

Magnetic resonance venography and venous ultrasonography for diagnosing deep venous thrombosis

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Deep venous thrombosis (DVT), usually originates in the deep veins of the calf, and due to sluggish blood flow it is common in the venous sinuses of the soleus and gastrocnemius. Rarely DVT may arise in the popliteal, femoral, or iliac veins. Patients with DVT may have minimal or atypical symptoms, and clinical features considered typical of DVT can be found in non-thrombotic disorders.¹ Other than treatment failure, problems leading to mortality and morbidity usually result from misdiagnosis and anticoagulant related bleeding. A correct diagnosis is therefore, essential. Despite the limitations of clinical diagnosis, history, and physical examination continue to be the first step in evaluation of these patients. For many years, ascending contrast venography was the only available method for objective diagnosis of DVT and is still considered the gold standard. However, it is no longer appropriate as an initial diagnostic test and alternative diagnostic tests have replaced ascending contrast venography for screening DVT.² Venous ultrasonography (VU), the most accurate non-invasive diagnostic test, has become widely available and used. Despite its accuracy, complex strategies are required to exclude patients from the treatment. To definitely exclude DVT, as many as 34% of outpatients and most inpatients need to undergo repeated VU at 1-2 week intervals.³ Other problems with VU include a less accurate diagnosis of below knee DVT, poor sensitivity in asymptomatic patients, and difficulty in diagnosing DVT recurrence as well as limited visualization of veins in the pelvis. Therefore, a non-invasive test is needed that accurately detects above knee DVT, thrombus below the knee, in the pelvis, in asymptomatic limbs, and delineates the proximal extension. Recently, magnetic resonance venography (MRV) has been reported to be a useful diagnostic test for suspected DVT. We conducted a cross-sectional analytical study comparing MRV with VU for diagnosing DVT. The aim of the study was to compare the diagnostic value of MRV and VU in clinically suspected cases of DVT.

The study was conducted at King Fahd specialist Hospital, Buraidah, Al-Qassim, Kingdom of Saudi Arabia from January to December 2007. The institute research and ethics committee approved the study.

Consecutive patients admitted to our institution with a clinical suspicion of DVT, were included in this study. A detailed history and physical examination was carried out at the time of admission and a specially designed form was used to collect data. The study and procedures involved were explained to the patients. Informed consent for the procedure was taken from all patients. Patients were excluded from the study if they were less than 18 years of age, had contraindication for MRV, if the duration of symptoms was more than 2 weeks, or they had a history of previous ipsilateral limb DVT. All patients had a VU and MRV within 48 hours of admission. The MRV was performed using a superconducting magnet operating at 1.5 Tesla unit (GE, Signa Horizon, USA). The VU of the symptomatic lower limb was performed using a 5 to 7-MHZ linear array transducer (GE Logic 400, USA). A qualified radiologist performed color Doppler evaluation of the whole limb, including the calf veins in all patients. Sonographic examination included compression and augmentation maneuvers. All the lower limb veins were examined including iliac veins. Two different radiologists, unaware of the result of the other modality, analyzed the VU and MRV. On MRV, venous segments were assessed by reading the coronal source data and standard image reconstruction techniques. Patency was defined as normal flow within different venous segments studied, and thrombosis was defined as low signal intensity within the venous lumen. The criteria of thrombosis on VU included non-compressibility, absent flow or visibility of thrombus within a vessel. The findings were recorded in a standardized format.

The data were computed and compared by applying Chi square test for paired data using Yates' correction. A *p*-value of <0.05 was considered significant.

Forty consecutive patients admitted to our institution with a presumptive diagnosis of DVT were included during the study period. Nine patients were excluded due to various reasons. Two patients had previous DVT of the same limb, 2 had symptoms for more than 2 weeks, 2 were pregnant, one patient had an implanted metallic device, and one refused to give consent for MRV, while in another patient VU was reported to be technically difficult due to morbid obesity. There were 21 (67.7%) females and 10 (32.3%) males. The age of our patients ranged from 18-85 years, the median age of females (33±14.5 years) was less than that of males (44±23.8 years). All the patients had pain, swelling, or both at the time of presentation, and the duration of symptoms ranged from 1-14 days with a median of 6 days. Fifteen of our patients (15/31, 48.4%) had a risk factor for developing DVT. The diagnosis was confirmed in 22 patients (22/31, 71%); 21 (67.7%) by

Table 1 - Detection of involvement of various venous segments as detected by different imaging modalities.

Venous segment	Imaging study				P-value
	MRV		VU		
	Positive	Negative	Positive	Negative	
	n (%)				
Calf vein	12 (38.7)	19 (61.3)	8 (25.8)	23 (74.2)	0.42
Popliteal	14 (45.2)	17 (54.8)	15 (48.4)	16 (51.6)	1.00
Femoral	20 (64.5)	11 (35.4)	19 (61.3)	12 (38.7)	1.00
Iliac	19 (61.3)	12 (38.7)	7 (22.6)	24 (77.4)	<0.05
IVC	5 (16.1)	26 (83.9)	Not assessed		

MRV - magnetic resonance venography, VU - venous ultrasonography, IVC - inferior vena cava

both the modalities and in one patient only by MRV. The MRV detected thrombosis in iliac veins in 19 patients compared with 7 by VU (Table 1). Unsuspected thrombosis of the inferior vena cava (IVC) was detected in 5 patients by MRV (Table 1). In another patient, MRV revealed thrombosis of the femoral and iliac veins in the asymptomatic limb

Our study confirms the diagnostic value of MRV in DVT. The superiority of MRV over VU in the evaluation of thrombus extension was also demonstrated in this study. Although the number of patients in this study is small, these were drawn from consecutive requests made by the clinicians who suspected DVT on the basis of leg symptoms and signs. The age range varied widely, and the cases included patients without or with risk factors for DVT including those who were postoperative, had a malignancy, or were postpartum. Due to its noninvasive nature and easy availability, VU of the lower limb, with compression and augmentation maneuvers, has become the current standard for routine clinical assessment of possible lower extremity DVT.⁴ The accuracy of VU in comparison with contrast venography has been well established. The weighted mean sensitivity and specificity of VU for the diagnosis of proximal DVT are 97% and 94%, allowing the treatment decisions to be taken without further confirmatory tests.⁴ Limitations of this procedure include technical (edema, wound, immobilization devices, tenderness, obesity, trophic involvement) and diagnostic (operator dependence, difficulties in differentiating recanalized from fresh thrombus). The VU is reported to have poor sensitivity for diagnosing below knee DVT, although specificity remains high. The VU failed to diagnose calf vein thrombosis in 4 of our patients who had such an involvement on MRV. It is interesting that none of our patients had isolated calf vein thrombosis. Although in our study the overall advantage of MRV to VU in decision to treat was seen only in one patient out of

22, yet MRV has obvious advantages over VU, which include lack of operator dependability, reproducibility between observers, the ability to study IVC and iliac veins, and as found in our study, the ability to detect below knee and pelvic vein thrombosis in a higher proportion of patients. Additionally MRV, in our study, revealed extension of thrombosis into the iliac veins in 12 cases and into the IVC in 5 patients.

Ascending contrast venography is considered to be the most reliable test for DVT, however, it is invasive, difficult to perform, and its inaccuracies are well known. A true "gold standard" for the assessment of DVT is still missing. As symptoms and signs alone are inadequate for evaluation of possible DVT, different clinical models have been developed to identify the risk categories.² No doubt addition of D-dimer testing to this model may further stratify the patients into a group in whom chances of DVT are minimal; we are still in need of an ideal test.² It is noteworthy that isolated pelvic thrombosis has been demonstrated by MRV in as many as 20.4% cases in a recent series reported by Spritzer et al.⁵ In fact, they demonstrated a higher sensitivity of MRV in pelvic DVT even when compared with ascending contrast venography.⁵ The major limitations of our study are a relatively small number of patients, and that we could not have an arm of comparison with ascending contrast venography, the "gold standard," because of the technical difficulties and invasive nature of this procedure. However, despite a small number of patients and lack of comparison with the hitherto "gold standard" ascending contrast venography, our study has, again, confirmed the diagnostic value of MRV in DVT, and we believe that MRV could become the "gold standard" for initial assessment of DVT as it is noninvasive, does not expose the patient to ionizing radiation, is highly accurate, provides comprehensive imaging of the full extent of the thrombosis, and is reproducible. The barriers to its widespread use for the

assessment of DVT include the lack of availability, high cost, and a long examination time. As scanners become more plentiful, and cheaper with rapid scanning speeds, the costs will decrease and soon this modality may be the gold standard for the diagnosis of DVT.

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