Evaluation of Lower Limb Venous Incompetence and Varicosities Using Doppler Ultrasound

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Abstract

Background: lower extremities varicose veins are one of the common diseases with widely varying prevalence. In recent years, advanced imaging techniques have developed the field of varicose vein diagnosis and evaluation. Doppler ultrasound (US) serves as the standard first-line tool for evaluating lower limb Varicose. **Aim of the study:** this study aimed to evaluate the prevalence of venous incompetence and the types and distribution of varicosities in lower limb veins using Doppler ultrasound. **Research Design:** A cross-sectional study carry out at ultrasound department in King Fahad General Hospital – Jeedah, It sought to understand the associated complications and the correlation between age and the severity of findings in the study population. **Study subjects**: A total of 100 patients, 27 males (27%) and 73 females (73%), with a mean age of 47.8years, were enrolled for the study from ultrasound department. **Tools of data collection:** Doppler ultrasound was utilized for venous assessment, focusing on the great saphenous vein, short saphenous vein, sapheno-femoral junction, and perforating veins. Varicosities were classified as reticular or segmental, and complications such as mild edema and superficial thrombophlebitis were assessed**. Results:** it was revealed from the study that a high prevalence of venous incompetence, with the great saphenous vein were showing incompetence in 47% of cases. Also, Varicosities were present in 90% of participants, mostly reticular. And, the Associated complications included mild edema (17%) and superficial thrombophlebitis (4%). **Conclusion:** A significant correlation was found between age and severity of venous findings, with older patients revealing more severe incompetence and extensive varicosities.

Keywords: Doppler US, Varicosities, competence, GSV, SSV, SFJ

Introduction

Lower extremities Venous pathology is a serious health problem with economic and social costs. It comprises rang of pathologies such as minor varicose veins (VVs) and venous static ulcers (SUs) and potentially deadly deep vein thrombosis (DVT) **(Huang, Y. K., et al., 2019 & Beebe et al., 2005).** Varicose veins are a frequent, multifactorial disease. Despite its prevalence, the pathophysiological mechanism of varicose veins remains incompletely understood. According to various sources, the key mechanisms of the development of this disease are valvular insufficiency and changes in the venous wall **(Kolosovych, et al., 2025).**

Lower extremities varicose veins are one of the common diseases with widely varying prevalence. In recent years, advanced imaging techniques have developed the field of varicose vein diagnosis and evaluation It is estimated that 30–60% of adults have some form of true lower extremity varicose veins **(Laurikka, et al., 1993)** Varicose veins are twisted, dilated veins most commonly located on the lower extremities **(Raetz, et al., 2019).** Comprise the great and small saphenous veins and their tributaries between the fascia and the skin **(Abou-ElWafa, et al., 2020)**. In addition to causing varicosities, chronic venous insufficiency, varicose can cause Potential complications include infection, leg ulcers, stasis changes, and thrombosis **(Bergan, et al., 2006).** In recent years, advanced imaging techniques have developed the field of varicose vein diagnosis and evaluation **(Karande,et al 2016).** Ultrasonography serves as the standard first-line tool for evaluating lower limb Varicose. It is painless and readily available modality that can assess the anatomy and physiology of the lower extremity venous system. It can help determine which saphenous junctions are incompetent, the diameter of the junctions, the extent of reflux, and the location and size of other incompetent perforating veins.

It can also assess for acute and occult deep venous thrombosis and superficial thrombophlebitis **(Lee, Whal et al., 2008).** However, ultrasonography is both difficult and insensitive in patients exhibiting obesity, edema, or tenderness **(Karande, et al 2016).** Other imaging modalities, such as computed tomography, magnetic resonance imaging, and venography, are used only if venous ultrasonography is inconclusive or for more complex surgical situations **(Neglén, et al., 2002).** Although Various methods are used in the preoperative evaluation of varicose veins, such as ascending venography and handheld Doppler and duplex sonography **(Pleass, H 1996)**. Because of the ability to evaluate hemodynamic information and its convenience and availability, duplex sonography is considered the reference standard for safe and accurate anatomic and functional evaluation of venous reflux **(KR, Shankar et al., 2023).**

Methodology:

This a cross-sectional study design to evaluate varicosities in lower limb veins using Doppler ultrasound. And aimed to provide a extensive understanding of the prevalence of venous incompetence, types and distribution of varicosities, associated complications, and the correlation between age and severity of findings among the study population**.**

A total of 100 patients, 27 males (27%) and 73 females (73%), with a mean age of 47.8years from ultrasound depart in King Fahad General Hospital – Jeedah, were conducted in the study. Inclusion criteria included individuals who presented with symptoms of lower limb varicose, such as leg swelling, pain, or visible varicosities. Exclusion criteria included a history of deep vein thrombosis and recent lower limb surgery. Doppler ultrasound was utilized for venous assessment, focusing on the great saphenous vein, short saphenous vein, sapheno-femoral junction, and perforating veins. Varicosities were classified as reticular or segmental, and complications such as mild edema and superficial thrombophlebitis were assessed. The demographic profile of the participants including age, sex was also recorded.

Doppler ultrasound was utilized as the primary diagnostic tool for assessing venous incompetence and identifying varicosities. All evaluations were performed by trained sonographers with expertise in vascular imaging. Also participants were examined for the presence of Mild lower leg edema, superficial thrombophlebitis and reactive lymphadenopathy the ultrasound examinations were conducted using a high-resolution ultrasound machine equipped with a linear transducer operating at a frequency of 7.5-10 MHz. Data analysis was performed using statistical software.

Results

In this section, we present the findings from evaluation of varicosities in lower limb veins using Doppler ultrasound, highlighting specific aspects of the findings related to varicosities, venous incompetence, and associated complications.

Demographics Findings

The study included a total of 100 patients, comprising 27 males and 73 females, with an age range from 20 to 74 years. The mean age of the participants was 47.7 years. The assessment revealed various degrees of venous incompetence and the presence of varicosities across different veins in the lower limbs. The demographics and general findings are summarized in **Table 1**.

Prevalence of Venous Incompetence

The evaluation of the saphenous veins and perforators demonstrated a high prevalence of venous incompetence. The findings indicated that the great saphenous vein (GSV) was incompetent in 47% of the cases, while the short saphenous vein (SSV) showed incompetence in 21% of the evaluated participants. The sapheno-femoral junction (SFJ) exhibited incompetence in 31% of the patients, while sapheno-popliteal junction (SPJ) was incompetence in 10% the prevalence rates of incompetence are detailed in **Table 2**.

Types and Distribution of Varicosities

The Doppler ultrasound findings revealed a variety of varicosities, with the most common types being reticular varicosities and segmental varicosities. Reticular varicosities were observed in 61% of the cases, while segmental varicosities were noted in 29% of the patients. The distribution of varicosities across different regions of the lower limbs is summarized in **Table 3**.

Associated Complications

The evaluation also identified several complications associated with venous insufficiency and varicosities. Mild lower leg edema was observed in 17% of the patients, while superficial thrombophlebitis was noted in 4% of the cases. Additionally, reflux 15%, and a subset of patients exhibited reactive lymphadenopathy 8%, particularly in the groin and popliteal regions. The associated complications are summarized in **Table 4**.

Correlation between Age and Severity of Findings

A significant correlation was observed between age and the severity of venous incompetence and varicosities. Patients aged 60 years and above exhibited a higher incidence of incompetence extensive varicosities and other complication such as edema, reflux, Reactive Lymphadenopathy or Reactive Lymphadenopathy, compared to younger patients. The correlation is illustrated in **Table 5**.

Table (1): The demographics characteristics and general findings of the studied sample (n=100)

Demographics	Count (n)	Percentage (%)
Male	27	27%
Female	73	73%
Age Range	20 - 74	-
Mean Age	47.8	-

Table (2): The prevalence rates of Saphenous Vein of the studied sample

Vein/Valve	Incompetence (n)	Percentage (%)
Great Saphenous Vein	47	47
Short Saphenous Vein	21	21
Sapheno-Femoral Junction	31	31
Perforators	42	42
SPJ	10	10

Table (3): The distribution of varicosities across different regions of the lower limbs of the studied sample

Type of Varicosity	Count (n)	Percentage (%)
Reticular Varicosities	61	61
Segmental Varicosities	29	29
Location - Femur	23	23
Location - Lower Leg	45	45
Location - Knee Region	32	32
Side - Left limb	35	35
Side - Right limb	33	33
Side - Bilateral	32	32

Table (4): The associated complications of the studied sample

Complication	Count (n)	Percentage (%)
Mild Lower Leg Edema	17	17
Reflux	15	15
Reactive Lymphadenopathy	8	8
superficial thrombophlebitis	4	4

Table (5): The correlation among the studied variables

Age Group	Incompetence (n)	Varicosities Present (n)	Other complications
20-39 years (n 24)	15 (62%)	20 (83%)	10 (41%)
40-59 years (n 57)	48 (84%)	52 (91%)	25(43%)
60+ years (n 19)	16 (84%)	18 (94.7%)	9 (47%)

Discussion

The findings of the study shows important perceptions into the prevalence and characteristics of varicosities and venous incompetence in lower limb veins, as evaluated through Doppler ultrasound. This section discusses the consequences of the results, comparing them within literature, and highlights their importance for clinical practice and future research.

Our study involved cohort of 100 patients, with a high female majority (73%). the prevalence of varicose veins appears to be high among female, with approximately two third of women and a third of men affected, the result aligns with **(Fowkes, et al., 2001)** study which reported that A lower prevalence has been observed in men The participants age ranged of (20 to 74 years) indicates a broad spectrum of venous health, allowing for a comprehensive evaluation of varicosities and incompetence across different population. This demographic distribution is consistent with findings from other study done by **[Eklof et al., 2014],** which indicate that both gender and age significantly influence the prevalence of venous diseases. The mean age of 47.8 years aligns with previous study by **[(Rabe et al., 2012],** whom suggest that an increased incidence of venous disorders in middle-aged populations.

In our study there were also slight higher number of affected left sided limbs (35 %) than the affected right one (33%) However (32%) of participant with bilateral affected limbs. We guess that this may be associated to the left iliac artery crossing the left iliac vein. Although, other studies in literature show equal involvement of right and left lower limbs **(Irodi, A., et al., 2011).**

High prevalence of venous incompetence observed in the great saphenous vein (47%), perforators veins (42%), particularly in the sapheno-femoral junction (31%), underscores the significance of these areas in the pathophysiology of chronic venous insufficiency. These findings are consistent with the **(Chastanet, et al., 2013)** study, which recognizes the GSV as a primary contributor to venous insufficiency. The prevalence of incompetence in the short saphenous vein (21%) and sapheno-popliteal junction (10%) also point out the multifactorial nature of venous disease, suggesting that general assessments should include multiple venous segments to well understand the extent of venous incompetence.

The documentation of reticular and segmental varicosities represent (61%) and (29%) respectively is particularly relevant for clinical practice. Reticular varicosities, often considered less severe than their segmental counterparts, can nonetheless contribute to symptoms and cosmetic concerns **(Baker, K et al., 2018).** The distribution of varicosities across the lower extremities, with a notable concentration in the lower leg (45%), aligns with previous findings by **(Gloviczki et al., 2011),** which suggest this area is mostly susceptible to varicosities due to gravitational forces and venous pressure. Understanding the types and locations of varicosities can advise treatment approaches, emphasizing the need for targeted interventions based on specific anatomical considerations.

The assessment of associated complications, including mild lower leg edema (15%), superficial thrombophlebitis (4%), reactive lymphadenopathy (8%), and reflux (17%), indicates the latent clinical implications of venous incompetence. The relatively low incidence of superficial thrombophlebitis is noteworthy, as this condition can complicate the management of varicosities and may require additional therapeutic strategies. The presence of reactive lymphadenopathy, particularly in the groin and popliteal regions, suggests that venous disease may have broader systemic consequences, warranting further investigation into the interplay between venous insufficiency and lymphatic function.

The study also demonstrate a significant correlation between age and the severity of venous incompetence and varicosities and other complication such as edema, reflux, or Reactive Lymphadenopathy. Patients aged 60 years and above presented a evidently higher incidence of severe incompetence and extensive varicosities compared to younger cohorts. This observation is consistent with existing literature that highlights aging as a critical risk factor for the development of CVI **(Molnár, A. Á et al., 2021).** The biological mechanisms underlying

this correlation may include changes in venous wall structure, loss of elasticity, and alterations in venous valve function associated with aging **(Molnár, A. Á et al., 2021).** This awareness highlight the importance of early detection and management of venous disease in older populations to avoid the risk of complications.

The findings from this study highlight the significant prevalence of venous incompetence and varicosities in the lower limbs among the assessed population. The results indicate that older age groups are more likely to experience severe venous insufficiency and associated complications. The identification of reticular and segmental varicosities emphasizes the need for further clinical correlation and potential intervention strategies for affected individuals.

In conclusion, Doppler ultrasound serves as a valuable diagnostic tool in evaluating varicosities and venous incompetence, and very useful in identifying the distribution and extent of reflux and other complications in these patients for complete diagnosis and mapping of incompetent sites providing critical insights into vascular health and guiding appropriate management strategies.

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