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Assessment of Occupation-Related Lower Limb Venous Disorders Using Doppler Ultrasonography: A Cross-Sectional Study

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ABSTRACT

The lower limb contains the hip, femur, knee joint, tibia, fibula, and foot. Some common abnormalities of lower limbs are varicose veins, followed by deep vein thrombosis, fractures, tumors, etc. **Objectives:** To evaluate lower limb venous abnormalities in patients related to their occupation using Doppler ultrasonography. **Methods:** This was a descriptive cross-sectional study conducted within the Radiology Department. A high-frequency linear probe, a TOSHIBA ultrasound machine, and the patient table were used in the equipment for this study. The patients were included after written consent. A sample size of 117 patients was considered using a convenience sampling technique. All patients with lower limb pain, swelling, tortuous veins, and tenderness were included in the study. The data were entered and analyzed using SPSS version 26.0. **Results:** Lower limb abnormalities are most common at the age of 41-50 years, 46 (39.3%). There were 75 (64.1%) male in the study and 42 (35.9%) female in the study. Most of the patients, 41 (35.0%), were housewives, followed by businessmen, 4 (20.5%). Superficial femoral vein 55 (47.0%) was involved in most patients. The most common diagnosis was varicose veins, 71 (60.7%), followed by deep vein thrombosis (DVT), 32 (27.4%). Lower limb venous abnormalities are seen to be more common in male than in female. These abnormalities are common at the age of 41-50 years. **Conclusions:** In conclusion, the most common occupation is seen to be housewives. The most common venous abnormality was left-sided varicose veins, followed by Deep Vein Thrombosis.

INTRODUCTION

The lower limb contains the hip, femur, knee joint, tibia, fibula, and foot. The femur is one of the longest, heaviest, and strongest bones in the body. The femur contains a pyramid neck attached to the proximal side, two bony protrusions, and a lesser and greater trochanter that move the hip and knee [1]. The hip is a kind of ball-and-socket joint composed of the acetabulum, which is connected by the ligament femoris. The knee, also called the patella, is the largest joint of the human body. The knee contains the medial collateral ligament, the lateral collateral ligament, the anterior cruciate ligament, and the posterior cruciate ligament. Its main functions are to provide movement and weight-bearing to the human upper skeleton [2, 3]. The venous system of the lower limbs is divided into two parts: superficial veins and deep veins [4]. The femur is supplied by the femoral artery (a branch of the external Iliac artery), medial and lateral circumflex arteries, and obstructer artery (IIA) [5]. Deep Vein anatomy in the lower limbs varies quite a bit. Veins typically follow arteries. The posterior tibial, peroneal, and anterior tibial veins run with the major arteries in the leg; there are often two, but seldom three, veins with each artery. The gastrocnemius veins, which are the greatest of these, are visible in the upper calf as they ascend to join the other deep veins in the lower popliteal area. The small saphenous vein is located subcutaneously on the fascia surrounding the calf, whereas the

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gastrocnemius vein can be followed distally down into the muscle [6]. Some common abnormalities of lower limbs are varicose veins, followed by deep vein thrombosis, fractures, tumors, etc. DVT can be symptomatic or asymptomatic and can cause severe complications in the human body [7]. Some risk factors of DVT are ankle, femoral fractures, diabetes, and pulmonary embolism. The incidence of DVT in adult populations is 1.6 1.8 approximately 1 per 1000 annually. In one month, approximately 6% died with DVT and 10% with PE [8]. Diagnoses of DVT are lower in the United States, while 25% higher in America. It is seen to be more common in men than in women. The mortality rate of DVT is higher in the early years, while the annual mortality rate noted was 1.6% [9]. DVT is mostly asymptomatic and cannot be detected on physical examination. Prolonged work- and computer-related seated immobility also increases the risk of venous thromboembolism, highlighting the occupational component of venous disorders [10]. When it is symptomatic, some common symptoms can be a warm affected site, swelling, pain, redness of the area, and engorged superficial veins of the legs. Some other symptoms, including discoloration, dilated superficial veins, and swelling, can be noted in case of calf vein thrombosis [11]. A symptom called Homan's sign is noted during examination, suspecting DVT, in which when the knee is extended, DVT with dorsiflexion or the foot will experience calf pain [12, 13]. Varicose veins are another type of lower limb pathology. In varicose veins, dilatation of veins occurs most commonly in the lower limbs, often linked to occupational strain and prolonged standing [14]. Discomfort in legs, discoloration of the area around the ankle, cluster of veins, enlarged veins, and dark veins are common clinical features. Some common causes are prolonged sitting, standing, damage to the valves of the lower limbs, and loss of elasticity in the veins. Another abnormality is a thrombus in the lower limb [15]. After surgery, most tiny thrombi in the lower extremities usually resolve on their own. However, these thrombi may expand into the proximal femoral venous system of the leg in roughly 15% of patients [16, 17]. Blood flow in the veins slows and even stops in certain places when there is no regular contraction of the leg muscles, such as while walking or moving, which puts patients at risk for thrombosis. Around 15% of isolated calf vein thrombi in the postoperative patient extend to the femoral vein, whereas up to 50% of all isolated calf vein thrombi resolve spontaneously within a few hours [18]. The current study shows that Color Doppler ultrasound depicts the type and level of incompetence, venous reflux, and presence of varicose veins and superficial thrombosis. The study suggests that Doppler ultrasound can help in the early detection of clinically suspected cases. Furthermore, it emphasizes the association between occupational risk and venous abnormalities, encouraging early screening in professionals with prolonged standing or sitting jobs. The current study creates awareness among people of several professions involving long conditions to get scanned early in case of any discomfort to prevent pulmonary embolus and other complications of the lower limbs.

This study aimed to evaluate lower limb venous abnormalities in patients related to their occupation using Doppler ultrasonography.

METHODS

This was a descriptive cross-sectional study conducted within the Radiology Department of Aziz Bhatti Teaching Hospital, Gujrat, Pakistan. The primary aim of this analysis was to describe the sample characteristics and the prevalence of findings. Therefore, the results are presented using descriptive statistics (frequencies and percentages) to summarize the data. Inferential statistics were not employed as the study design was not geared towards testing specific hypotheses or associations between variables. Data were obtained from the hospital in the period of 6 months from September 2022 to February 2023. A high-frequency (7–10 MHz) linear probe, a TOSHIBA ultrasound machine, and a patient table were used in the equipment for this study. The patients were included after written informed consent. Ethical approval was taken from the institute. The subjects were informed that there are no bio-effects of Doppler USG, and the procedure was non-invasive. Patients were scanned in the supine and standing positions. The probe was placed in the longitudinal plane. The scan started from the iliac veins, followed by the saphenous, inferior calves, and superficial veins. Then the patient was turned into a decubitus position to scan the knee and lower leg partially. A sample size of 117 patients was calculated by taking the mean of three previously published articles, using convenient sampling techniques. The sample size was calculated using the formula for estimating a single population proportion for descriptive cross-sectional studies. Based on previous literature, the proportion (p) of lower limb venous abnormalities in symptomatic patients was assumed to be 50% to obtain the maximum sample size, with a 95% confidence level and a 9% margin of error (d). This calculation yielded a minimum sample size of 119 participants. The final sample of 117 was therefore adequate and aligns closely with this calculated requirement. Convenience sampling was used as patients were enrolled from those presenting to the Radiology Department during the study period; although this may introduce selection bias, it was the most feasible approach to achieve the required sample size within the available

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time frame. Patients who had lower limb symptoms were included in the study and were included in the Radiology Department. All patients with lower limb pain, swelling, tortuous veins, and tenderness were included in the study. Patients diagnosed with scrotal hernia, femoral hernia, and carcinoma were excluded from the study. The data were collected using data sheets according to the variables of the questionnaire, including age, gender, diagnosis, site, occupation, and USG findings. All examinations were performed using a TOSHIBA ultrasound machine with a 7–10 MHz linear probe. Patients were examined in supine and standing positions. Scanning was performed in a longitudinal plane from the iliac to the calf veins, including common femoral, superficial femoral, popliteal, great and lesser saphenous veins. B-mode imaging assessed vein morphology and compressibility, while Color and Spectral Doppler evaluated flow direction and reflux. Venous reflux was defined as reverse flow >0.5 seconds in superficial and >1.0 seconds in deep veins after compression or during the Valsalva maneuver. Non-compressibility with absent color flow indicated deep vein thrombosis (DVT). All findings were recorded on standardized data sheets, and machine settings were kept uniform to ensure consistency. The data were entered and analyzed using SPSS version 26.0. Given the descriptive nature of this cross-sectional study, the analysis was focused on summarizing the sample characteristics and the prevalence of findings. Descriptive statistics were employed: categorical variables (e.g., gender, occupation, diagnosis) are presented as frequencies and percentages (n, %). Continuous variables (e.g., age) were categorized and also presented as frequencies and percentages. No inferential statistical tests (e.g., chi-square, t-tests) were applied, as the study objective was to describe the distribution of venous abnormalities and not to test formal hypotheses or associations between variables.

RESULTS

Findings show the age of the patients. The age was divided into different groups. The first age group was 20-40 years, 45 (38.5%), followed by 41-50 years, 46 (39.3%), and 61-70 years, 26 (22.2%). Lower limbs abnormalities are most common at the age of 41-50 years, 46 (39.3%). The study illustrated the distribution of patients' ages in relation to lower limb abnormalities. This suggests that lower limb abnormalities are most prevalent among middle-aged patients. There were 75(64.1%) male in the study and 42(35.9%) female. 41 (35.0%) were housewives, 24 (20.5%) were businessmen, 24(20.5%) were storekeepers, 20 (17.1%) were painters, and 8 (6.8%) were jobless. Most of the patients, 41 (35.0%), were housewives, followed by businessmen (Table 1).

Table 1: Age and Gender of the Patients

Variables	Frequency (%)	Valid Percent	Cumulative Percent
Age			
20-40 Years	45 (38.5%)	38.5%	38.5%
41-50 Years	46 (39.3%)	39.3%	77.8%
61-70 Years	26 (22.2%)	22.2%	100.0%
Total	117 (100%)	100.0%	–
Gender			
Male	75 (64.1%)	64.1%	64.1%
Female	42 (35.9%)	35.9%	100.0%
Total	117 (100.0%)	100.0%	–
Occupation			
Housewife	41 (35.0%)	35.0%	35.0%
Businessman	24 (20.5%)	20.5%	55.6%
Storekeeper	24 (20.5%)	20.5%	76.1%
Painter	20 (17.1%)	17.1%	93.2%
Jobless	8 (6.8%)	6.8%	100.0%
Total	117 (100.0%)	100.0%	-

Common femoral veins were involved in 35 (29.9%) patients, followed by the popliteal vein in 3 (2.6%), the great saphenous vein in 13 (11.1%), the lesser saphenous vein in 3 (2.6%), deep calf veins in 8 (6.8%), and the superficial femoral vein in 55 (47.0%). In most of the patients, superficial femoral veins are 55 (47.0%), followed by common femoral veins 35 (29.9%) (Table 2).

Table 2: Vein involvement

Variables	Frequency (%)
Common Femoral Vein	35 (29.9%)
Popliteal Vein	3 (2.6%)
Great saphenous vein	13 (11.1%)
lesser saphenous vein	3 (2.6%)
Deep Calf veins	8 (6.8%)
Superficial femoral vein	55 (47.0%)
Total	117 (100.0%)

The study presents the distribution of venous abnormalities according to the affected side. Findings revealed that venous abnormalities were predominantly left-sided, observed in 82 patients (70.1%), whereas 35 patients (29.9%) showed right-sided involvement. This indicates that left lower limb venous abnormalities were more frequent among the study participants (Table 3).

Table 3: The Side of the Leg

Variables	Frequency (%)
Right	35 (29.9%)
Left	82 (70.1%)
Total	117 (100.0%)

Normal patients referred to symptomatic patients who presented with lower limb complaints but showed no detectable venous abnormalities on Doppler ultrasonography. These patients were included because

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they met the clinical inclusion criteria, although their scans were reported as normal. The most common diagnosis was varicose veins, 71(60.7%), followed by DVT, 32(27.4%), and cellulitis, 7(6.0%)(Table 4).

Table 4: Diagnosis of the Patients

Variables	Frequency (%)
Cellulitis	7(6.0%)
Varicose Veins	71(60.7%)
DVT	32(27.4%)
Normal	7(6.0%)
Total	117(100.0%)

DISCUSSION

A study was done by Sharma et al. in which 100 patients of all ages and genders were included. All patients were present in the radiology department complaining about lower limb pain or swelling, etc. The objective of the study was to evaluate the frequency of lower limb venous abnormalities using color Doppler ultrasonography. In the study, it was concluded that lower limb venous abnormalities are most commonly seen in the aged 21 to 40 years. The study also revealed that the frequency of varicose veins is most seen in patients who were presented to the radiology department and were followed by DVT [19]. The current study also concluded that the most common disease diagnosed in patients using Doppler ultrasonography is varicose veins. Varicose veins are more common in males, including lower limb tortuous veins. One retrospective study was done by Zaria *et al.* in which a total of 252 patients were included. All patients visiting the Radiology Department for the scan of the lower limbs were included in the study. The scanning of patients was done by using DC-3Mindray Ultrasound machines. The most common focus on lower limbs venous abnormality was on DVT. Out of 252 patients, 122 were male and 130 were female. The objective of the study was to determine the role of USG in diagnosing DVT as a lower limb venous abnormality. The results of the study revealed that DVT is more common in females in middle age. Left-sided leg DVT was more common than right-sided DVT. DVT was most noted in the area above the knee joint. The study concluded that DVT can accurately be diagnosed by using ultrasonography as a gold standard [20]. The current study also concluded that DVT is common in patients after varicose veins in which is commonly noted above the knee joint, and it is seen to be more common in the left-sided leg than the right-sided leg. A study was done by Abou-ElWafa *et al.* in which a questionnaire was used to record the answers of patients. A sample size of 201 patients was taken. The study aimed to evaluate the varicose veins and their associated risk factor in patients. It was concluded in the study that prolonged standing is one of the major risk factors with a prevalence of 18.4% for developing varicose veins in patients referred to the radiology department [21]. In the current study, most of the patients were housewives and had a history of prolonged standing and sitting. It is proven that prolonged sitting and standing are the cause of lower limb venous abnormalities. Another study done by Subramani and fellows concluded that one of the most common and accurate tools for diagnosing venous abnormalities of the lower limb is ultrasound. Color Doppler ultrasound is also useful for assessing blood flow, edema, and other important parameters to evaluate venous abnormalities. The study revealed that ultrasound is a noninvasive, portable, and cheap modality for diagnosing lower limb pathologies [22]. The current study also proved that venous abnormalities of the lower limb can be accurately diagnosed using color Doppler ultrasonography.

CONCLUSIONS

In conclusion, this study found that varicose veins were the most common lower limb venous abnormality, followed by deep vein thrombosis. These conditions were more frequently observed in the left lower limb and were most prevalent among individuals aged 41–50 years. Housewives constituted the largest occupational group affected, highlighting a potential association between prolonged standing and venous disorders.

Authors Contribution

Conceptualization: WK
Methodology: KN, MM
Formal analysis: WK, NA
Writing review and editing: WK, NA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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