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Original Article

Obesity and Venous Thromboembolism in Total Knee Arthroplasty Patients in an Asian Population

Kenny Tay, MBBS, MRCS (Edinburgh) *,
Hamid Rahmatullah Bin Abd Razak, MBBS, GDFM, MRCS (Glasgow),
Andrew Hwee Chye Tan, MBBS, FRCS (Glasgow), FRCSEd (Ortho)

Department of Orthopaedic Surgery, Singapore General Hospital, Singapore, Singapore

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ABSTRACT

Background: Venous thromboembolism (VTE) is a known complication of total knee arthroplasty (TKA). In addition, obesity has been implicated as a risk factor and justification for chemoprophylaxis for VTE. We wanted to review the prevalence of VTE among our patients and evaluate the incidence rates of VTE among nonobese and obese patients.

Methods: We reviewed 894 patients who underwent elective unilateral total knee arthroplasty by a single surgeon from March 2003 to November 2014 in our center. Any patients with clinically significant symptoms or signs of VTE such as deep venous thrombosis (DVT) or pulmonary embolism (PE) were diagnosed radiologically. The patient demographics analyzed included age, gender, body mass index, the number of comorbid diseases, and a history of hyperlipidemia.

Results: We found the incidence of VTE of 0.67% in our patients (6 patients of 894). Four of the 6 patients (66.7%) who developed DVT and PE belonged to nonobese group. The frequency of VTE in nonobese patients was 0.65% and 0.73% in the obese patients. There were no significant differences in age, number of comorbidities, and a history of hyperlipidemia between those who developed DVT and PE and those who did not.

Conclusion: With the low prevalence of VTE among our study population, including patients with obesity, advanced age, multiple comorbidities, or hyperlipidemia, the practice of routine chemoprophylaxis should be reviewed.

Venous thromboembolism (VTE) is a known complication in patients undergoing total knee arthroplasty (TKA) and consists of deep venous thrombosis (DVT) and pulmonary embolism (PE). Patients with obesity are commonly viewed as being at higher risk for VTE, and hence surgeons would routinely provide chemoprophylaxis to such patients, in addition to mechanical prophylaxis. However, a number of studies have suggested that the actual risk of VTE with obesity alone is low [1,2].

In addition, the prevalence of clinically significant VTE in the Asian population has also been found to be lower than that of the Western population. Previous studies point to an incidence rate of 1.9%-3% of clinically significant DVT and 0.01% for PE [3,4] in Asian populations, compared with 42%-80% and 1.5%-10%, respectively in Western populations [5–9].

A previous study in our center found a risk of clinically significant VTE of 0.75% [7]. When considering this against the risk of bleeding complications secondary to chemoprophylaxis, there is need to review the practice of routinely administering chemoprophylaxis to patients. Our objective was to evaluate the prevalence of VTE in patients undergoing TKA and describe any difference in the prevalence between that of obese and nonobese patients in our population.

Materials and Methods

We reviewed 894 patients who underwent elective unilateral TKA by a single surgeon from March 2003 to November 2014 in our center. The surgical technique and postoperative care are thus consistent. All patients underwent unilateral TKA with a tourniquet

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* Reprint requests: Kenny Tay, MBBS, MRCS (Edinburgh), Department of Orthopaedic Surgery, Singapore General Hospital, Outram Road, 169608, Singapore.

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inflated throughout the duration of surgery, and TKA was performed in a standardized manner, with no patella resurfacing performed for any patient. Every patient had a surgical drain inserted, and this was removed on the second postoperative day, or if drainage volume was less than 100 mL, whichever occurred earlier.

Our patients received standardized postoperative care according to the care protocol established in our center. These include analgesia, intermittent pneumatic compression (IPC) calf pumps, continuous passive motion from the first postoperative day, and daily ambulatory physiotherapy from the second postoperative day. No patient received chemoprophylaxis.

Any clinically significant symptoms or signs of DVT or PE were noted and recorded during our daily rounds of our patients and any patients identified with possible VTE underwent imaging for diagnosis. DVT was diagnosed on venous ultrasound for DVT and PE by computed tomography (PE protocol). On discharge, patients were followed up in the outpatient setting at 2 weeks, at 1, 3, and 6 months and at 1 year. In our department, TKA patients are routinely followed up to 2 years for Short Form-36 scores, and all patients included in this study were followed up for this duration. Any clinical symptoms of VTE such as calf swelling or pain or fever were noted, as were any physical examination findings of increased calf girth, tenderness, or erythema were also recorded.

The patient demographics analyzed included age, gender, body mass index (BMI), the number of comorbid diseases, and a history of hyperlipidemia. We used the World Health Organization's definition of obesity ($\geq$30 kg/m^2) in our study. The current consensus is that this cutoff is applicable in Asian populations [8].

Statistical Methodology

For continuous variable such as age, 2-sample *t*-test was used. For categorical variables, we applied the Fisher exact test. We used a BMI cutoff of 30 kg/m^2 to categorize patients into obese and nonobese groups, and the number of comorbidities were categorized into 2 groups: (1) 2 or less comorbidities and (2) more than 2 comorbidities. The aforementioned 2 variables were categorized to compare whether there was any difference in the outcome group.

Unadjusted odds ratios (ORs) and 95% confidence intervals were estimated for variables such as age, BMI, hyperlipidemia, number of comorbidities, and length of stay (LOS) using univariate logistic regression. We built a multivariate logistic regression model to determine whether BMI was significantly associated with the development of any DVT and PE after adjusting for age, number of comorbidities, and LOS. We did not include hyperlipidemia in the regression model as it was strongly related to number of comorbidities. Values of $P < .05$ were considered significant.

Statistical analyses were performed using the Stata version 13.0.

Results

There were a total of 894 patients who underwent TKA. The mean age was 65.8 years with standard deviation of 7.8 years. Most of the patients were female at 78.3%. The percentage of patients who had a BMI $\leq$ 30 was 69.2%. About 78.9% of the patients had 2 or less comorbidities. The median LOS was 4 days with interquartile range of 4-6 days.

The prevalence of DVT or PE was 0.67% (6 patients of 894). The prevalence of VTE in the nonobese group was 0.65%, and that for the obese group was 0.73%; due to these low numbers, a decision was made not to stratify the numbers into the obesity subgroups, which would skew data analyses.

Five patients developed symptomatic DVT, 3 of which occurred on the fifth postoperative day or later. One patient developed bilateral pulmonary embolism on the second postoperative day, which led to death. All 6 patients commenced ambulation on the second postoperative day.

Four of the 6 patients (66.7%) who developed DVT and PE belonged to nonobese group (Table 1). All 6 patients were female and had two or less comorbidities. There were no significant differences in age, number of comorbidities, and a history of hyperlipidemia between those who developed DVT and PE and those who did not. After adjusting for age, number of comorbidities, and LOS, BMI was not significantly associated with the outcome of developing DVT or PE (Table 2). However, LOS was significantly associated with the outcome of developing DVT or PE (OR: 1.19; 95% confidence interval: 1.07-1.33). The median LOS for patients who suffered VTE complications was 10 days, compared with 5 days for those who did not. Review of the clinical notes points to a slower progress in ambulation initially; however, the necessary management of VTE (commencement of chemical anticoagulation and the time required for therapeutic levels therein) also contributed to the prolonged stay.

Discussion

The understanding of VTE in TKA, and the armamentarium in preventing or treating it, has grown over the past decades. Although evidence regarding mechanical prophylaxis is established and the practice widely established [9,10], complete consensus with regard to chemical prophylaxis remains elusive. This is perhaps even more so in the context of our Asian population, where the confluence of differing genotypes, demographic factors, and environmental factors all contribute to a lower incidence of VTE and thus ameliorating the need for routine chemoprophylaxis for every patient undergoing a TKA.

The prevalence of symptomatic VTE in our study was 0.67%. This is comparable to those found in studies performed in Asian populations, which look into symptomatic VTEs that are of consequence to the patient. A population-based evaluation of 52,566 patients in Taiwan found an overall incidence of symptomatic VTE of 0.64% [11]. A Korean retrospective review of 55 unilateral TKAs performed without chemoprophylaxis found an incidence rate of DVT of 2% with no patients having a PE [12]. The authors postulated that possible genetic traits such as the factor V Leiden mutation in activated protein C and the prothrombin promoter G20210A mutation are much rarer in the Asian population, leading to the consistently lower prevalence of VTE among knee arthroplasty patients.

The factor V Leiden mutation is found in approximately 5% of the Caucasian American population, in contrast to 0.45% of the Asian

Table 1
Population Characteristics.

Demographic Variables	VTE Events		*P* Value
	Positive (N = 6)	Negative (N = 888)	
Gender			
Female	6 (100%)	694 (78.2%)	.350
Male	0	194 (21.8%)	
BMI (kg/m^2)			
≤30	4 (66.7%)	615 (69.2%)	1.00
>30	2 (33.3%)	273 (30.8%)	
Mean age (y)	66.3 (SD 7.7)	65.8 (SD 7.8)	.868
Comorbidities			
≤2	6 (100%)	699 (78.7%)	.352
>2	0	189 (21.3%)	
Hyperlipidemia			
Positive history	2 (33.3%)	416 (46.8%)	.690
Negative history	4 (66.7%)	472 (53.2%)	

VTE, venous thromboembolism; BMI, body mass index; SD, standard deviation.