

VALIDITY OF COLOUR DOPPLER ULTRASONOGRAPHY WITH D-DIMERS IN CLINICALLY SUSPECTED DEEP VEIN THROMBOSIS OF THE LOWER LIMB

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ABSTRACT

Objective: This study was designed to evaluate the validity of colour Doppler ultrasonography with D-dimers in clinically suspected deep vein thrombosis of the lower limb.

Study Design: Validation study

Place and Duration of study: Radiology Department CMH/MH Rawalpindi Six months from 15 June 2006 to 31 December 2006.

Subjects and Methods: Thirty cases of clinically suspected deep vein thrombosis of the lower limb were included in the study selected on non probability convenience sampling technique. Colour Doppler ultrasonography examination of the affected lower limb was carried out and results compared with D-dimers assays results.

Results: Among 30 patients who underwent colour Doppler ultrasonography examination of the affected limb for diagnosis of deep vein thrombosis, 27 (90%) were diagnosed to have deep vein thrombosis, 3 (10%) were diagnosed not to have deep vein thrombosis. Amongst them 2 patients had raised D-dimers levels and repeat Doppler ultrasound advised. On revised ultrasound deep vein thrombosis in these patients was confirmed. This showed that colour Doppler ultrasonography examination has sensitivity of 93.1%, specificity 100%, positive predictive value 100%, negative predictive value 33.33% and overall accuracy of 93.33 %.

Conclusion: Colour Doppler ultrasonography has a high diagnostic yield in cases of deep vein thrombosis of lower limb when used in conjunction with D-dimers assays.

Keywords: Deep vein thrombosis, Colour Doppler ultrasonography, D-dimers

INTRODUCTION

The incidence and prevalence of venous thrombosis depends on the age and sex of the population. It is more common in men than woman at any age¹. Deep vein thrombosis (DVT) and pulmonary embolism are common causes of morbidity and mortality. Venous thromboembolic disease has an estimated annual incidence in developed countries of one in 1000 people². The frequency of distal vein involvement greatly exceeds that of proximal involvement in patients with DVT.

DVT needs prompt diagnosis and management because the mortality rate associated with unrecognized and untreated thrombo-embolism is 30-60%³. The useful modalities available for venous assessment are color-flow duplex ultrasound, D-Dimers, contrast venography and magnetic resonance

imaging.

Venography which is invasive and has associated risks has been traditionally used to diagnose DVT. This has led to general reliance on Doppler ultrasound to confirm or refute the diagnosis. Colour flow Doppler is rapidly becoming the de facto gold standard radiological investigation and Duplex ultrasound is the initial imaging modality used for the diagnosis of DVT. Modern color-flow duplex ultrasound equipment can provide flow information in conjunction with high-resolution views of deep vein system. The goal of imaging is to identify and map all areas of obstruction within venous system. Plasma D-dimers are specific cross linked derivatives of fibrin, produced when fibrin is degraded by plasmin, so concentrations are raised in patients with venous thromboembolism. Although sensitive for venous thromboembolism, high concentrations of d-dimers are insufficiently specific for making a positive diagnosis because they occur in other disorders such as malignancy, pregnancy and after operations.

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Nevertheless, D-dimer tests generally have a high negative predictive value when used in conjunction with clinical probability, plethysmography, or ultrasonography^{4,5}. It was decided to perform a hospital based study in which we evaluated the validity of colour Doppler ultrasonography with D-dimers in diagnosis of clinically suspected deep venous thrombosis of the lower limb.

MATERIALS AND METHODS

The study was carried out on 30 patients in CMH/MH Rawalpindi for duration of six months from 15 June 2006 to 31 Dec 2006. Thirty cases of clinically suspected deep venous thrombosis of the lower limb were included in the study selected on non probability convenience sampling technique. All patients referred from Outpatient Departments / admitted in hospital presenting with clinical suspicion of having deep venous thrombosis were included in the study after having taken informed consent

Patients of either sex or age above 16 years presenting with signs and symptoms of suspected deep venous thrombosis were included in the study. Patients with Previous history of radiologically proven DVT in the affected limb, pulmonary embolism an on heparin or anti-coagulation therapy were excluded.

First of all Colour Doppler ultrasonography examination of the affected lower limb of the patients was performed later on these patients were subjected to D-dimers assay as a Gold Standard and finally the results of both were compared.

Toshiba Aplio ultrasound machine was used to examine patients. Scanning was performed in the axial plane (Figure) from the calf to the groin by using a 5 to 11-MHz transducer, depending on the size of the leg (depth of the vein) to be evaluated.

Blood samples for D-dimer assay were sent to Armed Forces Institute of Pathology Rawalpindi.

Findings of colour Doppler ultrasonography were matched against the D-dimers report findings of the same patient.

DVT was ascertained with presence of following specific findings on Colour Doppler ultrasonography:

- Incompressibility: A clot-filled vein would not compress.
- Loss of augmentation: Loss of appropriate increased flow when the lower extremity was squeezed implied an obstruction (clot) between the transducer and the squeezed area.
- Visualization: Directly visualized DVT.
- Doppler flow: Doppler color-flow imaging could depict areas in which an isoechoic clot may not be visible.

Wells Clinical scoring chart was used to determine the probability of DVT (Table-1). According to wells clinical prediction rule for DVT patients were divided into 3 groups i.e high probability (score 3 or greater), moderate probability (scoring 1-2) and low probability (scoring 0 or less).

All data collection was analyzed using SPSS 11. Descriptive statistics were used to describe the data. Diagnostic measures i.e preedective value (PPV), sensitivity, specificity, positive and negative predictive values (NPV) and accuracy of Color Doppler ultrasonography were calculated using D-dimmers as Gold standard.

RESULTS

Out of a total of 30 patients included in the study, there were 22 (73%) males and 8 (27%) females.

The age of the patients ranged from 20 to 90 years with mean age of 49.5 years and standard deviation of 17.11.

Twenty seven (90%) patients were diagnosed to have DVT on colour Doppler ultrasonography examination. While 3 (10%) did not show any features of DVT on colour Doppler ultrasonography. Out of the 3 patients who did not show any signs of DVT on Doppler ultrasonography examination, one had a normal D-dimer report from the laboratory,

thus excluding the possibility of DVT. The other 2 patients had significantly raised D-dimer levels despite having an initial negative Doppler ultrasonography examination. A repeat Doppler performed later on, confirmed DVT. Thus confirming the operator dependant

doppler reports and D-dimer assay reports is shown in table 2. diagnostic measure of color Doppler ultrasonography were, sensitivity 93.1%, specificity 100%, PPV 100%, NPV 33.3% and accuracy was 93.3%. description of patients according to wells clinical prediction rules was

Table-1: Wells clinical scoring chart.

Clinical feature	Points
Active cancer (treatment within 6 months, or palliation)	1
Paralysis, paresis, or immobilization of lower extremity	1
Bedridden for more than 3 days because of surgery (within 4 weeks)	1
Localized tenderness along distribution of deep veins	1
Entire leg swollen	1
Unilateral calf swelling of greater than 3 cm (below tibial tuberosity)	1
Unilateral pitting edema	1
Collateral superficial veins	1
Alternative diagnosis as likely as or more likely than DVT	-2

omission and making a false negative result in our study. The comparison between colour

given in table 3.

DISCUSSION

Deep venous thrombosis of the lower limbs is a frequent affection that needs precise diagnosis. Since clinical evaluation cannot assure reliable diagnosis by lack of sensitivity and specificity, complementary exams are needed⁶. Strong evidence supports the use of clinical prediction before further testing. D-dimer assays have a high negative predictive value for presence of venous thrombi however their higher concentrations are insufficiently specific for making a positive diagnosis^{5,7}. Color flow Doppler Ultrasonography is rapidly becoming the gold standard radiological investigation for the diagnosis of deep venous thrombosis as it is non-invasive, safe, efficient and cost effective^{8,9}.

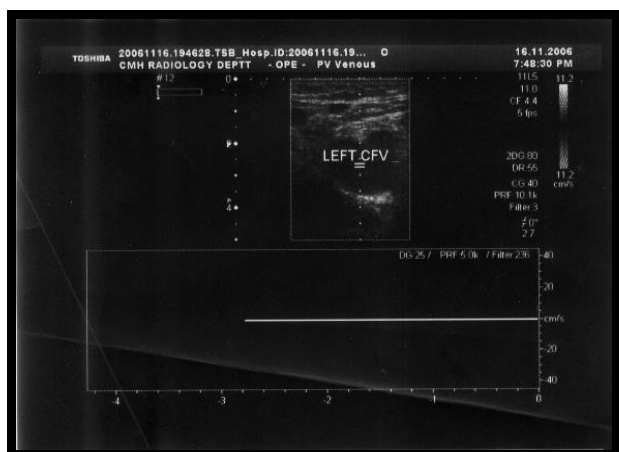


Figure.1: Absence of flow in left Common Femoral vein on Doppler ultrasound.

Table-2: Comparison of color Doppler ultrasonography and D - dimmers (n=30).

Color Doppler Ultrasonography	D - dimmers		Total
	Positive	Negative	
Positive	27	0	27
Negative	2	1	3
Total	29	1	30

Table-3: Description of patients according to Wells clinical prediction rule (n=30)

Probability class	No. of patients	Percentage
High probability	27	90
Moderate probability	2	7
Low probability	1	3

thrombosis of lower limb but still it has not achieved 100% accuracy. It is better for diagnosing proximal deep venous thrombosis than distal deep venous thrombosis¹⁰.

The emphasis in all branches of radiology is to move from invasive to noninvasive methods of diagnosis. We compared the findings of colour Doppler ultrasonography with D-dimer assay results in the detection of lower limb thrombosis. The cross tabulation of Doppler ultrasound proves that D-dimer is superior to the Doppler ultrasound in the diagnosis of DVT. The sensitivity of Doppler ultrasound was 93.1% and specificity of 100% in the detection of deep venous thrombosis. However we missed two cases of deep vein thrombosis initially on Doppler. In those patients Doppler did show augmentation of blood flow and the compression ultrasound was equivocal. However D-dimer and repeat Doppler ultrasonography confirmed the diagnosis of deep venous thrombosis in the calf veins. Therefore the Doppler alone lagged behind in those two controversial cases, which were later solved by D-dimer and repeat Doppler.

Naidich¹¹ found that the Doppler had an overall accuracy of 94% (96% sensitivity, 90% specificity) in DVT. He concluded that non-invasive tests should be the preferred initial diagnostic method and contrast venography should be reserved for cases of doubt.

Cronan^{12,13} showed compression ultrasound was extremely accurate in the assessment of femoral and popliteal veins but its sensitivity falls off in the deep calf veins. However, if there is strong clinical concern, repeat compression ultrasound combined with Doppler and contrast venography can be employed. Anjum MN attested the value of colour Doppler ultrasonography in the diagnosis of DVT, particularly in pregnancy and other conditions where the use of contrast medium or radiation is contraindicated¹⁴. Tscherisch¹⁵ found that Doppler ultrasonography had 95-99% sensitivity for proximal venous thrombosis compared with contrast venography in patients with clinically

suspected disease. For isolated calf-vein thrombus, the sensitivity decreased below 50%. Perrier¹⁶ demonstrated in asymptomatic patients the high accuracy of ultrasonography versus venography for the diagnosis of proximal DVT. In our study as well, the false positives were nil on the Doppler ultrasound in the diagnosis of the deep venous thrombosis, which correlates well with the international studies. Tick¹⁷ showed the utility of D-dimer in combination with clinical assessment in the initial investigation of outpatients with suspected DVT. Fancher¹⁸ concluded that the combination of low clinical probability for deep vein thrombosis and a normal result from D-dimer test safely excludes a diagnosis of acute venous thrombosis. Cornuz¹⁹ and Schutgens²⁰ supported the combination of a D-dimer assay with a clinical prediction rule which provided sufficient negative predictive value to reduce the need for further imaging studies in appropriately selected patients with low pretest probability of disease.

CONCLUSION

Colour Doppler ultrasonography has a high diagnostic yield in diagnosing or ruling out cases of deep venous thrombosis of the lower limb when used in conjunction with D-dimers assays. D-dimers are required in patients in whom results of other noninvasive tests are equivocal or negative in the setting of high clinical suspicion. Treatment is ensued if the Doppler test is positive and also when Doppler findings are negative but clinical suspicion is high.

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