

DIAGNOSIS OF DEEP VEIN THROMBOSIS BY DUPLEX DOPPLER ULTRASOUND IMAGING AT THE SINGAPORE GENERAL HOSPITAL

C Chan-Wilde, W E H Lim

ABSTRACT

Deep vein thrombosis (DVT) of the lower extremity is the major cause of pulmonary embolism and chronic venous obstruction disease of the legs. However, the clinical diagnosis of leg vein thrombosis is notoriously difficult. Venography, using iodine containing contrast materials, has been the most reliable older method for diagnosing thrombosis. It is relatively more invasive, requires exposure to radiation and is not free of risks. Doppler ultrasonography has been shown to be highly sensitive and specific in the diagnosis of obstruction of flow in veins. We present 25 patients studied at Singapore General Hospital (SGH) with Doppler for the presumptive clinical diagnosis of DVT. Thirteen were found to have complete or partial obstruction of leg veins and 12 showed normal veins. These 12 patients were thus spared the risk and expense of long term anticoagulation. In experienced hands, Duplex Doppler ultrasonography is an excellent diagnostic modality for the diagnosis or exclusion of significant deep vein thrombosis of the legs. It can be carried out safely and reliably in the very sick, in patients with renal failure, diabetics and the pregnant.

Keywords: deep venous thrombosis, duplex ultrasound, colour Doppler.

SINGAPORE MED J 1995; Vol 36: 56-59

INTRODUCTION

The decision whether to anticoagulate a patient with suspected deep vein thrombosis (DVT) and thus at risk of pulmonary embolism can be a difficult one. The clinical diagnosis is not reliable since approximately 75% of patients are asymptomatic⁽¹⁾ and anticoagulation represents risk. The time honoured method of confirming the presence or absence of DVT is venography which is relatively more invasive, involves radiation and injection of contrast materials and is also not without risks⁽²⁾. Duplex Doppler Ultrasonography allows the non-invasive study of vascular flow and has been shown to be a reliable substitute for venography⁽³⁾. DVT was thought to be a rare event among Southeast Asians^(4,5), though it may be present in up to 26% of routine autopsy studies done in Western countries^(4,6). It is a real threat to traumatised and elderly post-operative and bedridden patients. This report represents our one-year experience (1992) at the Singapore General Hospital (SGH) with colour and duplex Doppler scans on patients suspected clinically of having DVT.

MATERIALS AND METHODS

Patients with clinical signs suggestive of DVT were referred to the ultrasound laboratory for Duplex Doppler study carried out by the same radiologist. An Acuson 128XP/10 unit (Acuson Co, Mountainview, California) with a 5.0 or 7.5 MHz linear-array transducer was utilised. The study began with identification of the femoral vein and artery at the inguinal region (Fig 1a, b, c and d). One could then see, with colour Doppler technique, directional flow of blood in both vessels. Complete manual compressibility of the vein is indicative of full patency and absence of clots⁽⁴⁾. The superficial femoral vein is followed down

to its entry into the adductor canal. Patients were then turned into the decubitus position and the popliteal vein is traced in the popliteal fossa down to its tributaries (posterior tibial and peroneal veins). Compressibility is tested along the entire course of the study. Veins below the popliteal cannot always all be visualised adequately. Obesity and severe edema have an adverse effect on the reliability at this level. A diagnosis of DVT is made when an echogenic or non-echogenic obstruction or impairment to flow is detected with or without persistent dilation and this vein is non-compressible⁽¹⁾. A normal study is reported if flow is not impaired and the vein is completely compressible⁽¹⁾. The anatomic site of the DVT is identified in the report Fig 2(a,b) and 3(a,b). Long term follow up and/or confirmatory venography were not always possible in this series; however, all patients diagnosed as having DVT were anticoagulated. The high sensitivity and the specificity of this procedure for the diagnosis of acute DVT have been well documented in previous studies⁽¹⁻⁴⁾.

The examination time for positive patients (DVT in femoral or popliteal veins) may take only 1-2 minutes whereas negative patient may take as long as 30 minutes to 1 hour as the peroneal and posterior tibial vein were examined routinely and thoroughly. At times, augmentation of the flow in the calf veins may be helpful, by gently squeezing the patient's calf; flow within patent veins will show up as a colour doppler signal.

With advanced software that is sensitive to red blood cell perfusion ("Colour Doppler energy"/"Power Doppler"/"Ultrasound angio" – depending on manufacturer) examination of the calf veins is facilitated, with increase in sensitivity and specificity of the examination.

RESULTS

Twenty-five patients with a clinical diagnosis of DVT were studied. Nine of these were subjected to a study of both lower extremities. The clinical diagnosis of DVT was confirmed by Doppler study (DS) in 13 patients (19 limbs). Clinical and DS findings recorded in these two groups are seen in Tables I – III.

Venography was carried out after the Doppler study in one individual, confirming the "negative for DVT" finding. None of the positive cases were confirmed by contrast studies. None of the individuals with normal venous flow on Doppler study were anticoagulated and anticoagulants were stopped in one patient who had been started on heparin therapy before the Doppler study.

Department of Diagnostic Radiology
Singapore General Hospital
Outram Road
Singapore 0316

C Chan-Wilde, MD, ABDR
Consultant

W E H Lim, MBBS, FRCR
Registrar

Correspondence to: Dr C Chan-Wilde

Fig 1a – Transverse scan of the femoral artery (FA) and vein (FV), showing normal doppler flow signal

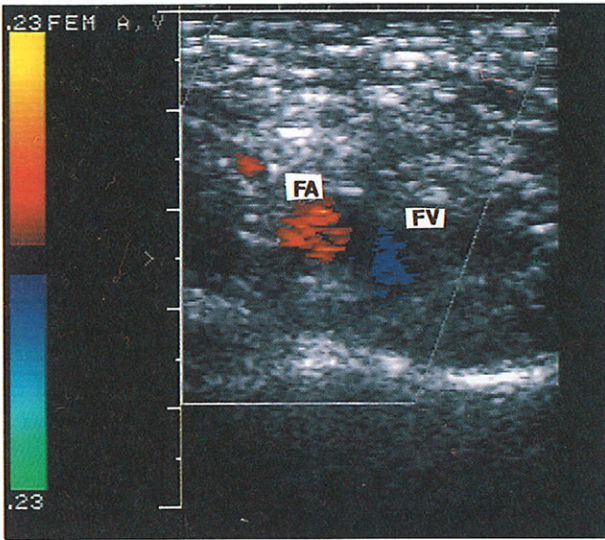


Fig 1c – Transverse scan at the same level as (a), showing normal obliteration of venous flow signal on compression via the ultrasound probe. Note presence of doppler flow signal in the femoral artery which is not occluded by the application of pressure.

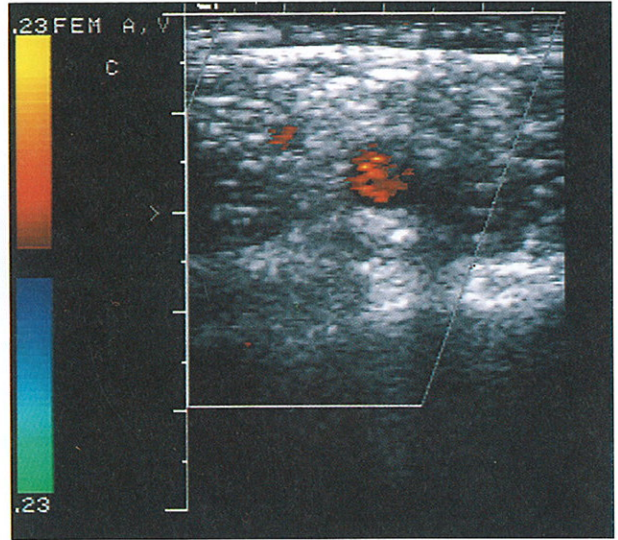


Fig 1b – Longitudinal scan of the femoral vein with normal doppler flow signal

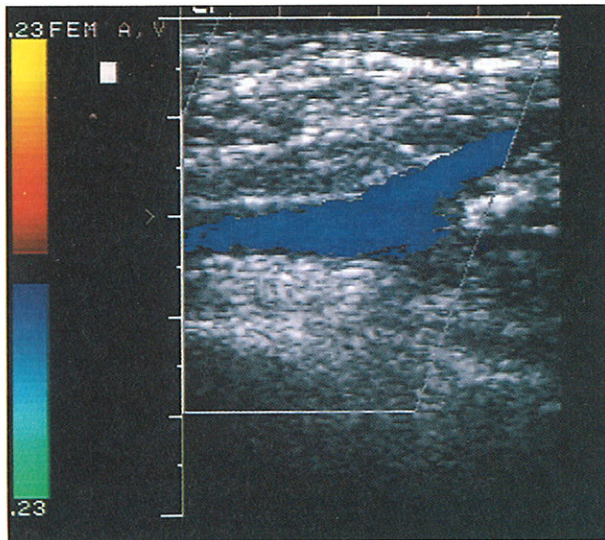


Fig 1d - Longitudinal scan of the femoral vein with absence of doppler signal due to compression

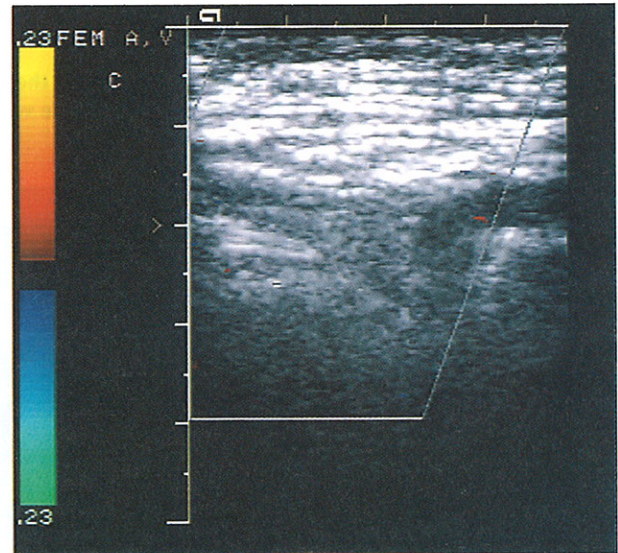


Fig 2 (a) Transverse and (b) longitudinal scans of the femoral vein filled with echogenic thrombus in a patient with deep venous thrombosis.

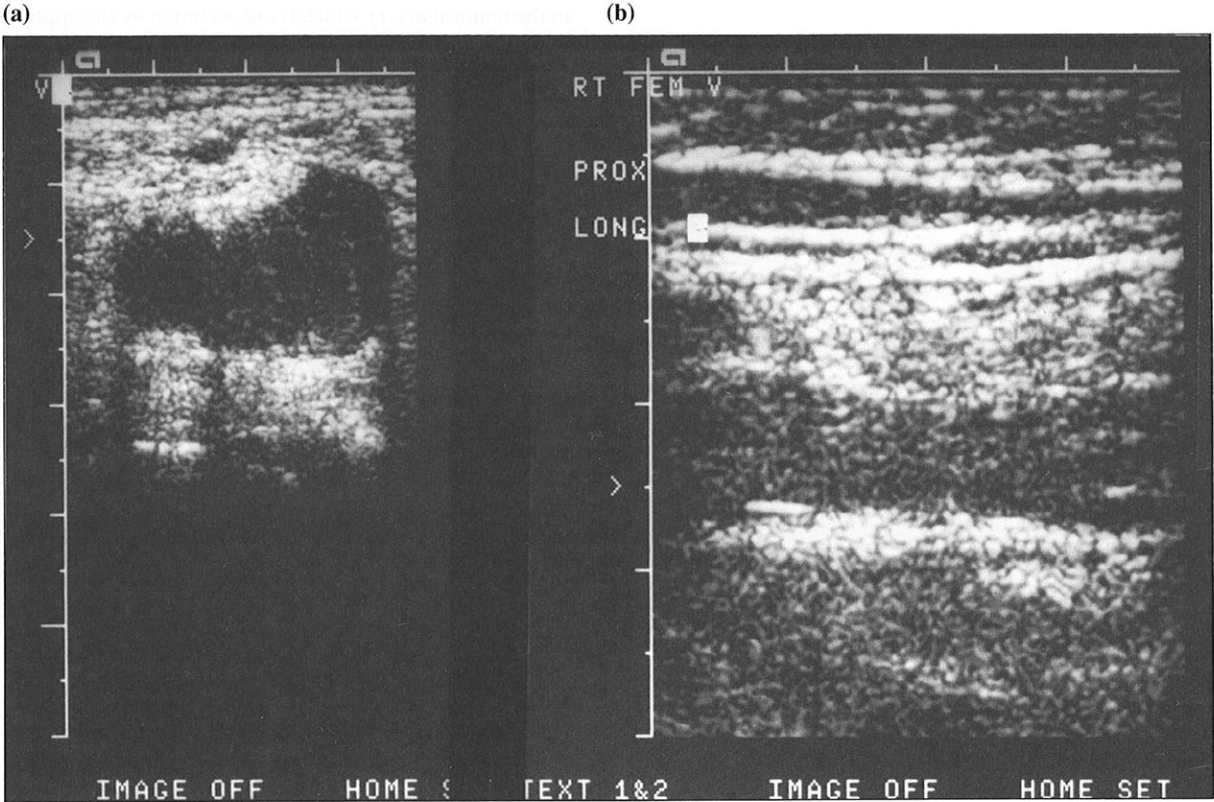


Fig 3 – (a) Transverse and (b) longitudinal scans of the popliteal vein of the same patient as in Fig 2 showing presence of echoes within the vessel lumen due to a thrombus.

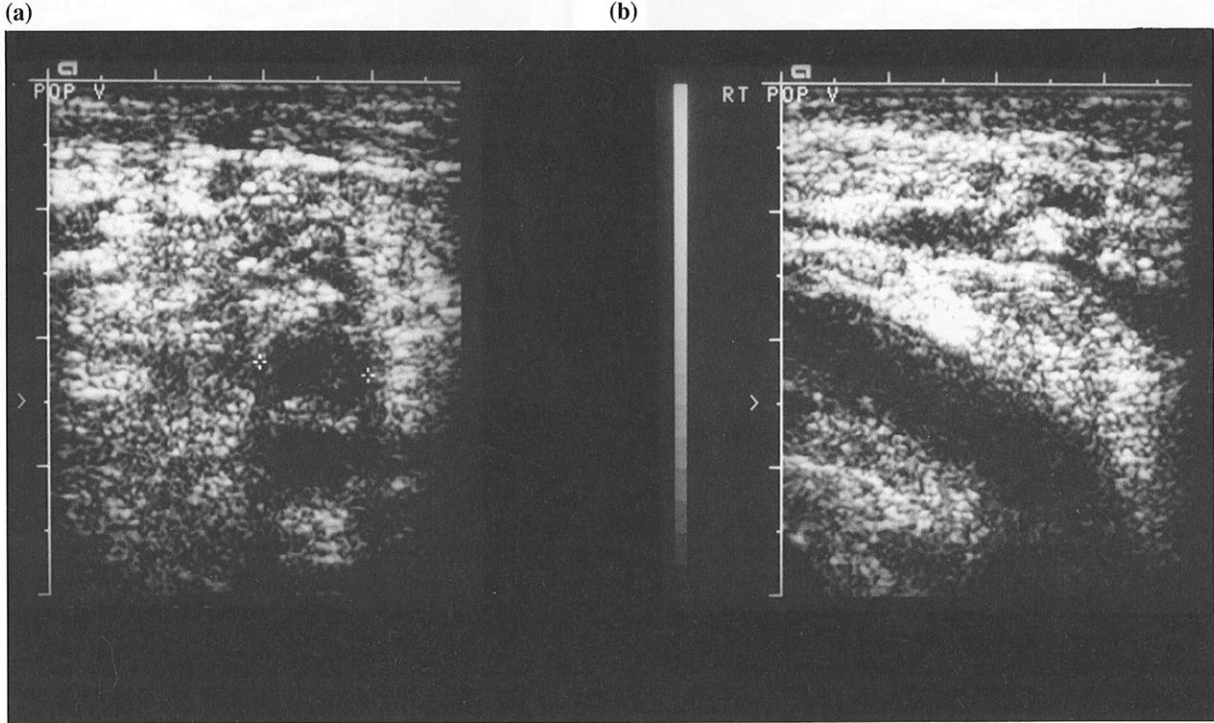


Table I – Clinical findings in patients with and without DVT on duplex sonography (DS)

Clinical symptom or sign	Positive for DVT on DS	Negative for DVT on DS
Swollen leg	10	10
Warm leg	1	4
Painful/tender leg	2	7
Redness	1	4
Inequality of girth	7	6
Local tenderness	1	7
Prominent dorsal veins	1	0
Pitting edema	2	4
Calf pain on dorsiflexion	2	0
Age range (years)	38-86	24-77
Mean (Age)	62	54

Table II – Risk factors for DVT recorded among patients studied

Risk factor	Positive for DVT on DS	Negative for DVT on DS
Recent major surgery	5	1
Malignancy	9	0
Prolonged bed rest	4	3
Use of estrogens	0	1
Uterine myomata	2	0
Others (pregnancy)	0	1

Table III – Doppler study findings in the DVT positive group

Location of DVT	Right leg	Left leg
Entire leg	6	5
Below knee only	0	0
Partial occlusion, entire leg	0	4
DVT found in the other clinically normal limb	3	1

DISCUSSION

Contrary to the previous report from Bangkok and Singapore^(4,5), DVT does not appear to be rare among Singaporeans. Our patient population was a selected one and included only those whom the attending clinicians suspected the presence of DVT on the basis of symptoms and signs. It was not possible to distinguish the group positive for DVT on DS from those who are negative on clinical grounds alone. We found that 48% of these patients studied did not have DVT and were then spared the expense and risk of anticoagulation. The clinical symptoms and signs of DVT can be mimicked by trauma, cellulitis, venous insufficiency and lymphangitis. Pelvic malignancies were common among the patients found to have DVT. Study of the femoral and popliteal veins is very sensitive but in the calf region, the sensitivity may drop slightly due to some limitations (such as edematous leg, obesity, varicoses, etc). Although significant emboli can arise from the deep veins of the calf alone^(7,8), others argue that the popliteal vein must at least be involved⁽⁹⁻¹¹⁾.

Our limited experience, so far, with Doppler venography is in keeping with reports from Western countries. It appears to be the procedure of choice for the diagnosis and exclusion of DVT. It can be done safely and reliably in critically ill patients, those with renal failure, diabetes and the pregnant, the ones most at risk from DVT and contrast venography.

ACKNOWLEDGEMENT

Our thanks to Miss Loke Yin Khuen for typing the manuscript and Mr Alias B Rahmed for photo editing.

REFERENCES

1. Cronan JJ, Dorfman GS, Scola FH, Schepps B, Alexander J. Deep venous thrombosis: US assessment using vein compression. *Radiology* 1987; 162:191-4.
2. Cronan JJ. Recurrent deep venous thrombosis: limitations of US. *Radiology* 1989; 170:739-42.
3. Polak JF, Culter SS, O'Leary DH. Deep veins of the calf: assessment with colour Doppler flow imaging. *Radiology* 1989; 171:481-5.
4. Vathesatogkit P, Saenghirunvattana S, Nitiyanant P. Autopsy proven cases of pulmonary thromboembolism, 18-year study at Ramathibodi Hospital. *J Med Assoc Thai* 1989; 72:271-4.
5. Hwang WS. The rarity of pulmonary thromboembolism in Asians. *Singapore Med J* 1968; 9:276-9.
6. Bergquist D, Lindblad B. A 30-year survey of pulmonary embolism verified at autopsy: an analysis of 1,274 surgical patients. *Br J Surg* 1985; 72:105-8.
7. Havig O. Deep vein thrombosis and pulmonary embolism: an autopsy study with multiple regression analysis of possible risk factors. *Acta Chir Scand (Suppl)* 1977; 478:1-120.
8. Moreno-Cabral R, Kistner RL, Nordyke RA. Importance of calf vein thrombophlebitis. *Surgery* 1976; 6:735-42.
9. Moser KM, Le Moine JR. Is embolic risk conditioned by location of deep venous thrombosis? *Ann Intern Med* 1981; 94:439-44.
10. Dorfman GS, Cronan JJ, Tupper TB, Messersmith RN, Denny DF, Lee CH. Occult pulmonary embolism: a common occurrence in deep venous thrombosis. *AJR* 1987; 148:263-6.
11. Huisman MV, Buller HR, Ten Cate JW, Vreeken J. Serial impedance plethysmography for suspected deep venous thrombosis in outpatient. *The Amsterdam General Practitioner Study. N Engl J Med* 1986; 314:823-8.