



Radio Diagnosis

"ROLE OF COLOUR DOPPLER ULTRASOUND IN CHRONIC VENOUS INSUFFICIENCY"

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ABSTRACT

The term chronic venous insufficiency refers to the venous valvular incompetence in the superficial, deep and/or perforating veins. Incompetence of the vein valves permits reversal of flow and promotes venous hypertension in the distal segments. This form of venous dysfunction may be the result of recanalisation of thrombosed venous segments, pathological dilation of the vein or due to congenital absence of competent valves [15].

Chronic venous insufficiency of the lower limbs (CVI) is characterized by symptoms or signs produced by venous hypertension as a result of structural or functional abnormalities of veins. Symptoms may include aching, heaviness, leg tiredness, cramps, itching, sensations of burning, swelling, the restless leg syndrome, dilatation or prominence of superficial veins, and skin changes. Signs may include telangiectasia, reticular or varicose veins, edema, and skin changes such as pigmentation, lipodermatosclerosis, eczema, and ulceration [12].

The introduction of Doppler ultrasound technique has irrevocably altered the diagnosis and treatment of CVI. The rationale is quite simple: thrombotic obstruction of the underlying vein distorts the venous flow pattern and these perturbations are readily detected by the Doppler instrument [14]. This technique is non invasive, repeatable, can be performed rapidly in the clinic, at patient's bedside or even at home and the results are available immediately. It can be used in pregnant women, permits multiple views in various positions of the leg [10] and the study is safe, painless inexpensive [14].

The main objective of this study is to evaluate the spectrum of findings on colour duplex ultrasound in patients who present with clinical symptoms and signs of varicose veins and to evaluate the role of Doppler in the diagnosis of venous reflux. 50 patients with symptoms of lower extremity were included in this study. Study was done to identify the cause of their symptoms and to diagnose and establish venous insufficiency as their symptomatic cause with the help of Doppler ultrasound technique.

The present study included 50 patients who were referred to the Department of Radiodiagnosis in a period of 2 years from in the hospital attached to Santhiram Medical College, Nandyal.

In our study 50 patients with clinical suspicion of venous pathology were subjected for Doppler examination. Majority of patients were males (66%) and had a higher incidence of positive Doppler study (78.57%).

The age limits in our study was 11 to 80 years; maximum incidence of venous abnormalities were noted in the 41 to 50 years age group (34%). Unilateral involvement was found to be more common (81%) than bilateral. Venous abnormalities were more common in the left extremity i.e. 57% of the positive cases showed left side involvement. In 24% venous abnormalities were confined to the right extremity and in 19% involvement was bilateral.

Ultrasound has the advantage that the segments of deep and superficial systems can be examined and the direction of blood flow within each segment can be demonstrated. Compared to other modalities like contrast enhanced CT and MRV, Colour Doppler is much cheaper, reasonably accurate and much more widely available. Colour Doppler helps in differentiation between obstruction and valvular incompetence [13].

KEYWORDS : Continuous wave Doppler, Pre systolic velocity, End diastolic velocity, Mean velocity, Ultra Sound, Common femoral vein, Popliteal vein, Magnetic resonance venography.

INTRODUCTION:

The term chronic venous insufficiency refers to the venous valvular incompetence in the superficial, deep and/or perforating veins. Incompetence of the vein valves permits reversal of flow and promotes venous hypertension in the distal segments. This form of venous dysfunction may be the result of recanalisation of thrombosed venous segments, pathological dilation of the vein or due to congenital absence of competent valves^[15].

Chronic venous insufficiency of the lower limbs (CVI) is characterized by symptoms or signs produced by venous hypertension as a result of structural or functional abnormalities of veins. Symptoms may include aching, heaviness, leg tiredness, cramps, itching, sensations of burning, swelling, the restless leg syndrome, dilatation or prominence of superficial veins, and skin changes. Signs may include telangiectasia, reticular or varicose veins, edema, and skin changes such as pigmentation, lipodermatosclerosis, eczema, and ulceration^[12].

The most frequent causes of CVI are primary abnormalities of the venous wall and the valves and secondary changes due to previous venous thrombosis that can lead to reflux, obstruction, or both. A number of diagnostic investigations have been developed that can elucidate whether there is calf muscle pump dysfunction and can determine the anatomic extent and functional severity of obstruction or reflux^[12].

CVI may affect only the superficial veins or it may be a sequelae to deep vein thrombosis. Deep vein thrombosis can cause pain and swelling of the affected limb and it may also cause structural damage to the valves of the deep veins, which results in post phlebitis syndrome.

DVT of the lower extremity is one of the most common cause of pulmonary embolism; which in turn is responsible for majority of the deaths.

The clinical signs and symptoms of deep venous thrombosis are nonspecific^[9] and even though clinical examination can lead to correct diagnosis in case of varicose veins, it is important to promptly perform objective testing to confirm the diagnosis and enable the institution of safe and effective therapy.

The introduction of doppler ultrasound technique has irrevocably altered the diagnosis and treatment of CVI. The rationale is quite simple: thrombotic obstruction of the underlying vein distorts the venous flow pattern and these perturbations are readily detected by the Doppler instrument^[14]. This technique is non invasive, repeatable, can be performed rapidly in the clinic, at patient's bedside or even at home and the results are available immediately. It can be used in pregnant women, permits multiple views in various positions of the leg^[10] and the study is safe, painless inexpensive^[14]. Venous system is evaluated for flow, phasicity, pliability and augmentation. It is useful as a screening modality in high-risk patients to ensure prompt and early treatment.

Duplex ultrasound, complemented with colour flow imaging, has been validated as a sensitive and specific modality for the identification of superficial and deep vein thrombosis^{[9],[11]}. Valvular incompetence can be confirmed with spectral and colour doppler, and unlike photoplethysmography and APG, venous insufficiency can be localized to specific valve sites in the deep and superficial veins. Incompetent perforators can similarly be identified and mapped prior to intervention^[6].

The present study aims to evaluate the role of colour flow duplex ultrasound in clinically suspected patients of varicose veins of the lower limbs.

AIMS & OBJECTIVES :

1. To evaluate the spectrum of findings on colour duplex ultrasound in patients who present with clinical symptoms and signs of varicose veins.
2. To identify patients who can be taken up for various venous surgery without any risk of pulmonary embolism by ruling out deep venous thrombosis.
3. To evaluate the role of Doppler in the diagnosis of venous reflux.

MATERIALS & METHODS :

50 patients with symptoms of lower extremity were included in this study. Study was done to identify the cause of their symptoms and to diagnose and establish venous insufficiency as their symptomatic cause with the help of Doppler ultrasound technique.

Any other cause of their symptoms was also noted in Doppler ultrasound examination.

The present study included 50 patients who were referred to the Department of Radio diagnosis in a period of 2 years attached to Santhiram Medical College, Nandyal.

Inclusion Criteria

Clinically suspected cases of chronic venous disease, varicose veins. Patients who present with swelling and ulcers over the foot.

Exclusion Criteria

Pregnant ladies.
Seriously ill patients

Specifications Of The Colour Doppler Ultrasonography Machine

- Manufacturer : Siemens
- Type of transducer : Linear array
- Frequency of transducer : 3.5 MHz, 7.5 MHz

METHODS

In All Patients, The Following Protocol Was Followed:

Detailed clinical history was elicited with reference to onset, duration and progress of the symptoms and special reference to risk factors.

Patients With Following Symptoms Were Included In The Study:

Pain, swelling, pedal edema, varicosities, erythema, venous ulcer.

Review of all the previous radiological (chest radiograph, ultrasound of abdomen and pelvis, Doppler ultrasonography of lower extremities in patients with history of DVT and pathological investigations was done.

Standard examination would evaluate common femoral vein, superficial femoral vein, popliteal vein followed by calf veins. The patient was examined in supine position with legs abducted and extremely rotated with slight flexion of knee for evaluation of femoral venous segment. Patient was given prone position for evaluation of popliteal vein. Calf veins were evaluated in supine position and the knee slightly flexed, internally rotated for the anterior tibial veins and externally rotated for the posterior tibial and peroneal veins.

7.5 MHz linear array transducer was used for femoral and popliteal venous segments and calf veins.

Superficial venous system was assessed for SFJ and SPJ incompetence. For detection of incompetent veins, patients were examined in standing position facing the examiner supporting his/her weight on contralateral extremity. Veins were manually compressed (asked to cough, perform valsalva maneuver) and released suddenly and tested for reflux.

In lower extremity venous imaging; in which vessels run parallel to the skin surface without tortuosity, all venous segments were encoded in blue and corresponding arteries in red.

Examination included gray- scale, colour Doppler and spectral evaluation of lower extremity veins. Statistical analysis by proportions.

OBSERVATIONS & RESULTS :

Study Design:

An observational correlation radiological study with 50 patients is undertaken to study the spectrum of findings on colour duplex ultrasound in patients who present with clinical symptoms and signs of varicose veins, To identify patients who can be taken up for various venous surgery without any risk of pulmonary embolism by ruling out deep venous thrombosis and To evaluate the role of Doppler in the diagnosis of venous reflux.

DISCUSSION :

This study was done to assess the role of colour duplex sonography in evaluation of chronic venous insufficiency of lower limbs.

In our study 50 patients with clinical suspicion of venous pathology were subjected for doppler examination. Majority of patients were males (66%) and had a higher incidence of positive doppler study (78.57%).

The age limits in our study was 11 to 80 years; maximum incidence of venous abnormalities were noted in the 41 to 50 years age group (34%). Unilateral involvement was found to be more common (81%) than bilateral.

Venous abnormalities were more common in the left extremity i.e. 57% of the positive cases showed left side involvement. In 24% venous abnormalities were confined to the right extremity and in 19% involvement was bilateral.

Symptoms that prompted for doppler examination were swelling in 12%, varicosity in 44%, pain in 16%, ulcer in 14% and eczema in 4% of the cases. Thus varicosity were the predominant symptoms. In cases showing evidence of DVT, most common symptom was swelling (55.56%) followed by venous ulcer (38.89%).

Of the 40 patients showing varicosities, GSV varicosities predominated in our study (60%), SFJ incompetence was noted in 54% of cases.

Perforator incompetence was seen in 40 cases (80%) of the 26 cases having varicosities; with below knee, mid calf and above ankle perforators showing equal incidence 20 cases each (50%)[Images 1].



Image 1: Perforator In Middle Of Leg.

8 cases in the study population showed normal venous study, of which 2 cases was Bakers cyst, 4 cases was cellulitis, rest of the cases did not show any pathology.

Deep vein thrombosis was seen in 18 cases (36%) more common in 40-50 years of age (11%) common in males (13 – 72%) than females. In Deep vein thrombosis with varicosities are seen in 10 cases (55%) and swelling with DVT seen in 3 cases (16%), pain with DVT was seen in 7 cases (38%).

In DVT with varicosity in greater saphenous vein was seen in 11 cases (61%) and DVT with short saphenous vein varicosity was seen in 2 cases (11%).DVT with sapheno femoral junction involvement was seen in 7 cases (38%).

DVT with sapheno popliteal junction involvement was seen in 5 cases (27%).DVT with below knee incompetence was seen in 8 cases (44%).DVT with mid calf incompetence was seen in 6 cases

(33%). DVT with above ankle incompetence was seen in 6 cases (33%) Among the 50 cases studied for suspected venous pathology colour duplex showed positive findings in 42 cases; 6 cases showed other causes of symptoms; and 2 cases had normal findings.

AGE

The range of age of patients with venous abnormalities in our study was 11-80 years. We studied a total of 50 patients, of which 42 were detected to have venous abnormalities, the study group which showed maximum incidence was the age group 41 - 50 years, 17 cases (34%). Out of the total 50 cases, 33 cases (i.e. 66%) were more than 40 years.

In a randomized controlled study Belcaro G et al (2002) Italy, found that venous abnormalities increased with increasing age^[1].

In the Edinburgh Vein Study (Evans, 1999), the prevalence of trunk varices rose from 11.5% in persons aged 18 to 24 years to 55.7% in the population between 55.64 years of age. The occurrence of skin changes in CVI depend on the patient's age as well.

This study correlate well with our study; in which out of the total 50 cases, 33(66%) were more than 40 years. The mean age of cases with CVI in our study was 44.31 years.

In the Tecumseh Health Study (2002), the prevalence of skin changes in women aged 30 to 39 years was 1.8%, whereas in patients at the age over 70 years the prevalence of 20.7% was reported. Similarly the prevalence of varicose ulcers increases with age. In the general population it is about 1%, at the age over 80 years it increases up to 4.5%^[8].

SEX:

Males contributed the major group 33 (66%) in our study with suspected venous abnormalities and they also had a higher incidence 29 (78.57%) of positive Doppler study. In our study out of the total 50 cases, 17 (34%) are females with 13(75%) showing doppler features of chronic venous insufficiency.

These findings correlate well with the study done by Strandness et al (1983) in which they showed a higher incidence of chronic venous insufficiency in males. In their study 66% of the male patients had a positive study. In another study Evans CJ et al (1999) {Edinburgh Vein Study} had also found a definite male predominance^[2].

However contradictory to these findings many of the published epidemiological studies like Canonico (1998) Italy { prevalence in males 17% compared to 35.2% in females, Capitao (1995) Portugal { male 17.8%, females 34%}, Laurikka (1995) Finland { males 19%, females 43%} and Komsuoglu (1994) Turkey { males 14.6%, females 22.1%} have found that the female gender is one of the risk factors for CVI.

TYPE OF INVOLVEMENT:

In our study venous abnormalities were more common in left extremity. 24 cases i.e. 57% of the positive cases showed left side involvement, 10(24%) showed right side involvement and bilateral involvement was found in 8(19%).

This is in correlation with the study conducted by Cockett, Niges and Thomas (1976) who showed that the venous abnormalities were more common in the left extremity. This was attributed to the crossing over of left common iliac vein by right common iliac artery, giving rise to venous stasis. Also in a venographic study of the incidence of DVT, Stamatakis JD et al (1978) found that major thrombi occur more frequently in the left limb.

SYMPTOMS:

The symptoms that prompted for Doppler examination were swelling in 6 (12%) patients, varicosity in 22(44%), pain in 8 (16%), ulcer in 7(14%), varicosity and swelling in 3 (6%), varicosity and pain in 2 (4%) and eczema in 2(4%) patients^[7].

In cases showing venous abnormalities; varicosity (44%) were the predominant symptoms. Among the 18 patients showing evidence of DVT the most common symptom was swelling (55.56%), next most common symptom was venous ulcer (38.89%).

This correlates with the study by Glover G et al (1996). In their study 40% of cases with unilateral leg swelling were found to have DVT by duplex scanning, whereas DVT was evident in only 5% of patients in

the absence of leg swelling. This is explained by the venous physiology that when the major venous channels are occluded, the resultant increase in venous pressure and volume manifest itself as edema^[9].

This is in correlation with the study by Langefeld M et al (1987) who also found that leg swelling was the most common symptom in patients diagnosed to have DVT^[4].

Predisposing factors were searched retrospectively in those patients who had positive doppler findings. In our study with doppler findings of DVT history of prolonged hospitalization 5 (27.8%) and trauma 3 (17%) were the most common factors. History of previous surgery was noted in 2 (11%); no known predisposing factors in 8 (44.44%). In cases with other cause of varicosities occupational, prolonged standing were common in 8 (33.33%); hereditary factors 3 (13%); trauma in 3 (13%) and no known predisposing factors noted in 8 (33.33%) [Table 1].

Table 1: Predisposing Condition

Pre disposing condition	Number of patients (n=50)	%
Absent	26	52.0
Present	24	48.0
• Occupational	10	20.0
• Prolonged hospitalization	5	10.0
• Hereditary	3	6.0
• Trauma	3	6.0
• Surgery	2	4.0
• Others	1	2.0

DISTRIBUTION OF VARICOSITIES:

This includes both primary and secondary varicosities involving 40 patients whose Doppler findings were suggestive of varicosities. 25 patients had left sided involvement, 12 right sided involvement; 3 patients had bilateral involvement [Table 4,5].

Table 4: Varicosity Distribution To Deep Vein Thrombosis Of Patients Studied

Varicosity	Deep vein thrombosis				P value
	NO (n=32)		YES (n=18)		
	No	%	No	%	
Absent	10	31.2	5	27.7	0.288
Present	22	68.8	13	72.2	
• Great saphenous vein	19	59.4	11	61.1	
• Short saphenous vein	3	9.4	2	11.1	

Table 5: Anatomic Distribution Of Varicosities Distribution To Deep Vein Thrombosis Of Patients Studied

Anatomic distribution of varicosities	Deep vein thrombosis				
	NO (n=32)		YES (n=18)		P
	No	%	No	%	
Sapheno femoral junction (SFJ)					
• No	15	46.8	11	61.1	0.388
• Yes	17	53.2	7	38.8	
Sapheno popliteal junction (SPJ)					
• No	27	84.3	13	72.2	0.463
• Yes	5	15.6	5	27.8	

Varicosities along GSV predominated in our study, 30 cases (86%); and along SSV 5 cases (14%) were noted [Images 2,4]. Sapheno femoral junction incompetence was noted in 24 (57%) of our cases [Table 2].



Image 2: Left Sapheno Femoral Junction Incompetence

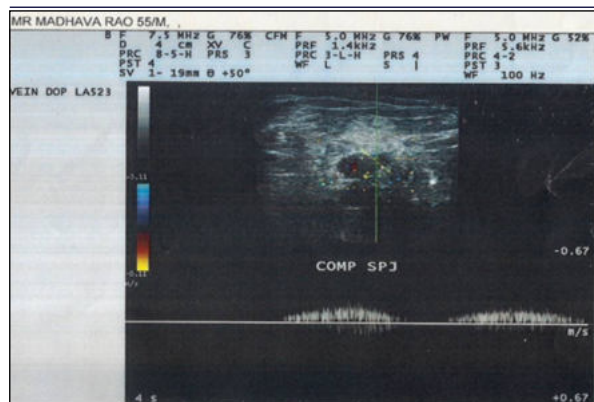


Image 4: Competent Sapheno Popliteal Junction.

Table 2: Anatomic Distribution Of Varicosities

Anatomic distribution of varicosities	Number of patients (n=50)	%
Sapheno femoral junction (SFJ)		
• No	26	52.0
• Yes	24	48.0
Sapheno popliteal junction (SPJ)		
• No	40	80.0
• Yes	10	20.0

SPJ incompetence was noted in 9 (21.5%) cases of which 3 cases showed associated dilatation varicosities of short saphenous vein.

This is in accordance with the study by Engelhom CA (2005) et al, in which reflux was detected in 472 extremities (80%): 100 (17%) had reflux in both the GSV and SSV, 353 (60%) had GSV reflux only, and 19 (3%) had SSV reflux only, for a total prevalence of 77% at the GSV and 20% at the SSV.

Perforator incompetence was seen in 38 (95%) cases of the 40 varicosity cases[Image 3]. Below knee, mid calf and above ankle perforators showed (20 cases each, 50%) equal incidence and distribution and were the most common[Table 3].

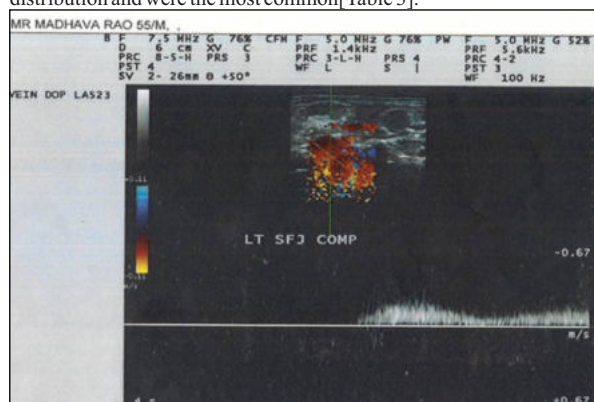


Image 3: Left Sapheno Femoral Junction Competence

Table 3: Perforator Incompetence

Perforator incompetence	Number of patients (n=50)	%
Above knee(AK)		
• No	48	96.0
• Yes	2	4.0
Below knee (BK)		
• No	30	60.0
• Yes	20	40.0
Mid calf		
• No	30	60.0
• Yes	20	40.0
Above ankle		
• No	30	60.0
• Yes	20	40.0

This correlated with the study by Dellis KT et al (1998) who found that IPV s are located predominantly in the medial aspect of lower

extremity, more often in the middle third of the calf, followed by lower calf and middle thigh. The prevalence of IPV's and their calf to thigh ratio increased linearly with the clinical severity of CVI.

Out of the 8 cases with normal doppler study, 2 cases showed normal findings[Image 4].

Out of 6 cases 2 cases were bakers cyst and 4 cases were cellulitis. Additional finding of inflamed bursa and ruptured bakers cyst were seen in 2 cases, who also had doppler evidence of DVT; probably it might also have contributed to presenting symptom of pain in them.

CONCLUSION:

Lower limb venous system pathology is a common occurrence and clinically presents venous insufficiency situation which may be associated with considerable morbidity and mortality. Colour duplex assessment of peripheral veins gives diagnostically adequate anatomic and hemodynamic information. Colour Doppler can be used instead of venography or vancography in many cases and may be the only examination required to define the anatomy and function in patients with varicose veins. Varicography show perforator veins which are obviously incompetent and some superficial and deep venous segments but ultrasound has the advantage that the segments of deep and superficial systems can be examined and the direction of blood flow within each segment can be demonstrated. Colour doppler helps in differentiation between obstruction and valvular incompetence. Colour doppler valuable in Accurate clot localization in cases with diagnosis of DVT. Colour doppler defines the location and extent of valvular dysfunction. Colour doppler is easy to evaluate the competence of SFJ and SPJ valves and depict anatomic variations, collaterals.

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