SCREENING FOR DEEP-VENOUS THROMBOSIS AFTER HIP AND KNEE REPLACEMENT WITHOUT PROPHYLAXIS

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We performed routine venography after operation in a consecutive series of 252 patients with total joint arthroplasties in whom no form of routine chemical or mechanical prophylaxis had been used.

The prevalence of deep-vein thrombosis (DVT) was 32% (16% distal, 16% proximal) after total hip replacement and 66% (50% distal, 16% proximal) after total knee replacement ($p < 0.001$). We did not treat distal DVT. There were only two readmissions within three months of surgery because of thromboembolic disease. There were two deaths within this period, neither of which was due to pulmonary embolism.

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Deep-vein thrombosis (DVT) is a common complication of total hip or knee replacement (THR and TKR). The published incidence of DVT without prophylaxis after such surgery varies widely, depending on the study and its protocol, but has been up to 70%.[1-7]

Much has been written about the aetiology of DVT but surprisingly little is known about its natural history. Proximal DVT is an established cause of pulmonary embolism (PE), but the importance of calf-vein thrombosis is uncertain.[8-12]

Many authors have recommended prophylaxis to reduce the incidence of postoperative DVT, assuming that it will result in a reduction in the rate of fatal PE, the overall mortality rate and the incidence of the postphlebitic syndrome.[13-16] This approach may be too simplistic since such measures, with the possible exception of mechanical methods, have an inherent morbidity and mortality.[1,14,17-19] Furthermore, accurate figures for death from PE are still not available. Early estimates suggested an incidence as high as 3.4% after THR,[14-16,20] but recent reviews estimate the rate as less than 1% for both THR and TKR.[21-23]

We felt that conclusive evidence for the benefits of prophylaxis was lacking and we therefore used an alternative approach attempting to assess every patient by venography after operation. This prevented large numbers of patients being anticoagulated unnecessarily, but subjected all to our chosen method of screening. In our study we present the results of our experience using this regime in a clinical setting in which no form of mechanical or chemical prophylaxis was routinely prescribed over a period of 27 months.

Our aim was as follows: 1) to determine the prevalence of DVT one week after operation in patients having unilateral, primary THR or TKR without any form of prophylaxis to establish figures applicable to our current practice of early mobilisation; 2) to assess the readmission and death rate from thromboembolic complications after discharge, especially for the patients with untreated distal DVT; and 3) to assess how realistically can we expect to obtain satisfactory venograms on which to base management decisions. Venography is still considered the 'gold standard' for investigating DVT, but is neither 100% specific nor 100% sensitive. It has its own morbidity and mortality, and is also time-consuming, painful and subject to technical inadequacies and to interobserver error.[24-26]

PATIENTS AND METHODS

Since 1993 it has been the policy of the senior author (PJG) to perform both THR and TKR without the use of any form of mechanical or chemical prophylaxis against thrombosis. This specifically excludes the use of elasticated stockings, pneumatic compression boots, non-steroidal anti-inflammatory drugs, warfarin, heparin in any form, dextran or ergot alkaloids. Patients are mobilised routinely within 48 hours of operation and screened for DVT by venography five to seven days after surgery. Proximal thrombosis is

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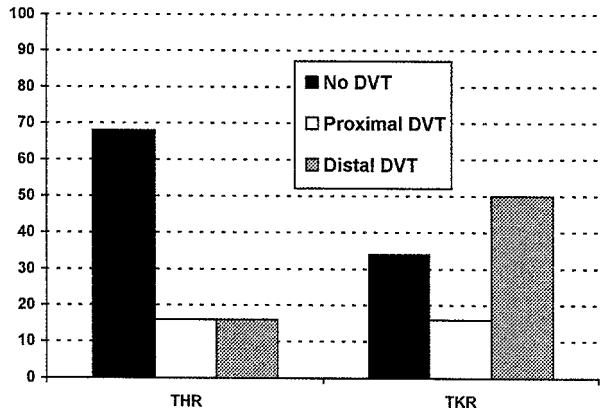

Fig. 1

The percentage prevalence of DVT at one week after THR and TKR. DVT is identified as proximal or distal.

treated with warfarin for three months. Distal thrombi, regardless of size, receive no form of treatment. This management is based on clinical opinion and approval from an ethical committee has not been sought.

From 1993 to 1995 we performed 125 primary THRs and 127 primary TKRs. Of the hips, 118 were cemented, six were hybrid and one uncemented, whereas 77 knees were cemented and 50 uncemented. All the patients with THR had general anaesthesia, in five with additional epidural anaesthesia, whereas of those with TKR 124 had general anaesthesia, in ten with additional epidural, and three had spinal anaesthesia. All the patients were registered on a computer database.

Operative technique. We performed THR using a Hardinge approach and TKR by a medial parapatellar approach with a tourniquet. Bilateral and revision operations were not included since they are at special risk for DVT.[12,27,28]

All operations were elective and performed or supervised by one of two experienced surgeons (PJG, WMH).

Venography. Unilateral ascending venography was carried out on the fifth, sixth or seventh day after operation, using the method described by Rabinov and Paulin[29] except that the superficial veins were occluded by an ankle tourniquet. All venograms were reviewed by a radiologist blinded to the original report. DVT was classified as proximal (popliteal, femoral or iliac) or distal (peroneal, posterior tibial, anterior tibial or soleal). When thrombosis was identified within the proximal veins, proximal thrombosis was recorded regardless of the presence of any distal clot. Specific attention was paid to deep veins which were not visualised adequately and to DVT not identified on the original report.

Thromboembolic complications. Any readmission within three months was recorded from a review of all patients' case notes, analysis of the computer databases of all local hospitals and a questionnaire sent to every patient at one year after operation. The reason for readmission was identified in each case.

Statistical analysis. We used chi-squared analysis to identify differences in proportions for the prevalence of DVT after THR and TKR.

RESULTS

Venography was attempted in 115 patients with THR and 120 with TKR; the results were considered successful in 104 and 112, respectively. The 19 patients with unsuccessful venograms were investigated by Duplex ultrasonography of the proximal deep veins, but no attempt was made to identify calf-vein thrombosis by this method. In 18 of the 19, the result was normal, with no evidence of proximal DVT. In the remaining patient, a proximal DVT was identified at seven days after THR and anticoagulation with warfarin was started. In the 17 patients in whom venography was not attempted eight had a past history of PE or recurrent DVT and were therefore given anticoagulation in the perioperative period until discharge. The other nine were all on long-term anticoagulation for left ventricular failure, prosthetic cardiac valves, or recurrent DVT or PE.

Prevalence of DVT (Fig. 1)**.** After THR, 70 of the 104 patients who had successful venography showed no evidence of DVT (68%). Seventeen had thrombi in the calf veins only (16%) and 17 had proximal thrombosis (16%).

After TKR, 38 of the 112 patients who had successful venography showed no evidence of DVT (34%). Fifty-six had thrombi in the calf veins only (50%), and 18 had proximal thrombosis (16%).

THR was less likely to be complicated by DVT than TKR (32% *v* 66%; chi-squared test 24.033; $p < 0.0001$), but there was no difference in the incidence of proximal thrombosis.

Inpatient thromboembolic complications. Four patients developed symptoms of PE and were investigated by combined ventilation and perfusion scans. Three showed no evidence of PE but one had a high probability of PE on the seventh day after THR. The venogram of this patient had been unsuccessful, but Doppler ultrasound of the proximal veins performed just before the lung scan did not show proximal DVT. There was therefore only one case of proven symptomatic PE during the inpatient period.

One patient had venography without evidence of DVT seven days after THR but developed symptoms and signs of DVT in the same limb at 14 days. A further venogram on the 14th day showed distal DVT with an isolated thrombus in the proximal femoral vein. Treatment with warfarin was initiated for three months.

Readmission for thromboembolic complications after discharge (Table I)**.** Six patients with a THR were readmitted for problems related to thromboembolic disease. No patient with a TKR was readmitted.

The two patients (cases 3 and 5) admitted with chest infections could well have had PE. One patient (case 3) died, but there was no evidence of PE at postmortem

Table I. Readmission for thromboembolic disease during the period of the study

Case	Surgery	Reason for readmission	Day after surgery	Comments
1	THR	Proximal DVT	28	Normal venogram on day 7
2	THR	?Proximal DVT	30	Died of GI bleed
3	THR	Chest infection	42	Died. Infection confirmed at PM
4	THR	Chest pain	57	V/Q scan normal. No diagnosis made
5	THR	Chest infection	61	Clinical diagnosis. No sequelae
6	THR	Proximal DVT	88	2 cm distal DVT on day 7

Table II. Our findings for bilateral venography in a previous series (unpublished data). The observations in the ipsilateral leg are tabulated against those in the contralateral leg

	Ipsilateral leg					
	THR (n = 41)			TKR (n = 55)		
Contralateral leg	Normal	Distal DVT	Proximal DVT	Normal	Distal DVT	Proximal DVT
Normal	27	5	5	16	22	3
Distal DVT	1	1	2	1	6	2
Proximal DVT	0	0	0	1*	2*	2

* change of management on the basis of knowledge of the patency of the contralateral deep veins (i.e., proximal DVT contralaterally with distal or no DVT ipsilaterally)

examination. The second patient (case 5) recovered after treatment for a chest infection. One patient (case 4) was admitted with pleuritic chest pain but a combined ventilation and perfusion scan indicated a low probability of PE. The symptoms settled with conservative treatment.

Only two of the 125 patients in the THR group and none of the 127 in the TKR group were positively shown to have complications which were attributable to thromboembolic disease after discharge. One patient (case 1) was readmitted 28 days after operation with thrombosis in the femoral, popliteal and calf veins which was treated with warfarin. Venography on the seventh day after operation had shown no evidence of DVT. The other (case 6) was readmitted 88 days after operation with thrombosis in the femoral, popliteal and calf veins, which was then treated with warfarin. Venography on the seventh day after operation had shown a distal thrombus 2 cm in length.

Deaths. The overall mortality for THR at three months was 1.6% (95% confidence limit 3.8%). None of 127 with TKR died within three months.

One patient (case 3) was readmitted with the clinical diagnosis of a chest infection six weeks after surgery and died the same day. At postmortem the clinical diagnosis was confirmed; there was no evidence of PE. The second patient (case 2) was admitted to a medical ward one month after operation with a clinical diagnosis of DVT. Intravenous heparin was begun but death occurred from gastrointestinal bleeding before further investigations could be undertaken. There was no postmortem examination.

Unilateral venography. We performed unilateral venography because earlier experience of bilateral venography after THR and TKR without prophylaxis during 1990 to 1993 had shown that while there was a significant number of contralateral DVTs, this information would have changed our management in few cases (Table II). Our policy was not to treat distal thrombi; contralateral proximal thrombosis was uncommon. The overall incidence of contralateral DVT in this earlier group of patients was 9.8% for THR, all of which were distal, and 25.5% for TKR of which 9.1% were proximal and 16.4% distal. Since only 5.5% of the venograms for TKR and none for THR resulted in a change of management, we decided to perform unilateral venography alone.

Quality of venography. To determine whether our venograms were of sufficient quality, we reviewed 285 which had been performed routinely on patients with joint arthroplasty between 1990 and 1995. Of these, 205 were deemed adequate, with filling of all the distal and proximal deep veins usually examined for DVT, but in 77 (27%), one of the three major sets of deep calf veins, and in three (1.1%), two of the three were not adequately visualised.

We identified DVT on seven venograms which had initially been reported as normal. In each the thrombosis was distal and ranged from 1 to 10 cm in length. One venogram had been reported to show a distal thrombosis of 3 cm, but this was not confirmed on review.

DISCUSSION

The use of routine, unilateral venography after THR or TKR has provided satisfactory, but not ideal management. Our findings for the prevalence of distal and proximal DVT after TKR and THR are similar to those observed by others.[1,2,4-7]

To determine the true incidence of DVT after THR or TKR, repeated examinations are needed. This is impractical with venography but more feasible with ultrasound which is less invasive and readily repeatable. We did not use ultrasound because in our hospital it takes longer to perform than venography and would have overstretched our

radiological service. Ultrasound has been shown to be highly sensitive and specific for occlusive proximal DVT, but it may be less sensitive for the detection of distal or non-occlusive proximal thrombi,[30-33] and its sensitivity in routine clinical practice has not been established to our knowledge. It is human nature that ultrasound done as part of a trial is likely to be performed with more diligence than if part of routine clinical practice in a busy radiological department. It would be difficult to obtain a true comparison of the sensitivity of ultrasound in this setting as it would mean performing venography on the same patients without the knowledge of the ultrasonographer. To set up such a trial would be exceedingly difficult. While we recognise that a similar problem of inadequate examination can arise with venography, we would expect this to be less marked than with ultrasound in which hard copies are less readily interpretable by independent observers.

Our earlier study of the value of bilateral venography showed that 9.8% of patients with THR and 25.5% of those with TKR had contralateral DVT, but that most of the thrombi were distal. These results agree with those of other reported series for TKR which showed contralateral DVT in 13% to 33% of patients,[3,4,9] but were lower than reports for THR which showed contralateral thrombi in up to 54% of patients.[19,34]

There were a surprisingly small number of readmissions for thromboembolic disease. If it is assumed that DVT did not alter significantly during the period from venography to discharge (average four days), we therefore discharged 73 patients with untreated distal and 35 with treated proximal thrombi in the operated limb alone. Our experience with bilateral venography implies that 28 patients would have been discharged with DVT in the contralateral limb, 21 distal and seven proximal. Six of the 125 patients (4.8%) with THR were readmitted within three months because of DVT or associated problems (Table I). Only two (1.6%) had proven thromboembolic disease. No patients who were readmitted with thromboembolic problems received a TKR. This is surprising in view of our own experience that distal thrombus is more extensive after TKR than after THR (unpublished data). The two patients who were readmitted had either no evidence of DVT or a distal thrombus of 2 cm on the initial postoperative venogram.

Other authors have studied readmission for thromboembolism. Warwick et al[21] in 1995 investigated 1162 patients with THR in whom compression stockings had been used for prophylaxis; there was a readmission rate of 1.4% within 28 days. Seagroatt et al[23] reported readmission of 0.73% of over 8000 patients with THR and no specified prophylaxis. The rate of readmission for thromboembolism appears to be very low, suggesting that the problem of undiagnosed thromboembolic disease after discharge may be less serious than is generally believed. The death rates in our series are similar to those reported in the literature. Our study was small and the confidence intervals are therefore wide, extending up to 3.8% from the 1.6% for THR. Making allowance for a background mortality of 0.43% over a three-month period,[23] the excess mortality due to THR in our group was 1.2%.

We have found that routine venography is valuable in assessing DVT after THR and TKR. It gives precise identification of thrombi in each patient at a defined time and allows appropriate treatment, but it has limitations, especially in technical adequacy.

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