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Original research

Association Between Simultaneous Bilateral Total Hip Arthroplasty Without Any Anticoagulant or Antiplatelet Therapy and Deep Venous Thrombosis: A Cohort Study

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ABSTRACT

Background: The association of simultaneous bilateral total hip arthroplasty (THA) with postoperative deep venous thrombosis (DVT) remains controversial. The aim of the study is to determine whether simultaneous bilateral THA without chemoprophylaxis has a higher risk than unilateral THA without chemoprophylaxis.

Methods: This is a population-based retrospective cohort study of all adults who underwent primary THA without any anticoagulant or antiplatelet therapy between July 2012 and March 2021 at the Department of Orthopedic Surgery, Toranomon Hospital, Tokyo, Japan. The association of simultaneous bilateral THA with postoperative DVT was examined by unadjusted analysis and overlap propensity score weighting. The primary outcome was the incidence of DVT (confirmed by ultrasonography of the lower limb veins) within 7 days postoperatively.

Results: Of the 557 consecutive patients who underwent primary THA in the study period, 458 met the inclusion criteria. The mean (standard deviation) age of these patients was 67 (11.7) years, and 364 (79.5%) were women; 75 (16.4%) of the 458 patients underwent simultaneous bilateral THA, and 383 (83.6%), unilateral THA. A total of 64 patients (14.0%) developed a postoperative venous thromboembolism, all of which were a distal DVT. The overlap weighting analysis found no significant difference in the incidence of postoperative DVT complications among patients who underwent simultaneous bilateral THA and those who underwent unilateral THA (31.1 [13.6%] vs 22.9 [10.0%], respectively; risk ratio, 1.36; 95% confidence interval, 0.67 to 2.77; $P = .40$).

Conclusions: Our findings indicate that the occurrence of DVT within 7 days after surgery is not significantly different between patients undergoing simultaneous bilateral THA or unilateral THA without any *anticoagulant or antiplatelet therapy.*

Level of Evidence: Level II-III.

Introduction

Total hip arthroplasty (THA) is currently one of the most stable types of arthroplasty and contributes to patient satisfaction and improvement in postoperative activities of daily living and quality of life. Previous studies found that most patients who have bilateral end-stage hip osteoarthritis or are developing bilateral disease may require contralateral surgery within 10 years [1,2].

In 1971, Jaffe and Charnley reported on simultaneous bilateral THA and demonstrated excellent functional outcomes [3]. Later, Tsiridis et al. wrote that simultaneous bilateral THA had the potential to reduce the overall operative time, anesthesia time, and duration of the hospital stay, as well as to save on medical costs [4]. However, controversies still exist regarding differences in the complications of simultaneous bilateral and unilateral THA, especially deep venous thrombosis (DVT) events. Currently, the evidence on this issue is limited to case series and unblinded trials.

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Racial differences are known to exist in the incidence of DVT and pulmonary embolism (PE) after THA, which is related to influence thromboembolic prophylaxis [5-7]. In particular, previous studies reported a low incidence of DVT and PE after THA in Asian patients when no anticoagulants were administered for perioperative thromboprophylaxis [6,7]. Nevertheless, it remains to be clarified whether simultaneous bilateral THA can be safely performed without anticoagulants.

To address this key knowledge gap in the field, we used a propensity score approach and compared the incidence of DVT after simultaneous bilateral THA or unilateral THA without *any anticoagulant or antiplatelet therapy*.

Patients and methods

Patients

In this single-center cohort study, we examined the records of all consecutive patients who underwent primary cementless THA at the Department of Orthopedic Surgery, Toranomon Hospital, Tokyo, Japan, between July 2012 and March 2021. The consecutive nature of the series provided for control of DVT as a potential variable. We enrolled patients who had undergone THA by the direct anterior approach and who had received a cementless prosthesis under general anesthesia; to eliminate confounding factors in the perioperative period, the perioperative thromboprophylaxis permitted was physical therapy *and the use of elastic bandages during surgery, postoperative thromboembolic stockings, and mechanical prophylaxis with pneumatic compression devices*. Patients were excluded if they underwent revision surgery or surgery for hip trauma, received anticoagulant or antiplatelet agents *either preoperatively or postoperatively*, or were on hemodialysis. Patients were assigned to one of 2 groups, that is, the simultaneous bilateral THA group or unilateral THA group.

The study was performed in accordance with the Declaration of Helsinki and its revisions and was approved by the local research ethics board (approval number: 2189-H/B). Patients gave written informed consent for their data to be analyzed.

Clinical procedures

Patients were considered suitable for simultaneous bilateral procedures in cases of bilateral disease, American Society of Anesthesiologists (ASA) score 1-3, and absence of severe comorbidities. The surgeries were performed by 2 experienced surgeons under general anesthesia. All operations were performed using the same technique and in a supine position. Both lower limbs were prepped and separately draped. Before the skin incision, tranexamic acid 1000 mg was administered intravenously. The incision began approximately 3 cm distal and 3 cm lateral to the anterior superior iliac spine. The joint capsule was incised in a V-shape, and the anterolateral portion was removed. The femoral head was extracted using a corkscrew. Acetabular exposure and visualization were obtained with the use of 2 or 3 retractors. After reaming, a hemispherical Ti alloy shell (SQRUM TT shell; Kyocera, Japan, or AHFIX Q3 shell; Kyocera, Japan) was fixed aiming at 10-20° of anteversion and 40° of deviation. In order to get access to the proximal femur, the hip capsule was released posterolaterally so that the femur was lifted using a retractor behind the tip of the trochanter. Broaching was facilitated by putting the leg into extension, adduction, and external rotation. We used uncemented Ti alloy femoral components (J-Taper stem; Kyocera, Japan, or INITIA stem; Kyocera, Japan) and ceramic head.

Before the wound was closed, tranexamic acid 2000 mg and a drug cocktail (morphine hydrochloride hydrate, 5-10 mg; ropivacaine hydrochloride hydrate 0.75%, 20 mL; dexamethasone sodium phosphate, 3.3 mg; adrenaline 0.1%, 0.3 mg; and saline solution, 20 mL) were administered by intra-articular injection into the hip joint. During the operation, elastic bandages were applied to both lower legs. The average operating time was 80 minutes for unilateral procedures and 165 minutes for simultaneous bilateral ones.

Depending on the patients' reported pain and renal function, a nonsteroidal anti-inflammatory drug, acetaminophen, or tramadol hydrochloride was given for postoperative pain control.

In patients undergoing simultaneous bilateral THA, 800 mL of blood was stored preoperatively for intraoperative or postoperative autologous blood transfusion. *Autologous blood was collected in the single collection bags, containing citrate-phosphate-dextrose-adenine -1 (CPDA-1) as the preservative, and all blood was preserved as whole blood. Autologous blood was transfused on the day of surgery (400 ml) and on postoperative days 1-3 (400 ml) only for all patients with bilateral simultaneous THA. The percentage of allogenic blood transfusions administered intraoperatively and postoperatively was 4% for patients with bilateral simultaneous THA and 6% for patients with unilateral THA.*

We encouraged patients to perform ankle joint exercises immediately after surgery, with a goal of 500 repetitions per hour and 5000 per day. *All patients wore thromboembolic calf stockings postoperatively only in the hospital*. Patients in whom no DVT was detected by bilateral lower limb venous ultrasonography *both before and after operation* underwent intermittent pneumatic compression on both feet with a Kendall SCD Express Compression System. The pneumatic compression cycle was set at 11 seconds, with a pressure of 45 mm Hg applied for 60 cycles per hour. The compression device was used until the patients could walk with a walker. *The average period (standard deviation [SD]) to stabilize walking with a walker and remove the SCD after surgery was 5.92 (3.85) days for patients with unilateral THA and 7.03 (3.72) days for patients with bilateral simultaneous THA*.

For preoperative screening and postoperative evaluation for DVT, color flow duplex scanners (APLIO XG; Toshiba Medical Systems, Tochigi, Japan) with 7.5- to 10-MHz linear transducers were used. The patients were scanned from the femoral vein downwards to the popliteal and tibial veins. DVT *was defined as proximal (femoral, with the popliteal fossa included to the proximal) and distal (distal to the popliteal) according to the location of the thrombus*. All patients underwent bilateral lower limb venous ultrasonography within 3 days before and 7 days after surgery by a technician authorized as a vascular examination specialist. Patients who developed postoperative DVT underwent another lower extremity ultrasonography 7 to 10 days after the initial postoperative ultrasonography. *Eligible patients received the same treatment with or without DVT discovered preoperatively or postoperatively*.

Covariates

The covariates of interest were determined from previous studies that assessed their potential for confounding and were as follows [8-18]: sociodemographic information, lifestyle factors, American Society of Anesthesiologists score, the primary disease related to THA, comorbidities, medication use, and preoperative laboratory data. Sociodemographic information included age at the time of surgery and sex, and lifestyle factors included body mass index and smoking history (former or current smoker). Information on these covariates was obtained from each patient's electronic medical record, together with information on comorbidities such as hypertension, diabetes, hyperlipidemia, stroke history, depression, inflammatory bowel disease, autoimmune disease, venous thromboembolism, chronic obstructive pulmonary disease, history of malignancy, and varicose veins. Medications included glucocorticoids and selective estrogen receptor modulators. Preoperative

Table 1
Baseline characteristics before and after overlap propensity-score weighting.

Baseline characteristics before and after weight	Crude			After propensity score weighting		
	Simultaneous bilateral THA (N = 75)	Unilateral THA (N = 383)	Standardized mean difference	Simultaneous bilateral THA	Unilateral THA	Standardized mean difference
Age, mean (SD), y	62 (11.2)	69 (11.6)	−0.545	62.4 (10.3)	62.4 (12.3)	0.00
Sex (%)			0.056			0.00
Male	18.7	20.9		20.04	20.04	
Female	81.3	79.1		79.96	79.96	
Body mass index, average (SD), kg/m^2	23.2 (3.5)	23.2 (3.6)	0.022	23.28 (3.6)	23.28 (3.9)	0.00
American Society of Anesthesiologists score (%)						
1	20 (26.7)	118 (30.3)	−0.092	26.64	26.64	0.00
2	52 (69.3)	250 (65.2)	0.087	69.3	69.3	0.00
3	3 (4)	15 (3.9)	0.004	4.06	4.06	0.00
Primary disease of the surgery (%)						
Primary osteoarthritis	12 (16)	54 (14.1)	0.053	15.72	15.72	0.00
Secondary osteoarthritis	49 (65.3)	251 (65.5)	−0.004	66.95	66.95	0.00
Avascular necrosis of the femoral head	13 (17.3)	48 (12.5)	0.135	15.51	15.51	0.00
Other	1 (1.3)	30 (7.8)	−0.315	1.82	1.82	0.00
Smoking						
Former smoker (%)	24	14.6	0.239	21.09	21.09	0.00
Current smoker (%)	10.7	9.1	0.051	10.44	10.44	0.00
Preoperative deep venous thrombosis (%)	8	12.3	−0.141	8.05	8.05	0.00
Medical history						
Hypertension (%)	38.7	38.6	0	39.39	39.39	0.00
Hyperlipidemia (%)	14.7	32.1	−0.420	16.84	16.84	0.00
Malignant history (%)	10.7	15.7	−0.148	11.01	11.01	0.00
Stroke history (%)	2.7	3.4	−0.042	2.08	2.08	0.00
Inflammatory bowel disease (%)	2.7	1.3	0.097	2.01	2.01	0.00
Autoimmune disease	6.7	5.7	0.038	5.31	5.31	0.00
Diabetes (%)	5.3	8.4	−0.119	6.46	6.46	0.00
Varicose veins (%)	1.3	2.1	−0.058	1	1	0.00
Medication use						
Steroids (%)	9.3	9.1	0.007	9.47	9.47	0.00
Initial laboratory data						
Serum C-reactive protein, average (SD), mg/dL	0.338 (1.067)	0.268 (0.755)	0.075	0.35 (1.14)	0.35 (1.03)	0.00
Serum albumin, average (SD), g/dL	4.17 (0.334)	4.18 (0.357)	−0.03	4.19 (0.329)	4.19 (0.349)	0.00
Serum hemoglobin, average (SD), g/dL	13.26 (1.004)	13.2 (1.431)	0.060	13.28 (1.031)	13.28 (1.411)	0.00
Serum white blood cell, average (SD), per μL	6409.33 (1845.656)	6251.17 (1746.46)	0.088	6409.33 (1845.656)	6234.67 (1452.675)	0.00
Serum hematocrit, average (SD), %	39.93 (3.270)	39.73 (4.05)	0.054	39.93 (3.270)	39.85 (3.817)	0.00
Serum platelet count, average (SD), per μL	258706.667 (59069.174)	235527.415 (63190.24)	0.378	25180.1 (57566.09)	251801.1 (65881.1)	0.00
Serum creatinine, average (SD), mg/dl				0.6709 (0.188)	0.6709 (0.292)	0.00
Prothrombin time, average (SD), sec	98.9093 (12.015)	100.583 (12.968)	−0.133	99.41 (12.26)	99.41 (12.17)	0.00
Activated partial thromboplastin time, average (SD), sec	28.854 (3.329)	28.234 (3.775)	0.174	28.81 (3.298)	28.81 (3.649)	0.00
D-dimer, average (SD), μg/mL	0.881 (0.814)	1.2032 (1.583)	−0.255	0.901 (0.868)	0.901 (1.065)	0.00

laboratory data included serum C-reactive protein, albumin, hemoglobin, white blood cell count, hematocrit, and serum platelet count; prothrombin time; activated partial thromboplastin time; and D-dimer.

Outcomes

The primary outcome was the incidence of DVT (confirmed by ultrasonography of the lower limb veins) within 7 days postoperatively. *The DVTs detected by ultrasonography of the lower limb veins before surgery and unchanged by ultrasonography of the lower limb veins after surgery were not included in the outcome. The secondary outcome was new or change in DVT on the follow-up ultrasound for those who had a day-7 ultrasound documented DVT, not including DVTs discovered on preoperative screening.*

Statistical analyses

Because the choice of surgical procedure may be a major confounder in epidemiological studies evaluating the effect of simultaneous bilateral THA, we used an overlap propensity score weighting analysis to determine the adjusted association between simultaneous bilateral THA and the incidence of DVT and to compare it with that of unilateral THA. Overlap weighting is used to adjust for confounding because of differences between groups and also to decrease the influence on models of extreme weights [19]. We calculated the propensity score by using the aforementioned covariables. Then, we applied the overlap propensity score-weighted generalized linear model. Patients with chronic obstructive pulmonary disease and depression were excluded from the analysis because of the difference in sample sizes. We compared cohorts before and after overlap propensity score-weights for balance by using weighted standardized differences (Table 1). A standardized difference of less than 0.1 was considered to be an acceptable balance of the measured covariates. All statistical analyses were performed with Stata version 17 software (StataCorp LLC, College Station, TX). Data were summarized as medians with interquartile ranges or as means with SDs. All *P* values were 2 sided, and a *P* value less than .05 was considered to indicate statistical significance.

Results

Patient characteristics before weighting

Of the 557 consecutive patients who underwent primary THA between July 2012 and March 2021, 458 met the inclusion criteria. The mean (SD) age of these patients was 67 (11.7) years, and 364 [79.5%] were women; 75 (16.4%) of the 458 patients underwent simultaneous bilateral THA, and 383 (83.6%), unilateral THA (Fig. 1). A total of 64 patients (14.0%) developed a postoperative venous thromboembolism, all of which were a distal DVT; none was a proximal DVT or fatal or symptomatic PE. *All detected DVTs were asymptomatic, and therefore, PE screening was not performed in this study.* We found no significant difference in the incidence of postoperative DVT among patients who underwent simultaneous bilateral THA and those who underwent unilateral THA before overlap weight analysis (9 [12.0%] vs 55 [14.3%], respectively; risk ratio, 0.836; 95% confidence interval, 0.432-1.618; $P = .594$). Patient characteristics are shown in Table 1.

Compared with patients undergoing unilateral THA, those undergoing simultaneous bilateral THA were younger (mean age 62 vs 69 years; standardized difference, −0.545) and had a lower prevalence of preoperative DVT *identified by prescreening* (8% vs 12.3%; standardized difference, −0.141), hyperlipidemia (14.7% vs 32.1%; standardized difference, −0.42), and a history of malignancy (10.7% vs 15.7%, standardized difference, −0.148); lower mean D-dimer levels (0.88 μg/mL vs 1.20 μg/mL; standardized difference, −0.255); a higher prevalence of smoking (former smoker, 24% vs 14.6%; standardized difference, 0.239); and a higher serum platelet count (258,706/μL vs 235,527/μL, standardized difference, −0.378) (Fig. 2).

After overlap weight analysis

The standardized differences were less than 0.1 for all baseline characteristics (Table 1). Furthermore, we still found no significant difference in the incidence of postoperative DVT between patients who underwent simultaneous bilateral THA and those who underwent unilateral THA (mean [SD] prevalence, 31.1% [13.6%] vs 22.9 [10.0%]; risk ratio, 1.360; 95% confidence interval, 0.67-2.77; $P = .40$) (Table 2).

The second postoperative lower extremity ultrasonography in patients with DVTs detected at the initial postoperative ultrasonography did not find any new DVTs or increases in the size of the DVTs. *Nine of 64 (14.1%) DVTs were found to resolve or decrease in size.* In addition, none of the patients were readmitted for treatment of DVT or PE.

Discussion

This retrospective cohort study found that simultaneous bilateral THA was not associated with a higher incidence of DVT compared with unilateral THA within 10 days.

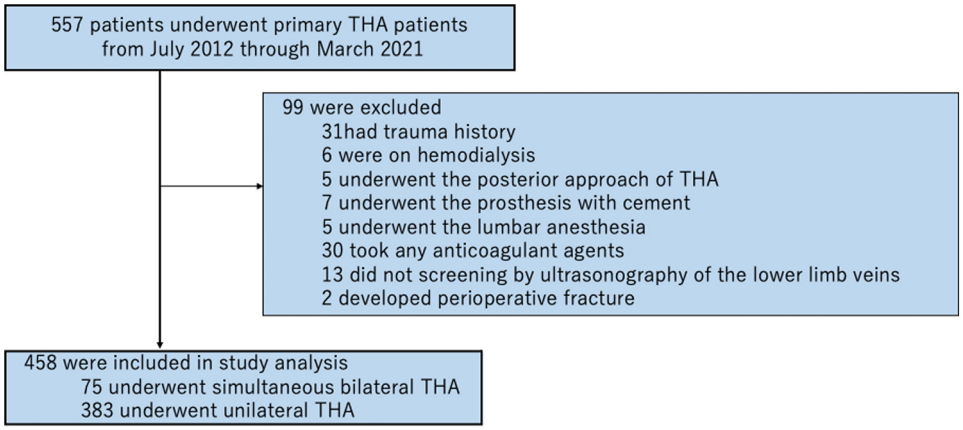

Figure 1. Selection of study population.

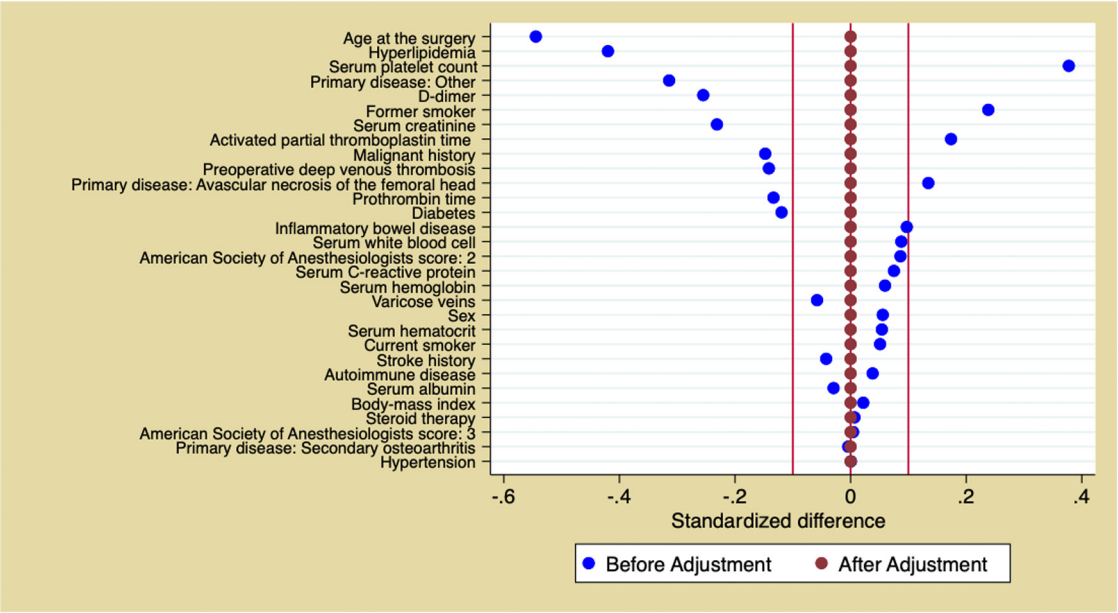

Figure 2. Balance of the simultaneous bilateral total hip arthroplasty (THA) group and unilateral THA group. An absolute mean standardized difference less than or equal to 0.10 indicates good balance.

An association of simultaneous bilateral THA with postoperative DVT remains controversial. In addition, the thromboprophylaxis in simultaneous bilateral THA has not been established. The most desirable study for risk assessment would be an unbiased randomized control study comparing simultaneous bilateral THA with unilateral THA under simple thromboprophylaxis; however, such a study would be ethically difficult to perform. Currently, evidence on complications of simultaneous bilateral and unilateral THA is limited to case series and unblinded trials, and most studies of bilateral THA compared it with unilateral THA or 2-staged THA. However, a comparison with unilateral THA is desirable to determine whether the risk of venous thrombosis is higher in bilateral THA, which would enable appropriate thromboprophylaxis to be performed.

A previous meta-analysis found no significant differences in the incidence of DVT and PE between simultaneous bilateral THA and unilateral THA [4]. However, this meta-analysis had methodologic weaknesses, for example, it included studies with lack of incidence of DVT or PE and differences in the detection of DVT and PE. In contrast to this meta-analysis and our findings, a retrospective observational study found that PE occurred at a significantly higher rate in the group that underwent simultaneous bilateral THA [20]. In this observational study, the prosthesis type including the cement type was matched between the 2 groups, although the patient backgrounds were not. Another previous study that analyzed the New York State database between 1990 and 2010 found that simultaneous bilateral THA was associated with a higher incidence of PE and DVT [21]. In both simultaneous bilateral THA and unilateral THA, this study also found a significant increase in blood transfusions and mortality rate for low-volume surgeons compared with high-volume surgeons. It is conceivable that these differences may have affected the incidence of DVT and PE in the study, depending on whether or not the facility and surgeons routinely performed simultaneous bilateral THA. Compared with unilateral THA, simultaneous bilateral THA is expected to double the operation time, blood loss, the time lapse, and rate of insertion of a femoral component. The increased surgical time increases both the length of immobilization during surgery and the risk of a longer period of immobilization after surgery, and immobilization is considered to be a predisposing factor for thromboembolic events. To prevent DVT due to immobility during and immediately after surgery, in the present study, elastic bandages were applied to both lower legs of patients during the operation, and patients were encouraged to perform active ankle joint exercises from the day of surgery.

Currently, thromboprophylaxis is recommended for THA in the perioperative period. Although prophylactic administration of anticoagulants can be expected to reduce thromboembolic risk, previous studies reported that it contributed to postoperative hematoma, bleeding, and infection [22-24]. Therefore, there has been a shift toward the use of aspirin as well as thromboxane as the standard of care, which are no longer associated with the significantly increased risk of hematoma, bleeding, and infection [25]. A difference in the incidence of DVT between races may also affect perioperative thromboprophylaxis. In Asia, performing THA without anticoagulants was reported by 2 studies to be safe regarding perioperative thrombotic events because the incidence of postoperative DVT and PE was lower in Asians than in Westerners

Table 2
Risk of primary outcome before and after overlap propensity-score weighting.

Outcome	Entire cohort (N = 458)	Before weight	Risk ratio (95% CI)	*P* value	Entire cohort (N = 458)	After weight	Risk ratio (95% CI)	*P* value
	Simultaneous bilateral THA (N = 75)	Unilateral THA (N = 383)			Simultaneous bilateral THA	Unilateral THA		
No. of events (%)	9 (12)	55 (14.3)	0.84 (0.432-1.618)	.594	31.12 (13.6)	22.88 (10.0)	1.36 (0.668-2.772)	.397

[6,26]. One of these studies evaluated the safety of simultaneous bilateral THA without anticoagulants and found no significant difference in the incidence of DVT and PE [6]. However, this study was not sufficiently powered to assess the risk of venous thromboembolism because detailed patient backgrounds were not assessed and no consideration was given to comorbidities or indication bias in surgical treatment methods. When making decisions on simultaneous bilateral THA, surgeons tend to select younger patients with fewer previous comorbidities, which may cause an indication bias when comparing this procedure with unilateral THA [21].

Blood transfusion is a known risk factor for DVT/venous thromboembolism [27]. In this study, autologous blood transfusion was performed only in cases of simultaneous bilateral THA, which may lead to a higher frequency of patients with unilateral THA in allogenic blood transfusions and affect the results.

When deciding whether to administer prophylactic chemoprophylaxis to patients planning to undergo THA, physicians should weigh the risks and benefits for each patient. Our findings indicate that in Asian patients, the same prophylactic interventions may be used in simultaneous bilateral cementless THA as in unilateral cementless THA.

The strength of the present study is the standardization of procedures: All included patients underwent THA by the direct anterior approach under general anesthesia and received a cementless prosthesis, and perioperative thromboprophylaxis was treated by physical therapy *and the use of elastic bandages during surgery, postoperative thromboembolic stockings, and mechanical prophylaxis with pneumatic compression devices*. This standardization probably eliminated confounding factors in the perioperative period. In addition, all patients underwent ultrasonography of the lower limb veins to evaluate preoperative and postoperative DVT. The potential confounders associated with an increased risk of thrombosis events after THA were also measured and controlled for [8-18].

Limitations

This study has several limitations. First, it was a retrospective, nonrandomized, observational study and, thus, was prone to residual selection bias, despite the use of propensity score. Second, the sample size was small. Third, the study was limited to Asian patients. *Fourth, patients receiving anticoagulants or antiplatelet agents chronically for any reason were excluded from the analysis. Fifth, the lack of anticoagulant or antiplatelet therapy after THA and standardized DVT screening with ultrasound does not represent the standard of care. Sixth, no monitoring or evaluation of venous thromboembolism events occurred outside the 10-day period of this study, and it is conceivable that long-term monitoring may alter outcomes.* Despite these limitations, our findings provide clear evidence for the relative effectiveness and safety of simultaneous bilateral THA without any *anticoagulant or antiplatelet therapy*.

Conclusions

Our findings indicate that in the 7 days after surgery, the incidence of DVT is not higher after simultaneous bilateral THA without *any anticoagulant or antiplatelet therapy* than that after unilateral THA without *any anticoagulant or antiplatelet therapy*. These findings may help inform decisions about perioperative thromboprophylaxis for THA, although further research is needed to understand the postoperative risk of venous thromboembolism after THA.

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Statement of ethics

The present study was performed in accordance with the principles of the Declaration of Helsinki, and the patients gave written informed consent for their data to be analyzed.

Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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