Research Square

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Suction Drainage Is Associated With Early Hemoglobin Decline but No Additional Clinical Benefit After Total Joint Arthroplasty: A Propensity Score–Matched Study

Byeong-Hun Jeon
Catholic Kwandong University International St. Mary's Hospital
Tae Hyung Kim
Seran Hospital
Tae Kang Kim
Severance Hospital
Hyuck Min Kwon
Severance Hospital
Byung Woo Cho
Gangnam Severance Hospital
Woo-Suk Lee
Gangnam Severance Hospital
Kwan Kyu Park
kkpark@yuhs.ac

Severance Hospital

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Abstract

Purpose

To evaluate the impact of routine postoperative suction drainage on perioperative outcomes following primary total hip arthroplasty (THA) and total knee arthroplasty (TKA) using a propensity score–matched cohort.

Methods

A retrospective cohort study included 2,339 consecutive patients who underwent primary THA or TKA between January 2020 and May 2026. Patients were categorized according to postoperative suction drain use. Propensity score matching using age, sex, and body mass index, with exact matching for procedure type, yielded 630 matched pairs (1,260 patients). Primary outcomes were postoperative hemoglobin (Hb) change and estimated blood loss (EBL). Secondary outcomes included transfusion, length of stay, and postoperative infectious, wound, and thromboembolic complications. Subgroup analyses were performed according to procedure type, antiplatelet use, and anticoagulant use.

Results

Following propensity score matching, the suction drain group demonstrated a greater reduction in Hb on POD1 (2.0 ± 1.0 vs. 1.8 ± 0.9 g/dL, p = 0.005), whereas Hb change on POD2 was comparable between groups. Estimated blood loss, transfusion rate, length of stay, postoperative wound complications, thromboembolic events, and acute periprosthetic joint infection were similar between groups. Procedure-specific subgroup analyses demonstrated generally consistent findings in both THA and TKA. Among patients receiving antiplatelet or anticoagulant medications, postoperative hemoglobin decline, estimated blood loss, transfusion rate, and length of stay were comparable between the suction drain and no-suction drain groups.

Conclusions

Routine suction drain use following primary total joint arthroplasty was primarily associated with early postoperative laboratory differences, without meaningful differences in clinically relevant perioperative outcomes.

Level of Evidence: Retrospective cohort study, Level

Introduction

Postoperative suction drainage has traditionally been used after total joint arthroplasty to reduce hematoma formation, minimize wound tension, and decrease wound-related complications. The theoretical benefits of drainage include improved wound healing, reduced soft-tissue swelling, and prevention of postoperative infection through evacuation of blood and fluid accumulation. [1–3]

Despite its widespread use, the clinical value of routine drainage remains controversial. Several studies have reported that drain placement may increase postoperative blood loss and transfusion requirements without providing clear benefits in terms of wound healing or complication prevention. Furthermore, drains may increase patient discomfort, require additional postoperative management, and potentially prolong hospitalization [1, 3–7].

In recent years, advances in perioperative blood management, particularly the routine use of tranexamic acid and enhanced recovery protocols, have further challenged the necessity of postoperative drainage after arthroplasty. Contemporary studies have reported conflicting results regarding the effectiveness of drainage, and considerable variation in practice patterns persists among surgeons and institutions [1, 2, 8, 9].

Most previous investigations have focused on either total knee arthroplasty or total hip arthroplasty separately and were often limited by relatively small sample sizes [7, 10–13]. In addition, systematic reviews evaluating the use of drainage after primary arthroplasty have reported inconsistent conclusions and insufficient evidence to establish definitive recommendations [14]. Therefore, the role of postoperative drainage in contemporary primary total joint arthroplasty remains incompletely understood.

The purpose of this study was to evaluate the association between routine postoperative suction drainage and perioperative outcomes following primary total hip or total knee arthroplasty using a propensity score–matched cohort. We hypothesized that routine postoperative suction drainage would not be associated with superior perioperative outcomes compared with no drain use.

Methods

Study design and patient selection

The study was approved by the Institutional Review Board of Severance Hospital (IRB No. 4-2026-0771), and the requirement for informed consent was waived because of the retrospective nature of the study. This retrospective cohort study included consecutive patients who underwent primary total hip arthroplasty (THA) or total knee arthroplasty (TKA) at a single tertiary referral center between January 2020 and May 2026. A total of 2,339 patients were identified. According to the intraoperative use of a closed suction drain, patients were divided into the No-Suction Drain (No-SD) group (n = 1,012) and the Suction Drain (SD) group (n = 1,327).

Propensity Score Matching

Propensity score matching (PSM) was performed to minimize baseline differences between the suction drain (SD) and no-suction drain (No-SD) groups. [15, 16] Propensity scores were estimated using a logistic regression model incorporating age, sex, and body mass index (BMI). One-to-one nearest-neighbor matching without replacement was performed using a caliper width of 0.2, while procedure

type (total hip arthroplasty [THA] or total knee arthroplasty [TKA]) was matched exactly [17–19]. Covariate balance after matching was assessed using standardized mean differences (SMDs). Following matching, 630 matched pairs (1,260 patients) were included in the final analysis (Fig. 1).

Perioperative Management

All procedures were performed by two fellowship-trained arthroplasty surgeons using standardized surgical techniques and institutional perioperative protocols. During the study period, institutional practice regarding routine closed suction drain use changed, and patients underwent surgery with or without a drain according to the standard practice in place at the time of surgery. For patients in the suction drain (SD) group, a closed suction drain was placed before wound closure and was routinely removed on postoperative day (POD) 1. Drain removal could be delayed based on postoperative drain output.

All patients routinely received 2 g of tranexamic acid diluted in normal saline, administered intra-articularly before wound closure unless contraindicated. Standard perioperative management, including prophylactic antibiotic administration, venous thromboembolism prophylaxis, early postoperative mobilization, standardized rehabilitation, and discharge according to predefined institutional criteria, was provided for all patients.

Transfusion was considered in patients with a postoperative hemoglobin level < 8.0 g/dL or symptomatic anemia [20].

Data Collection and Outcome Measures

Clinical and perioperative data were retrospectively collected from the electronic medical record (EMR) system. Baseline variables included age, sex, height, weight, body mass index (BMI), procedure type (total hip arthroplasty [THA] or total knee arthroplasty [TKA]), American Society of Anesthesiologists (ASA) physical status classification, preoperative hemoglobin (Hb) level, and preoperative antiplatelet or anticoagulant medication use.

The primary outcomes were postoperative Hb change and estimated blood loss (EBL). Hemoglobin levels were routinely measured preoperatively and on postoperative day (POD) 1. POD2 hemoglobin measurements were obtained according to the treating physician's clinical judgment and discharge planning. Hb change was calculated as the difference between preoperative and postoperative Hb levels.

Secondary outcomes included transfusion rate, length of hospital stay, and postoperative complications occurring within 3 months after surgery. All postoperative complications were assessed within 3 months after surgery and categorized as either systemic or local. Systemic complications included pulmonary thromboembolism, stroke, and myocardial infarction, whereas local complications included superficial surgical site infection (SSI), postoperative hematoma, and acute periprosthetic joint infection (PJI) [21,

22]. SSI was defined as a superficial wound infection managed with antibiotic treatment alone without surgical intervention. Acute PJI was defined as an infection requiring debridement, antibiotics, and implant retention (DAIR).

Estimated Blood Loss Calculation

Estimated blood loss (EBL) was calculated using the hemoglobin balance method based on the estimated blood volume (EBV) [23]. EBV was estimated using the Nadler's formula according to patient sex, height, and weight. EBL was subsequently calculated using preoperative and postoperative hemoglobin concentrations according to the following equation:

Male

$$\mathrm{EBV\,(L)} = 0.3669 \times \ \mathrm{Height\,(m)}\,3 + 0.03219 \times \ \mathrm{Weight\,(kg)} + 0.6041$$

Female

$$\mathrm{EBV\,(L)} = 0.3561 \times \ \mathrm{Height\,(m)}\,3 + 0.03308 \times \ \mathrm{Weight\,(kg)} + 0.1833$$

$$\mathrm{EBL} = \mathrm{EBV} \times \ \frac{(Hb_{pre} - Hb_{post})}{Hb_{mean}}$$

where

$$Hb_{mean} = \frac{(Hb_{pre} + Hb_{post})}{2}$$

Separate EBL values were calculated using postoperative hemoglobin concentrations obtained on postoperative day (POD) 1 and POD2.

Statistical Analysis

Continuous variables are presented as mean ± standard deviation (SD), and categorical variables as frequencies and percentages. The normality of continuous variables was assessed using the Shapiro–Wilk test. Normally distributed continuous variables were compared using Welch's t-test, whereas non-normally distributed variables were compared using the Mann–Whitney U test. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate. All statistical tests were two-sided, and a *P* value < 0.05 was considered statistically significant. Statistical analyses were performed using R (version 4.5.1; R Foundation for Statistical Computing, Vienna, Austria).

Results

Patient Characteristics

A total of 2,339 patients who underwent primary THA or TKA during the study period were identified. Of these, 1,012 patients were included in the No-SD group and 1,327 in the SD group (Fig. 1). Before propensity score matching, patients in the SD group were older, more likely to be female, and underwent TKA more frequently than those in the No-SD group. Baseline imbalances were also observed in height, estimated blood volume, and ASA physical status classification (Table 1).

Table 1
Baseline Demographic and Clinical Characteristics Before and After Propensity Score Matching

	Pre-matching			Post- Matching		
	No-SD (n = 1012)	**SD (n = 1327)**	**SMD**	**No-SD (n = 630)**	**SD (n = 630)**	**SMD**
Age (years)	65.6 ± 13.3	69.8 ± 10.6	0.353	67.4 ± 12.7	67.1 ± 12.5	0.031
Female, n (%)	683 (67.5)	991 (74.6)	0.157	445 (70.6)	446 (70.8)	0.003
Weight (kg)	64.8 ± 12.6	64.6 ± 11.6	0.019	65.1 ± 12.7	64.8 ± 12.3	0.025
Height (cm)	160.2 ± 9.7	157.0 ± 9.1	0.343	159.3 ± 9.8	157.9 ± 9.5	0.146
BMI (kg/m²)	25.4 ± 3.7	26.3 ± 7.9	0.109	25.5 ± 3.7	25.8 ± 3.8	0.082
EBV (L)	3.94 ± 0.74	3.82 ± 0.66	0.181	3.91 ± 0.73	3.86 ± 0.69	0.071
THA, n (%)	642 (63.4)	260 (19.6)	0.894	260 (41.3)	260 (41.3)	0.000
TKA, n (%)	370 (36.6)	1067 (80.4)	0.894	370 (58.7)	370 (58.7)	0.000
ASA class I/II/III/IV	21/568/418/5	27/587/702/11	0.242	15/345/269/1	17/301/308/4	0.140

Values are presented as mean ± standard deviation unless otherwise indicated.

Abbreviations: BMI, body mass index; EBV, estimated blood volume; THA, total hip arthroplasty; TKA, total knee arthroplasty; ASA, American Society of Anesthesiologists

Following 1:1 propensity score matching, 630 patients remained in each group (total n = 1,260). Baseline demographic and clinical characteristics were well balanced after matching, with standardized mean differences below 0.2 for all measured variables. Procedure type was identical between groups because exact matching was performed according to THA and TKA. Small differences in ASA physical status classification persisted after matching, although the standardized mean difference remained below the prespecified threshold for adequate balance [24](Table 1).

Perioperative Clinical Outcomes

Clinical outcomes following propensity score matching are summarized in Table 2. Postoperative hemoglobin decline was greater in the SD group on POD1 (2.0 ± 1.0 vs. 1.8 ± 0.9 g/dL, p = 0.005), whereas Hb change on POD2 was comparable between the groups. Consistent with these findings, postoperative hemoglobin levels were lower in the SD group on both POD1 and POD2. Estimated blood loss on POD1 and POD2, transfusion rate, length of stay, and the proportions of patients receiving antiplatelet or anticoagulant medications were comparable between the groups (Table 2)

Table 2
Clinical outcomes after propensity score matching

Preoperative Hb (g/dL)	**No-SD (n = 630)**	**SD (n = 630)**	**p**
	13.1 ± 1.5	**12.9 ± 1.5**	**0.001**
Hb on POD 1 (g/dL)	11.3 ± 1.5	10.9 ± 1.4	< 0.001
Hb on POD 2 (g/dL)	10.4 ± 1.5 (n = 332)	9.9 ± 1.6 (n = 191)	< 0.001
Hb change on POD 1 (g/dL)	1.8 ± 0.9	2.0 ± 1.0	0.005
Hb change on POD 2 (g/dL)	2.6 ± 1.1 (n = 332)	2.7 ± 1.4 (n = 191)	0.983
EBL on POD 1 (mL)	619 ± 395	634 ± 341	0.459
EBL on POD 2 (mL)	954 ± 560(n = 332)	943 ± 527 (n = 191)	0.832
Anticoagulant use, n (%)	25 (4.0)	33 (5.2)	0.061
Antiplatelet use, n (%)	107 (17.0)	122 (19.4)	0.062
Transfusion, n (%)	13 (2.1)	20 (3.2)	0.290
Length of stay, days	4.6 ± 6.4	4.5 ± 2.0	0.711
Values are presented as mean ± standard deviation unless otherwise indicated.			
Abbreviations: Hb, hemoglobin; POD, postoperative day; EBL, estimated blood loss.			

Subgroup Analysis According to Procedure Type

Procedure-specific subgroup analyses are presented in Table 3. Among patients undergoing THA, hemoglobin change on POD1 and POD2 was comparable between the groups. Postoperative hemoglobin level on POD2 was lower in the SD group than in the No-SD group (9.1 ± 1.5 vs. 10.0 ± 1.6 g/dL, $p < 0.001$), whereas preoperative hemoglobin level, postoperative hemoglobin level on POD1, estimated blood loss on POD1 and POD2, transfusion rate, and length of hospital stay were comparable between the groups.

Table 3
Subgroup analysis according to procedure

Preoperative Hb (g/dL)	**THA**	**THA**	**p**	**TKA**	**TKA**	**p**
	No-SD (n = 260)	**SD (n = 260)**		**No-SD (n = 370)**	**SD (n = 370)**	
	13.1 ± 1.7	**13.0 ± 1.7**	**0.300**	**13.1 ± 1.4**	**12.8 ± 1.4**	**< 0.001**
Hb on POD 1 (g/dL)	11.1 ± 1.6	10.8 ± 1.6	0.083	11.5 ± 1.4	11.0 ± 1.3	< 0.001
Hb on POD 2 (g/dL)	10.0 ± 1.6 (n = 139)	9.1 ± 1.5 (n = 70)	< 0.001	10.7 ± 1.2 (n = 193)	10.4 ± 1.4 (n = 121)	0.026
Hb change on POD 1 (g/dL)	2.1 ± 1.1	2.2 ± 1.1	0.299	1.6 ± 0.8	1.8 ± 0.9	0.003
Hb change on POD 2 (g/dL)	3.0 ± 1.2 (n = 139)	3.3 ± 1.7 (n = 70)	0.117	2.3 ± 0.8 (n = 193)	2.3 ± 1.0 (n = 121)	0.968
EBL on POD 1 (mL)	789 ± 492	719 ± 395	0.076	499 ± 246	575 ± 283	0.001
EBL on POD 2 (mL)	1262 ± 691 (n = 139)	1231 ± 627 (n = 70)	0.961	733 ± 281 (n = 193)	777 ± 371 (n = 121)	0.230
Anticoagulant use, n (%)	8 (3.1)	10 (3.8)	0.711	17 (4.6)	23 (6.2)	0.417
Antiplatelet use, n (%)	37 (14.2)	41 (15.8)	0.713	70 (18.9)	81 (21.9)	0.362
Transfusion, n (%)	12 (4.6)	15 (5.8)	0.559	1 (0.27)	5 (1.4)	0.216
Length of stay, days	5.6 ± 9.7	4.9 ± 2.5	0.273	3.9 ± 1.5	4.2 ± 1.5	0.005

Values are presented as mean ± standard deviation unless otherwise indicated. Sample sizes for POD2 analyses are shown because postoperative hemoglobin measurements on POD2 were not routinely available for all patients.

Abbreviations: Hb, hemoglobin; POD, postoperative day; EBL, estimated blood loss.

Among patients undergoing TKA, hemoglobin decline on POD1 was greater in the SD group than in the No-SD group (1.8 ± 0.9 vs. 1.6 ± 0.8 g/dL, $p = 0.003$), whereas Hb change on POD2 was comparable between the groups. Postoperative hemoglobin levels on POD1 (11.0 ± 1.3 vs. 11.5 ± 1.4 g/dL, $p < 0.001$) and POD2 (10.4 ± 1.4 vs. 10.7 ± 1.2 g/dL, $p = 0.026$) were lower in the SD group. Estimated blood loss on POD1 was greater in the SD group (575 ± 283 vs. 499 ± 246 mL, $p = 0.001$), whereas estimated blood loss on POD2 and transfusion rate were comparable between the groups. Length of hospital stay was longer in the SD group (4.2 ± 1.5 vs. 3.9 ± 1.5 days, $p = 0.005$).

Subgroup Analysis According to Antithrombotic Medication

Subgroup analyses according to antiplatelet and anticoagulant use are summarized in Table 4. The distributions of THA and TKA were comparable between the SD and No-SD groups in both subgroups.

Table 4
Subgroup analysis according to antithrombotic medication

THA/TKA	Antiplatelet No-SD (n = 107)	Antiplatelet SD (n = 122)	p	Anticoagulant No-SD (n = 25)	Anticoagulant SD (n = 33)	p
	37/70	**41/81**	**0.878**	**8/17**	**10/23**	**0.890**
Preoperative Hb (g/dL)	13.1 ± 1.5	12.8 ± 1.5	0.191	13.5 ± 2.2	12.5 ± 1.7	0.079
Hb on POD 1 (g/dL)	11.3 ± 1.4	10.8 ± 1.3	0.021	11.5 ± 1.9	10.6 ± 1.4	0.050
Hb on POD 2 (g/dL)	10.3 ± 1.4 (n = 55)	9.8 ± 1.4 (n = 34)	0.093	10.3 ± 2.0 (n = 14)	9.4 ± 1.2 (n = 8)	0.188
Hb change on POD 1 (g/dL)	1.8 ± 1.0	2.0 ± 0.9	0.198	2.0 ± 0.9	2.0 ± 1.1	0.753
Hb change on POD 2 (g/dL)	2.6 ± 1.2 (n = 55)	2.8 ± 1.2 (n = 34)	0.466	2.6 ± 1.0 (n = 14)	2.6 ± 1.4 (n = 8)	0.995
EBL on POD 1 (mL)	583 ± 356	635 ± 311	0.243	645 ± 300	654 ± 326	0.916
EBL on POD 2 (mL)	886 ± 447 (n = 55)	981 ± 464 (n = 34)	0.345	897 ± 370 (n = 14)	860 ± 484 (n = 8)	0.857
Transfusion, n (%)	1 (0.9)	3 (2.5)	0.625	1 (4.0)	1 (3.0)	1.000
Length of stay, days	4.1 ± 1.5	4.3 ± 1.6	0.300	4.6 ± 1.7	5.7 ± 3.8	0.304

Values are presented as mean ± standard deviation unless otherwise indicated. Sample sizes for POD2 analyses are shown because postoperative hemoglobin measurements on POD2 were not routinely available for all patients.

Abbreviations: Hb, hemoglobin; POD, postoperative day; EBL, estimated blood loss.

Among patients receiving antiplatelet therapy, hemoglobin change on POD1 and POD2 was comparable between the groups. Postoperative hemoglobin level on POD1 was lower in the SD group than in the No-SD group (10.8 ± 1.3 vs. 11.3 ± 1.4 g/dL, $p = 0.021$), whereas preoperative hemoglobin level, postoperative hemoglobin level on POD2, estimated blood loss on POD1 and POD2, transfusion rate, and length of hospital stay were comparable between the groups.

Among patients receiving anticoagulant therapy, hemoglobin change on POD1 and POD2 was comparable between the groups. Preoperative hemoglobin level, postoperative hemoglobin levels on

POD1 and POD2, estimated blood loss on POD1 and POD2, transfusion rate, and length of hospital stay were also comparable between the groups.

Postoperative Complications

The incidences of systemic complications, including pulmonary thromboembolism (PTE), stroke, and myocardial infarction (MI), were low and comparable between the groups. Similarly, local complications, including superficial surgical site infection (SSI), postoperative hematoma, and acute postoperative periprosthetic joint infection (acute postoperative PJI) were infrequent and did not differ significantly between the No-SD and SD groups. Overall, routine suction drain use was not associated with an increased risk of postoperative complications (Table 5).

Table 5
Postoperative complications

Systemic complications	**No-SD (THA/TKA)**	**SD (THA/TKA)**	**p**
PTE, n	1/1	1/1	1.000
Stroke, n	2/0	0 /0	0.500
MI, n	0/1	0/1	1.000
Local complications	No-SD (THA/TKA)	SD (THA/TKA)	p
SSI, n	3/1	1/2	0.486
Postoperative hematoma, n	1 /0	0/0	1.000
Acute postoperative PJI, n	1/3	0/6	0.400
P values were calculated using the total number of events in each group.			
Abbreviations: THA, total hip arthroplasty; TKA, total knee arthroplasty; SD, suction drain; SSI, surgical site infection; PJI, periprosthetic joint infection; PTE, pulmonary thromboembolism; MI, myocardial infarction.			

Discussion

The principal finding of the present study was that routine suction drain use was associated with differences in early postoperative laboratory findings without corresponding differences in clinically relevant perioperative outcomes following primary total joint arthroplasty. Specifically, patients in the SD group demonstrated lower postoperative hemoglobin levels and a greater hemoglobin decline on POD 1. However, these laboratory differences were not accompanied by significant differences in estimated blood loss, transfusion rate, length of hospital stay, or postoperative complications. Collectively, these findings indicate that the effect of routine suction drainage is primarily reflected in early postoperative laboratory parameters, with little apparent impact on clinically relevant perioperative outcomes.

These findings are consistent with previous studies evaluating routine suction drainage following primary arthroplasty. Ayan et al. demonstrated lower postoperative day 1 hemoglobin levels in the drainage group without significant differences in total blood loss, transfusion rate, complications, or length of hospital stay among patients undergoing primary TKA with routine tranexamic acid administration [8]. Similarly, Yang et al. reported greater postoperative hemoglobin loss and a longer hospital stay in patients receiving closed suction drainage after primary TKA, while no differences were observed in pain, functional recovery, or postoperative complications [11]. Maliarov et al. also reported that although suction drainage was associated with lower early postoperative hemoglobin levels, it did not influence calculated blood loss, functional recovery, or early clinical outcomes following primary TKA [10]. Building upon these previous reports, our findings strengthen the existing evidence by demonstrating similar results in a large contemporary propensity score-matched cohort including both THA and TKA.

Procedure-specific subgroup analyses demonstrated generally consistent findings between THA and TKA. In patients undergoing THA, routine suction drainage was not associated with significant differences in hemoglobin change, estimated blood loss, transfusion rate, or length of stay. In contrast, patients undergoing TKA demonstrated greater hemoglobin decline and estimated blood loss on POD1 in the drainage group, although these differences were no longer evident on POD2. A possible explanation is that elimination of the tamponade effect of the postoperative hematoma by suction drainage may increase early postoperative bleeding, a mechanism that has been proposed in previous clinical studies. [1, 7, 8, 10, 25–27] This transient effect may have been more apparent in patients undergoing TKA and may be related to the predominance of bleeding during the immediate postoperative period following tourniquet release. However, no corresponding differences were observed in transfusion rate or postoperative complications, suggesting that these early laboratory differences were not translated into clinically meaningful perioperative benefits.

Patients receiving antiplatelet or anticoagulant therapy are generally considered to be at increased risk of perioperative bleeding, and postoperative drainage has traditionally been used with the expectation of reducing hematoma formation in these patients. However, evidence supporting this practice remains limited. In the present subgroup analysis, patients receiving antiplatelet therapy demonstrated comparable postoperative hemoglobin decline, estimated blood loss, transfusion requirements, and length of hospital stay regardless of suction drain use, although postoperative hemoglobin levels on POD1 were lower in the SD group. Similarly, among patients receiving anticoagulant therapy, postoperative hemoglobin decline, estimated blood loss, transfusion requirements, and length of hospital stay were also comparable between the SD and No-SD groups. While postoperative hemoglobin levels on POD1 tended to be lower in the SD group, this difference was not accompanied by greater hemoglobin decline or differences in other perioperative outcomes. Taken together, these findings suggest that routine suction drainage was not associated with additional perioperative benefits among patients receiving either antiplatelet or anticoagulant therapy, although the relatively small sample size of these subgroup analyses warrants cautious interpretation.

This study has several limitations. First, this was a retrospective single-center study and is therefore subject to inherent selection bias despite propensity score matching. However, the inclusion of a large contemporary propensity score–matched cohort enhances the applicability of the findings to current arthroplasty practice in the tranexamic acid era. Second, although propensity score matching improved baseline comparability, residual differences in variables not included in the matching model, such as preoperative hemoglobin and ASA class, remained after matching, and their potential contribution to the observed outcomes could not be fully excluded. In addition, POD2 hemoglobin measurements were obtained selectively based on clinical judgment rather than routinely in all patients, which may have introduced additional selection bias in POD2-based analyses. Third, because the use of closed suction drains reflected institutional practice rather than random treatment allocation, temporal changes in perioperative management and surgical practice may have introduced residual confounding despite propensity score matching. Fourth, the relatively small number of postoperative complications and patients receiving antithrombotic medications may have limited the statistical power of these subgroup analyses. However, evidence regarding routine suction drainage in patients receiving antithrombotic therapy remains limited, and the present study provides additional data in this clinically relevant population. Finally, this study focused on early perioperative outcomes following primary total joint arthroplasty, and longer-term functional outcomes and patient-reported outcomes were not evaluated. However, because the expected effects of routine suction drainage occur predominantly during the immediate postoperative period, assessment of early perioperative outcomes remains the most clinically relevant endpoint.

Conclusion

Routine suction drain use following primary total joint arthroplasty was primarily associated with early postoperative laboratory differences, without meaningful differences in clinically relevant perioperative outcomes.

Declarations

Ethics approval and consent to participate

This retrospective cohort study was approved by the Institutional Review Board of Severance Hospital (IRB No. 4-2026-0771). The study was conducted in accordance with the Declaration of Helsinki. The requirement for informed consent was waived owing to the retrospective nature of the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

Byeong-Hun Jeon (Co-first author): Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Visualization, Writing – original draft, Writing – review & editing.Tae Hyung Kim (Co-first author):Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Visualization, Writing – original draft, Writing – review & editing.Tae Kang Kim: Investigation, Data curation, Validation.Hyuck Min Kwon: Writing – review & editing.Byung Woo Cho: Writing – review & editing.Woo-Suk Lee: Writing – review & editing.Kwan Kyu Park: Conceptualization, Supervision, Project administration, Writing – review & editing.

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Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Figures

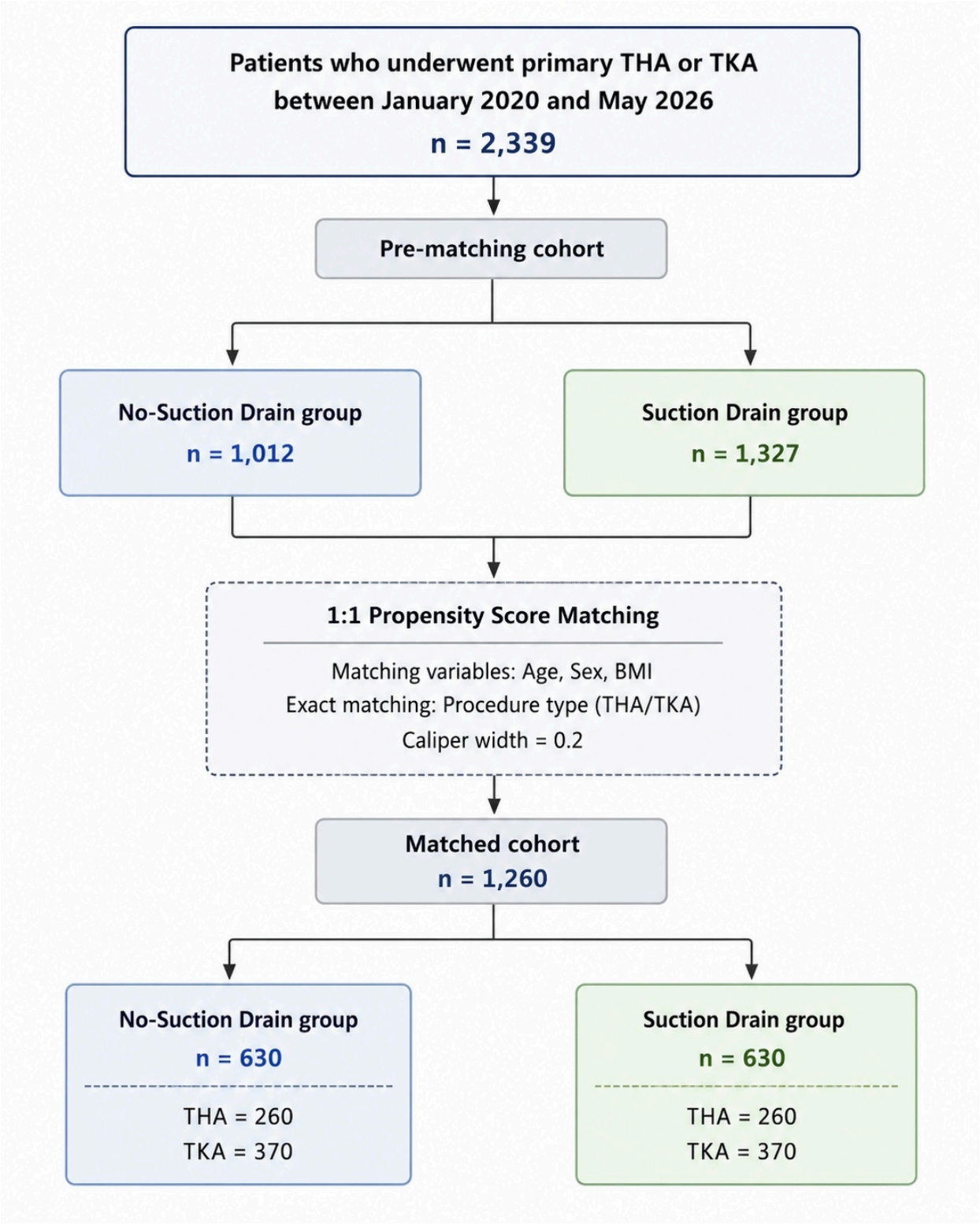


Figure 1

Flow diagram of patient selection and propensity score matching.
A total of 2,339 patients who underwent primary THA or TKA were identified. Following 1:1 propensity score matching using age, sex, and body mass index with exact matching for procedure type, 630 patients remained in each group.