PAPERS AND ORIGINALS

Postoperative deep vein thrombosis: identifying high-risk patients

A J CRANDON, K R PEEL, J A ANDERSON, VALERIE THOMPSON, G P McNICOL

Summary and conclusions

A prospective study was carried out to confirm the validity of a predictive index for patients at risk of developing deep vein thrombosis. The index, which correctly identified nine out of 10 patients and incorrectly identified seven out of 52 patients as being at risk, is based on five variables—namely, the euglobulin lysis time, serum concentration of fibrin-related antigen, age, percentage overweight for height, and presence of varicose veins.

Thus a population of patients at particularly high risk of developing postoperative deep vein thrombosis may be identified preoperatively by means of this index, so that prophylaxis may be used more rationally.

Introduction

Evidence suggests that prophylactic low-dose subcutaneous heparin reduces the incidence of postoperative deep vein thrombosis.^{1,2} Such treatment, however, is associated with an increased risk of bleeding.¹⁻³ Prophylaxis for all patients entails giving unnecessary treatment to many who would not have developed deep vein thrombosis in any case. One answer is to restrict prophylaxis to patients with a high risk of deep vein thrombosis in whom, therefore, exposure to the risks of prophylaxis is justified.

Department of Obstetrics and Gynaecology, Leeds Maternity Hospital, University of Leeds

A J CRANDON, MRCOG, MAUSCOG, research registrar

The Hospital for Women, Leeds LS8 1NT

K R PEEL, FRCOG, FRCSED, consultant gynaecologist

School of Mathematics, University of Newcastle upon Tyne

J A ANDERSON, MA, DPHIL, reader in statistics
VALERIE THOMPSON, BA, MSC, research associate

University of Leeds

G P McNICOL, MD, PHD, professor of medicine

Clayton *et al*⁴ showed that high-risk patients could be accurately identified preoperatively by using two simple laboratory tests (the euglobulin lysis time and serum fibrin-related antigen concentration) and three pieces of clinical information (age, percentage overweight for height, and presence or absence of varicose veins). Using stepwise logistic discriminative analysis they developed a prognostic index which gave good prediction of patients at risk of developing postoperative deep vein thrombosis. The approach was inevitably biased towards a favourable result, however, since the formula was reapplied to the same group of patients from which it had originally been derived.

We undertook the present study to assess the predictive index when applied prospectively to a new group of gynaecological patients.

Methods and patients

Euglobulin lysis time was measured using the method of Blix⁵ and serum fibrin-related antigen by latex agglutination using the Thrombo-Wellcotest. Preoperative height and weight were measured on admission with the patient wearing night attire and in bare feet. The percentage overweight for height was then estimated.⁶ The predictive index was calculated for each patient using the formula of Clayton *et al*⁴:

$$I = -11.3 + 0.009a + 0.22b + 0.085c + 0.043d + 2.19e$$

where a = euglobulin lysis time (minutes), b = concentration of fibrin-related antigen (mg/l), c = age (years), d = percentage overweight for height, and e = presence or absence of varicose veins (scored as 1 or 0 respectively).

An index value was calculated for each of 62 consecutive patients aged 40 years or older about to undergo major gynaecological operations by either the abdominal or vaginal route. The indications for surgery were malignant disease in 11 patients (17.7%) and benign disease in 51 (82.3%). The malignant disease was uterine in five patients (8.1%), cervical in four (6.5%), and ovarian in two (3.2%). Of the patients with benign disease, 21 (33.9%) had dysfunctional bleeding, two (3.2%) fibroids, 20 (32.2%) prolapse, and eight (12.9%) miscellaneous diseases. None of the patients received specific prophylaxis to prevent postoperative deep vein thrombosis, and the predictive index value was unknown when they were screened for the presence of this condition postoperatively.

Diagnosis of deep vein thrombosis—All patients underwent isotope

scanning of their legs before and after operation, using ^{125}I -fibrinogen scanning. Deep vein thrombosis was diagnosed when a difference in uptake of 20% or more was found between adjacent points on the same limb or the same point on the contralateral limb and this difference persisted for 24 hours or more.⁷ Routine postoperative scanning was performed on the first, third, and sixth days, but if a high count was obtained daily scanning was started. All positive scans were confirmed by ascending phlebography.

Results

No patient had clinical or isotopic scan evidence of deep vein thrombosis before surgery. Of the 62 patients, 10 developed deep vein thrombosis postoperatively. The table shows the median values and interquartile ranges of the variables incorporated in the predictive index, and the figure shows the distribution of index values. Good

Distribution of the five variables in the predictive index subdivided according to whether patients did or did not develop deep vein thrombosis

	Patients not developing deep vein thrombosis		Patients developing deep vein thrombosis	
	Median	Interquartile range	Median	Interquartile range
Euglobulin lysis time (min)	117.5	107.5	197.5	366.3
Serum fibrin-related antigen (mg/l)	1	1	4	12
Age (years)	44.0	13.7	75.0	13.7
Percentage overweight for height	4.7	20.3	25.2	35.0
No (%) of patients with varicose veins	21 (40)		9 (90)

Distribution of preoperative predictive indices for the 62 patients studied.

○ = Patients who did not develop deep vein thrombosis.
▲ = Patients who developed deep vein thrombosis.

preoperative separation was obtained between patients who did and did not develop deep vein thrombosis postoperatively. The number falling into the high-risk group varies according to the cut-off point selected. If -2 is chosen nine patients (90%) who developed deep vein thrombosis were correctly allocated and one was missed, while only seven (13.5%) were incorrectly identified as being at risk.

Discussion

These data confirm the findings of Clayton *et al.*⁴ that five preoperative observations will identify patients at high risk of developing postoperative deep vein thrombosis. They also show that the index had good predictive power when applied prospectively to gynaecological patients.

When -2 was taken as the cut-off point nine (90%) of patients who subsequently developed deep vein thrombosis were correctly allocated, while only seven (13.5%) were incorrectly identified as being at risk. This discrimination is as good as that obtained when the same cut-off point is applied to the data of Clayton *et al.*⁴ Rakoczi *et al.*⁸ also found that this index effectively differentiated a population at high risk of developing postoperative deep vein thrombosis, but the distribution of their results was shifted appreciably to the right because of longer euglobulin lysis times; their assays were performed on stored frozen platelet-poor plasma, which probably accounted for this variation.

This index appears to be a valuable way of predicting preoperatively patients who are at high risk of developing postoperative deep vein thrombosis.

We are grateful to Professor J S Scott for his interest and advice during the course of this work.

Financial support was received from the special trustees of the General Infirmary at Leeds.

We are grateful to Mrs B Griffin, Miss C Jackson, Mrs S Urquhart, Mrs G Levell, and Mrs H Hale for laboratory help.

References

- Gallus AS, Hirsh J, Tuttle RJ, *et al.* Small subcutaneous doses of heparin in prevention of venous thrombosis. *N Engl J Med* 1973;288:545-51.
- International Multicentre Trial. Prevention of fatal postoperative pulmonary embolism by low doses of heparin. *Lancet* 1975;ii:45-51.
- Belch JJF, Lowe GDO, Pollock JG, Forbes CD, Prentice CRM. Subcutaneous heparin in the prevention of venous thrombosis after elective aortic bifurcation graft surgery. *Thromb Haemostas* 1979;42:303.
- Clayton JK, Anderson JA, McNicol GP. Preoperative prediction of postoperative deep vein thrombosis. *Br Med J* 1976;iii:910-2.
- Blix S. Studies on the fibrinolytic system in the euglobulin fraction of human plasma. *Scand J Clin Lab Invest* 1961;13, suppl 58:3-19.
- Documenta Geigy. Scientific Tables.* 7th ed. Macclesfield: Geigy Pharmaceuticals, 1970:712.
- Kakkar VV. The diagnosis of deep vein thrombosis using the ^{125}I -fibrinogen test. *Arch Surg* 1972;104:152-9.
- Rakoczi I, Chamone D, Collen D, Verstraete M. Prediction of postoperative leg vein thrombosis in gynaecological patients. *Lancet* 1978; i:509-10.

(Accepted 18 June 1980)

ONE HUNDRED YEARS AGO Dr Thomas R French relates, in the *Annals of the Anatomical and Surgical Society of New York*, a very remarkable case of double epiglottis. It is that of a man, thirty years old, by occupation a singer and contortionist at variety shows. He came complaining of a weakness of the voice; that he could not always grasp the note at the beginning of a piece or turn of a song. He can command with ease the chest and the falsetto registers, and in singing has a baritone and a falsetto voice. Neither gives him the least discomfort, and in ordinary conversation he has no preference as to which to use. In his family he uses the high voice entirely, but in business prefers the low voice. He uses either according to habit or association, and asserts that many of his friends are not aware that he has two voices. He gained the extra voice when he was sixteen years old. In singing he always uses the high voice, as with it he can command a greater compass. In the high voice he has the upper and lower range in the falsetto register, and can run the scale from A to F. The compass of the low voice is so small that he can not reach the high notes of an ordinary song with it, and in singing only uses it to break into the falsetto voice and produce a sensation. He may be said to command the lower range in the chest-register, and can run the scale from A to A. His throat externally is very prominent, on account

of an angular curvature of the spine in the dorsal region. The cricoid cartilage is large, and has a deep V-shaped notch in its upper border. The mouth and throat above the base of the tongue are quite normal in shape and condition. There is a marked double arrangement of the glandular tissue at the base of the tongue. The epiglottis is double. The right half of the cartilage overlaps the left to a slight extent. The division in the mucous membrane extends down to the median glosso-epiglottic fold; but the division in the cartilage must extend further, as during the production of the falsetto voice the lateral halves move inward, as if they were hinged in the middle. The difference in the length and width of the cords, as well as the elliptical opening in the falsetto register, and apposition in the chest register, can readily be demonstrated. Whether the peculiar formation of the epiglottis has anything to do with his ability to command the two voices, Dr French is not prepared to say; but it is very probable that it has, for, when the sides of the epiglottis are drawn in during the formation of notes in the falsetto register, the calibre of the laryngeal cavity is decreased to a considerable extent, and thereby probably renders the production of the falsetto voice easier. (*British Medical Journal*, 1880.)