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## Diagnosing deep vein thrombosis in the lower extremity: correlation of clinical and duplex scan findings

### 診斷下肢中的深層靜脈血栓症：臨床與複式掃描發現的相關性

**Objective.** To identify factors that predict a positive duplex scan examination result in patients with suspected deep vein thrombosis of the lower extremity.

**Design.** Retrospective study.

**Setting.** Vascular laboratory in a university teaching hospital, Hong Kong.

**Subjects and methods.** The results of 345 lower extremity duplex venous scans performed between August 1994 and November 1998 were reviewed. All patients were in-patients referred from different specialties due to clinical suspicion of lower extremity deep vein thrombosis. Positive duplex scans were correlated with patients' demographic data (sex, age), medical history (history of malignancy, deep vein thrombosis, and pulmonary embolism) and clinical features (leg swelling, venous insufficiency, calf pain, and leg ulcer). Univariate analysis was performed using the Chi squared test.

**Results.** A total of 345 scans were performed for 313 patients. The mean age was 55 years (range, 19-92 years). Sixty-three patients (49 male, 14 female) had a positive scan, giving a yield of 18.3%. Four factors had a significant association with a positive scan: male sex ( $P=0.0102$ ), history of malignancy ( $P=0.0040$ ), history of deep vein thrombosis ( $P=0.0001$ ), and history of pulmonary embolism ( $P=0.0265$ ).

**Conclusions.** Common presenting clinical features do not predict the result of ultrasonographic investigation for deep vein thrombosis. The chance of having a positive scan is significantly higher in male patients and those with a history of malignancy, deep vein thrombosis, or pulmonary embolism.

**目的：**鑒別預示被懷疑有下肢深層靜脈血栓症患者複式掃描陽性結果的因素。

**設計：**回顧性研究。

**安排：**大學教學醫院的血管實驗室，香港。

**患者與方法：**總結了1994年8月至1998年11月期間進行的345次下肢複式靜脈掃描的結果。所有患者均為在患病時臨床懷疑有下肢深層靜脈血栓症的不同特徵。陽性複式掃描與患者的人口統計學數據(性別、年齡)、病史(惡性、深層靜脈血栓、及肺部栓塞史)和臨床特徵(腿腫、靜脈不足、小腿痛、及腿潰瘍)等的關聯。使用Chi squared 測試進行了單變量分析。

**結果：**對313名患者進行了合共345次掃描。平均年齡為55歲(範圍，19至92歲)。63名患者(49男，14女)呈掃描陽性，佔18.3%。四個因素與掃描陽性有重要關聯，男性( $P=0.0102$ )，惡性史( $P=0.0040$ )，深層靜脈血栓病史( $P=0.0001$ )，和肺部栓塞史( $P=0.0265$ )。

**結論：**共同呈現的臨床特徵並不預示深層靜脈血栓症超聲波調查結果。在男性患者和那些有惡性、深層靜脈血栓及肺部栓塞史的患者中有陽性掃描的可能性比較高。

#### Key words:

Leg;

Pulmonary embolism;

Ultrasonography, Doppler, duplex;

Venous thrombosis

#### 關鍵詞：

腿；

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超聲波掃描術，多普勒，複式；

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#### Introduction

Deep vein thrombosis (DVT) is a significant cause of morbidity and is sometimes fatal. The lack of specific symptoms and pathognomonic signs poses a diagnostic challenge to both surgeons and physicians. Preventive measures and early diagnosis through appropriate investigation are essential in reducing the risk of fatal pulmonary embolism (PE). Duplex venous scanning, due to its high sensitivity and specificity, especially for proximal deep veins, has replaced venography as the gold standard diagnostic method for DVT.<sup>1,2</sup>

Recent years have seen the proliferation of non-invasive diagnostic procedures in the surgical field. Although the introduction of these techniques may reduce procedure-related morbidity, excessive referrals can lead to a waste of resources, and appropriate guidelines are therefore necessary to prevent overuse of these investigations. The expanding demand for ultrasonographic studies of patients with a provisional clinical diagnosis of DVT is of concern in the vascular laboratory. This study reviewed risk factors and indications for all patients undergoing a duplex scan for the diagnosis of DVT and aimed to identify factors associated with a positive scan.

## Methods

Between August 1994 and November 1998, all lower extremity duplex ultrasonographic studies performed at the Vascular Laboratory of the Department of Surgery at Queen Mary Hospital were reviewed. Patients were referred from different specialties for venous duplex scanning because of clinical suspicion of DVT. All scans were performed by a registered vascular technologist. The examination was conducted using a colour-flow ultrasonographic scanner (Acuson 128 XP 10 Scanner, Acuson Inc. Mountain View, California) with a 7-MHz transducer. The ultrasonographic criteria for the diagnosis of acute DVT included visualisation of light echogenic intraluminal thrombus, lack of phasic venous flow, lack of flow augmentation, and loss of normal vein compressibility on light probe pressure. The ultra-sonographic features of chronic DVT included the appearance of a bright, echogenic, intraluminal thrombus, a recanalised vein lumen with securely attached thrombus, and the presence of multiple venous collaterals.

Clinical information including demographic data, clinical features, and medical history were recorded. Duplex scan findings regarding the presence or absence of DVT, acute or chronic DVT, and the extent of thrombosis were reported. Nine factors were studied for their association with a positive scan result: sex, age, leg swelling, venous insufficiency, leg ulcer, calf pain, history of malignancy, history of DVT, and history of PE. Univariate analysis was performed using the Chi squared test. The P value of <0.05 was considered statistically significant.

## Results

A total of 345 lower limb duplex scans were performed for 313 patients. Sixty-three patients (49 men, 14 women) were found to have a DVT. Venous thrombosis occurred in the left limb in 21 patients, in the right limb in 42 patients, and bilaterally in eight patients. The thrombus extended proximally from the popliteal vein to the external or common iliac veins in 30 patients.

Leg swelling was the most common presenting sign. Of 202 patients who presented with leg swelling alone, 27 patients had ultrasonographic evidence of DVT. Among the 21 patients with a history of DVT who had a positive scan, five had acute thrombosis and 16 had chronic thrombus. Ten patients with a history of malignancy had a DVT. The primary tumour was in the bladder (3), rectum (3), sigmoid colon (1), stomach (1), liver (1), and one patient had a leiomyosarcoma. Six patients suffered from PE. Five of these patients had a duplex scan of the lower limbs performed at the time of diagnosis, and three were found to have a DVT. One patient with a history of PE was referred for a duplex scan because of leg swelling. The result in this case was negative.

Univariate analysis was performed using the Chi squared test. Four factors were found to be significantly associated with a positive scan: male sex ( $P=0.0102$ ), history of malignancy ( $P=0.0040$ ), history of DVT ( $P=0.0001$ ), and history of PE ( $P=0.0265$ ) [Table].

## Discussion

The difficulty of making an accurate clinical diagnosis of DVT due to the lack of specific signs and symptoms is well known. The potential for thrombus propagation and PE necessitates early diagnosis and prompt treatment. With the introduction of duplex venous scanning, which is both accurate and non-invasive, there has been increasing demand for investigation of suspected DVT. The positive yield of these scans reported varies between 2% to 31%, depending on the population studied and the clinical setting.<sup>3,4</sup> In this study, all examinations were performed in the same laboratory by the same vascular technologist. This study aimed to identify clinical parameters associated with a

**Table. Patient data and predictive factors for deep vein thrombosis**

| Clinical feature              | Total No. of patients | No. of patients with DVT* (%) | No. of patients without DVT (%) | P value             |
|-------------------------------|-----------------------|-------------------------------|---------------------------------|---------------------|
| Male sex                      | 211                   | 49 (23.2)                     | 162 (76.8)                      | 0.0102 <sup>†</sup> |
| Female sex                    | 134                   | 14 (10.4)                     | 120 (89.6)                      | -                   |
| Leg swelling                  | 266                   | 51 (19.2)                     | 215 (80.8)                      | 0.2760              |
| Venous insufficiency          | 36                    | 0 (0)                         | 36 (100)                        | 0.6878              |
| Leg ulcer                     | 29                    | 4 (13.8)                      | 25 (86.2)                       | 0.9275              |
| Calf pain                     | 25                    | 7 (28.0)                      | 18 (72.0)                       | 0.4049              |
| History of malignancy         | 20                    | 10 (50.0)                     | 10 (50.0)                       | 0.0040 <sup>†</sup> |
| History of DVT                | 27                    | 21 (77.8)                     | 6 (22.2)                        | 0.0001 <sup>†</sup> |
| History of pulmonary embolism | 6                     | 3 (50.0)                      | 3 (50.0)                        | 0.0265 <sup>†</sup> |

\* DVT = deep vein thrombosis

<sup>†</sup> Statistically significant

positive duplex scan for lower limb DVT. Both the parameters studied and the yield of positive results were comparable to other studies conducted in the West.<sup>5-7</sup>

Leg swelling alone was the most common indication for duplex venous scan; however, the majority of these patients did not satisfy the ultrasonographic criteria for the diagnosis of DVT. It is not surprising that a non-specific symptom such as leg swelling is not predictive of DVT. If it is quantified by objective measurement, leg swelling has been shown to be useful in diagnosis in some studies. Criado and Burnham<sup>6</sup> for example, found a discrepancy of less than 2 cm in the calf circumference of the involved and the normal limb predicted the absence of DVT in 93% of in-patients. A similar result was obtained by Nypaver et al,<sup>7</sup> who reported that a discrepancy of less than 3 cm in calf circumference was associated with a negative scan in in-patients, with a specificity of up to 90%.

The association between a history of DVT and a positive result on duplex scan may be explained in two ways. Chronic thrombus rather than an acute episode of DVT may be the cause of leg swelling. In this study, 16 of 21 patients had duplex scan features of chronic DVT. In addition, patients with a previous DVT may have predisposing factors for developing recurrent DVT. A history of malignancy was also found to be associated with a positive scan. The relationship between occult malignancy and DVT has been widely investigated; the reported incidence of a subsequent diagnosis of malignancy in patients with unexplained DVT varies between 2% to 25%.<sup>8,9</sup> There is no evidence to suggest that DVT is associated with a specific type of tumour. In this study, seven (70%) of 10 patients with malignancy had a primary malignancy of the pelvic organs. A simple postulation is that there is extrinsic compression of the pelvic veins, either by the tumour or due to pelvic lymphadenopathy. The role of malignancy screening for this group of patients is unclear, but a simple clinical evaluation, including medical history, physical examination, routine laboratory tests, and chest X-rays, is justified.

In this study, three (60%) of five patients with acute PE had positive duplex scans showing DVT in the lower limbs. Fowl et al<sup>5</sup> reported that for patients with PE

confirmed by pulmonary angiogram or ventilation perfusion scan, the incidence of acute DVT detected by duplex scan was approximately 43%. However, if the diagnosis of PE was made on clinical grounds only, the incidence of DVT detected dropped to approximately 10%. With the recent development of spiral computed tomography, the diagnosis of PE can be made by non-invasive testing. It is appropriate, therefore, to confirm the diagnosis of PE before subjecting patients to duplex scans.

## Conclusion

Common clinical features are poor indicators of the presence of DVT. Thus, it is difficult to establish appropriate inclusion criteria for evaluation of suspected DVT using duplex scanning studies. The results of this study suggest that the combination of female sex and the sole presentation of leg swelling make the diagnosis of DVT very unlikely. Before the implementation of either inclusion or exclusion guidelines for referral can be considered, further prospective studies are required.

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