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The incidence of proximal deep vein thrombosis following total knee arthroplasty in an Asian population: A Doppler ultrasound study

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ABSTRACT

Purpose. To investigate the incidence of deep vein thrombosis (DVT) following total knee arthroplasty in an Asian population.
Methods. A prospective study of 149 consecutive cases of total knee arthroplasty done for osteoarthritis was conducted over a 5-year period. All patients underwent duplex ultrasonographic assessment of the lower limbs within the first postoperative week.
Results. The incidence of proximal DVT was found to be 4.38% in this study. Symptomology was statistically significant in predicting the presence of proximal DVT in all cases. General anaesthesia was associated with a statistically significant–higher incidence of DVT as compared with regional anaesthesia. There was a significant association between a sedentary lifestyle and the development of DVT.
Conclusion. The incidence of proximal DVT in Asian patients after total knee arthroplasty is higher than that previously reported for this demographic group.

Key words: *Asian; deep vein thrombosis; total knee replacement*

INTRODUCTION

There is global concern about deep vein thrombosis (DVT) and the sequelae of thromboembolic disease. Venous thromboembolic disease and its prevention are regarded as major public health concerns.[1,2] In addition, there has been growing awareness about the post-phlebetic syndrome and its association with arthroplasty.[1,3,4] The previous issues are relatively ignored in Asia, where there is a reluctance to adopt thromboprophylaxis in the belief that the throm-

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boembolic condition is rare there,[5–22] and that anticoagulation poses an unacceptable risk of bleeding and blood loss. The above 2 assumptions are supported by a number of studies.[5,6,8,14] Most of these papers take the form of small scale, short duration studies that evaluate heterogeneous conditions treated by numerous surgeons. Furthermore, femoral, popliteal, and distal thromboses have been collectively grouped[9,12,14,16,17,23,24] although their risks of embolisation are very different.[3,25,26] The management of isolated asymptomatic calf DVT in the postoperative setting is also controversial.[27] The risk of pulmonary embolism (PE) from DVT in distal veins has been reported to be negligible.[3,25,26] Doppler ultrasonography is less sensitive in the assessment of distal veins due to poor visualisation in the calf.[28–30]

This paper addresses these issues by focussing on patients treated with elective total knee arthroplasty for osteoarthritis of the knee by 2 surgeons. These patients were assessed by Doppler ultrasonography for the occurrence of proximal DVT of the popliteal and femoral veins.

PATIENTS AND METHODS

Between March 1994 and April 1999, total knee replacements were performed on 149 patients (148 Asians and one Caucasian) by the 2 senior authors (PT and SDD) for osteoarthritis of the knee. Routine duplex sonography was done on postoperative day 5 or 6 to assess the status of the popliteal and femoral veins. Based on the findings of this investigation, patients were classified into 3 groups i.e. the 'normal' group where there was no evidence of DVT, the 'proximal DVT' group in whom DVT was found above the calf veins, and the 'distal DVT' group in whom DVT was found in the calves. Due to the low risk of PE, the calves of patients were not routinely assessed for the occurrence of distal DVT in this study unless clinically indicated.

Exclusion criteria included Caucasian race (n=1), high risk of DVT requiring anticoagulation[1,15,22,30,31] (n=2), non-steroidal anti-inflammatory drug ingestion within 2 weeks of surgery[29] or ongoing anticoagulation (n=6), and patients with varicose veins (n=1). The incidence of distal DVT in this study was very low compared to similar epidemiological studies, where the incidence of calf DVT is approximately 4 times that in proximal veins.[28] The major reason for this is that the calves were not routinely assessed in this study as outlined above. All cases of distal DVT were therefore excluded from the study (n=2). Accordingly, 12 patients were excluded based on the above criteria.

Parameters assessed were age, race, sex, anaesthesia, duration of tourniquet time, blood loss, transfusion requirement, clinical assessment, and ambulation in the preoperative period and subsequent follow-up. Table 1 shows the data in the 6 patients who developed proximal DVT.

Anaesthesia was investigated as a contributory cause of DVT. The types of anaesthesia used were general anaesthesia (n=84), spinal anaesthesia (n=40), and epidural anaesthesia (n=13). The average duration of anaesthesia, which was recorded in the operative notes, was 121 minutes (range, 60–135 minutes). Tourniquet time was also recorded in the operative notes and averaged 84 minutes (range, 45–150 minutes). Blood loss assessment was based on intraoperative and postoperative loss. Intra-operative loss was recorded in the anaesthetic charts, while postoperative loss was noted in the clinical charts. The average blood loss was 603 mL (range, 110–1580 mL).

Ambulation was quantified in terms of preoperative ambulatory status. The 3 groups were homebound (n=21), ambulant up to 1 km (n=83), and ambulant beyond 1 km (n=33). All patients were followed up for an average of 53 days (range, 20–80 days).

The unpaired two-tailed *t* test was used to assess the significance of continuous variables, while the Chi squared test was used to assess the significance of categorical variables. Statistical significance was defined as a p value of less than 0.05.

RESULTS

DVT was found in 9 out of the 148 Asian patients (the Caucasian patient excluded) in this study, yielding an overall incidence of 6.08%. Seven cases occurred in the femoral or popliteal veins and the remaining 2 in the distal veins of the calf.

12 cases, among which there were 3 cases of DVT, were excluded as outlined above. This yielded a study population of 137 patients (116 females and 21 males). The mean age was 65 years (range, 41–85 years).

The corrected incidence of proximal DVT in Asians following total knee arthroplasty was found to be 4.38%, comprising 6 cases out of 137 (Table 1). The average age of patients with proximal DVT was 69.2 years (range, 62–77 years). Age was not a significant risk factor for the development of proximal DVT ($p<0.12$).

Five patients with proximal DVT had undergone surgery with general anaesthesia (5.95%) and one patient had undergone spinal anaesthesia (2.50%). The

13 patients with epidural anaesthesia were not complicated by DVT. Epidural anaesthesia was continued into the early postoperative period. Regional anaesthesia (spinal and epidural) was associated with a statistically significant–lower incidence of DVT as compared with general anaesthesia ($p<0.05$).

Duration of anaesthesia was not found to be a significant risk factor for DVT. The average anaesthetic time in the proximal DVT group was 117 minutes, in comparison with an average time of 121 minutes in the normal group. Patients with DVT appeared to have tourniquets on for a correspondingly longer duration. The average time was 91 minutes in the proximal DVT group, compared to 84 minutes in the normal group. The difference was, however, not statistically significant. Average blood loss in patients with DVT was 592 mL as opposed to 603 mL in cases without DVT. This difference was not statistically significant either.

Clinical findings were found to be predictive of the presence of proximal DVT. All patients with ultrasound-proven DVT had clinical findings of DVT (range of duration, 0–4 days) prior to the ultrasound scan (average, 1.5 days). These findings were statistically significant ($p<0.05$).

Sedentary patients were more likely to develop DVT. All patients with DVT were ambulant preoperatively up to 1 km only. 9.5% of home-bound patients (2 out of 21) and 4.8% of patients ambulant up to 1 km (4 out of 83) developed proximal DVT. No patient preoperatively ambulant beyond 1 km

Table 1
Data of patients with proximal deep vein thrombosis

Patient No.	Age (years)/ Sex	Race	Anaesthesia method	Tourniquet (min)	Anaesthesia (min)	Blood loss (mL)	Transfusion
1	72/F	Chinese	GA*	85	110	285	1
2	62/F	Chinese	GA	105	135	540	Nil
3	65/M	Indian	GA	100	125	380	Nil
4	77/F	Chinese	GA	95	120	475	3
5	72/M	Chinese	Spinal	105	130	855	1
6	67/F	Chinese	GA	55	80	1020	Nil

* GA general anaesthesia

Table 1 (cont'd)
Data of patients with proximal deep vein thrombosis

Patient No.	Symptom onset (days)	Time of duplex scan (days)	Time of symptom resolution (days)	Follow-up (days)	Preoperative mobility (km)	Remarks
1	1	5	6	60	Home	Nil
2	3	3	8	60	<1	Nil
3	4	5	9	80	<1	Nil
4	5	7	Persistent	35	Home	Peptic ulcer disease
5	6	7	10	52	<1	Nil
6	6	7	9	55	<1	Nil

Table 2
Studies on DVT in Asian patients undergoing total knee arthroplasty

Study/year	Country	Number of patients	Diagnostic modality	Total DVT (%)	Proximal DVT (%)
Kim[41]/1990	Korea	244	Venogram	32.8	0.8
Dhillon et al.[12]/1996	Malaysia	34	Venogram	76.5	Nil*
Kim and Suh[14]/1988	Korea	62	Venogram	11.3	1.6
Fujita et al.[39]/2000	Japan	138	Venogram	48.6	14.5
Wang et al.[40]/2000	Taiwan	102	Venogram	65.7	2.9

* Data are not available because the parameter was not specifically highlighted

developed DVT. This difference was statistically significant ($p<0.05$).

None of the patients included in the study developed clinical PE. Subclinical PE was not specifically excluded for the purposes of this study.

DISCUSSION

Duplex ultrasonography was the preferred means of diagnosis in this study. Venography remains the most reliable and accurate modality to detect DVT, and is regarded as the index method.[6,27,32–34] Duplex ultrasonography as a non-invasive screening tool has not received universal acceptance.[22,33,35–37] In a review by Weinmann and Salzman,[33] ultrasonography was regarded a poor predictor of asymptomatic DVT of the proximal leg veins.[38] More recently Grady-Benson et al.[32] showed that ultrasonographic diagnosis of DVT correlated well with venographic diagnosis.[6,28–30] In their study, duplex ultrasonography demonstrated 100% sensitivity and specificity for the diagnosis of proximal DVT. The major advantages of this modality of diagnosis are its non-invasive nature and the absent risk of thrombosis, skin irritation, and necrosis secondary to contrast injection required in venography.[12,14,28,30,32–34]

The incidence of distal DVT was not actively sought in this study. The clinical course of distal DVT has been studied by Oishi et al.[27] In their study of 273 patients screened for DVT on postoperative day 4 after total hip or knee arthroplasty, the incidence of proximal DVT was 9% and distal DVT 15%. A further 2.56% progressed from distal DVT to proximal DVT over the following 2 weeks. Other studies showed the rate of proximal extension to range from 5.6% to 23% of cases of distal DVT.[17] None of these patients developed fatal PE. The management of distal DVT remains controversial and further study is required before recommendations regarding its clinical significance and treatment can be made.

There are few studies on the incidence of DVT complicating total knee arthroplasty in Asians (Table 2).[12,14,39–41] The incidence of proximal DVT in these studies ranges from 0.8% to 14.5%. Of note was the observation that lower incidences were reported in the previous studies[29] as opposed to the more recent ones.[39,40] In our study, proximal DVT was found in 4.38% of patients, contrasting sharply with the rate (10–20%) reported in the western literature.[1,6,12,28,30,33] Since the age distribution in this study is similar to that in other studies,[1,6,12,28,30,33,39–42] age is therefore not considered a contributing factor to DVT in Asian compared to western patients.

General anaesthesia was found to be a statistically significant contributor to the risk of DVT, compared with regional anaesthesia. This finding is consistent with other similar studies. The likely cause is the prolonged recumbence that occurs in patients under general anaesthesia.[1,2,6,28,30]

The use of a tourniquet provides a bloodless field for surgery. This in turn results in stagnation of blood flow and a theoretical predisposition to DVT.[1,2,6,28,30] The duration of use of the tourniquet was not noted to be a significant contributor to the incidence of DVT in this study.

Clinical findings are generally considered poor predictors of the presence of DVT.[31,33,43] While the authors also subscribe to this impression, it is interesting to note that in this study, all cases of DVT had associated positive clinical findings. Clinical evaluation should therefore not be discounted in the assessment of these patients.

Sedentary patients are considered to be at greater risk of DVT.[1,2,6,28,30] This was a significant finding in this study. The finding underscores the necessity for early postoperative ambulation.

In our study no patient developed symptomatic PE. It has been demonstrated by cadaveric studies in various causes of death that asymptomatic PE occurs in up to 64% of cases.[33] PE that caused or contributed to death has been found in 4% to 28% of autopsies in the west.[2,38,44–47] These figures are more conservative in similar Asian series,[8,21,43,48,49] where PE was found in 0.1% to 15.4% of all autopsies, and was identified to be the cause of death in 0.2% to 6% of autopsies.

Thromboembolic risk has been classified according to a risk profile.[1,28,30] The thromboembolic risk factor (THRIFT) classification stratifies total knee arthroplasty into the highest risk category with a proximal DVT rate of 10% to 20% , symptomatic PE rate of 5% to 10%, and a fatal PE rate of 1% to 5%. Based on our figures of a proximal DVT rate of 4% to 8%, the risk profile of Asian patients undergoing total knee arthroplasty matches the high-risk category. Recommended prophylaxis in this category includes anticoagulation and physical measures in the prevention of DVT.[1,9,12,16,21]

The risk of complications from serious bleeding with anticoagulation ranges from 0% to 6%.[28,33] In addition, studies have indicated an increase in the mean blood loss in 1% to 3% of patients undergoing surgery.[6] The comparatively low incidence (0.8%–4%) of DVT in Asians shown in previous studies[5,14,15] therefore justified the omission of anticoagulation in these patients.

Our present study suggests that the risk of pro-

ximal DVT in total knee arthroplasty among Asians at 4.38% is generally lower than that reported by similar epidemiological papers in the West, which quote an incidence of up to 20%.[1,6,28,30,32,33] However, the incidence obtained in our study, together with those from similar studies more recently published, was noted to be higher than that from earlier Asian studies.[39,40,42] Asians undergoing total knee arthroplasty should therefore be considered to be at high risk of developing DVT as per the THRIFT classification.[1,28,30]

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