of IIPVs were ranged between 2.5 mm to 4.2 mm in the anteromedial calf of right legs (mean diameter 3.3 mm), between 2.2 mm to 4.4 mm in the anteromedial calf of left legs (mean diameter 3.1 mm), between 3 mm to 4.2 mm in the posteromedial calf of right legs (mean diameter 3.3 mm) and 3.4 mm in the posteromedial calf of left legs. Valve of an IIPV (4.2 mm) in the anteromedial calf of right leg in 36 year-old female patient was missing, but others were complete. BMI of these patient groups were in between 20.8 to 28.7 (mean 24.1). The mean BMI of patients with IIPVs (24.1; normal weighted) was lower than the whole patients groups' BMI (28.1; overweighed).

Table 1. CEAP stage versus age, sex, BMI and IPVs

		CEAP stage						Analysis	
		CEAP 0-2		CEAP 3 and over		Total			
		n	%	n	%	n	%	Chi-square	P
Age	<50	428	69.4	112	60.2	540	67.2	21	0.000
	50 and over	189	30.6	74	39.8	263	32.8		
	Total	617	100.0	186	100.0	803	100.0		
Sex	Male	183	29.7	79	42.5	262	32.6	8.592	0.003
	Female	434	70.3	107	57.5	541	67.4		
	Total	617	100.0	186	100.0	803	100.0		
BMI	24.9 and lower (normal)	212	34.4	13	7	225	28.1	38.841	0.000
	25-29.9 (overweighed)	218	35.3	65	34.9	283	35.2		
	30 and over (obese)	187	30.3	108	58.1	295	36.7		
	Total	617	100.0	186	100.0	803	100.0		
Perforating veins	No IPVs	293	47.5	25	13.4	318	39.6	40.258	0.000
	IPVs present (not isolated)	302	48.9	161	86.6	463	57.7		
	IPVs present (isolated)	22	3.6	0	0	22	2.7		
	Total	617	100.0	186	100.0	803	100.0		

BMI; body mass index, IPVs; incompetent perforating veins, CEAP; clinical, etiological, anatomical and pathological classification

Only three patients has come back for the control ultrasound in six months – one year after the initial examination. Others did not show up for ultrasonography. Doppler ultrasonography findings were similar as the initial examination in those three patients. Change in the size or number of IIPV's, regression or progression in the other Doppler ultrasonography findings were not detected. The patients were treated by the same clinician or vascular surgeon who evaluated them before the Doppler examination. Patients of CEAP 3 or more were treated with sclerotherapy or went to surgery. Patients with lower CEAP (1,2) are treated conservatively, such as with compression socks or stockings.

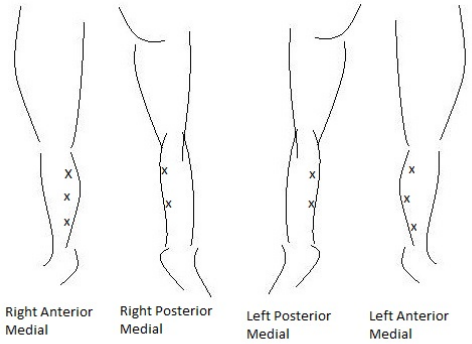

Figure 3. The locations where isolated incompetent perorating veins are encountered

DISCUSSION

In our study most common reflux patterns according to CEAP stage were as follows: perforator reflux associated with SVS reflux in CEAP 0-2 (32.1%), no reflux in CEAP 0-2 (23.9%); perforator reflux with SVS (63.3%), and perforator reflux with SVS and DVS in CEAP 3 and over (20.2%). The data obtained from the study demonstrates that as the CEAP score worsens IPVs tend to be associated with SVS and DVS reflux with an increasing rate in accordance with in the literature[4,8].

The etiology of perforator reflux is still not fully understood. The mostly accepted theory is the weakening of the venous wall giving rise to valvular insufficiency [13]. PVs are connectors between SVS and DVS. The lower limb PVs take over the normal function of an incompetent saphenofemoral junction and saphenopopliteal junction help to transfer venous blood from superficial veins to deep venous veins in upright position[1]. Mostly they become incompetent as a result of SVS incompetency and this explains why superficial reflux correction can also correct PVs reflux as shown in some studies [13,20]. In the literature the hemodynamic and clinical importance of perforator incompetence is still uncertain but as the clinical severity (so the CEAP) increases, the incidence and diameters of IPVs also increase[13,21-25]. Age; recurrent chronic venous disease; superficial, deep or perforated reflux; number of IPVs; were significantly associated with the CEAP classification. Delis was reported that the independent predictors of CEAP clasification were the perforator incompetence or the number of IPVs, which were considered as individually occurred[24].

IPV occurrence in limbs with superficial or deep reflux is well known and it has been reported that more IPVs occur in extremities with superficial reflux and competent deep veins than in limbs with deep reflux, regardless of superficial reflux[12]. Also IPV occurrence in limbs with deep reflux is reported to be proportionally more frequently than in limbs without reflux. In the study of Delis, an independent determinant for perforator incompetence is the emergence of age[11]. The emergence of age is parallel to its importance in relation to chronic venous disease severity. Compared with competent perforator veins, IPVs feature higher peak and mean flow velocity and volume flow, longer time to peak reflux velocity, several times greater reflux volume displaced outward, and greater diameter. A diameter of 3.5 mm or greater below the fascia identifies an IPV in 90%, 29 yet a third of IPVs have a diameter of 3.9 mm or less. Deep reflux enhances peak velocity, volume flow, and displaced volume of IPV reflux[23-25].

IIPVs has been reported to be rare and the prevalence or the importance of IIPVs is unknown. In one report IIPVs were reported to occur rarely in crural ulcer region[12]. Labropoulos et al. reported that IIPVs occur very rarely, but they didn't give a percent[22]. Vashist et al. reported that, in a significant number of patients (26%) isolated perforator incompetence is the cause of symptoms, indicating

the significance of perforators in pathogenesis of varicose veins[26]. In our study we detected IIPVs with a low incidence (2.7%) in 803 legs. All patients with IIPVs had CEAP stage 0,1,2. The reason why we did not detect any IIPV in higher CEAP stages may be due to an increasing number of combined type of reflux (IPV+SVS or IPV+SVS+DVS) to occur starting with these stages[13]. In CEAP 1 patient group, these perforators seem to be the only factor contributing chronic venous disease. The indication for treatment of isolated perforator insufficiency remains up to discussion, especially in CEAP 2 and CEAP 3 varicosities[27].

Our study has limitations. During the Doppler examination, augmentation was not carried by tools mechanically but by the radiologist on examination. Most of the patients were lost to follow up and did not appear on control doppler ultrasound.

The results of this study show that IIPVs may also be a cause of CVI. The percent of patients who come back for the control study is low in our study group. But the real importance of detected IIPVs is to be remained unrevealed until they are controlled with repeated duplex studies in large volume studies. BMI does not seem to be a significant factor in patients with IIPVs.

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