Two-Point Compression Ultrasonography for Lower Extremity Deep Venous Thrombosis in Comparison to Whole-Leg Duplex Ultrasonography


*Department of Radiology, Benazir Bhutto Hospital Rawalpindi; **Department of Pathology, Benazir Bhutto Hospital Rawalpindi; ***Department of Orthopaedic Surgery, Benazir Bhutto Hospital, Rawalpindi

Abstract

Background: To determine the validity of 2-point compression ultrasound in the evaluation of DVT in comparison to whole-leg duplex scan.

Methods: In this cross-sectional study 2-point compression scan and whole leg duplex scan were performed. In two point compression ultrasound the common femoral at the groin and the popliteal vein down to its branching into the calf deep veins at the popliteal fossa were examined in the transverse phase with a linear probe. In duplex ultrasound all leg veins were imaged continuously along their length in the transverse plane. Vein incompressibility was the diagnostic criteria for two point compression and whole leg duplex scan.

Results: The mean age was 51.5±16.7 years with 44% males. Out of 50 patients, majority (54%) had positive and 26% had a negative 2-point CUS. Thirty five (70%) had positive and 48% had a negative whole-leg duplex scan. Two-point CUS was correct in 92% cases. Patients with a positive 2-point CUS had a statistically significant probability of having a confirmed DVT on whole-leg duplex scan; p=0.00, Odds ratio (OR) = 8.095, 95% confidence interval (CI) = 3.303-19.840. The calculated sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the 2-point CUS in comparison to whole-leg duplex scan was 97%, 80%, 92% and 92.3% respectively.

Conclusion: 2-point compression ultrasound is more accurate as compared to whole-leg strategy for the diagnosis of DVT in symptomatic patients presenting with leg swelling.

Key Words: deep venous thrombosis; duplex ultrasound; 2-point compression ultrasound.

Introduction

Rapid and accurate detection of deep venous thrombosis and the prevention of pulmonary embolism is a critical aspect of emergency medicine worldwide. None of the available imaging modalities have ideal test characteristics. In 2006, the American College of Emergency Physicians (ACEP) released a clinical compendium outlining the use of emergency ultrasonography, in which bedside compression ultrasonography was described as an appropriate method for evaluating lower extremity deep venous thrombosis.

Duplex ultrasonography (compression ultrasonography, as well as color and flow doppler ultrasonography) of the lower extremity, performed by a radiologist has emerged as an effective first-line method of detecting deep venous thrombosis, with a reported sensitivity of 91% to 96% and a specificity of 98% to 100%. Many now consider duplex ultrasonography of the lower extremity to be the standard of care in diagnosing proximal lower extremity deep venous thrombosis and has replaced ascending venography and other diagnostic methods in common practice. The newer color-coded doppler ultrasound scanners allow the evaluation of the entire deep venous system, from the groin to the ankle (whole-leg ultrasonography). With this strategy, color flow artifacts are exploited to enhance small vessel visualization, although vein compressibility still constitutes the main diagnostic criterion. However, it needs top-quality ultrasound equipment and experienced operators; therefore, it is often unobtainable after hours and during the weekends.

In 2-point compression ultrasonography compression is applied to the common femoral vein at the groin and the popliteal vein at the popliteal fossa. Relevant features of this strategy are simplicity (may be proficiently learned in <2 hours), reproducibility, and broad availability (may be performed with virtually all ultrasound scanners, irrespective of age, model, and even of the probe frequency).

Patients and Methods

It was a cross-sectional study carried out at the Department of Radiology at Benazir Bhutto Hospital...
Rawalpindi over 6 months from October 2011 to March 2012. A total of 50 patients with leg swelling suspected of having DVT were selected. DVT was diagnosed when the patient had classical symptoms of swelling, pain, and discoloration in the involved extremity. Pregnant women, patients younger than 18 years, past history of VTE and those with suspected pulmonary embolism were excluded from the study.

The radiology resident performed a 2-point compression ultrasound. All compression ultrasonographic measurements were followed by immediate (within 3 hours) duplex ultrasonographic evaluation by the specialist radiologist to assess for lower extremity deep venous thrombosis. Whole-leg duplex scan was considered as the gold standard.

In the two point compression ultrasound common femoral at the groin and the popliteal vein down to its branching into the calf deep veins at the popliteal fossa were examined in the transverse plane with a linear probe (5-10 MHz). Vein incompressibility was the only diagnostic criterion applied. Test results were categorized as normal (compressible veins) or abnormal (noncompressible veins).

Whole leg duplex scans were performed with a linear array probe. All veins were imaged continuously along their length, in the transverse plane. The proximal deep veins were examined first, including the veins (common femoral, superficial, and deep) and the popliteal vein down to its trifurcation. Then, only in patients with normal proximal findings, the calf veins were evaluated, including the axial (peroneal and posterior tibial) and the muscular veins. Vein incompressibility was the diagnostic criterion adopted for abnormal testing of the proximal and axial calf veins. Adjunctive criteria for abnormal testing of the muscular veins only included lack of spontaneous or reverse-flow intraluminal color-filling after augmentation maneuvers (ie, manual squeezing of the calf).

Results

The age ranged from 32 to 67 years with a mean age of 51.5±16.79 years. It included 22 (44%) males and 28 (56%) females. Majority (70%) had positive whole-leg duplex scan. Thirty seven (54%) had positive 2-point CUS. Among 37 positive 2-point CUS; 74.1% had confirmed DVT on whole-leg duplex scan. Among 13 negative 2-point CUS patients; 1 (2%) had confirmed DVT on whole-leg duplex scan and 12 (24%) had negative whole-leg duplex scan. This one false negative case had a calf DVT. When the results of 2-point CUS and whole-leg duplex scan were compared using the chi-square test it was found that patients with a positive 2-point CUS had a statistically significant probability of having a confirmed DVT on whole-leg duplex scan; p = 0.00, OR = 8.095, 95% CI = 3.303-19.840. The calculated sensitivity, specificity, PPV and NPV of the 2-point CUS in comparison to whole-leg duplex scan was 97%, 80%, 92% and 92.3% respectively. 2-point CUS was correct in 92% cases (Table 1).

Table 1 – Summary of results of whole-leg colour duplex US and 2-point compression ultrasound.

<table>
<thead>
<tr>
<th>Ultrasound</th>
<th>Patients with DVT (as confirmed on whole-leg color duplex US)</th>
<th>OR* (95% CI)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal (n)</td>
<td>Normal (n)</td>
<td>2-point compression US</td>
</tr>
<tr>
<td>34</td>
<td>3</td>
<td>8.095 (3.303-19.84)</td>
</tr>
<tr>
<td>Normal (n)</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Total (n)</td>
<td>35</td>
<td>15</td>
</tr>
</tbody>
</table>

*OR=Odd Ratio; CI=Confidence Interval

Discussion

Present study demonstrated diagnostic accuracy of 2-point compression ultrasonography for lower extremity deep venous thrombosis with a conventional ultrasonographic machine. The observed results are consistent with those reported in previous large cohort studies.8,9 Two-point strategy missed one calf vein DVT. It has also being mentioned by many previous studies.10,11 This handicap of 2-point CUS has been questioned by many authors.5,6 Studies7 reported incidence of thromboembolic events after 3 to 6 months of follow-up in patients spared anticoagulants on the basis of a normal ultrasound is fully comparable with that observed in studies which did not investigate the calf veins.12-14 In the study by Bernardi et al, out of 2,098 patients, randomized to 2-point ultrasonography and whole-leg duplex ultrasonography (which included detection of isolated calf vein deep venous thrombosis), 2-point ultrasonography had a lower prevalence of deep venous thrombosis compared with whole-leg duplex ultrasonography.15 The entire difference was accounted for by 65 missed cases of isolated calf deep venous thrombosis. Because the long-term outcome of the 2 groups was found to be similar, the need for detection and treatment of isolated calf deep venous thrombosis may warrant further investigation and thus may not be as critical as previously thought.16
management of patients with clinically suspected deep vein thrombosis with a single negative compression ultrasonographic examination is associated with a low risk of deep venous thrombosis in a 3-month follow-up period.\textsuperscript{17} Since 2-point CUS has chances of missing the calf DVT some suggest the use of serial 2-point CUS after a week and combining it with D-dimer assay. Repeat testing may be safely avoided in patients with a normal D-dimer test result at presentation. \textsuperscript{16}

For whole-leg ultrasonography, patients with suspected DVT need to wait hours or even days before whole-leg ultrasonography is obtained and are unnecessarily administered anticoagulants in the meantime. This problem can be resolved if the radiology trainees are trained to perform a 2-point compression ultrasound with portable ultrasound machines, who can screen patients in the emergency department and on the bedside for critically ill patients as soon as there is a clinical suspicion of DVT. Patients who are positive can be booked for a whole-leg duplex scan by the radiologist and those who are negative can be subjected to D-dimer assay. If D-dimer levels are raised patients can be booked for whole leg duplex. Those who are negative on screening 2-point CUS and on D-dimer assay can be safely discharged without anticoagulation. This incorporation of screening 2-point CUS into DVT diagnosis algorithm is only possible if this test is shown to have acceptable test characteristics. \textsuperscript{16,17}

Serial 2-point ultrasonography plus D-dimer and whole-leg color-coded doppler ultrasonography represent reliable diagnostic options for the management of symptomatic patients with suspected DVT of the lower extremities. Either strategy may be chosen based on the clinical context, on the patients' needs, and on the available resources. The former is simple, convenient, and widely available but some suggest that it requires repeat testing. The latter offers a more reliable answer, but is cumbersome, possibly more expensive, and may expose patients to the risk of (unnecessary) anticoagulation. \textsuperscript{18}

\textbf{Conclusion}

Radiology settings without duplex scanning and limited radiology services can use ultrasound as a tool for diagnosing lower extremity deep venous thrombosis.

\begin{center}
\textbf{References}
\end{center}
