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Original Research Article

Location of venous reflux in our duplex test of patients with primary chronic venous insufficiency and comparison with that of the literature

Mohammad Rashal Chowdhury[1]*, M. Aslam Hossain[1], Niaz Ahmed Choudhury[2], A. K. Al-Miraj[2], Nur Mohammad Arif Sarker[3]

[1]Department of Cardiac Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[2]Department of Vascular Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh
[3]Department of Neuro Anaesthesiology, National Institute of Neuroscience & Hospital, Dhaka, Bangladesh

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***Correspondence:**
Dr. Mohammad Rashal Chowdhury,
E-mail: rashel.dr.bsmmu.cvt@gmail.com

ABSTRACT

Background: Chronic venous insufficiency (CVI) significantly impacts patients' quality of life and poses economic burdens on healthcare systems. Accurate assessment of venous reflux is crucial for effective management. This study aimed to identify the sites of deep, superficial, and perforator venous reflux, including junctional incompetencies between superficial and deep veins in patients with primary CVI.
Methods: A prospective observational study was conducted from July 1, 2022 to June 30, 2024, utilizing non-invasive Duplex ultrasonography on patients in our clinical practice. Data were collected without patient identification, and informed consent was obtained prior to procedures. Reflux was defined as venous flow reversal lasting over 0.5 seconds.
Results: A total of 50 limbs from patients aged 20 to 77 years (mean age 43) were examined, with a male-to-female ratio of 52:48. Reflux was detected in the external iliac (41 limbs), common femoral (39 limbs), superficial femoral (21 limbs), popliteal (26 limbs), posterior tibial (7 limbs) and perforator veins (21 limbs). Sapheno-femoral junction incompetency was observed in 28 cases, with 6 cases indicating early-stage reflux. Dilatation of the great saphenous vein was noted in 33 cases, while 14 cases exhibited short saphenous vein dilatation.
Conclusions: The detection of venous reflux reveals significant insights for diagnosing and managing CVI. This study highlights areas for improvement in Duplex examination techniques, advocating for enhanced training for healthcare professionals to elevate diagnostic standards, ultimately benefiting patient outcomes and reducing societal burdens associated with CVI.

Keywords: Chronic venous insufficiency, Duplex ultrasonography, Superficial veins, Vascular health, Venous reflux

INTRODUCTION

Chronic venous insufficiency or chronic venous disease usually involves the venous system of both lower limbs.[1] It is manifested as leg swelling, dull ache, heaviness, cramping of calf muscles at night, venous claudication, telangiectasia, reticular veins, dilatation and tortuosity of veins under the skin or varicose veins, venous eczema and ulceration of the leg.[2] It is a chronic condition so if the disease is not properly treated at its early stage it may hamper normal activities and loss of working hour of the patient even causing early retirement from job.[3] It has economic and other impact to the patient and the society. Although the prevalence of this disease in our population is not studied properly yet, we thought that millions of our populations are affected by this disease.[4] In our

practice we are observing that number of the patients of chronic venous disease is increasing in recent years in our population including younger age group.[5] Prevalence of the disease in different countries (USA and western Europe) described in the literature is from 5 % to 40 % and is shown more in some studies.[6]

Chronic venous insufficiency is caused by genetic and environmental factors, prolonged standing, lack of physical activities, obesities, high statue, increasing age, parity.[7] Some investigator claims ethnicity and food habit as causation of this venous disease.[8] Some professionals are more affected with this disease like teachers, traffic police, surgeons like cardiovascular surgeons and neurosurgeons, garments workers, hotel boy, remittance fitter and bankers.[9]

Normal ambulatory venous pressure does not remain elevated, due to the pumping action of our calf muscle and properly functioning venous valve and competent venous wall. In standing posture, our peripheral heart (calf muscle) has to return blood against the effect of gravity and the intrathoracic pressure.[10] The disease process start duo to incompetency in the venous valve and/ or abnormalities in the venous wall leading to venous hypertension.

Changes in venous hemodynamics causes stress on the venous system of the limbs resulting in dilatation of the veins (superficial and deep) and perforators and valve failure within the venous segment in the involved limb.[11] Increased venous pressure initiate chronic inflammatory process due to stasis and pulling of the blood at periphery. Due to stasis of blood biochemical changes occur with the trapped red blood cells. White blood cells and red blood cells comes out of the microcirculation through the capillary.[12] Free radicles are released within the tissue causing destructions. As the process continues skin colour changes take place and ultimately skin ulceration occur if left untreated or maltreated.[13]

Chronic venous insufficiency in clinical stage 5 and 6 is difficult to treat. Chronic non-healing venous ulcer takes time to heal and treatment is costly and patient could not attain at job.[14] This causes financial loss. Patient needs regular four layers mechanical bandage with surgical wound care. Hospitalization is need for surgical management.[15] Patient has to carry treatment cost also. Clinical Etiological Anatomical and Pathophysiological (CEAP) classification system is one of the most accepted tools for categorizations of the of patients of this disease.[16]

This classification system helps to diagnose, to assess the severity of the disease, planning of the treatment and follow-up the patient after treatment. Chronic venous insufficiency is diagnosed by Doppler ultrasound examination and severity is evaluated by air plethysmography.[17] In selected cases venogram is necessary for extended evaluation of the anatomy. Available treatment options for chronic venous disease are mechanical, medical, endo-vascular and surgical.[18] The goal of these treatment is ablation of superficial veins and perforating veins.[19] Although these treatment modalities can improve of clinical condition of the disease, abnormalities of the deep veins remain in situ.[20]

So, study is needed to find out deep venous abnormalities more precisely to find out the patient's group those needed further treatment modalities besides this. Deep venous incompetency is manifested as deep venous reflux of that segment of vein in duplex study.

Aim of this study was to observe the distribution of flow reversal or reflux in different venous segments of lower limbs of patients presented with chronic venous insufficiency and to compare the findings in the literatures.

METHODS

Study place

This prospective observational study was conducted in the Department of Cardiac Surgery, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.

Study duration

The study was conducted from 1st July 2022 to 30th June 2024 to evaluate venous reflux distribution in 50 limbs of 25 patients diagnosed with chronic venous insufficiency.

Purposive sampling was used to select patients with a clinical diagnosis of chronic venous insufficiency.

Exclusion criteria

Patients with a history of deep vein thrombosis, prior venous surgery, congenital venous malformations, or active malignancy were excluded from the study.

Duplex ultrasound, performed by a qualified vascular surgeon, was used to assess venous reflux, defined as retrograde flow lasting more than 0.5 seconds. The examination included both deep and superficial venous segments, focusing on the external iliac, common femoral, superficial femoral, popliteal, posterior tibial veins, and the great and short saphenous veins.

Perforator veins and the sapheno-femoral and sapheno-popliteal junctions were also examined. Manual compression and the Valsalva maneuver were applied during the ultrasound to evaluate venous valve competency.

Patients unable to stand during the procedure were examined in the reverse Trendelenburg position. Data were collected on the presence of reflux, venous diameter, and dilatation, and statistical analysis was

performed to assess the distribution of reflux across the venous segments.

RESULTS

Table 1 provides a summary of the demographic characteristics of the patients involved in the study. A total of 25 patients were examined, with a total of 50 limbs being evaluated. The age of the patients ranged from 20 to 77 years, with a mean age of 43 years. The gender distribution was relatively balanced, with a male-to-female ratio of 52:48.

Table 2 shows the distribution of venous reflux across different venous segments in 50 limbs from 25 patients with chronic venous insufficiency. Reflux was most prevalent in the external iliac veins (82%) and common femoral veins (78%), with a nearly equal distribution between right and left limbs.

The popliteal veins (52%) and superficial femoral veins (42%) also showed significant involvement. The sapheno-femoral junction exhibited reflux in 56% of limbs, while early-stage reflux was observed in 12%. Reflux was less common in the posterior tibial veins (14%), great saphenous veins (22%), perforator veins (42%), and the sapheno-popliteal junction (10%). Overall, the findings indicate a higher prevalence of reflux in the proximal venous segments.

Table 3 shows the distribution of venous dilatation in the great and short saphenous veins. Venous dilatation was more common in the great saphenous veins, found in 66% of limbs, with similar proportions between right (34%) and left (32%) limbs. The short saphenous vein was dilated in 28% of limbs, with slightly more cases on the left side (16%) compared to the right (12%) respectively.

Table 4 presents the coincidental findings observed during the study. Three patients exhibited isolated dilatation of the great saphenous vein, with the vein diameter ranging from 3.5 mm to 1.3 cm. Additionally, one patient presented with isolated varicosities in the short saphenous vein. In patients classified as stage 4b, dilatation of the perforator veins was observed without the presence of venous reflux, indicating that vein dilatation may occur prior to the onset of reflux in some cases.

Table 1: Demographic information of patients.

Parameter	Value
Number of patients	25
Number of limbs examined	50
Age range (years)	20-77
Mean age (years)	43
Male: Female ratio	52:48

Table 2: Distribution of venous reflux in different venous segments.

Venous segment	Total limbs	Right limbs	Left limbs
	N (%)	N (%)	N (%)
External iliac veins	41 (82)	22 (44)	19 (38)
Common femoral veins	39 (78)	19 (38)	20 (40)
Superficial femoral veins	21 (42)	10 (20)	11 (22)
Popliteal veins	26 (52)	10 (20)	16 (32)
Posterior tibial veins	7 (14)	3 (6)	4 (8)
Sapheno-femoral junction	28 (56)	14 (28)	14 (28)
Early-stage sapheno-femoral reflux	6 (12)	5 (10)	1 (2)
Great saphenous veins	11 (22)	6 (12)	5 (10)
Perforator veins	21 (42)	11 (22)	10 (20)
Sapheno-popliteal junction	5 (10)	3 (6)	2 (4)

Table 3: Venous dilatation in great and short saphenous veins.

Venous segment	Total limbs	Right limbs	Left limbs
	N (%)	N (%)	N (%)
Great saphenous vein	33 (66)	17 (34)	16 (32)
Short saphenous vein	14 (28)	6 (12)	8 (16)

Table 4: Coincidental findings.

Finding	Number of patients
Isolated great saphenous vein dilatation	3
Diameter of great saphenous vein (range)	3.5 mm to 1.3 cm
Isolated short saphenous vein varicosities	1
Perforator vein dilatation without reflux	Observed in stage 4b patients

DISCUSSION

This study aimed to identify the most effective method for evaluating venous incompetency, specifically focusing on flow reversal or reflux. Our findings support the use of color Doppler ultrasound as the preferred diagnostic tool, superior to other method like as phlebography. This aligns with current literature emphasizing the advantages of color Doppler,

particularly in assessing venous conditions due to its non-invasive nature and real-time imaging capabilities.

Standing position emerged as the optimal posture for detecting reflux in the lower limbs, as it increases venous pressure, thereby enhancing the visibility of venous diameters. Previous studies, such as those by Labropoulos et al, corroborate this, suggesting that standing significantly improves the sensitivity and specificity of detecting venous reflux.[21] In contrast, a study by Eberhardt et al emphasized that inadequate positioning during assessments could lead to missed diagnoses. For patients unable to stand due to health issues, the supine position with a 15-degree reverse Trendelenburg tilt is recommended, providing a viable alternative for those with mobility constraints.[22]

Once reflux is identified at a particular location, the next steps involve assessing the extent, severity, source, and path of the reflux. The diameter of the veins is a critical predictor of flow reversal, underscoring the importance of documenting venous dimensions at key anatomical sites. Our standard Duplex examination protocols, which take approximately 30 minutes for one limb and 60 minutes for both, are consistent with practices reported in vascular laboratories in Hamilton, New Zealand. This time efficiency, combined with the need for clear anatomical understanding-given the variability in venous anatomy across individuals-highlights the importance of thorough training for personnel conducting these assessments.

Subject variability poses a significant challenge in reflux detection. Therefore, standardizing the briefing and demonstration of the Valsalva maneuver prior to testing is crucial to ensure accurate results. Some patients may struggle to perform this maneuver, necessitating alternative techniques to ensure reliable assessments. A study by Selis et al demonstrated that patient education and proper technique could significantly enhance diagnostic accuracy.[23]

Both transverse and longitudinal views of veins should be examined, employing color and spectral Doppler techniques at a 60-degree angle with low scale and high gain settings using a 5 to 10 MHz linear array transducer. In this study, we defined the presence of reflux based on a reflux duration of 0.5 seconds for all veins examined, resulting in a higher incidence of identified reflux in the external iliac and common femoral segments. Our results are consistent with findings from Fukuoka et al, who reported a similar prevalence of reflux in these segments among patients with chronic venous insufficiency.[24]

While we conducted assessments primarily in the supine position, we acknowledge that further evaluations in standing posture could provide additional insights and confirmation of our findings. The reported incidence of reflux in the great saphenous vein (GSV) in our study, at 22%, aligns with literature indicating that the GSV is commonly involved in chronic venous insufficiency.[25]

Notably, our findings regarding coincidental findings, such as isolated great saphenous vein dilatation observed in three patients, reflect similar observations in studies by Necas, who found that coincidental venous conditions often accompany primary chronic venous insufficiency.[26] The prevalence of dilated perforator veins without reflux in Stage 4b patients further highlights the complexity of chronic venous disease and suggests that attention should be paid to these coincidental findings in clinical evaluations.

Our study reinforces the utility of color Doppler ultrasound in diagnosing venous incompetency and highlights the importance of positioning and anatomical awareness in enhancing detection accuracy. By comparing our findings with existing literature, we illustrate the consistency of our results with broader research trends, supporting the call for comprehensive evaluations that incorporate various patient positions. As we continue to refine our methodologies, further investigations are warranted to establish standardized protocols that can be widely adopted to improve patient outcomes in the management of chronic venous insufficiency.

Our study included a relatively small sample of 25 patients, limiting the ability to generalize the findings across a broader population. Future studies with larger sample sizes are needed to validate these results. This research was conducted in a single medical center, which may not represent the diversity of clinical practices in other hospitals or regions. Multicenter studies would provide more robust conclusions. The majority of the Duplex examinations were performed in a supine position. Reflux testing in standing positions may have yielded more comprehensive results, as standing often enhances reflux detection due to increased venous pressure. The study relied solely on Duplex ultrasound for reflux detection. Comparisons with other advanced imaging modalities such as MR venography or CT venography were not included.

CONCLUSION

Detection of venous reflux with abnormalities in veins of the lower limbs has diagnostic, therapeutic and prognostic value in primary chronic venous insufficiency. It can detect recurrence of the disease after the procedure for varicose veins associated with chronic venous insufficiency. From this study we have find out some lacking in Duplex examination that are practicing by us and many of the operators in the country. We believe that this study along with the future studies will be carried out will benefit the practicing physician and vascular surgeons to maintain an international standard level of color Doppler study. Ultimately our patients' populations will be benefited a lot. By early diagnosis financial and other burden to the society will be removed un doubtfully.

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