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Comparison of Doppler Ultrasonographic Findings in Complicated and Uncomplicated Lower-Limb Varicose Veins

Background/Objective: Comparing anatomicopathologic findings in complicated and uncomplicated lower-limb varicose veins by ultrasonography.

Patients and Methods: Totally, 231 consecutive patients [148 (64%) men; mean age, 46.8± 14.3 years (range: 16-88 years)]; 155 (54%) left and 132 (46%) right variceal legs were evaluated by Doppler ultrasonography with color-flow imaging using a 7.5-10 MHZ linear probe. The lower extremity venous system (including perforators and valves) were evaluated in the supine and standing position, at rest and during Valsalva's maneuver. Chi square and Fischer's exact tests were used for statistical analysis. We also performed a logistic regression analysis considering presence of any type of complication as the dependent variable and anatomic pathologies as independent variables.

Results: Of the 287 limbs with varicose veins, 124 (43%) had at least one complication (ulceration, pigmentation or infection). The highest complication rate was seen simultaneously with chronic deep vein thrombosis (DVT) with segmental obstruction (76.9) and the lowest complication rate in the incompetent valves was seen in patients with perforan vein reflux (50.4%).

Mostly, the complication rate was higher in patients with the pathology in comparison to patients without it (p values<0.005). In a multivariate logistic regression model, presence of DVT and saphenofemoral incompetency were statistically significant in the model in comparison to other pathologies (OR=10.6 and 7, respectively, p values<0.02).

In 175 patients (75.8%) one of the legs were involved

Conclusion: Presence of ulcer, pigmentation and infection are significantly associated with a higher incidence of DVT, deep vein, saphenofemoral and saphenopopliteal incompetency in patients with lower limb varices.

Keywords: Ultrasonography, Doppler, Varicose Veins, Lower Limb, Venous Insufficiency, Complication

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Introduction

Varicose veins are visible, palpable, tortuous, dilated veins in the subcutaneous tissue of the lower legs which can easily be seen.[1,2] It is one of the most common diseases in the world. Varicose veins affect about 30% of the adult population and a small proportion of the affected population end up with complications.[3] They cause cosmetic problems and although they medically deserve low precedence for treatment, the anxiety, concern and stress results as patient suffering. The most common complaint includes leg discomfort which is seen in prolonged standing. Another less frequent complaint is unilateral leg swelling related most often with a large varicose vein. Complications include ulceration, skin changes (pigmentation), infection and thrombophlebitis.[1,2] Obviously, complications are somehow an indicator of the severity of the disease.

The venous system of the lower limb is consisted of the superficial, perforating (communicating) and deep venous veins. Venous insufficiency of the saphenofemoral junction, saphenopopliteal junction, or the perforating veins are among the etiologies

of varicose veins in the lower extremities.[4]

Physical examination in conjunction with ultrasonography is the main diagnostic method to evaluate varicose veins.[1] Ultrasonography is sometimes the first evaluation performed. Duplex ultrasound gives the most precise imaging of reflux in the veins.[5] Doppler ultrasonography (US) is another imaging study which depends mostly on the operator's ability and experience.[1,2]

Besides causing the disease, anatomical pathologies such as deep vein thrombosis may predispose the varicose veins to some complications such as infection, ulceration and pigmentation. The fact that which pathology has more powerful association with the complications seems important. Thus, sonographic evaluation of the involved legs in complicated and non-complicated patients leads to better understanding of the pathophysiology and consequently disease management.

In this study, we are going to compare color Doppler findings between complicated and uncomplicated patients suffering from varicose veins who were examined ultrasonographically. We want to evaluate which pathology is more powerful association with variceal complications.

Patients and Methods

This study comprised 231 consecutive patients who were admitted to Shohada Tajrish Hospital. All of the patients were lower limb varicose vein cases referred to the general surgery clinic and were candidates for sonographic evaluation of lower extremity varicose veins. Informed consent was obtained from all patients. Fifty six of these patients had both legs involved. So a total of 287 legs were evaluated by Doppler ultrasonography with color-flow imaging. Venous reflux and valvular integrity were evaluated thoroughly in the superficial (greater saphenous and lesser saphenous veins), deep (common femoral vein, superficial femoral vein, popliteal vein, posterior and anterior tibialis vein) and perforating veins above, below and at the knee level. Doppler ultrasonography was performed with the patient in the supine and standing position at rest and during Valsalva's maneuver. The patients underwent grayscale and color Doppler sonography (HITACHI, EUB 525 TOKYO, JAPAN) using a 7.5-10 MHZ linear probe.

Deep vein narrowing due to chronic thrombotic scarring is defined as echogenic intraluminal material. Deep vein pathological reflux due to valve abnormality is defined as reflux after Valsalva's maneuver. Deep vein thrombosis is defined as lack of spontaneous flow, lack of phasicity, incomplete compressibility and absence of the Valsalva maneuver in suprapopliteal and subnormal or absence augmentation at infrapopliteal levels.

The perforators were evaluated in the standing position and proximal augmentation to see reversed flow and incompetency. The saphenofemoral and saphenopopliteal junctions were assessed in the supine position using Valsalva's maneuver. A reflux flow more than 0.5 second was defined as insufficiency.

Of these 287 legs, 155 (54%) were left and 132 (46%) were right legs. 148 (64%) of the patients were men and the mean age of the patients was 46.8±14.3 years (range: 16-88 years). Chi square and Fisher's exact test were used for statistical analysis. We also performed a logistic regression analysis considering presence of any type of complication as the dependent variable and anatomic pathologies as independent variables. We used SPSS 16 for Windows (Chicago, Illinois) for statistical analysis. All p-values less than 0.05 were considered statistically significant.

Results

Basic data: Of the 287 limbs with varicose veins, totally, 39 (13.5%) legs had incompetent deep valves (deep vein reflux), 117 (40.8%) had incompetent saphenofemoral valves (long saphenous vein reflux), 43 (14.9%) had incompetent saphenopopliteal valves (short saphenous vein reflux) and 144 (50.2%) had incompetent perforators (IPs). Chronic deep vein thrombosis (DVT) with segmental obstruction was detected in 26 legs (9.1%), incomplete compressibility in 76 legs (26.5%) and narrowing in 84 legs (29.3%) (Table 1). 50.2% of the legs had no valvular incompetency.

Presence of ulcer, infection or pigmentation was considered as a complication. Accordingly, of the 287 limbs with varicose veins, 124 (43%) had complication; 97 (33.8%) had ulceration, 122 (342.5%) had pigmentation and 7 (2.4%) had infection. Complications were more common in men; 58.7% in men versus 23% in women (p=0.0001).

Association of Doppler Findings with Complications: Ulcer, infection and pigmentation were evaluated and compared in patients with and without each anatomic abnormalities (including DVT, compressibility, narrowing, SF valve reflux, SP valve reflux, perforan vein incompetency in each compartment and deep vein incompetency) (Table 2).

The analysis has been performed in men and women separately and no difference has been detected regarding the frequency of complications in different pathologies. The distribution of single system and multisystem incompetencies are illustrated in Table 3. Table 4 demonstrates the association between different complications and various patterns of incompetencies.

In order to compare the severity of the pathological processes between patients with varicose veins in one leg and in two legs, we categorized the patients into two groups of one-leg disease and two-leg disease and then we compared complication and each anatomicopathologic finding between these two groups. 175 patients (75.8%) had a one-leg varicose vein involvement, whereas 28 patients (24.2%) had a two-leg varicose vein involvement.

Table 1. Frequency of Each Color Doppler Finding in the Legs

Ultrasound Findings	Number [Percent]
Chronic DVT with Segmental Obstruction	26 [9.1]
Incomplete Compressibility	76 [26.5]
Narrowing	84 [29.3]
Saphenofemoral Valve Incompetency.	117 [40.8]
Saphenopopliteal Valve Incompetency	43 [15]
Perforan Vein Valve Incompetency	144 [50.2]
Perforan Vein Valve Incompetency at Knee Level	46 [16]
Perforan Vein Valve Incompetency in Medial Calf	53 [18.5]
Perforan Vein Valve Incompetency Above Knee	58 [20.2]
Perforan Vein Valve Incompetency Lateral Calf	11 [3.8]
Perforan Vein Valve Incompetency Proximal calf	10 [3.5]
Perforan Vein Valve Incompetency Distal calf	15 [5.2]
Perforan Vein Valve Incompetency Ankle	48 [16.7]
Deep Vein Incompetency	39 [13.6]

The frequency of incomplete compressibility, deep vein incompetence, saphenofemoral incompetence, pigmentation, ulcer and any complication was significantly different between these two patient groups while the frequency of chronic deep vein thrombosis (DVT) with segmental obstruction, narrowing, saphenopopliteal incompetence, perforan incompetence and infection did not show any significant difference.

Poor deep vein compressibility was seen in 96.4% of two-leg variceal patients compared to the 75.4% frequency of this involvement in one-leg variceal patients (p-value=0.002). Deep vein reflux frequency in two-leg varicose vein patients was 19.7% and 5.8% in one-leg varicose vein patients (p value=0.02). Saphenofemoral reflux was detected in 33.9% of two-leg varicose patients and in 53.7% of one-leg varicose patients (p value=0.01). Pigmentation was detected in 0% and 69.7% of these two groups, respectively (p value=0.001). The frequency of ulcer was 0% and 55.4%, respectively. Comparison of any complication between these two groups was also significant with a 0% against 70.9% frequency in the two versus one-leg disease (p value=0.001). We did a multivariate logistic regression analysis between presence of any complication as dependent variable and DVT, saphenopopliteal incompetency, superficial or deep incompetency and perforan incompetency as independent variables. In this multivariate model, the variables of DVT and saphenofemoral incompetency remained in the model (p values=0.001 and 0.014, respectively, Odds Ratios=10.6 [95% CI=3.3-33.9] and 7 [95% CI=1.5-32.7], respectively).

Discussion

In this study, after Doppler ultrasonography of 287 legs with varicose veins, we compared anatomicopathological findings between complicated and uncomplicated cases and we overally observed that in complicated legs the frequency of these abnormalities were higher compared to non-complicated legs. Many studies have evaluated incompetency in different valves separately (one system incompetence) and simultaneously (multisystem incompetence).

In Wong et al.'s study, 53% of the legs with primary

Table 2. Comparison of the Frequency of Pigmentation, Ulcer, Infection and Any of These Complications in Patients With and Without Each Certain Color Doppler Finding.

		Pigmentation			Ulcer			Infection			Any Complication		
		%	OR [%95CI]	P-Value	%	OR [%95CI]	P-Value	%	OR [%95CI]	P-Value	%	OR [%95CI]	P-Value
Chronic DVT with Segmental Obstruction	With Abnormality	76.9	4.9 [1.9-12.7]	<0.0001	65.4	4.1 [1.8-9.6]	<0.0001	0	--	1	76.9	4.8 [1.9-12.3]	<0.0001
	Without Abnormality	40.3			31.5			2.7			41.1		
Incomplete Compressibility	With Abnormality	47.4	62.5 [8.5-500]	<0.0001	36.4	40 [5.5-333]	<0.0001	0	--	0.2	1.4	0.016 [0.002-0.117]	<0.0001
	Without Abnormality	1.4			1.4			3.9			47.4		
Narrowing	With Abnormality	41	13.7 [4.7-40]	<0.0001	30.9	8.8 [3-25.6]	<0.0001	0	--	1	4.8	0.07 [0.02-0.2]	<0.0001
	Without Abnormality	4.8			4.8			0.8			42.6		
Saphenofemoral Valve Incompetency.	With Abnormality	67	5.5 [3.3-9.2]	<0.0001	52.6	4 [2.4-6.8]	<0.0001	4.3	3.8 [0.7-19.7]	0.1	68.7	5.9 [3.5-10]	<0.0001
	Without Abnormality	26.9			21.6			1.2			26.9		
Saphenopopliteal Valve Incompetency	With Abnormality	60.5	2.2 [1.1-4.3]	0.017	55.8	2.8 [1.5-5.5]	0.002	4.7	2.3 [0.4-12.2]	0.3	62.8	2.4 [1.2-4.7]	0.009
	Without Abnormality	40.9			30.9			2.1			41.4		
Perforan Vein Valve Incompetency	With Abnormality	49.6	1.7 [1.1-2.7]	0.029	47.2	3.4 [2-5.7]	<0.0001	4.9	--	0.02	50.4	1.7 [1.1-2.7]	0.03
	Without Abnormality	36.7			20.9			0			37.4		
Perforan Vein Valve Incompetency at Knee Level	With Abnormality	41.3	0.88 [0.5-1.7]	0.7	39.1	1.3 [0.7-2.4]	0.5	6.5	4 [0.9-18.5]	0.09	41.3	0.85 [0.45-1.6]	0.62
	Without Abnormality	44.4			33.9			1.7			45.3		
Perforan Vein Valve Incompetency in Medial Calf	With Abnormality	62.3	2.5 [1.4-4.7]	0.003	62.3	4.2 [2.2-7.8]	<0.0001	7.5	6.1 [1.3-28]	0.03	64.2	2.7 [1.4-5]	0.001
	Without Abnormality	39.6			28.3			1.3			40		
Perforan Vein Valve Incompetency above Knee	With Abnormality	58.6	2.1 [1.2-3.8]	0.012	58.6	3.5 [1.9-6.4]	<0.0001	6.9	5.4 [1.2-24.7]	0.04	60.3	2.2 [1.2-4]	0.007
	Without Abnormality	40.2			28.6			1.4			40.6		
Perforan Vein Valve Incompetency Lateral Calf	With Abnormality	90.9	13.8 [1.7-109]	0.002	72.7	5.3 [1.4-20.6]	0.019	9.1	4.4 [0.5-39.6]	0.24	90	13.3 [1.7-105.7]	0.002
	Without Abnormality	42.1			33.3			2.2			42.9		
Perforan Vein Valve Incompetency Proximal Calf	With Abnormality	60	2 [0.5-7.1]	0.344	60	2.9 [0.8-10.6]	0.102	20	13.2 [2.2-78.3]	0.02	60	1.9 [0.5-6.9]	0.32
	Without Abnormality	43.4			34			1.9			44.2		
Perforan Vein Valve Incompetency Distal Calf	With Abnormality	100	--	<0.0001	100	--	<0.0001	13.3	7.9 [1.4-44.9]	0.05	100	--	<0.0001
	Without Abnormality	40.8			31.2			1.9			41.6		
Perforan Vein Valve Incompetency Ankle	With Abnormality	57.4	1.9 [1-3.6]	0.04	56.3	3 [1.6-5.6]	<0.001	2.1	0.8 [0.1-6.8]	1	57.4	1.9 [0.98-3.5]	0.052
	Without Abnormality	41.1			30.3			2.6			42		
Deep Vein Incompetency	With Abnormality	71.8	3.9 [1.8-8.1	<0.0001	64.1	4.1 [2-8.4]	<0.0001	0	--	0.6	74.4	4.3 [2-9.3]	<0.0001
	Without Abnormality	39.7			30.2			2.9			40.2		

Table 3. Distribution of Different Patterns of Superficial and Deep Vein Incompetencies in the Evaluated Lower Limbs

	Frequency	Percent
Only SSV	9	3.1
Only LSV	70	24.4
Only Deep	28	9.8
SSV+LSV	31	10.8
All	2	0.7
Other Situations	8	2.8
None of Them	125	43.6
Missing	14	4.9
Total	287	100.0

varicose veins which were evaluated by Duplex ultrasonography had saphenofemoral junction (SFJ) incompetence compared to 40% in our study and 21% had saphenopopliteal junction (SPJ) incompetence[6] compared to 14.9% in our study. This could be due to the fact that in our study, we included DVT cases which were not enrolled in Wong et al.'s study. In another study performed by Daher, 68% of the legs evaluated by continuous wave hand-held Doppler (CWHHD) demonstrated reflux at the saphenopopliteal junction.[7]

Sakurai et al. reported that 82% of the legs had insufficiency in the long saphenous vein, 26% had insufficiency in the short saphenous vein, 62% had incompetence in the perforators in the calf and 48% had reflux in the deep veins.[8] We have to mention that this higher involvement profile compared with our study could be due to the difference in the patients' condition, as the patients enrolled in Sakurai's study were patients who were referred for treatment, but in our study the patients included were those patients who were evaluated by Doppler ultrasonography; therefore had a better clinical situation. All the mentioned numbers were higher than those of our study; 40%, 14.9%, 49% and 13.5%, for saphenofemoral, saphenopopliteal, perforators and deep vein incompetency, respectively.

Katsamouris reported deep vein incompetence in thirty percent and perforating vein incompetence in fifty percent of the symptomatic legs. Sixty percent of the legs had saphenofemoral incompetence and 3% had saphenopopliteal incompetence.[9] All the mentioned frequencies were lower in our study except for saphenopopliteal valve reflux which was higher in our study (14.9% versus 3%).

Perrin reported that "in severe chronic vein insufficiency, deep vein insufficiency, as an isolated deficiency, is detected in less than 10% of the patients".[10] Andrade et al. performed Duplex sonography on 227 lower limbs, of which 7.5%, 3.5% and 17.6% had great saphenous vein reflux, short saphenous vein reflux and perforating vein reflux alone, respectively.[11]

A study conducted by Katsamouris reported saphenofemoral and saphenopopliteal incompetence together in 10% of the patients, and none of the two latter incompetences in 27%.[9]

Perrin stated that "deep vein insufficiency is accompanied with superficial reflux together or without perforator incompetence in 46% of the patients".[10] In Andrade et al.'s study, great saphenous vein (GSV) and short saphenous vein (SSV) were detected in 3.5%, great saphenous and perforating veins in 17.6%, SSV and perforating in 1.7% and 7.5% had all three types of reflux (SSV, GSV and perforating vein reflux).[11]

In another study carried out by Hanrahan et al., multisystem incompetence was applied to superficial and perforating plus superficial and deep plus perforating and deep plus superficial and perforating and deep incompetence and single system incompetence was referred to superficial plus perforating plus deep vein incompetence.[12] In this study, 66.3% had multisystem insufficiency, whereas 27.3% had single system incompetence and 45% of the ulcers had no duplex evidence of any venous abnormality in the ulcer bed.[12]

Table 4 demonstrates the frequency of multisystem involvement in this study.

Although superficial, perforating and deep venous system valvular incompetence alone or in combination are detected in patients with varicose veins, verifying the abnormality with the maximum impact on the development of complication is very intricate.[8]

Long saphenous vein (LSV) and SSV together or without perforator involvement was significantly associated with severe venous disease.[8] Femuropopliteal reflux had impact on the development of venous eczema and ulcers when it was accompanied with superficial venous reflux.[8]

Two-leg involvement gives the impression of a higher complication rate and more pathologies; on the contrary, in this study the exact opposite has been observed and some manifestations were seen more in patients with one-leg involvement or were similar

Table 4. Frequency of Different Complications in Patients with Various Patterns of Superficial and Deep Vein Incompetencies

	Ulcer	Pigmentation	Infection	Any Complication
Only SSV	11.1%	11.1%	0%	11.1%
Only LSV	49.3%	67.6%	4.3%	69.1%
Only Deep	71.4%	78.6%	0%	78.6%
SSV+LSV	67.7%	77.4%	6.5%	77.4%
SSV+LSV+Deep	50%	0%	0%	50%
None	12.2%	17.9%	1.6%	17.9%

in both groups (patients with one-leg and two-leg involvement). Possibly because patients with varicose veins in both legs consulted a doctor earlier than the other group; therefore, are diagnosed earlier when the complication and pathology have not yet become worse. If we knew when the disease began and the time the patient was referred to the doctor and the interval between diagnosis and sonography, maybe, this would clarify the conflict; consequently, helping to understand the situation.

The only group which had a reverse percentage of complication was the narrowing group in which complication was more frequent in the group without narrowing, and narrowing although a pathological state indicating worse involvement, shows a lower rate of complication; 4.8% complication in patients with narrowing compared to 42.6% in patients without narrowing (p=0.0001).

The difference is obviously significant between the patients with one-leg and two-leg disease, but according to some situation (the low number of sample) it is not significant statistically.

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