

Out-patient detection of deep vein thrombosis using a combination of risk scoring and strain-gauge-plethysmography: a follow-up study

N J Langford, K Tonks & M Singh

Abstract

Patients are frequently referred to hospital for exclusion of deep vein thrombosis (DVT); however, the diagnosis is only confirmed in 12% of those undergoing investigation. An effective strategy is required, which minimises the number of negative investigations, while safely excluding or confirming the diagnosis. This study investigates the combination of clinical risk scoring and strain-gauge plethysmography in the initial assessment of patients with suspected DVT. A survey was conducted of 1300 patients referred with suspected DVT over the course of a year. The results of this investigation were comparable to previous clinical trials and supports the use of strain-gauge plethysmography combined with clinical risk score in a busy acute medical unit.

Keywords:

Deep vein thrombosis; screening; strain gauge plethysmography

Introduction

Approximately 100 people per 100,000 of the population per year are affected with deep vein thrombosis (DVT).^{1,2} However the incidence of suspected deep vein thrombosis is considerably higher. Over the course of a year, for our hospital serving an inner city population of 350,000 patients, approximately 1500 patients are referred with suspected DVT. Of these, only 12% actually have a deep vein thrombosis diagnosed. A process is therefore required that allows the diagnosis to be confirmed or refuted, whilst utilising the limited available resources in the most cost-effective manner.

Traditionally, DVT was initially investigated using contrast venography. Although an effective means of visualising the venous system of the lower limb, this test is time consuming, disliked by patients and contra-indicated or physically impossible in some patients. More recently, compression doppler ultrasound has become the most widely used investigation for DVT. However this process requires a high degree of staff training which may limit its availability. Alternative methods have been introduced to ensure better targeting of resources. Non-invasive tests have been developed and shown

to be effective screening tools for deep vein thrombosis investigation.³⁻⁵ However within the United Kingdom there is no universally accepted method of investigating the presence or absence of a deep vein thrombosis. In a report by the Health Technology Assessment (HTA) group in 2006, 31 different methods of investigating deep vein thrombosis in the United Kingdom are described.⁶

Testing for d-dimers has been widely used to try and screen out those individuals who could be excluded from having a deep vein thrombosis. Unfortunately, although d-dimers have good sensitivity (91%), specificity is poor (55%).⁶ The poor specificity is due to a wide range of different conditions that may elevate d-dimers such as smoking, pregnancy, recent trauma or operations, malignancy and infection. Specificity can be improved when used in conjunction with a scoring system, however even with this combined approach, a significant number of patients still require further investigation. An alternative process highlighted in the HTA report was plethysmography. This has been shown to be effective in the out-patient setting for patients who require further investigation for DVT.⁷

Studies indicate strain-gauge plethysmography has an overall sensitivity for DVT of 83% (81-85 %) and 81% (79-82 %).^{6,8} However the sensitivity for distal DVT is considerably lower at 56%. Bearing this in mind we use an assessment pathway which combines clinical risk scoring and strain-gauge plethysmography that has been previously validated.⁷ This process has been in use in our department since 2002 (Figure 1).

Aims

The aims of this study were to determine whether patients who had been discharged from our service following exclusion of DVT had developed any problems, including venous thromboembolic disease, during the 3 months after their investigation.

Methods

The investigation was discussed with the local research ethics committee who deemed it a service evaluation. All out-patients who had been referred to

Nigel J Langford

MD
Medical Assessment Unit
City Hospital
Birmingham

Department of Clinical
Pharmacology
University of Birmingham
Birmingham

Karl Tonks

Medical Assessment Unit
City Hospital
Birmingham

Manjit Singh

Medical Assessment Unit
City Hospital
Birmingham

Correspondence:

NJ Langford.

Medical Assessment Unit,
City Hospital,
Dudley Road,
Birmingham,
United Kingdom.
B18 7QH
e-mail
nigel.langford@swbhb.nhs.uk

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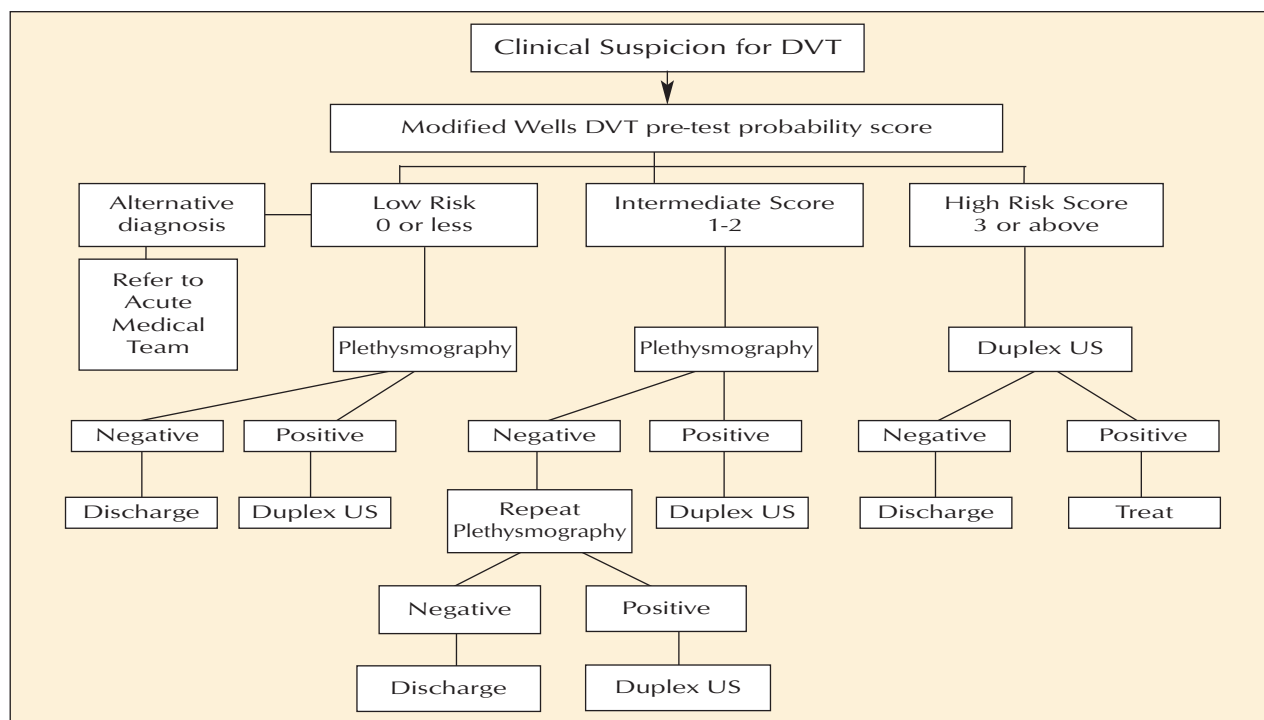


Figure 1. Deep Vein Thrombosis Diagnosis Algorithm (Adapted from MK Singh et al *Acute Medicine* 2005 4 (2) p67)

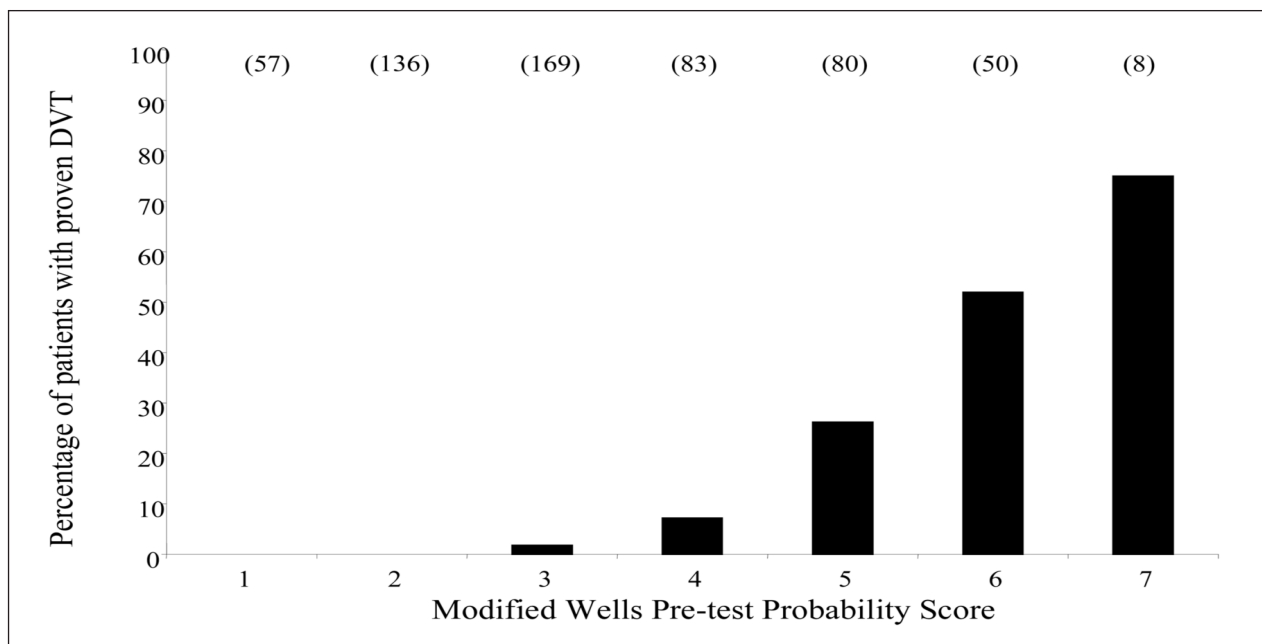


Table 1. Graph demonstrating increased likelihood of having a DVT compared to Modified Wells Score (number of patients in each group stated in brackets).

the clinic with a suspected deep vein thrombosis from March 2005 to March 2006 were included in the survey. Patients were excluded if they were hospital in-patients or were under the age of 18 at the time the procedure was performed.

All patients who fulfilled entry criteria were sent a letter, at least three months after their visit, requesting that they complete a short questionnaire about their experience at the clinic and enquiring whether further problems with their leg had occurred. Where the patient indicated that further problems with their leg had arisen,

such as the subsequent diagnosis of DVT, the general practitioner was contacted to confirm the diagnosis. In cases where the patient had died within 3 months of having an assessment the cause of death was investigated to ascertain whether a thromboembolic cause was listed.

Results

Over a 12 month period 1480 patients used the service for investigation of deep vein thrombosis. 1006 (68%) patients were referred from primary care, 282 (19%) came

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		Venous Ultrasonography and survey report		
		Pos	Neg	Total
Combine Wells + plethysmography	Pos	31	21	52
	Neg	2	459	461
	Total	33	480	513
Sensitivity - 93% (31/33) Specificity - 95% (459/480) Positive Predictive Value - 57% (31/52) Negative Predictive Value - 99.6% (459/461)				

Table 2. Comparison of combined plethysmography and pretest probability scores against venous ultrasonography and survey report for detection of DVT.

from the emergency department and 192 came from other community based services. Of the 1480 patients 45 patients were untraceable or not contactable, and 135 patients had died. None of those who died within 3 months of having a scan performed had a cause of death that appeared on the death certificate directly related to venous thrombo-embolism. 1300 individuals were surveyed.

We received 583 replies (45%). 62 (11%) of those who replied had been diagnosed as having a DVT at the time of their initial presentation

All patients had a modified Wells DVT pretest probability score performed⁸ (Table 1). 70 patients had proceeded directly to ultrasound owing to either high clinical risk scores (53 patients) or technical difficulties in performing plethysmography (ie inability to lie flat for 15 minutes, or raise their leg onto the stool (17 patients)). 29 (41%) were diagnosed as having DVT by ultrasound.

Of the remaining 513 patients, DVT was deemed to have been excluded in 368 patients who underwent clinical risk scoring followed by plethysmography. In this group no patient reported that they had experienced a subsequent thrombo-embolic event or complication. 145 were investigated using both plethysmography and ultrasound, owing to either a positive or inconclusive test or following repeat referral for the same condition. Minor deviations from protocol were noted during analysis.

Of the 54 patients with positive plethysmography, 33 patients (61%) were confirmed as having a deep vein thrombosis following ultrasonography. 2 patients who initially had an inconclusive plethysmography were diagnosed as having a deep vein thrombosis following a positive test performed three days later, which was confirmed by doppler ultrasound. In both of these cases the DVT was confined to the calf veins.

In those patients diagnosed with a confirmed DVT, only 5 patients required admission and in-patient anticoagulation. Overall the sensitivity of our test was 93% with a specificity of 95% in those that replied to the

questionnaire for subsequent symptomatic DVT. The negative predictive value of patients referred to the service was 99.6 %, though the positive predictive value was low at 57% (Table 2).

Discussion

This study provides follow-up data which supports the use of our algorithm incorporating combinations of plethysmography and clinical risk scoring. Importantly the results from this study appear consistent with our previous study where the calculated positive predictive value was 53% and most importantly the negative predictive value was 99%.⁷ This study shows that when our previously described clinical trial protocol is used in clinical practice the results remain consistent and patient safety appears to be maintained.

The HTA assessment suggests plethysmography is a cost effective method of clinically assessing and ruling out deep vein thrombosis. Although strain-gauge plethysmography was introduced as an easy near patient test, its cost effectiveness improves with experienced operators as the time taken to perform the scan is reduced. The material cost of a single test is approximately £15 per leg measurement. This compares to a cost of £12 per d-dimer test. However both of these costs are dwarfed compared to performing a full leg duplex scan, costing in the region of £125-£150 per scan. Limiting the number of negative ultrasound scans is important in improving the cost-effectiveness of our service. Furthermore, reducing the time required for DVT scans can enable the ultrasound service to provide more scanning time for other users, thereby optimising hospital resources. From the patients' perspective, by being able to confidently rule out a significant veno-thromboembolic event at the bedside at the point of admission prevents unnecessary dosing with anti-coagulants, alleviates patient anxiety and allows a rapid discharge from the Acute Medical Service. Historically, we have reduced the number of ultrasound requests by 70%, and over 50% of patients can be discharged within hours of

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presenting to the acute medical unit without requiring administration of anticoagulant drugs.

The value of combining a series of tests allows rational decisions to be made. Studies have demonstrated that using probability scoring and d-dimer testing can reduce the need for ultrasound testing in up to 38 per cent of patients.³ Our study suggests that only 36% of patients referred for DVT evaluation ultimately require a full leg compression ultrasonography. Further studies are required to see if clinical risk scoring, e.c.-dimers and plethysmography can be combined to improve screening further whilst remaining cost-effective.

Despite these results our study does have significant limitations. Only 45% of patients responded to our survey. We would argue that non-responders were less likely to have had further problems, whilst those dissatisfied with the service would be more likely to complain. Furthermore, given that we serve a local population, if problems arise, patients or their general practitioners readily contact us. Our study only used out-patients. Although the service is readily used by other specialities in the hospital, the proportion requiring

ultrasonography is considerably greater owing to higher clinical assessment scores.

Previous studies^{8,9} and our own experience has shown that plethysmography is less accurate at detecting below-knee deep vein thromboses. It is possible that, in the group of patients we investigated some will have had a below knee deep vein thrombosis that has been missed. This is a matter of concern, not only in the possibility that the clot may extend, but also the increased risk a patient may have of post-thrombotic syndrome.¹⁰ It could therefore be argued that this group of patients should be followed for a minimum of five years to ensure complications have not arisen. However the risk of missing below-knee DVT is not unique to strain-gauge plethysmography.

Despite these limitations we believe we have demonstrated that plethysmography in combination with clinical risk assessment can be used to exclude proximal deep vein thromboses in patients presenting to an acute medical clinic. In addition owing to its high negative predictive power, the number of patients requiring lower limb venous doppler examination can be reduced without compromising their safety.

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