



Original Article

# Pulmonary embolism following total knee arthroplasty in Taiwanese patients

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## Abstract

**Background:** Pulmonary embolism is a relatively uncommon, but serious, postoperative complication of hip and knee arthroplasty; however, little information is available about the prevalence of pulmonary embolism in Taiwan.

**Methods:** We report here a series of five patients who sustained a symptomatic pulmonary embolism after undergoing total knee arthroplasty (TKA). These patients were identified during a retrospective study of 1768 patients carried out between January 2007 and January 2010.

**Results:** Five (0.28%) patients who sustained a symptomatic pulmonary embolism after TKA were identified in a series of 1768 patients. The diagnosis was confirmed by computed tomography angiography findings in four patients and an increased D-dimer level in one patient. All the patients were women, with a mean age of 68.0 years (range 64–76 years). The average body mass index of these patients was 32.6 kg/m<sup>2</sup> (24–38 kg/m<sup>2</sup>). Four patients underwent simultaneous bilateral TKA, and one patient who was undergoing unilateral TKA also underwent revision TKA for a previously treated contralateral knee. None of the patients had a history of pulmonary embolism, and none was given prophylaxis for venous thromboembolism. The time at which pulmonary embolism occurred ranged from 2 to 8 days in five patients. After treatment, no patient had died by the end of the follow-up period. These case reports highlight the equal incidence of pulmonary embolism after TKA in Taiwanese and Western populations.

**Conclusion:** Steps to prevent pulmonary embolism should be undertaken in selected patients, such as these patients with a high body mass index and simultaneous bilateral TKA.

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**Keywords:** anticoagulant drugs; pulmonary embolism; total knee arthroplasty; venous thromboembolism

## 1. Introduction

Pulmonary embolism is a relatively uncommon, but serious, postoperative complication of hip and knee arthroplasty.<sup>1</sup> Studies in Western countries have provided data on the prevalence of pulmonary embolism following knee and hip

arthroplasty and the risk factors for its development.<sup>2,3</sup> However, not much is known about the prevalence of pulmonary embolism in these patients in Taiwan. We report here a series of five patients who sustained symptomatic pulmonary embolism following total knee arthroplasty (TKA) at Taipei Veterans General Hospital, Taiwan.

## 2. Methods

Between January 2007 and January 2010, we retrospectively reviewed 1768 patients who underwent TKA in our hospital by a single surgeon. Two hundred and sixty-one patients underwent simultaneous bilateral TKA. For cases of

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primary TKA, we performed a minimally invasive incision utilizing the subvastus approach; we used a traditional approach for patients needing revision TKA. The bone-cutting necessary was completed using an intramedullary guide in the femur part, and an extramedullary guide in the tibia part. All prostheses were fixed by a cement technique. During the study period, no drugs were prescribed for deep vein thrombosis and pulmonary embolism prophylaxis. The diagnosis of pulmonary embolism was confirmed by the patients' clinical symptoms, combined with computed tomography angiography (CTA) or an increased level of D-dimer.

### 3. Results

Five patients (0.28%) who sustained a symptomatic pulmonary embolism after TKA were identified. Four cases of pulmonary embolism were confirmed by CTA and one by an increased level of D-dimer. All the patients were women with a mean age of 68.0 years (range 64–76 years). The average body mass index (BMI) of these patients was 32.6 kg/m<sup>2</sup> (range 24–38 kg/m<sup>2</sup>). Four patients underwent simultaneous bilateral TKA; the one patient who underwent unilateral TKA also underwent revision TKA for the previously treated contralateral knee. The time during which pulmonary embolism occurred ranged from 2 to 8 days after surgery. No deaths occurred during the follow-up period (Table 1).

The first patient was a 65-year-old woman with a BMI of 37 kg/m<sup>2</sup> and a history of hypertension who underwent TKA of the left knee for the treatment of osteoarthritis (Fig. 1A). On the 3<sup>rd</sup> postoperative day the patient experienced shortness of breath, but a review of a radiograph obtained using a plain film showed no specific findings (Fig. 1B). However, CTA showed a pulmonary embolism in the posterior segment of the right upper lobe (Fig. 1C). The patient was transferred to the critical care unit for management, including treatment with anticoagulant drugs (low molecular weight heparin (LMWH) 3–5 days and bridge to warfarin). The patient stabilized 2 days later and was transferred back to the orthopedic ward for another week before discharge. No deep vein thrombosis was detected on the ultrasound examination of the lower extremities conducted during admission.

The second patient was a 66-year-old woman with a BMI of 32 kg/m<sup>2</sup> and a history of hypertension who underwent right-side TKA and left-side revision TKA. She experienced shortness of breath on the 2<sup>nd</sup> postoperative day. A CTA scan showed no indication of pulmonary embolism. However,

because the patient had a D-dimer level of 8.73 µg/mL and suggestive symptoms, she was transferred to the critical care unit and given treated with anticoagulant drugs. She was discharged 7 days after surgery after no further complications.

The third patient was a 64-year-old woman with a BMI of 38 kg/m<sup>2</sup> who underwent simultaneous bilateral TKA for the treatment of osteoarthritis. She experienced shortness of breath 5 days after surgery. A CTA scan showed the presence of a pulmonary embolism involving the bilateral main pulmonary arteries, lobar branches to the right upper, left upper, and left lower lobes, and all segmental branches to the left lower lobe. The findings of an ultrasound examination of the lower extremities were negative for deep vein thrombosis. The patient was treated with anticoagulant drugs without complications and discharged 2 weeks after surgery.

The fourth patient was a 76-year-old woman with a BMI of 32 kg/m<sup>2</sup> who underwent simultaneous bilateral TKA for the treatment of osteoarthritis (Fig. 2A). On the 6<sup>th</sup> postoperative day the patient underwent an emergency laparotomy to treat a duodenal perforation. One week later she developed respiratory failure; plain film radiography (Fig. 2B) and a CTA scan (Fig. 2C) showed a massive pulmonary embolism involving both the main pulmonary arteries. A cardiac ultrasound examination also indicated a possible right ventricular thrombosis. The patient was transferred to the critical care unit and treated with anticoagulant drugs. During her time in the critical care unit, she experienced repeated episodes of atrial fibrillation with a rapid ventricular response and underwent aggressive rate control. No clear sign of deep vein thrombosis was observed on ultrasound examination of the lower extremities. After 12 days of treatment the patient stabilized and was transferred back to the orthopedic ward for 1 week of conservative treatment before discharge.

The fifth patient was a 69-year-old woman with a BMI of 24 kg/m<sup>2</sup> and a history of hypertension who underwent TKA. She was discharged five days after surgery, but began to experience shortness of breath associated with hypoxia. Three days later she was sent to the emergency room where CTA showed a pulmonary embolism. She was discharged from the intensive care unit after 1 week.

### 4. Discussion

Pulmonary embolism is a serious complication of hip and knee arthroplasty. According to our hospital registry data, the overall incidence of pulmonary embolism in patients

Table 1  
Patient demographics and outcomes.

Patient no.	Sex	Age (y)	BMI (kg/m <sup>2</sup> )	Type of surgery	Diagnosis of PE	Time of PE event after surgery (d)	Status
1	Female	65	37	Unilateral TKA (left)	CTA	3	Alive
2	Female	66	32	Unilateral TKA (right), revision TKA (left)	Increased D-dimer levels	2	Alive
3	Female	64	38	Bilateral TKA	CTA	5	Alive
4	Female	76	32	Bilateral TKA	CTA	6	Alive
5	Female	69	24	Bilateral TKA	CTA	8	Alive

CTA = computed tomography angiography; PE = pulmonary embolism; TKA = total knee arthroplasty.

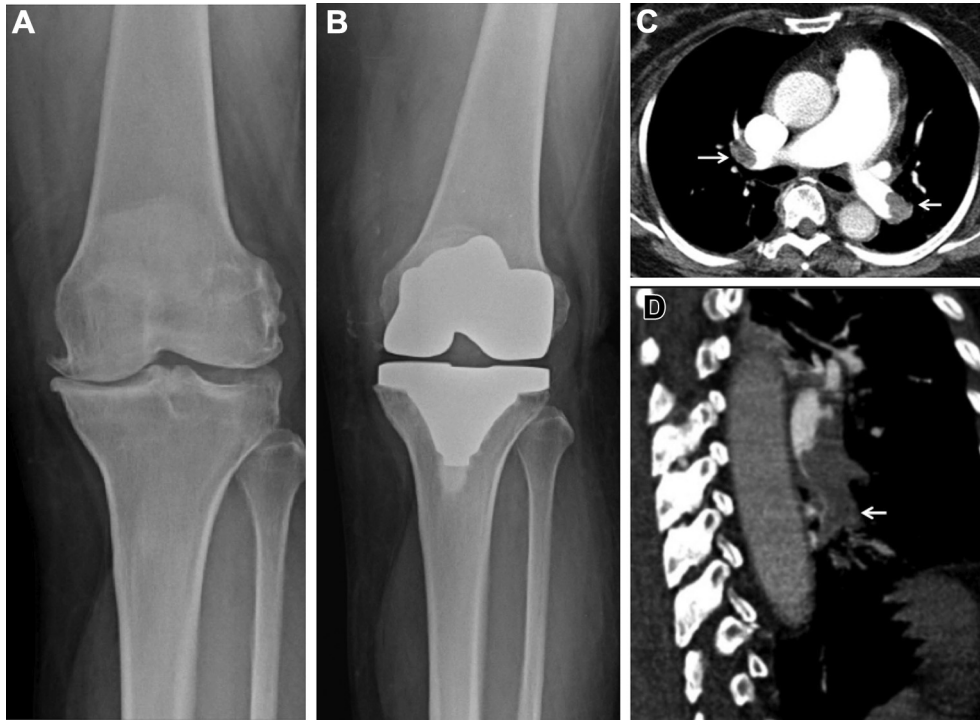


Fig. 1. Patient 1, a 65-year-old woman. (A) A plain film radiograph before treatment showed advanced osteoarthritis of the left knee. (B) Plain film radiograph after total replacement of the left knee. (C) Axial computed tomography pulmonary angiogram on the 3<sup>rd</sup> postoperative day showing pulmonary embolism at the bilateral main pulmonary arteries. (D) Oblique sagittal reformations of computed tomography pulmonary angiogram showing the emboli at the left pulmonary artery extension to the lobar and segmental pulmonary arteries.

undergoing TKA was 0.28%. Estimates of the incidence of pulmonary embolism in larger Western populations have indicated slightly higher rates.<sup>1–3</sup> In the Scottish Registry, the 90-day rate of fatal pulmonary embolism was 0.22% after 44,785 total hip arthroplasties and 0.15% after 27,000 TKAs.<sup>1</sup> A Medicare data study in the USA showed a 90-day rate of nonfatal pulmonary embolism of 0.93% after 58,521 total hip arthroplasties.<sup>2</sup> According to a review of 222,684 TKAs in

California, the 90-day rate of symptomatic pulmonary embolism was 0.41%.<sup>3</sup> Despite the low incidence, the importance of pulmonary embolism as a potentially life-threatening complication following TKA should not be underestimated. In the present series, due to timely intervention and proper treatment with anticoagulant drugs in patients with pulmonary embolism, five patients with symptomatic pulmonary embolism recovered without complications.

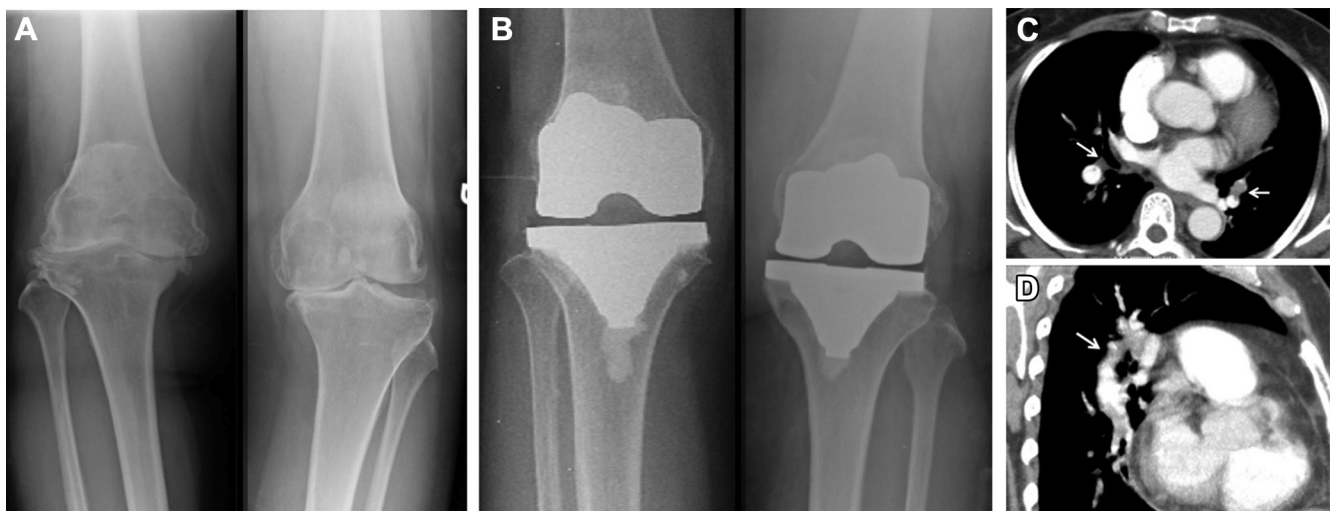


Fig. 2. Patient 4, a 76-year-old woman. (A) Plain film radiograph showing bilateral advanced osteoarthritis of the knee. (B) Plain film radiograph bilateral total knee replacements. (C) Axial computed tomography pulmonary angiogram showing pulmonary embolus affecting several segmental pulmonary arteries of the left lung. (D) Oblique sagittal reformations of computed tomography pulmonary angiogram showing pulmonary embolus affecting several segmental pulmonary arteries of the left lung.

It is worth noting that, in the 2<sup>nd</sup> patient reported here, pulmonary embolism was diagnosed because respiratory difficulties had developed, along with an increased D-dimer level. A large prospective randomized trial has found that in patients with a low probability of pulmonary embolism, D-dimer testing has a good negative predictive value,<sup>4</sup> but its positive predictive value and role in patients with a moderate or high probability of pulmonary embolism remain questionable.<sup>5</sup> Therefore in the our patient with non-suggestive CTA findings but an increased D-dimer level, further diagnostic tests such as sonography and venography should have been performed.

In the patients reported here, the average BMI was 32.6 kg/m<sup>2</sup> (4 of 5 patients had a BMI >30 kg/m<sup>2</sup>). It has been reported in a prospective study in women that there is a strong positive association between BMI and the risk of pulmonary embolism.<sup>2</sup> The risk of pulmonary embolism increased with increases in BMI; this was consistent across several subgroups. The risk of pulmonary embolism showed a nearly sixfold increase in patients with a BMI ≥35 kg/m<sup>2</sup>, which suggests that a high BMI is a risk factor to be considered when assessing the risk of pulmonary embolism.

The advantages of simultaneous bilateral TKA include a single hospital admission and only one anesthetic. However, the aggravated pain which can occur for several days during the postoperative period may compromise the patients' rehabilitation. The relationship between pulmonary embolism and simultaneous bilateral TKA is still unresolved.<sup>6–11</sup> However, of these five patients, four had simultaneous bilateral TKA, which suggests that simultaneous bilateral TKA is another risk factor for pulmonary embolism.

In Western countries, chemoprophylaxis for venous thromboembolism is currently routine after total hip and knee arthroplasty.<sup>12,13</sup> It is generally thought that the incidence of deep vein thrombosis after TKA in Asian patients is lower than that in Western patients.<sup>14–16</sup> A prospective epidemiological study in 19 centers across Asia (China, Indonesia, South Korea, Malaysia, the Philippines, Taiwan, and Thailand) found, however, that the rate of venographic thrombosis after TKA in Asian patients was 58.1%, similar to that reported in Western patients.<sup>17</sup> These workers therefore emphasized the need for randomized controlled studies to establish whether routine thromboprophylaxis after major joint surgery is also useful in Asia.

To prevent symptomatic pulmonary embolism after total hip and knee arthroplasty, guidelines developed by the American Academy of Orthopedic Surgeons recommend the use of regional anesthesia during surgery and mechanical prophylaxis intraoperatively or immediately postoperatively with continuation until discharge.<sup>18</sup> Regarding postoperative chemoprophylaxis, the guidelines recommend that the choice of drugs is stratified on the basis of the risks of pulmonary embolism and major bleeding.<sup>18</sup> For patients with an increased risk of postoperative bleeding, including those undergoing revision arthroplasty and those with a history of a bleeding disorder, recent gastrointestinal bleeding, or recent hemorrhagic stroke, aspirin may be an appropriate chemoprophylactic drug. For patients with an increased risk of pulmonary embolism, including those

with previous symptomatic pulmonary embolism, inherited thrombophilia, or a hypercoagulable state, and those having difficulties with early mobilization, warfarin is an appropriate choice for treatment. The new American Academy of Orthopedic Surgeons guidelines suggest the use of pharmacological drugs or mechanical compressive devices, or both, for the prevention of venous thromboembolism in patients undergoing elective hip or knee arthroplasty who are not at increased risk beyond that of the surgery itself for venous thromboembolism or bleeding.<sup>14</sup>

In conclusion, these case reports highlight the importance of preventing pulmonary embolism, a potentially life-threatening complication following TKA, in Taiwanese patients. Surgeons should consider a diagnosis of pulmonary embolism and perform CTA when a patient develops symptoms of respiratory difficulty in the postoperative period as these symptoms have a high level of accuracy in indicating the presence of a pulmonary embolism. Steps to prevent pulmonary embolism should be considered in selected patients due to the high death rate.

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