

Deep Vein Thrombosis after Total Knee Replacement

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Abstract

Introduction: The prevalence of deep vein thrombosis after total knee replacement has been quoted to be between 46% and 84% in the Western literature. The aims of this study were to determine its prevalence in the Singapore population and to assess the need for prophylaxis against deep vein thrombosis. **Materials and Methods:** We examined data on 100 consecutive patients undergoing total knee replacement at the Adult Reconstructive Service, Department of Orthopaedic Surgery, Singapore General Hospital and assessed the possible risk factors: age, sex, weight, previous surgery, unilateral or bilateral surgery, postoperative rehabilitation, tourniquet and operating time. Functional and knee scores based on the Knee Society Clinical Rating System were also assessed. No prophylaxis was given to these patients. These patients underwent a duplex scan of both lower limbs on the seventh postoperative day. Treatment was instituted only if proximal deep vein thrombosis was detected. **Results:** The overall incidence of deep vein thrombosis was 14% with 64.3% of it occurring distally. Deep vein thrombosis was more common in bilateral total knee replacement (22.2%) compared to unilateral total knee replacement (13.2%). Partial thrombosis was present in 71.4% and occurred predominantly in the ipsilateral leg. There was no evidence of propagation. Only 1 patient developed pulmonary embolism and was treated successfully but there was no evidence of deep vein thrombosis on duplex scan in this patient. **Conclusion:** There was no significant difference in the risk factors between patients who did and those who did not develop deep vein thrombosis.

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Introduction

Western literature reports a very high incidence of deep vein thrombosis in its population especially after orthopaedic surgery. In total knee replacement without prophylaxis, its incidence is quoted between 46% and 84% in various studies. This incidence was reduced to 20% to 57% with the use of pharmacological and/or mechanical prophylaxis.¹⁻⁴

Experience here in Singapore suggests a much lower rate of deep vein thrombosis after total knee replacement. Postoperative deep vein thrombosis in Asians has been reported to be between 2.6% and 17% which is much lower than the 28% and 53% in the West.⁵⁻¹⁰ The incidence of pulmonary embolism, the most feared and fatal complication of deep vein thrombosis, is also noted to be lower in Asians

(0.009% versus 0.14% in the West).¹¹⁻¹⁴ Pulmonary embolism accounts for 10% to 50% of sudden death in orthopaedic surgery.¹⁵

The aims of this study were to determine the prevalence of deep vein thrombosis after total knee replacement in the Singapore population and to assess the need for prophylaxis in these patients. We also studied various possible risk factors and tried to identify patients who were at risk for deep vein thrombosis.

Materials and Methods

This study was conducted between May 1995 and November 1995 in the Adult Reconstructive Service of the Department of Orthopaedic Surgery, Singapore General Hospital. One hundred consecutive patients undergoing

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total knee replacement in the service were included in the study. Patients were admitted generally the day before surgery, unless specific medical problems needed prior attention.

Preoperative assessment was documented in the questionnaire. Data were taken on age, sex, weight, diagnosis, previous surgery on the knee and whether it was a unilateral or bilateral knee replacement. The preoperative knee and functional knee scores were also determined according to the Knee Society Clinical Rating System.¹⁶ No specific pharmacological or mechanical prophylaxis measures were employed.

The majority of the operations were done under general anaesthesia and the limb was exsanguinated by elevation alone. Pneumatic thigh tourniquet was used. The duration of operation and the tourniquet time were recorded. Postoperative rehabilitation in the form of continuous passive motion was started according to surgeon's preference.

Bilateral lower limb duplex scan was performed between the seventh and tenth postoperative day at the Vascular Laboratory of the Department of Cardiovascular and Thoracic Surgery, Singapore General Hospital. The duplex scan was done by 1 ultrasonographer. Studies have demonstrated that 86% of deep vein thrombosis are present within the first postoperative day and a further 22% developed in the next week.¹⁷ Therefore, routine duplex scan is done between the seventh and the tenth postoperative day for the highest pick up rate. However, the scan was done earlier if there is any clinical suspicion of deep vein thrombosis.

Patients with deep vein thrombosis were followed up closely clinically and some with repeat duplex scan. Management of these patients was not altered unless proximal deep vein thrombosis was detected, in which case heparin therapy and warfarin therapy were started. Statistically significant differences in the demographic data between patients who developed and who did not

develop deep vein thrombosis were analysed using the Chi-square test.

Results

A total of 100 consecutive patients undergoing total knee replacement in the Adult Reconstructive Service, Singapore General Hospital were studied. There were 86 female and 14 male patients. Their ages ranged from 48 to 83 years with an average of 65 years (Fig. 1). Their weight ranged from 38 to 95 kg with an average weight of 62 kg (Fig. 2).

The primary diagnosis was osteoarthritis in 93 patients and rheumatoid arthritis in the other 7. Ninety-two per cent of the patients were on non-steroidal anti-inflammatory drugs (NSAIDs) prior to the operation.

There was a total of 91 unilateral total knee replacements, of which 52 were done on the right and 39 on the left. There were 9 bilateral total knee replacements. Four of them were done simultaneously and 5 were done staged, 1 week apart. Out of the 100 patients, 14 had a previous high tibial osteotomy on the same leg, 12 had a total knee replacement on the other leg and 8 had an arthroscopic knee washout on the same leg. Sixty-five had no previous surgery (Fig. 3).

The preoperative knee and functional scores ranged from 19 to 90 and 0 to 90 respectively, with an average of 61.8 and 46.3 respectively (Fig. 4). The operating time ranged from 45 to 205 minutes with an average of 96 minutes. The tourniquet time, on the other hand, ranged from 35 to 125 minutes with an average of 71 minutes (Fig. 5). Patients were usually started on continuous passive motion on the second postoperative day and ambulation on the fifth postoperative day.

There was a total of 14 patients who developed deep vein thrombosis giving an incidence of 14%. Nine of those were distal deep vein thrombosis. The other 5 were proximal, all of which occurred in unilateral total knee replacement. The point of demarcation between the proximal and the distal deep vein thrombosis was taken as the trifurcation of the calf vein. Among those with unilateral total knee

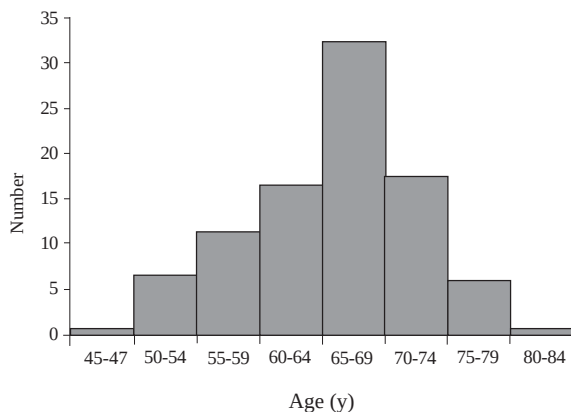


Fig. 1. Age distribution.

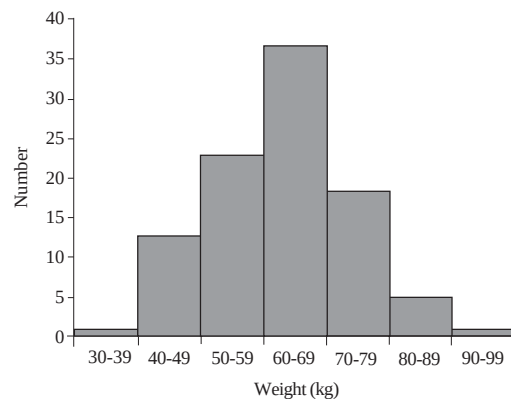


Fig. 2. Weight distribution.

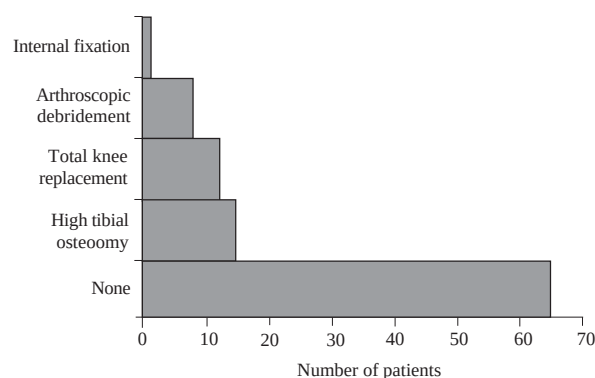


Fig. 3. Previous knee surgeries.

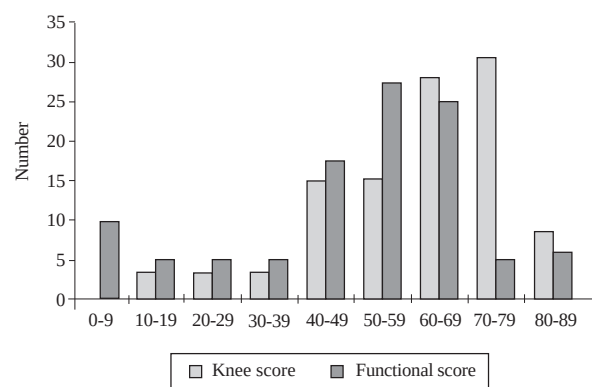


Fig. 4. Distribution of preoperative knee and functional score.

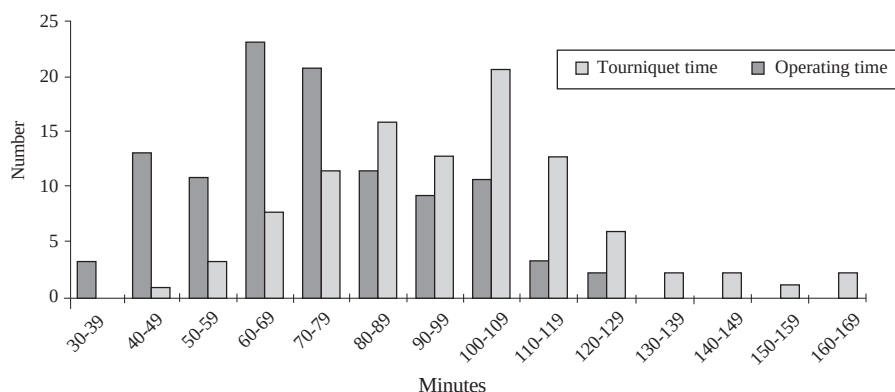


Fig. 5. Distribution of tourniquet and operating time.

replacements, there were 12 patients (13.2%) with deep vein thrombosis. Seven (7.7%) of them were distal and 5 (5.5%) were proximal deep vein thrombosis. On the other hand, there were 2 patients amongst the 9 undergoing bilateral total knee replacement who developed deep vein thrombosis giving a 22.2% incidence. There was only 1 patient who developed pulmonary embolism in this study (Table I).

The patients who developed deep vein thrombosis were all females. All but 1 of these patients had the primary diagnosis of osteoarthritis. All of these patients used NSAIDs preoperatively except for 1. Two of them had total knee replacements previously in the other leg and another patient had a previous high tibial osteotomy. These patients started continuous passive motion on the second day and ambulation on the fifth postoperative day.

Twelve of the deep vein thromboses were in the ipsilateral leg and 2 of these patients had bilateral deep vein thrombosis. Of these, 10 out of 14 patients (71.4%) had partial thrombosis.

The risk factors (age, weight, previous surgery, diagnosis, postoperative rehabilitation, preoperative knee and functional scores, tourniquet and operating time) that were

TABLE I: THROMBOEMBOLIC RATES

	Total no.	Distal DVT	Proximal DVT	PE	% DVT
Unilateral surgery					
Right knee	52	4	0	0	
Left knee	39	3	5	0	
Subtotal	91	7	5	0	13.2
Bilateral surgery					
Staged (within a week)	5	1	0	1	
Simultaneous (same operation)	4	1	0	0	
Subtotal	9	2	0	1	22.2
Total	100	9	5	1	14.0

DVT: deep vein thrombosis; PE: pulmonary embolism

studied were found not to be significantly different between patients who did and did not develop deep vein thrombosis (Table II).

The 5 patients with proximal deep vein thrombosis received treatment with heparin and warfarin. They recovered and did not show any evidence of pulmonary

TABLE II: COMPARISON BETWEEN PATIENTS WITH DVT AND WITHOUT DVT

	Patients with DVT mean (range)	Patients without DVT mean (range)
Age (y)	64.8 (58-75)	65.3 (48-83)
Weight (kg)	61.9 (45-78.5)	62.1 (38-95)
Tourniquet time (min)	69.0 (39-100)	71.6 (35-125)
Operating time (min)	94.8 (55-145)	95.9 (45-205)
Knee Society Clinical Rating System		
Knee score	60.7 (49-70)	64.2 (26-84)
Functional score	40.6 (28-67)	45.2 (15-70)

DVT: deep vein thrombosis

embolism. However, patients with distal deep vein thrombosis did not receive treatment. They were followed up clinically, some with a repeat duplex scan a week later. There was no propagation and some showed early resolution.

In this series, there was only 1 patient who developed pulmonary embolism. The patient was a 54-year-old lady weighing 54 kg presenting with osteoarthritis. She underwent a two stage bilateral total knee replacement within the same admission. The second operation was done 1 week after the first. The patient did not have a duplex scan between the first and second operations. During the second operation, she developed tachycardia and her blood pressure and oxygen saturation dropped. This occurred during intramedullary instrumentation of the tibia while the patient was still under tourniquet. Ventilation perfusion scan showed high probability of pulmonary embolism. However, the duplex scan showed no deep vein thrombosis. The two-dimensional echocardiogram revealed mildly dilated right ventricle with septum deviation to the left, suggestive of right ventricle overload. This was consistent with pulmonary embolism. The patient recovered well after treatment with heparin and warfarin. A repeat VQ scan 4 days later showed some degree of resolution. In this case there was a need to entertain the diagnosis of fat embolism. Fat embolism has been reported to occur in 3% to 12% of patients with bilateral total knee replacement especially with intramedullary instrumentation.

Discussion

Deep vein thrombosis and subsequent pulmonary embolism have been the most feared complications in total knee replacement surgery. Pulmonary embolism occurs in 8% to 17% of patients and is fatal in 0.1% to 0.7% of patients.²⁻⁴ Two-thirds are fatal within 30 minutes. Western literature reports a very high incidence of deep vein thrombosis after total knee replacement of between 40% and 84%.^{1,2,4} The use of various prophylactic measures, mechanical or pharmacological, has been employed in the

West to reduce this incidence to between 20% and 57%.⁴ The experience in the Singapore General Hospital suggests that the incidence is much lower in the local population. However, there is a need to balance the benefits of prophylaxis and the risk of bleeding associated with prophylaxis. The incidence of bleeding is reported to be between 5% and 21%.^{3,18} Total knee replacement patients are especially susceptible because of the exposed osseous surface and the potential dead space.

The overall incidence of deep vein thrombosis in this study is 14%. This is consistent with the reported lower postoperative deep vein thrombosis in Asians (2.6% to 17%) compared to the West (28% to 53%).⁵⁻¹⁰ However, a recent publication from Malaysia contradicted this trend by reporting a 76.5% incidence of deep vein thrombosis after total knee replacement.¹⁹ The data need to be interpreted with caution due to the small sample size as the author concedes. In this study, distal thrombosis accounted for 64.3% of the deep vein thrombosis. This concurs with other studies which report a rate of 50% to 80% of distal deep vein thrombosis.^{3,4,15,19}

Clinical detection of deep vein thrombosis is notoriously unreliable with a pick up rate of 5% and 17% and a high false negative rate.^{20,21} Symptoms are usually only present in extensive occlusive proximal deep vein thrombosis. In this study, bilateral lower limb duplex ultrasound was used to detect the presence of deep vein thrombosis. Although venogram has been the gold standard in the past, many recent studies have demonstrated the reliability of the duplex ultrasound in detecting deep vein thrombosis.²²⁻³¹ Its specificity and sensitivity for detection of both proximal and distal deep vein thrombosis are well above 80%. Woolsen et al²³ demonstrated in patients after total hip replacements that when compared with venogram, the sensitivity, specificity and accuracy of the duplex ultrasound in detecting proximal deep vein thrombosis were 89%, 100% and 99%, respectively. White et al²⁸ reported a positive predictive value of 100% and a negative predictive value of 95% using the duplex ultrasound. The ultrasonographic criteria for diagnosis of deep vein thrombosis were dependent on 4 factors and these further enhance its specificity and sensitivity. These criteria are:

1. Loss of compressibility (which is the most important factor);
2. Visualisation of the thrombus;
3. Absence of spontaneous and phasic flow;
4. Loss of augmentation with valsalva manoeuvre or respiration.

In this study, the diagnosis of deep vein thrombosis was made with the loss of compressibility and flow. Furthermore, advantages of the duplex scan are obvious. It is portable, painless, non-invasive, can be repeated serially and cheaper.

It avoids the side effects of the venogram, which include allergic reactions (3%), post venogram phlebitis (8%), incomplete venous filling (10%), contrast extravasation leading to skin necrosis and possible thrombus precipitation.³² The duplex ultrasound also has its limitations. There can be difficulty in visualising the deep veins of the calf.^{23,24} Benson et al²⁹ reported 88% sensitivity, 98% specificity and 98% accuracy of the duplex scan in detecting distal deep vein thrombosis.

However, various studies have shown that distal deep vein thrombosis is less likely than proximal deep vein thrombosis to cause pulmonary embolism, the fatal complication.^{33,34} Distal deep vein thrombosis is usually insignificant unless there is proximal extension. Proximal extension is invariable before embolism.³⁵ Literature suggests that 6% to 23% of distal deep vein thrombosis propagate proximally especially if the thrombus is larger than 5 mm.^{3,36} However, this study did not demonstrate any propagation of distal deep vein thrombosis. Furthermore, patients with distal deep vein thrombosis were not treated and all of them recovered. These data suggest that there may not be a need for prophylaxis in local patients undergoing total knee replacement, as has been the practice so far. Indirectly, this study concurs with the suggestion that treatment should be confined to proximal deep vein thrombosis.^{3,37,38}

Nevertheless, there might be a place for routine duplex scan on patients undergoing total knee replacement. This is important as the clinical pick-up rates of deep vein thrombosis are notoriously unreliable, which is between 5% and 17% only. Therefore, patients with proximal deep vein thrombosis can be identified and appropriate treatment instituted. It also avoids the cost and postoperative complications of prophylactic anticoagulation.

In this study, there was a higher incidence of deep vein thrombosis in bilateral total knee replacement (22.2% vs 13.2%). This was not statistically significant. This has also been shown in some studies especially in one stage bilateral total knee replacement.^{4,39} However, the incidence of deep vein thrombosis in each knee after a two stage total knee replacement is similar to unilateral total knee replacement.^{4,39}

There was only 1 patient who developed respiratory compromise intraoperatively suggestive of pulmonary embolism. However, in this patient there was no deep vein thrombosis detected in the lower limb using a duplex scan. Venogram was not used to confirm this finding. The possibility of fat embolism in this patient has to be considered as it occurred intraoperatively during intramedullary instrumentation. Literature reports a 3% to 12% possibility of this occurring in bilateral total knee replacement.^{40,41}

The risk factors studied including age, weight, previous surgery, knee and functional scores, tourniquet and operating time as well as postoperative rehabilitation were all not significantly different between patients who developed deep vein thrombosis and those who did not.⁴²

Conclusion

The incidence of deep vein thrombosis in the local population is much lower than the West. The patients appeared to do well without any prophylaxis. This suggests that prophylaxis for total knee replacement is not essential here. However, there may be a place for duplex scan screening of these patients, especially after bilateral total knee replacement.

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