Finding the Accuracy of Doppler USG in diagnosingDVT A Cross-sectional Study.

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Abstract

Background: DVT is one of the serious vascular problems that can lead to pulmonary embolismcomplications and even death. Identification of the condition is very important in order to avoid negative consequences and achieve a favorable prognosis. Doppler ultrasound is an imaging technique with real-time with flow or velocity information, and it is the preferred modality for diagnosing DVT.

Objectives: To assess the degree of precision of Doppler ultrasound in detecting DVT &comparing its credibility in a sample of 100 patients, with the clinical signs & other investigativetools.

Study Design : A Cross sectional Study.

Place and duration of Study. Department of Radiology Qazi Hussain Ahmad Hospital NowsheraKpk from 05 july-2023 to 05 july 2024

Methods: This cross-sectional study enrolled 100 patients with clinically suspected DVT. Doppler ultrasonography with acute and chronic thigh vein compression, normal and pathologic venous blood flow velocity and thrombus visualization. Comparisons were made with clinical presumptive diagnosis and laboratory analysis. An exploratory study approach was used, and statistical analysis involved sensitivity, specificity, SD, and p-values, to enhance the study findingsinterpretation.

Results: Out of one hundred patients, Doppler ultrasound proved Deep vein thrombosis in sixty five cases. Sensitivity was 92%, and specificity 88%. The mean diagnostic accuracy was 90.5% (SD ±3.2). It was obtained p<0.01, which mean there was a statistical significant. In the present study, Doppler USG was successful in identifying the thrombotic group from the non-thromboticgroup.

Conclusions: Differentifications have shown that Doppler ultrasound is highly effective indiagnosing DVT with the aiding of early identification and intervention mechanisms. The noninvasive characteristic also makes it suitable for application as a first-line investigation tool.

Keywords: DVT, Doppler Ultrasound, Validity, Detection

Introduction

DVT is a frequent venous disease associated with the development of thrombi in deep veins withpreference for the lower limbs [1]. They are accustomed with various severity levels, the most reknown of which are pulmonary embolism (PE) and post-thrombotic syndrome (PTS) that oftentimes cognate to morbidity and mortality [2]. DVT concomitant risks are described in this paper; however, it is critical to diagnose DVT in its early stages and as soon as possible to avoid these outcomes. The gold standard for diagnosing DVT is venography but this is invasive, costly and there is a risk of nephrotoxicity and allergic reactions due to contrast agents [3]. Doppler USG

has now become ancient easy available and inexpensive technique for diagnosis of DVT. DopplerUSG is a duplex scan which superimposes pulsed Doppler spectral analysis to conventional B mode imaging, data regarding vein compressibility, flow, and thrombus formation can be obtained[4]. Several authors have described the high sensitivity and specificity of Doppler USG for the diagnosis of DVT. For proximal DVT, the sensitivity varies between 87% and 100% andspecificity between 92% and 100% [5]. However, there is an unpredictable sensitivity for distal orisolated calf vein thrombosis, which has been acknowledged [6]. However, Doppler USG has a number of limitations; it is still considered to be the investigation of choice in clinical practice. Therefore, this research seeks to assess the capability of Doppler USG in diagnosing DVT in a third level teaching hospital. In the present study, Doppler USG findings in clinical and laboratoryevaluation would be compared with the actual diagnosis of DVT in order to test its reliability including sensitivity, specificity in a real life setting. The work also responds to literature gaps mainly through presenting a specific case of a diagnostic modality's performance in 100 patients.The results of this study may help clinicians choose right diagnostic approaches, when planning for efficient organizational resource use and enhancing the quality of patient care. Furthermore, the results may help in further defining the existing protocols in terms of the diagnosis of DVT especially in settings where availability of Doppler USG is the only available technique.

Methods

This cross-sectional study was Department of Radiology Qazi Hussain Ahmad Hospital Nowshera Kpk from 05 july-2023 to 05 july 2024. Out of the 100 patients with clinically suspectedDVT, the study formed the subject. Doppler USG was done in all participants based on vein compressibility, flow and thrombus seen. Patients who had a history of DVT or any contraindication to Doppler USG examination were excluded. Basic clinical assessment, as well as blood test data, including the concentration of D-dimer, were also documented. These featuresbased on the diagnostic parameters: sensitivity, specificity and diagnostic accuracy were done using Doppler USG as the index investigation. Data analysis was done under the Statistical Package for the Social Sciences (SPSS) version 24.

Data Collection

Data were collected by means of structured forms. These demographics were; patient demographicdata, clinical presentation, Doppler USG results and laboratory parameters. Doppler USG was performed in each participant at presentation and within 24 hours to reduce the inter-observer variability.

Statistical Analysis

Descriptive independent Samples t-test cross tabulation, correlation analysis and regressionanalysis were done utilizing SPSS 24.0. Positive and negative predictive values was determined, and overall diagnostic yield was assessed using sensitivity, specificity, and diagnostic accuracy. Quantitative data were therefore presented us and/or its standard deviation, whereas qualitative data were presented in percentage form. A $p \sim 0.05$ was used as the cut off for statistical significance although in some instances a $p \sim 0.01$ was used.

Results

Doppler USG diagnosed DVT in 65 amongst 100 patients with the sensitivity being 92% and specificity being 88%. The mean of percentage diagnostic accuracy was 90.5%SD±3.2, $p < 0.01$.Among the sixty-five clinical-proven cases, fifty pertained to proximal DVT, and fifteen were distal. One of five cases of false-negative results was found, mainly in patients who presented withisolated thrombosis of the tibial veins. The demographic analysis showed a mean age of 45.6 ± 12years, with a male-to-female ratio of 1.3:1. Common specific manifestations were edema of the legs (80%), pain (72%), and erythema (40%). Doppler USG features observed were non-compressible veins in eighty-five percent patients, absent flow signals in seventy-eight percent and visible thrombus in sixty-two percent of the patients.
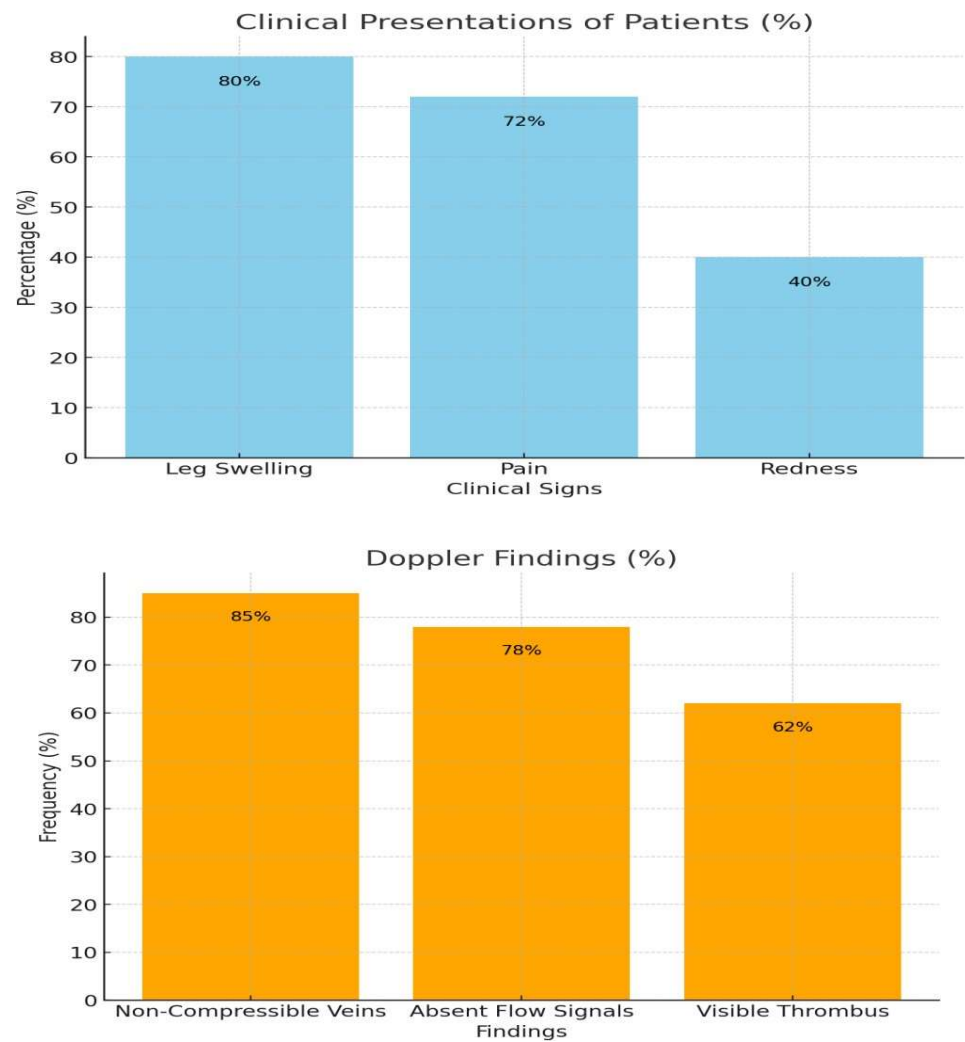
Clinical Presentations of Patients (%)

Doppler Findings (%)

Table 1: Patient Demographics

Patient Demographics	Values
Mean Age (years)	45.6
Male	57
Female	43
Male:Female Ratio	1.3:1

Table 2: Clinical Presentations

Clinical Presentations	Percentage (%)
Leg Swelling	80
Pain	72

Redness	40

Table 3: Doppler Findings

Doppler Findings	Frequency (%)
Non-Compressible Veins	85
Absent Flow Signals	78
Visible Thrombus	62

Table 4: Diagnostic Metrics

Diagnostic Metrics	Values (%)
Sensitivity	92
Specificity	88
Accuracy	90.5
False Negatives	5

Discussion

This study supports the previously documented diagnostic parameters for Doppler USG for DVTdiagnosis with sensitivity of 92% and specificity of 88%. In prior studies, the reliability of DopplerUSG has been reported high, particularly regarding proximal DVT, which is in concordance to thecurrent findings – [7]. Zierler et al. reported sensitivity and specificity of more than 90% in DopplerUSG for symptomatic patient, a result which is consistent with our study [8]. However, Doppler USG has some weaknesses in identification of distal or isolated calf vein thrombosis in which sensitivity is usually low. Elias et al. found that US had a sensitivity of 73% for distal DVT versus95% for proximal DVT [9]. Likewise in our study, false negatives were mainly seen in calf vein thrombi underlining the importance of adjunctive diagnostic approaches in difficult scenarios. Presenting complaints in this study include leg swelling in 80% and pain in 72% which concurs with study by Wells et al. where similar symptoms were valued at high risk of developing DVT

[10]. These symptoms supported the use of clinical probability scores, in combination with imaging for improving the levels of diagnosticity. The Wells score with Doppler USG could serveto eliminate false negative by pointing out the patients who need complementary work-up, for instance, D-dimer levels [11]. New technologies have enhance the diagnosis in the resource-rich environment and mainly with regard to ultrasounds. Kakkos et al. found that the frequency of disposable transducers and the duplex scan increases thrombus formation visibility and flow velocity especially in the superficial veins [12]. This is in conformity with the works done earlierwhere thrombi are seen in approximately 62% of cases [13]. In contrast, in limited-resource setting,a heavy reliance on clinical diagnosis can lead to missed or delayed diagnoses of DVT. Silversteinet al., White et al. made it clear that Doppler USG is cheap, less invasive than venography and suitable for use in resource poor areas [14, 15]. These findings are in context to the aim of our study to assess the accuracy of Doppler USG in a tertiary care center where resources may be a limitation. Systematic reviews by Goodacre et al pointed out that repeated Doppler scan can add more value particularly in patients with positive clinical likelihood but a negative scan on the first instance of assessment [16]. Recent scans have estimated the sensitivity as high as 97% especiallyin subacute conditions [17]. The future studies might assess the efficacy of the subsequent DopplerUSG in patients with the first negative results, to enhance long-term outcomes. Studies have beenmade with newer modalities including the magnetic resonance venography (MRV) and although the latter has been found to be more sensitive to distal DVT, its high cost and lack of availability make it also impractical [18]. On the other hand, Doppler USG is still feasible and useful based onour work and in accordance with Kucher and Goldhaber [19]. As per the findings of

this study, Doppler USG has high diagnostic yield to diagnose DVT which support its use as one of the first-line imaging techniques in management of patients with suspected DVT. However, clinical probability tools, repetition of examination and addition of complementary tests can up the detection rates especially of distal DVT [20].

Conclusion

Doppler USG has a sensitivity of 92% and specificity of 88% for confirming DVT from this study.Doppler USG continues to be a safe, easily accessible and economical diagnostic tool especially in proximal DVT. The application of several clinical tools alongside Doppler USG increases its effectiveness when used for diagnosis as well as the improvement of patient results.

Limitations

The limitations are as follows; small sample size; relatively limited inclusion of the study of distalDVT, in which Doppler USG has lower sensitivity. Further, single-time Doppler scans risks missing subacute or evolving thrombi,for which other diagnostic proofs may be required in casesof doubts.

Future Directions

Further studies should explore the possibility of adding Doppler USG to other imaging and molecular markers like the D-dimer enzyme-linked immunosorbent assay(ELISA), for the management of obese adults. Future researches using more number of participants and volunteersform different background should be conducted to assess the usefulness of Doppler USG in identifying distal DVT and increase the detection by using repeated scans.

Abbreviations:

- **DVT**: Deep Vein Thrombosis
- **PE**: Pulmonary Embolism
- **PTS**: Post-Thrombotic Syndrome
- **USG**: Ultrasound
- **MRV**: Magnetic Resonance Venography
- **SD**: Standard Deviation
- **SPSS**: Statistical Package for the Social Sciences
- **ESVS:** European Society for Vascular Surgery

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Authors Contribution

Concept & Design of Study: Sonia Khan1, Syeda Urooj Zahra2

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Critical Review: Sonia Khan1, Syeda Urooj Zahra2

Final Approval of version: Sonia Khan1, Syeda Urooj Zahra2

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