

Natural Course of Asymptomatic Deep Venous Thrombosis in Hip Surgery without Pharmacologic Thromboprophylaxis in an Asian Population

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Abstract

Background The clinical importance of asymptomatic deep venous thrombosis in elective hip surgery is not clearly known.

Questions/purposes We determined the preoperative and postoperative incidences of asymptomatic deep venous thrombosis, identified preoperative factors associated with postoperative deep venous thrombosis or pulmonary embolism, and established its natural course in patients who underwent elective hip surgery without receiving pharmacologic thromboprophylaxis.

This work was performed at Osaka University Hospital and Kyowakai Hospital.

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Each author certifies that his or her institution approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.

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Patients and Methods We reviewed 184 patients who underwent consecutive elective hip surgeries with a mechanical thromboprophylaxis regimen including combined general and epidural anesthesia, intraoperative calf bandaging, early mobilization, and postoperative intermittent pneumatic compression with additional use of elastic stockings. Duplex ultrasonography was performed routinely to diagnose deep venous thrombosis in all patients before surgery and on Postoperative Days 3 and 21. All patients with postoperative deep venous thrombosis underwent additional ultrasonography at 3-month intervals, and all patients were followed postoperatively for 6 months or more.

Results Preoperatively, we found asymptomatic deep venous thrombosis in two patients (1%); both thromboses had completely and spontaneously resolved by Postoperative Day 21. Postoperatively, no patients had a fatal or symptomatic pulmonary embolism or proximal deep venous thrombosis, but nine patients (5%) had asymptomatic distal deep venous thrombosis develop, with no preoperative associated factors. These nine patients were followed closely without anticoagulant drugs, and all thromboses had disappeared without pulmonary embolism or thrombophlebitis by 6 months.

Conclusions The incidence of preoperative and postoperative deep venous thrombosis was low in an Asian population having elective hip surgery and a nonpharmacologic thromboprophylaxis regimen. There were no preoperative factors associated with postoperative deep venous thrombosis, and all asymptomatic deep venous thromboses resolved spontaneously without associated pulmonary embolism or thrombophlebitis.

Level of Evidence Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

Introduction

Pulmonary embolism (PE) is a serious complication after elective hip surgeries such as THA, osteotomy, and other orthopaedic surgeries. Most PEs are thought to develop from deep venous thrombosis (DVT) [14, 20, 22]; conversely, the American Association of Orthopaedic Surgeons rejected DVT as a valid outcome because the panelists considered the link between DVT and PE to be unproven [5]. Several guidelines for DVT and PE prevention have recommended anticoagulant drugs based on studies showing efficacy for reducing the incidence of DVT, including asymptomatic DVT, using imaging modalities [8, 13, 23, 32]. However, mechanical prophylaxis with intermittent pneumatic compression (IPC) in combination with other nonpharmacologic modalities such as regional anesthesia, rapid mobilization, and/or aspirin also reportedly is effective for thromboprophylaxis with 0.7% to 5.3% incidences of DVT [4, 6, 12, 19, 26, 28, 29, 33, 34]. A previous multicenter study of 3016 patients who underwent elective hip surgeries and received IPC prophylaxis without pharmacologic agents showed no patients had fatal postoperative PE, one (0.03%) had a symptomatic PE, and four (0.1%) had symptomatic DVT [31]. However, it was not determined how many patients had either preoperative or postoperative asymptomatic DVT. Some authors consider preoperative DVT to be a contraindication for IPC prophylaxis [1, 32], as the risk of PE may be increased [30]. However, without preoperative ultrasonographic screening of DVT, we might have used IPC even for patients with asymptomatic DVT. Moreover, postoperative routine ultrasonographic screening may increase the reported incidence of DVT, although the clinical importance of asymptomatic DVT remains controversial [3, 14, 21, 22, 24], and the natural course of postoperative asymptomatic DVT is unclear.

Therefore, we reviewed our ultrasonographic findings to (1) determine the preoperative and postoperative incidences of asymptomatic DVT, (2) determine whether any preoperative factors were associated with postoperative DVT or PE, and (3) establish its natural course in patients undergoing elective hip surgery without pharmacologic thromboprophylaxis.

Patients and Methods

We prospectively followed and reviewed the medical records of all 184 patients (148 women, 36 men) who underwent elective hip surgeries between August 2007 and January 2009 at two of our affiliated hospitals. The patients mean age at the time of surgery was 59 years (range, 23–84 years), and their mean body mass index (BMI) was 23

(range, 15–32). Preoperative diagnoses were osteoarthritis in 158 patients, osteonecrosis of the femoral head in 13, loosening of implants in 12, and rheumatoid arthritis in one. Primary THA was performed in 166 patients, revision hip arthroplasty in 12, and hip osteotomy in six. In primary THA, all cups were uncemented. Cementless stems were used in 102 patients, cemented stems in 40, and cemented femoral head resurfacing was performed in the remaining 24 patients. Simultaneous bilateral THAs were performed in seven patients. For revision THA, cementless stems were used in three patients, cemented stems were used in four, and only cups were revised in the remaining five patients. Three patients had a modified Chiari (dome) pelvic osteotomy whereas three had rotational acetabular osteotomy. The minimum followup was 6 months (mean, 15.2 months; range, 6.3–24.5 months). No patients were lost to followup. We had prior approval of this study by the institutional review board committees at both hospitals.

The day before surgery, we obtained blood analysis (platelet count) and coagulation assays (% prothrombin time [PT], international normalized ratio of prothrombin time [PT-INR], activated partial thromboplastin time [APTT], and fibrinogen levels). General anesthesia combined with epidural anesthesia was used in all patients. NSAIDs were given for postoperative pain control according to the complaints of patients. One hundred seventy-nine of these patients had no pharmacologic thromboprophylaxis, but five had therapeutic pharmacologic thromboprophylaxis because they were receiving agents before surgery for various reasons. Five patients taking aspirin ($n = 2$) or warfarin ($n = 3$) before surgery stopped administration 1 week before surgery and resumed it 5 to 7 days after surgery. The postoperative duplex ultrasonographic examination for DVT was performed on Postoperative Day 3 for all patients. Thus, the incidence of DVT on Postoperative Day 3 was not influenced by these drugs, and these patients were not excluded from the study.

For mechanical prophylaxis against DVT and PE, all patients were treated with bilateral elastic bandages during surgery. Postoperatively, an A-V Impulse SystemTM foot pump (Orthofix Vascular Novamedix, Andover, UK) was used on both feet for all patients except those with preoperative DVT. The slippers were fitted to both feet in the recovery room, and the machine was activated. The pneumatic compression cycle was set at 20 seconds with a pressure of 110 mm Hg applied for 1 minute.

Most of the patients took loxoprofen orally, 60 mg, three times a day for 3 to 5 days postoperatively, which we suspect could not have influenced the incidence of DVT or PE. Moreover, from the medical records, we found no patients took any kind of drugs that might have influenced the incidence of DVT or PE such as naproxen, raloxifene, or strontium ranelate.

The IPC device was used continuously for 1 to 2 days until the patient started to walk using aids. We advised patients to perform active ankle dorsiplantar flexion in bed for 2 weeks. On Postoperative Day 1, all patients who underwent primary THA or revision THA without structural bone grafting were allowed to walk with full weightbearing as tolerated. Physical therapists checked walking ability and advised each patient to use a walker, crutches, or a cane as appropriate. They also assisted in ROM and muscle strengthening exercises. Most patients could walk without a cane in 1 to 3 weeks and returned to their usual daily activities at 1 month. Patients who underwent THA with structural bone grafting or revision THA with structural bone grafting or osteotomy, were allowed to stand without weightbearing on the operated limb and used a wheelchair on Postoperative Days 1 and 2. On Postoperative Day 3, physical therapists assisted the patients with walking using a walker or crutches without weightbearing, and with ROM and muscle strengthening exercises. At 1 month, patients were allowed partial weightbearing using crutches; full weightbearing was allowed at 3 months. These patients returned to their usual activities at 3 to 4 months.

To identify the presence of DVT, all patients underwent preoperative and postoperative routine duplex ultrasonography of both limbs. The preoperative examinations occurred 1 to 2 days before surgery, and the postoperative examinations were done on Postoperative Days 3 and 21. Color flow duplex scanners (Xario™ XG SSA-680A; Toshiba Medical Systems, Tochigi, Japan; or LOGIQ™ 7; GE Healthcare Japan, Tokyo, Japan) with 3.5-MHz convex and 7.5-MHz linear transducers were used. Real-time imaging information was obtained from the external iliac vein through the distal portion of the calf veins. Diagnostic criteria for DVT were observation of an intraluminal thrombus in a vein, loss of compressibility, and lack of flow. Patients who had postoperative DVT develop only in a calf vein distal to the popliteal vein were followed without thrombolytic therapy. If patients had DVT in a vein proximal to the popliteal vein, cardiovascular physicians were consulted. All patients who had postoperative DVT underwent additional duplex ultrasonography at 3-month intervals. Any readmission for DVT, PE, or thromboembolic complications was recorded.

All data were stored in a computer file and statistical analysis was performed using StatView™-J 5.0 software (Hulinks Inc, Tokyo, Japan). We determined differences in age, BMI, platelet count, %PT, PT-INR, APTT, fibrinogen level, duration of the operation, and volume of intraoperative blood loss between patients with and without development of DVT using the nonparametric method (Mann-Whitney U test).

Results

Preoperatively, asymptomatic distal DVT was identified in two patients (1%): a 59-year-old woman and a 77-year-old woman. Neither patient had any history of smoking, diabetes mellitus, hyperlipidemia, or hormonal therapy, and the results of blood analyses and coagulation assays were normal. Ultrasonography of these patients showed DVT in the muscular branches of the soleus muscle in the affected limb. The sizes of the DVTs were 2 mm long × 3.6 mm wide and 2.2 mm long × 3 mm wide, respectively. IPC was not used in these patients. Postoperatively, both DVTs had completely and spontaneously resolved by Postoperative Day 21 without associated PE or thrombophlebitis. At the 6-month followup, no symptomatic DVT or PE was identified in either patient.

Postoperatively, we identified no cases of fatal or symptomatic PE. No patients had proximal DVT develop, but nine of the 182 patients (5%) had asymptomatic distal DVTs develop (Table 1). All nine patients had undergone primary THAs, including seven patients with cementless THAs, one patient with a hybrid THA, and one patient with a cemented femoral head resurfacing. None of these nine patients had received preoperative pharmacologic thromboprophylaxis. Considering only the 164 patients who underwent THA, the incidence of asymptomatic DVT was 6%. DVT was found on Postoperative Day 3 in eight patients and on Postoperative Day 21 in the remaining patient. DVT occurred in the surgically treated leg in six of the nine patients, in the contralateral leg in two patients, and bilaterally in one patient. Peroneal veins were involved in three patients, whereas muscular branches of the soleus muscle were involved in the remaining six patients. The mean size of the DVT was 6.8 mm long (range, 3.1–10.6 mm) and 4.1 mm wide (range, 2–6.2 mm). No patients, however, had clinical signs of DVT such as pain or tenderness in the calf or thigh, unilateral swelling, erythema, or a positive Homan's sign. We identified no risk factors related to DVT, including hemostatic abnormalities (hypercoagulable state) or disorders of plasminogen and plasminogen activation in these nine patients. The mean age for the nine patients with DVTs was 60 years, their mean BMI was 24, mean platelet count was 235,200/mL, mean %PT was 107%, mean PT-INR was 0.98, mean APTT was 30 seconds, mean fibrinogen level was 247 mg/dL, mean duration of the operation was 136 minutes, and mean volume of intraoperative blood loss was 850 mL; none of these parameters differed from those in the 173 patients who were DVT free.

All nine DVTs completely and spontaneously resolved within 6 months postoperatively without associated PE or thrombophlebitis. DVTs had resolved by 3 months in seven patients and by 6 months in the remaining two

Table 1. Patients with postoperative DVT

Patient	Age (years)	Gender	BMI	Type of procedure	Onset (postoperative day)	Side of DVT	Site of DVT	Size of DVT (length × width; mm)	Symptom	Treatment	Progression	Postoperative month	Sequelae
1	60	Female	19	THA	3	Contralateral	SV	2 × 3	Absent	None	Resolved	3	None
2	77	Male	25	THA	3	Ipsilateral	PV	2 × 3	Absent	None	Resolved	6	None
3	56	Female	26	THA	3	Bilateral	SV	6 × 7	Absent	None	Resolved	3	None
4	58	Female	24	THA	3	Ipsilateral	SV	6 × 11	Absent	None	Resolved	6	None
5	74	Female	22	THA	3	Contralateral	PV	3 × 8	Absent	None	Resolved	3	None
6	57	Female	21	THA	3	Contralateral	PV	5 × 5	Absent	None	Resolved	3	None
7	50	Female	29	THA	3	Ipsilateral	SV	5 × 5	Absent	None	Resolved	3	None
8	58	Female	32	THA	21	Ipsilateral	SV	4 × 10	Absent	None	Resolved	3	None
9	52	Female	22	THA	3	Ipsilateral	SV	4 × 8	Absent	None	Resolved	3	None
						Ipsilateral	SV	5 × 5	Absent	None	Resolved	3	None

DVT = deep venous thrombosis; BMI = body mass index; SV = muscular branches of the soleus muscle; PV = peroneal vein.

patients. Moreover, no patients had new symptomatic DVTs and PEs develop after 3 weeks postoperatively, and no deaths were identified as of the 6-month followup.

Discussion

Some form of thromboprophylaxis seems to be warranted for patients having elective hip surgeries as DVT and PE are serious complications after such surgeries. Several guidelines for DVT and PE prevention have recommended anticoagulant drugs based on studies showing efficacy for reducing the incidence of DVT, including asymptomatic DVT [8, 23, 32]. However, mechanical thromboprophylaxis with IPC has been used for almost 20 years [19] and reportedly also has been effective as prophylaxis against DVT and PE when used in combination with other non-pharmacologic modalities with or without aspirin [4, 6, 12, 19, 26, 28, 29, 33, 34]. As IPC might be contraindicated with preoperative DVT, it is important to know the incidence of preoperative asymptomatic DVT when considering IPC for DVT and PE prophylaxis. Furthermore, what kind of treatment that is appropriate for asymptomatic distal DVT that has never been diagnosed without imaging modalities remains controversial [3, 14, 21, 22, 24]. We therefore identified the preoperative incidence of DVT diagnosed with routine ultrasonography before elective hip surgeries in an Asian population and clarified the natural course of asymptomatic DVT after the mechanical prophylaxis regimen without anticoagulant therapy for at least 6 months.

Our study has some limitations. First, this investigation reflected a retrospective review of the data, although we had introduced routine preoperative and postoperative duplex ultrasonography for diagnosis of DVT as a standard practice and no patients failed to undergo duplex ultrasonography during the study period. We thus were able to clarify the incidences of preoperative and postoperative asymptomatic DVT. Second, the subjects of this study were all Japanese and the prevalence of DVT may be different among various ethnic groups. Kim et al. [16, 17] reported Koreans undergoing THA have a low incidence of DVT [16, 17], although others reported the incidence of DVT appears similar between Asians and Western populations [7, 25]. We therefore cannot say whether the incidence in our population in fact differs from that of others. Third, our results were evaluated using duplex ultrasonography and therefore may not be comparable to other results of other studies using other imaging modalities such as venography. Venography was once widely used to investigate DVT but is invasive and impractical for repeated use. However, duplex ultrasonography is noninvasive and can be used repeatedly to monitor DVT. Moreover, compared with

venography, duplex ultrasonography reportedly has an 89% to 100% sensitivity, 100% specificity, and 99% to 100% accuracy for detection of proximal DVT and 83% to 92% sensitivity, 98% to 100% specificity, and 97% to 98% accuracy for detection of distal DVT [2, 10, 11, 15, 18, 27], and this method thus is considered by some to be the gold standard diagnostic procedure for DVT [2, 10, 11, 15, 18, 27]. Finally, the patients in our study had different types of treatment such as primary or revision hip arthroplasty, with or without osteotomy, cemented or cementless, simultaneous bilateral or unilateral, and early or delayed full weightbearing. The overall incidence of DVT was 5% (nine of 182) and PE was 0% (zero of 182), but looking at each surgical procedure, the incidence of DVT was 6% (nine of 164) in primary THA, 0% (zero of 12) in revision hip arthroplasty, and 0% (zero of six) in hip osteotomy. All nine DVTs resolved spontaneously, and all developed after primary THA. Thus, the incidence of DVT and PE may change if the proportion of revision hip arthroplasty or hip osteotomy increases. The natural course of DVT in the case of revision hip arthroplasty or hip osteotomy may be different. Additional studies are needed to clarify this possibility.

Some authors believe the use of IPC is contraindicated if a patient has a DVT preoperatively [1, 32] in part because one case of IPC associated with symptomatic PE has been reported [30]. However, lymphoma was diagnosed in that case and the patient had been in bed for 2 to 3 days with signs and symptoms of small bowel obstruction. IPC thus was not the only factor for PE, and prolonged bed rest could have invoked symptomatic PE. No reports have described fatal PE associated with the use of IPC in patients after elective hip surgery. However, without preoperative screening for DVT, exclusion of preoperative asymptomatic DVT is not possible. We found preoperative asymptomatic distal DVTs in two patients (1%) with sizes of 2 mm long × 3.6 mm wide and 2.2 mm long × 3 mm

wide; no patients had proximal DVTs. The incidence of preoperative asymptomatic DVT was relatively low and the size of the DVTs in the patients preoperatively was small. Therefore, one cannot predict what might have happened if nonpharmacologic prophylaxis had been used for these patients. If we assume this incidence was the same in a previous multicenter study of 3016 patients without pharmacologic thromboprophylaxis who underwent elective hip surgeries, that study might have included 33 patients with preoperative asymptomatic distal DVTs, but only one patient had symptomatic PE and there were no patients with fatal PEs [31]. Use of a nonpharmacologic regimen with IPC for patients undergoing elective hip surgery without preoperative routine screening for DVT thus does not seem dangerous. It may be unnecessary to perform routine duplex ultrasonography preoperatively on all patients.

Our data show there is a low incidence of DVT associated with the use of mechanical prophylaxis for patients undergoing elective hip surgeries, and we confirmed the results of others who reported low incidences of DVT and PE using mechanical thromboprophylaxis with IPC with or without aspirin for patients having elective hip surgery (Table 2) [4, 6, 12, 19, 26, 28, 29, 33, 34]. Moreover, none of our patients had proximal DVTs, none had fatal or symptomatic PEs, and the 6-month postoperative mortality was 0%. These results lead us to conclude the use of IPC in our patient population having elective hip surgery offers effective prophylaxis against DVT and PE. Being obese is reportedly a risk factor for DVT in the Japanese population [7]. The mean BMI for patients in this study was 23, which might have contributed to a low incidence of DVT. However, a report of the same ethnic group with a similar mean BMI (23.5) showed 23% of DVTs after THA [7]. Moreover, the mean BMI of the nine patients who had DVTs was 24 (range, 19–32), which did not differ from that of the 173 patients who did not have DVTs. Therefore, we do not

Table 2. Literature comparison of incidence of DVT and PE with mechanical prophylaxis after elective hip surgeries

Study	DVT	PE	Outcome time	Inspection method
Fordyce and Ling [6] (1992)	5% (2/39)		Postoperative Days 6 to 9	Venography
Woolson [34] (1996)	7% (20/289)	0% (0/289)	Postoperative Day 5	US
Warwick et al. [33] (1998)	18% (24/136)	0.7% (1/136)	Postoperative Days 6 to 8	Venography
Hooker et al. [12] (1999)	5% (23/425)	0.7% (3/425)	Postoperative Days 2 to 15	US
Ryan et al. [28] (2002)	8% (4/50)		Postoperative Days 3 to 5	MRV
Pitto et al. [26] (2004)	3% (3/100)	0% (0/100)	Preoperative, Postoperative Days 3, 10, 45	US
Lachiewicz and Soileau [19] (2006)	7% (76/1032)	0.9% (9/1032)	Before hospital discharge	US
Dorr et al. [4] (2007)	4% (55/1046)	0.3% (3/1046)	Before hospital discharge	US
Sugano et al. [31] (2009)	0.1% (4/3016)	0.03% (1/3016)		Medical record
Current study	5% (9/182)	0% (0/182)	Preoperative, Postoperative Days 3, 21	US

DVT = deep venous thrombosis; PE = pulmonary embolism; US = duplex ultrasonography; MRV = magnetic resonance venography.

believe the low incidence of DVT is exclusively related to the low BMI in our study patients.

It is crucial to know the natural history of DVT to determine proper treatment for asymptomatic distal DVT. However, few attempts have been made at such observations. Numerous authors agree patients with proximal DVT are at risk for PE [9, 14, 22, 24]. Giachino [9] reported 87% of fatal PEs originated from proximal DVTs. However, the clinical importance of distal DVT remains controversial. Some authors consider asymptomatic distal DVTs to be associated with little or no increased risk [3, 16, 21, 22], whereas others report patients with distal DVT have an increased risk for PE [9, 14, 24]. Kakkar et al. [14] reported, in the 40 patients who had distal DVTs, DVTs of nine patients (23%) extended into the popliteal and femoral veins, and four patients (10%) had PEs. Giachino [9] also reported 13% of fatal PEs originated only from distal DVTs. However, Kim et al. [16], using venography to evaluate the progress of DVT in a group of postoperative patients, found patients with distal DVTs had no increased risk of either asymptomatic or symptomatic PE compared with those without DVTs. Size of the DVT also may be important. Kakkar et al. [14] suggested a DVT greater than 5 mm is more likely to propagate and embolize. In our study, the rate of DVTs greater than 5 mm long or wide was 80%, but spontaneous resolution still occurred within 6 months postoperatively without associated PE or thrombophlebitis in all cases. Two possibilities can be considered for spontaneous resolution of DVT: the DVT liquefied spontaneously onsite or dislodged and liquefied in another part of the body, although no propagation of DVT to proximal veins or PE was seen. We could not determine the mechanism of DVT resolution. However, none of the nine DVTs in our study patients were associated with fatal or symptomatic PE or thrombophlebitis during the course of resolution. Our data therefore suggest asymptomatic distal DVT follows a benign course regardless of DVT size, and patients with DVTs do not require anticoagulation.

The incidence of preoperative and postoperative DVTs was low in an Asian population undergoing elective hip surgery with a nonpharmacologic thromboprophylaxis regimen. There were no preoperative factors associated with postoperative DVT, and all asymptomatic DVTs resolved spontaneously without associated PE or thrombophlebitis. We believe these data are important to choose a thromboprophylaxis regimen and treatment of asymptomatic DVT diagnosed with ultrasonographic screening.

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