DIAGNOSTIC ACCURACY OF DOPPLER ULTRASOUND IN COMPARISON WITH VENOGRAPHY IN THE DIAGNOSIS OF VARICOSE VEINS OF THE LEGS

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ABSTRACT

Objective: To determine the diagnostic accuracy of Doppler ultrasound in the diagnosis of varicose veins of legs using venography as gold standard in picking up deep vein thrombosis.

Study Design: Prospective validation study.

Place and Duration of study: Six months, 01 Apr -30 Sep 2006 at Radiology Department, Combined Military Hospital, Quetta.

Patients and Methods: Fifty cases were included in study, fulfilling the inclusion and exclusion criteria. The patients sampled were referred by surgeons from out patients department.

Results: The sensitivity of Doppler was 75 %, specificity 100% and accuracy 98% in picking up deep venous thrombosis (DVT). For the detection of incompetent perforators/reflux disease, at spheno-femoral junction the sensitivity of Doppler ultrasound was 85.7%, specificity 95% and accuracy 94%. At spheno-popliteal junction the sensitivity of Doppler ultrasound was 70%, specificity 100% and accuracy 76 %.

Conclusion: Patients with varicose veins of legs should be evaluated first with Doppler ultrasound. Venography remains the examination of choice when absolute determination of the presence and extent of thrombus is needed, for the determination of the reflux disease level in obese patients, in patients with severe leg edema or in patients in whom results of Doppler ultrasound is equivocal or negative in the settings of high clinical suspicion

Key words: Deep vein thrombosis, Doppler ultrasound, Venography, Varicose vein

INTRODUCTION

Varicose veins are enlarged, tortuous, bulging veins under the influence of increased venous pressure[1]. These are associated with symptoms such as tired, heavy, or aching limbs. In severe cases, varicose veins can rupture and can form ulcers on the skin. These dilated veins are the visible surface manifestation of an underlying venous insufficiency[2].

Venous insufficiency syndromes allow venous blood to escape from its normal flow path and flow in a retrograde direction down into an already congested leg.

Varicosities are more common in women than in men at any age[3,4]. When treating a patient with varicose veins, the possibility of associated DVT must always be considered because the mortality rate associated with unrecognized and untreated thrombo-embolism is 30-60%[5].

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Varicose veins are described as being either primary or secondary in nature[6]. Primary varicose veins are always the long and short saphenous veins and are frequently associated with incompetent perforating veins; the deep venous system is however normal. Secondary varicose veins on the other hand occur as a result of previous DVT [7,8]. Less common causes of varicosities of the leg veins include arterio-venous malformations and congenital anomalies, such as the Klippel–Trenaunay syndrome.

The perforating veins contain valves which normally only permit flow from the superficial to the deep system. In primary varicose veins there is only intermittent reversal of the flow, whereas in secondary varicose veins the flow is predominantly reversed, owing to the damage in the deep system[9]. Prolonged standing leads to increased hydrostatic pressures that can cause chronic venous distention and secondary valvular incompetence anywhere within the superficial venous system. If proximal junctional valves become incompetent, high

pressure passes from the deep veins into the superficial veins and the condition rapidly progresses to become irreversible. Women are particularly susceptible to varicose disease because vein walls and valves periodically become more distensible under the influence of cyclic increases in progesterone[10,11]. Pregnancy increases this susceptibility because of circulating hormonal factors. Late in pregnancy, the enlarged uterus compresses the inferior vena cava, causing secondary distension of leg veins. With advancing age, the elastic lamina of the vein becomes atrophic and the smooth muscle layer begins to degenerate, leaving a weakened vein that is more susceptible to dilatation.

Duplex ultrasound is the imaging modality used for the diagnosis of varicose insufficiency syndromes and for treatment planning and preoperative mapping. Modern color-flow duplex ultrasound equipment can provide flow information in conjunction with high-resolution views of both deep and superficial venous systems. The direct contrast venogram is the most labor-intensive and invasive venous imaging technique[12,13]. Venography has been replaced by duplex ultrasound for the routine evaluation of venous disease, but the technique remains extremely useful for difficult or confusing cases [14,15].

The goal of imaging is to identify and map all areas of acute or chronic obstruction and all areas of reflux within the deep and superficial venous system. In Pakistan, not much research has been done on these diagnostic modalities. Our study was hospital based in which we assessed diagnostic accuracy of Doppler ultrasound in picking up deep veins thrombosis and incompetent perforators taking venography as gold standard.

PATIENTS AND METHODS

Fifty patients were selected for the study at the department of Radiology, Combined Military Hospital Quetta over a period of six months from 01 April to 30 September 2006, fulfilling the following inclusion and exclusion criteria.

Patients, referred by surgical specialists, with dilated veins of the legs for venography between 25 years to 60 years of either sex were included in the study.

Post operative elderly (above 60 yrs) patients and pregnant women were excluded in the study.

Data Collection Procedure:

Patients of varicose veins referred from surgical out patient department, fulfilling the inclusion criteria were included in the study.

1. History: A Comprehensive history was obtained taken including duration of onset, predisposing factors, drug history, family history and abdominal/ pelvic operations

2. Physical examination of the patient: Varicose veins, discoloration of skin, leg ulcers and edema.

3. Same Doppler Ultrasound machine (ALOKA Prosound SSD-5500. Japan) having linear array transducer (7-10 MHz with inter changeable frequency) was used for color flow mapping and pulsed Doppler analysis of all the patients. Doppler flow studies were performed along the whole length of the popliteal, superficial femoral and common femoral veins. The ready compressibility of a vein was a good indication of normality. Then the level of incompetent perforator was identified at spheno-popliteal and spheno-femoral level, in the calf and in the thigh, as indicated by retrograde flow and enhancement of flow on Valsalva maneuver.

4. Venography was carried out on Image Intensifier Fluoroscopic X-Ray machine (KXO-80G-KDU 800-1000 mA, Toshiba, Japan, with low osmolar contrast medium (Iopamiro). The procedure was performed with the patient in an erect or semi-erect position. A vein on the dorsum of the foot was cannulated. Two tourniquets applied, one around the ankle, second above the knee. 60–100 ml of contrast medium was injected. During the injection of contrast medium the calf veins, popliteal, femoral and iliac veins were examined fluoroscopically and spot radiographs were taken in various projections. The Doppler ultrasound was performed by one of the five radiologists. The venography was performed

by the co-investigating radiologists, who were unaware of the findings of Color Doppler Ultrasonography.

Data Analysis Procedure:

Computer package SPSS version 11.0 was used for computation and analysis of data. Descriptive statistics like specificity, sensitivity, PPV, NPV and accuracy for Doppler ultrasound and venography were calculated.

RESULTS

Most of our patients were personnel belonging to Pakistan Armed Forces and their families. However, some civilian patients from Baluchistan and Afghanistan were also included.

The mean age of the patients who underwent this study was 41.54yrs (SD=12.85). Males comprised 76% and females 24%.

Thrombosis:

In 50 patients of varicose veins, we found only 6 patients having DVT. However, we missed two cases of deep vein thrombosis on Doppler ultrasound in which there was deep vein thrombosis in the resolving stage. In these patients, there was augmentation of blood flow on Doppler ultrasound while the compression ultrasound was negative. This false negative might be because of formation of collateral circulation as both had long standing deep venous thrombosis. However later venography confirmed the diagnosis of deep venous thrombosis in the calf veins as scattered foci of filling defects in the veins representing thrombus.

The sensitivity of Doppler ultrasound was 75 % and specificity 100% in the detection of deep venous thrombosis. Positive predictive value was 100% and negative predictive value 95% with overall accuracy 96% (Table-1).

Reflux disease

There were 6 cases that showed reflux at the spheno-femoral level on Doppler as well as venography. In one patient we missed the reflux on Doppler ultrasound. Two patients were diagnosed having Spheno-femoral reflux on Doppler but the venogram was unremarkable. This happened in the fatty patients where the visualization was poor and we could not determine the true blood flow direction. The sensitivity and specificity of Doppler ultrasound was 86% and 95%; PPV and NPV 75% and 98% with diagnostic accuracy of 94% (Table-2).

Doppler ultrasound revealed reflux at spheno-popliteal junction in 29 patients but we missed reflux in 12 cases due to the numerous varicose channels. The sensitivity of Doppler for assessing the reflux disease reduced as we went down on the legs. Overall sensitivity and specificity of Doppler ultrasound was 71% and 100% respectively; Positive predictive value 100% and Negative predictive value 43% with accuracy of 76% (Table-3).

DISCUSSION

According to an international study, the varicosities were observed in 72% of women aged 60-69 years but in only 1% of men aged 20-29 years16, whereas our study comprised of 76% males and 24% females. This difference in

Table-1: Comparison of Doppler ultrasound and venography for Thrombosis (n=50)

Test results	Thrombosis present	Thrombosis absent
Doppler ultrasound positive	6	0
Doppler ultrasound negative	2	42

Table-2: Diagnostic accuracy of Doppler ultrasound for Spheno-femoral reflux (n=50)

Test result	Spheno-femoral reflux present	Spheno-femoral reflux absent
Doppler ultrasound positive	6	2
Doppler ultrasound negative	1	41

Table-3: Diagnostic accuracy of Doppler ultrasound for Spheno-popliteal reflux (n=50)

Test result	Spheno-popliteal reflux present	Spheno-popliteal reflux absent
Doppler ultrasound positive	29	0
Doppler ultrasound negative	12	9

age from the international study can be justified that this study was carried out in an army hospital where the main influx was of serving soldiers. The sex variation can also be due to social taboos in our country as females are shy of reporting their cosmetic problems.

In the present study, venography was used as the gold standard for the evaluation of Doppler ultrasound because venography has been shown to be the most reliable method of diagnosis of varicose veins due to deep vein thrombosis and it is the touchstone to judge the accuracy of other methods. It accurately pinpoints the site and extent of involvement but has several disadvantages such as its cost and some degree of discomfort. It is invasive and almost always results in a transient and mild phlebitis. It cannot be performed on all patients easily and cannot be repeated, a limitation which diminishes its usefulness in evaluating prophylactic measures. Its other drawbacks are side effects associated with ionic contrast media[17].

Color Doppler ultrasound is now claimed to be the first line investigation for diagnosing DVT in a patient with varicose veins. It is easy, non invasive, safe, rapid, cost effective and portable. It can quickly pinpoint a major obstruction and is very useful in helping distinguish thrombophlebitis from cellulitis or lymphangitis in an acutely swollen limb. Baxter showed that Color Doppler allows the classification of thrombi into occlusive and non-occlusive types, which may be of prognostic significance[18].

Naidich[19] compared combined Doppler flow and plethysmography with venography and found that the noninvasive tests had an overall accuracy of 94% (96% sensitivity, 90% specificity). They concluded that these combined tests should be the preferred initial diagnostic method and contrast venography should be reserved for cases of doubt or when other information is required.

Cronan[20] compared compression ultrasound with ascending venography and found that the method had a sensitivity of 95% and a specificity of 98%[21]. Compression ultrasound is extremely accurate in the assessment of femoral and popliteal veins but its sensitivity falls off in the deep calf veins.

Anjum[22] concludes that ultrasound imaging for the diagnosis of DVT are somewhat dependent on the skills of the sonographer, but even in the best hands, ultrasound imaging is neither as sensitive nor as specific as contrast venography. Contrast venography is the criterion standard for assessing venous reflux, vein abnormalities, and the presence of valves. Venography is time-consuming and requires a high degree of technical expertise.

Feied[23] compared diagnostic modalities and concluded that each test is most sensitive when DVT is symptomatic, when thrombus causes complete venous outflow obstruction, and when the clot extends into the upper thigh. Each test misses many cases of DVT. The rate of missed DVT is highest when the thrombus is localized below the knee or above the groin, when the thrombus is non-obstructing, and when the patient is asymptomatic. In our study we also missed two cases on Doppler ultrasound in whom the DVT was in resolving stage which was later on confirmed on venography.

Our findings were in agreement with many previous reports. As our study has clearly shown the accuracy of Doppler ultrasound in diagnosis of DVT as the cause of varicose veins comparable to that of venography, we can confidently recommend its routine use as it will facilitate early, cost effective and non invasive diagnosis of DVT in such patients.

We missed two cases of deep vein thrombosis on Doppler ultrasound in which there was deep vein thrombosis in the resolving stage. In these patients on Doppler ultrasound, there was augmentation of blood flow and compression ultrasound was negative. These false negative might be because of formation of collateral circulation as both had long standing deep venous thrombosis. However later venography confirmed the diagnosis of deep venous thrombosis in the calf veins as scattered foci of filling defects in the veins representing thrombus.

Most of the patients who had undergone these two tests were having short saphenous involvement. It was difficult to visualize and to assess the anatomy of venous system around the knee and the calf region on Doppler ultrasound. Therefore the sensitivity of Doppler ultrasound declined in patients with spheno-popliteal reflux. However it was easy to see the problem areas on venography. To assess the true sensitivity of Doppler ultrasound separate operators carried out Doppler and venography on all the patients of varicose veins without knowing the results of each other.

Both invasive and noninvasive studies were conducted by Podnos[24] and concluded that venography was the standard investigation for assessing venous reflux, vein abnormalities, and the presence of valves.

The selective use of Hand Held Doppler (HHD) can avoid duplex imaging for many patients, with a low failure rate for detecting correctable venous reflux. Duplex would not have been requested in 645 of 1052 (62%) limbs. Among these HHD missed significant reflux in the long saphenous vein in 18 (3%) and the short saphenous in 25 (4%). Reasons for requesting duplex were popliteal fossa reflux (202); recurrent (94) or atypical (86) varicose veins; and possible previous thrombosis (67)[25]. In our study the sensitivity of Doppler for assessing the reflux disease reduced as we went down on the legs in the popliteal fossa. The frequency of reflux was observed more at the spheno-popliteal junction as compared to spheno-femoral junction, i.e. 50% and 12% on Doppler USG and 72% and 10% on venography. This means that short venous is more often involved.

CONCLUSION

Patients with varicose veins should be evaluated first with Doppler ultrasound. Venography remains the examination of choice when absolute determination of the presence and extent of thrombus is needed; for determination of the reflux disease level in obese patients; in patients with severe leg edema or in patients in whom results of Doppler ultrasound are equivocal or negative in the settings of high clinical suspicion.

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