Research Square

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Risk factors for deep vein thrombosis after unicompartmental knee arthroplasty: a retrospective cohort study

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Abstract

Background

With the rapid adoption of unicompartmental knee arthroplasty (UKA), the risk of postoperative venous thromboembolism (VTE) has garnered increasing attention. However, a dedicated risk factor profile and predictive model remain lacking.

Objective

To investigate independent risk factors for deep vein thrombosis (DVT) in the lower extremities following UKA, providing evidence-based support for individualized anticoagulation strategies.

Methods

A retrospective cohort study included 294 patients who underwent primary UKA at Hebei Provincial People's Hospital between August 2018 and August 2025.Patients were categorized into DVT (n = 40) and non-DVT (n = 254) groups based on DVT detection via color Doppler ultrasound within 14 days postoperatively. Demographic, laboratory, and perioperative data were collected. Univariate analysis identified risk factors, while multivariate logistic regression screened independent predictors.

Results

The postoperative DVT incidence was 13.5%. Multivariate analysis revealed that bilateral simultaneous surgery (reference) was associated with a significantly higher risk of DVT compared to unilateral surgery (left-side OR = 0.135...; right-side OR = 0.180...). Each 1 μmol/L increase in serum uric acid (OR = 1.006...) was also an independent risk factor. Age ≥ 70 years, retired status, shortened preoperative PT, and low albumin levels were also significantly associated.

Conclusion

Compared to TKA, although UKA offers advantages of less tissue trauma and shorter operative time, bilateral simultaneous surgery and hyperuricemia significantly increase the risk of DVT. Routine preoperative assessment of coagulation, metabolic, and nutritional parameters with risk stratification management should be implemented.

Research Background

In an era of accelerating global aging, the patient population with knee osteoarthritis (KOA) continues to expand. Statistics indicate KOA prevalence rates of 10–15% among individuals aged 65 and 40% among those aged 80 and above. Projections suggest the number of KOA patients will increase by half by 2040[1] .An epidemiological survey indicates that the prevalence of KOA in China is 8.1%[2] .Currently, knee surface arthroplasty is a key treatment for end-stage knee osteoarthritis. Compared to total knee arthroplasty (TKA), unicompartmental knee arthroplasty (UKA) is a bone- and ligament-sparing

alternative for patients with end-stage degeneration in a single knee compartment[3]. It offers advantages including reduced trauma, shorter hospital stays, higher functional scores, and postoperative outcomes closer to those of a normal knee[4, 5] .Therefore, unicompartmental knee arthroplasty is increasingly favored by physicians. According to medical association statistics, China performed approximately 23,000 unicompartmental knee replacements in 2020. Compared to 2019, the proportion of unicompartmental procedures within all joint replacements rose from 1.95% to 2.46%.According to an English report covering January 2010 to March 2022, a total of 1,455,842 hip and knee replacements were performed. Among these, 2,556 were unicompartmental knee replacements conducted as day surgeries.The day surgery rate for UKA surged from 1.98% in 2016 to 9.3% in 2022[6] .According to research from a U.S. healthcare platform, 1,662 UKA procedures were performed in 2022, representing a 590% increase over the 241 cases in 2012. UKA volume is projected to continue rising, with models predicting exponential adoption growth through 2035[7] .

Deep vein thrombosis (DVT) and pulmonary embolism (PE) are complications of knee replacement surgery, with symptomatic DVT posing greater risks to patients[8]. Thrombus formation directly impacts postoperative functional recovery and patient satisfaction. Postoperative satisfaction has become a key indicator for measuring patient acceptance and satisfaction with surgical intervention[9]. Furthermore, thrombus detachment leading to pulmonary embolism can result in life-threatening consequences[10]. A Danish study examining symptomatic VTE incidence within 90 days post-UKA in 3,927 patients reported a DVT rate of 0.28%, a PE rate of 0.13%, and an overall VTE incidence of 0.41%[11]. A study involving 167,054 patients demonstrated that the DVT incidence in the UKA group was approximately half that of the TKA group (0.42% vs. 0.83%), with lower rates of pulmonary embolism and other complications as well[12]. Even though the probability of lower limb venous thrombosis after unicompartmental knee arthroplasty is relatively low.However, venous thromboembolism prevention guidelines for TKA may not be directly applicable to UKA[13]. Currently, there are virtually no independent VTE guidelines or predictive models specifically developed for UKA. While insights can be gained from TKA prevention guidelines, a one-size-fits-all approach is not feasible. Instead, we must enter an era of precision risk management.

This retrospective study aims to investigate risk factors for lower extremity venous thrombosis following unicompartmental knee arthroplasty. It seeks to provide evidence-based medical evidence and construct a refined predictive model to assist clinicians in more accurately identifying high-risk thrombosis patients. This will enable the development of more individualized anticoagulation regimens, ultimately maximizing patient health and benefits.

Materials and Methods

1.1 General Data

This retrospective study analyzed clinical data from 294 patients who underwent primary unicompartmental knee arthroplasty at Hebei Provincial People's Hospital between August 2018 and

August 2025. Patients were categorized into a deep vein thrombosis (DVT) group (n = 40) and a non-DVT group (n = 254) based on postoperative color Doppler ultrasound findings.

Inclusion Criteria:

(1) Location of pathology: Knee osteoarthritis confined to a single compartment with intact cartilage in other compartments.

(2) Range of motion: Knee flexion > 90° with no significant flexion contracture (< 15°).

(3) Joint stability: Medial and lateral collateral ligaments, as well as anterior and posterior cruciate ligaments intact, with no significant instability.

(4) Deformity correction: Knee varus deformity ≤ 15°, with deformity passively correctable.

(5). History of lower extremity thrombosis: No evidence of old thrombosis in the lower extremities prior to surgery.

(6) General condition: Patient in good overall health with no contraindications such as severe cardiopulmonary insufficiency or coagulation disorders.

Exclusion Criteria:

(1). Multicompartmental disease: Knee osteoarthritis affecting multiple compartments cumulatively, or inflammatory arthritis including rheumatoid arthritis, infectious arthritis, etc.

(2). Ligament abnormalities: Loss of function in the anterior or posterior cruciate ligaments.

(3). Severe deformity: Knee range of motion < 90°, varus/valgus deformity > 15° that cannot be passively corrected.

(4). Structural alterations: History of major surgery on the affected knee, such as high tibial osteotomy. Alternatively, patellofemoral joint dislocation or severe patellar chondromalacia.

(5) Neuromuscular disorders: Quadriceps muscle weakness or nerve damage affecting postoperative rehabilitation.

(6). Systemic conditions: Inability to tolerate surgery and anesthesia, cardiopulmonary failure, severe hepatic or renal insufficiency, etc.

(7). Other conditions: Incomplete clinical documentation.

1.2 Treatment Methods

All patients underwent unicompartmental knee arthroplasty with clear indications for unicompartmental replacement. Based on preoperative assessment and anesthesiologist evaluation, combined spinal-epidural anesthesia or general intravenous anesthesia was administered. The surgical approach utilized a medial anterior knee incision with medial parapatellar entry into the joint cavity. An inflatable tourniquet was applied to the thigh for hemostasis throughout the procedure.Surgical steps and prosthesis installation procedures were standardized. The incision was closed in layers after applying compression in the extended position and allowing bone cement to set. Drainage tubes were routinely placed, and intraoperative injections of ropivacaine and tranexamic acid were administered. All patients received routine pharmacological thromboprophylaxis postoperatively. According to institutional protocols and individual risk stratification, postoperative anticoagulation was administered as follows:Low molecular weight heparin (LMWH) group: Patients received a fixed-dose regimen of subcutaneous enoxaparin sodium at 4000 IU (40 mg) once daily, initiated 12 hours after surgery and continued for 14 days. For patients with extremely low body weight (< 50 kg) or severe renal insufficiency (creatinine clearance < 30 mL/min), the prophylactic dose was reduced to 2000 IU (20 mg) once daily. Dose adjustments for morbidly obese patients (e.g., BMI > 40 kg/m²) were considered at the discretion of the attending physician based on clinical assessment.Aspirin group: Patients received enteric-coated aspirin 100 mg orally once daily, starting on postoperative day 1 and continuing for 4 weeks.

1.3 Diagnostic Criteria for Venous Thrombosis

Color Doppler ultrasound screening is routinely performed upon admission to exclude patients with preoperative lower extremity thrombosis. Postoperatively, ultrasound scans of the femoral vein, popliteal vein, anterior tibial vein, posterior tibial vein, and intermuscular veins are conducted based on clinical symptoms.Clinical diagnostic criteria primarily include: (1) swelling of the affected limb or unilateral limb, with circumference at the same level exceeding the healthy side by > 2 cm; (2) pain and tenderness in the affected limb; (3) skin discoloration (redness, purplish hue, pallor) with elevated or decreased skin temperature; (4) positive Homans' sign or Neuhauser's sign. Ultrasound diagnosis employs the following criteria[14] : (1) Inability to completely flatten the venous lumen; (2) Visible solid hypoechoic or moderate echoic filling within the lumen; (3) Complete absence of blood flow signals on color Doppler imaging. If the patient presents with concomitant symptoms such as chest tightness, chest pain, or decreased oxygen saturation, urgently perform pulmonary artery CTA to determine whether pulmonary thromboembolism (PTE) has occurred.

1.4 Evaluation Criteria

1. Demographic and Baseline Data:

Gender, age, occupation, smoking history, height, weight, BMI, season of surgery, surgical side, duration of illness (years), hypertension, diabetes, coronary heart disease, autoimmune diseases, hematologic disorders, history of varicose veins, history of thrombosis, history of major hemorrhage.

2. Laboratory and Biochemical Parameters:

Coagulation panel (PT, APTT, TT, FIB), preoperative D-dimer, hemoglobin, platelets, albumin, preoperative neutrophils, hematocrit, UA.

3. Perioperative indicators:

Length of hospital stay (D), blood transfusion, postoperative anticoagulant therapy, anesthesia method, blood loss, operative time (min),

1.5 Statistical Methods

Data analysis was performed using SPSS 27.0. Differences were considered statistically significant at $P < 0.05$. Quantitative data are expressed as mean ± standard deviation. Comparisons between groups were performed using the independent samples t-test. For quantitative data not normally distributed, median (interquartile range) [M (Q1, Q3)] was used, and comparisons between groups were performed using the two-sample rank sum test.Categorical data were expressed as cases (%). The chi-square test was applied. Multivariate logistic regression analysis was used to explore risk factors for deep vein thrombosis following unicompartmental knee arthroplasty.

Results

2.1 Analysis of Lower Limb Deep Vein Thrombosis Incidence After Unicompartmental Knee Arthroplasty

This study included 294 patients undergoing unicompartmental knee arthroplasty. Postoperative DVT occurred in 40 cases (13.51%), comprising 14 males and 26 females.

2.2 Univariate Analysis of Risk Factors for Postoperative Deep Vein Thrombosis in the Lower Extremities

The study found significant differences between the two groups in age, occupation, postoperative anticoagulant medication, surgical side (using bilateral simultaneous unicompartmental replacement as the reference group), history of thrombosis, PT, preoperative albumin, and uric acid levels ($P < 0.05$). This indicates that age > 70 years, different occupations, postoperative anticoagulant medication, history of thrombosis,preoperative PT, preoperative albumin, and hyperuricemia may be associated with postoperative deep vein thrombosis.Marginal significance was observed for total testosterone ($p = 0.084$), length of hospital stay ($p = 0.058$), and preoperative D-dimer ($p = 0.094$). No significant correlations were found with BMI, preoperative hemoglobin, blood loss, operative time, hypertension, diabetes, or anesthesia type ($p < 0.05$). (See Tables 1–2)

Table 1
Comparison of baseline and perioperative characteristics between DVT and non-DVT groups after UKA

Variable	DVT group (n = 40)	Non-DVT group (n = 254)	t or z-value	P-value
Demographic characteristics				
BMI (kg/m²)	27.93 ± 3.72	28.11 ± 3.66	0.291	0.771
Coagulation parameters				
Prothrombin time (s)	10.56 ± 0.63	10.79 ± 0.65	2.057	0.041
Thrombin time (s)	17.66 ± 1.21	17.98 ± 1.05	1.732	0.084
Fibrinogen (g/L)	2.87 ± 0.73	2.81 ± 0.61	-0.542	0.588
Hematological and Biochemical Parameters				
Hemoglobin (g/L)	134.55 ± 12.83	132.89 ± 12.73	-0.768	0.443
Albumin (g/L)	40.6 (37.7, 42.8)	41.9 (39.6, 44.1)	2.301	0.021
Uric acid (μmol/L)	322.3 (287.0, 391.9)	297.5 (252.6, 341.1)	2.548	0.011
Perioperative variables				
Length of stay (days)	11 (9, 14)	10 (8, 12)	1.892	0.058
Blood loss (mL)	20 (20, 50)	20 (20, 30)	0.073	0.942
Operative time (minutes)	121.5 (97.8, 197.5)	115.0 (95.0, 135.0)	1.476	0.140

2.3 Multivariate Analysis of Risk Factors for Postoperative Deep Vein Thrombosis in the Lower Extremities

Multivariate logistic regression analysis indicated that surgical side and elevated uric acid levels were independent risk factors for postoperative lower extremity deep vein thrombosis following unicompartmental knee arthroplasty.Compared with bilateral surgery, left-sided unicompartmental arthroplasty (OR = 0.135, 95% CI: 0.048–0.378, P < 0.001) and right-sided unicompartmental arthroplasty (OR = 0.180, 95% CI: 0.069–0.468, P < 0.001) significantly reduced DVT risk, while each 1μmol/L increase in uric acid level increased DVT risk by 0.6% (OR = 1.006, 95% CI: 1.002–1.011, P = 0.008). (See Table 3)

Table 3
Multivariate analysis of risk factors for DVT after UKA

Variable	B	SE	Wald	OR	95% CI	P-value
Age ≥ 70 years	0.544	0.401	1.839	1.722	0.785–3.779	0.175
Length of stay (days)	0.092	0.048	3.740	1.096	0.999–1.203	0.053
Prothrombin time (s)	-0.467	0.278	2.830	0.627	0.364–1.080	0.093
Uric acid (μmol/L)	0.006	0.002	7.010	1.006	1.002–1.011	**0.008**
Preoperative albumin (g/L)	-0.069	0.042	2.707	0.934	0.860–1.013	0.100
Preoperative D-dimer (mg/L)	0.125	0.206	0.369	1.133	0.757–1.695	0.544
Surgical side (Ref: 0)	-	-	16.520	-	-	**<0.001**
Surgery side (L)	-2.002	0.525	14.560	0.135	0.048–0.378	**<0.001**
Surgery side (R)	-1.714	0.487	12.385	0.180	0.069–0.468	**<0.001**

Model fit

Nagelkerke $R^2 = 0.209$, Hosmer-Lemeshow test $\chi^2 = 5.492$, $P = 0.704$.

Discussion

In recent years, with the increasing popularity of minimally invasive concepts, the proportion of unicompartmental knee arthroplasty (UKA) procedures has been steadily rising both domestically and internationally. Early prevention of thrombosis is a critical step in managing deep vein thrombosis (DVT) following UKA. Previous studies have primarily focused on total knee arthroplasty (TKA) and lacked relevant predictive models. Do the results differ significantly from those of UKA?Therefore, investigating risk factors for lower limb venous thrombosis following unicompartmental knee arthroplasty is of significant importance. Among the 294 patients included in this study, the incidence of DVT was 13.51%.The study found that age, occupation, postoperative anticoagulant therapy, surgical side, history of thrombosis, PT, preoperative albumin, and uric acid levels were associated with postoperative lower limb venous thrombosis. Multivariate logistic regression analysis indicated that surgical side and elevated uric acid levels were independent risk factors for deep vein thrombosis in the lower limbs following unicompartmental knee arthroplasty.

Analysis of Causes

(1) This study identified advanced age (≥ 70 years) as a risk factor for postoperative lower limb venous thrombosis in unicompartmental knee arthroplasty. Cao et al[15]. similarly demonstrated age as a key thrombogenic factor in unicompartmental knee arthroplasty studies. This aligns with Dimitra Akrivou et al.'s research on the pathophysiology of aging and venous thrombosis, where elderly individuals often exhibit altered venous vessel walls, endothelial cell degeneration, and blood characterized by "low-grade

inflammation" and hypercoagulability[16]. Additionally, the mean venous capacity and mean venous outflow in the affected limb are significantly reduced after knee replacement[17], These hemodynamic alterations compound the physiological foundations of aging. Studies indicate that individuals over 70 face a 10-fold higher risk of lower extremity venous thrombosis compared to those under 50. Moreover, the incidence of deep vein thrombosis in the lower limbs progressively increases with age[18]. Aging and bodily deterioration also induce a novel platelet production pathway distinct from the traditional route, involving the direct generation of megakaryocyte precursors (MkPs) from hematopoietic stem cells (HSCs). Platelets generated through this new pathway exhibit heightened reactivity, enabling the formation of larger and more stable thrombi, thereby exacerbating thrombotic risks in the elderly[19].

(2) Our study also found that the occupation of "retired" was associated with an increased risk of lower limb venous thrombosis following unicompartmental knee arthroplasty. This conclusion may initially seem counterintuitive. Therefore, we compared the average ages across different occupational groups (see Table 4) and found that the average age of retired individuals was 70.23 years, higher than the average ages of the other three groups.We note that occupation here represents not merely a professional classification but rather a composite indicator of age and aging status. Research confirms that women with higher occupational physical activity intensity exhibit lower VTE risk[20]. Retirement often leads to social isolation, limiting physical activity as many lose regular work routines. Additionally, life changes like retirement frequently diminish social connections among older adults, making them particularly vulnerable to loneliness.Loneliness is frequently investigated and discussed alongside social isolation[21]. Consequently, retired seniors are more prone to emotional fluctuations and even depression, manifesting as increased physical limitations and chronic diseases—50% of retirees suffer from at least two chronic conditions[22]. Crucially, loneliness and depression can increase venous thrombosis risk through neuro-mediated pathways[23] .In summary, post-retirement physiological aging alongside changes in physical activity levels and psychological factors constitute significant indirect contributors to thrombosis. This study employed broad occupational classifications and did not capture detailed information such as retirees' pre-retirement occupations, duration of retirement, or quality of life. Future research should address these gaps.

Table 4
Mean age of patients by occupational category

Occupational category	Number of cases (n)	Mean age (years)
Farmer	128	65.24
Retired	28	70.18
Unemployed	9	60.56
Other	129	65.96

(3)In this study, postoperative anticoagulants were categorized into low molecular weight heparin (LMWH) and aspirin groups. No DVT events were observed in the aspirin group, while the incidence in

the LMWH group was 16.9% (40/237). Due to complete separation of events between groups, we did not calculate the conventional OR and its confidence interval. Part of the discrepancy may stem from selection bias caused by preoperative non-random stratification.This stems from physicians not randomly selecting postoperative anticoagulants but instead preoperatively assessing patients. Those with lower thrombotic risk or higher bleeding risk were assigned to the aspirin group, while high-risk individuals received the more potent LMWH for prevention. Thus, the aspirin group may inherently represent a selected "high-quality" cohort, with its favorable outcomes partly attributable to patients' better baseline conditions.In a recent study by Roham Borazjani et al., aspirin emerged as the preferred or viable chemopreventive option for total hip and knee arthroplasty, as well as revision surgery. This preference stems from aspirin's accessibility, cost-effectiveness, ease of administration, lack of requirement for routine blood monitoring, and efficacy comparable to other anticoagulants.Specifically, they demonstrated no significant difference in outcomes between aspirin and low molecular weight heparin for preventing postoperative VTE after knee replacement surgery. This finding was corroborated[24]. in large-scale studies by Hovik [25] and Matharu[26] .Concurrently, the use of low-dose aspirin after total knee arthroplasty has surged significantly, becoming the mainstream choice. Recent research by Parsa et al. further confirms that, regardless of a patient's VTE risk level, low-dose aspirin demonstrates advantages over other regimens in reducing the risks of DVT, pulmonary embolism, bleeding, infection, and hospitalization. Its application is particularly widespread among low-risk patients[27].However, this study focuses on unicompartmental knee arthroplasty, which involves less surgical trauma, blood loss, and tissue damage compared to total knee arthroplasty.For this "low-risk" procedure, the latest authoritative guidelines—such as the American College of Chest Physicians' Antithrombotic Therapy Guidelines (10th Edition, 2021 and its 2023 draft update)—now recommend aspirin as an option for specific patient groups based on high-quality evidence.These guidelines indicate that aspirin is an effective and safe prophylactic choice for patients undergoing low-risk procedures like knee arthroscopy, or for those at higher risk of bleeding following total hip/knee arthroplasty[28].Although unicompartmental knee arthroplasty (UKA) is not separately classified in the guidelines, its surgical trauma and risk profile are often considered intermediate between total knee arthroplasty and arthroscopy. In clinical practice, surgeons likely already risk-stratify UKA patients and select aspirin for those assessed as low-risk, achieving excellent outcomes.This essentially represents a forward-looking practice embodying the spirit of guideline individualization. Therefore, our findings do not negate the standard status of traditional anticoagulants like low molecular weight heparin, but rather strongly support the core contemporary concept of "risk-based individualized antithrombotic strategies." Future research may further clarify specific risk prediction models for aspirin application after unicompartmental knee arthroplasty.

(4) A key finding in this study is that hyperuricemia represents an independent risk factor for deep vein thrombosis (DVT) in the lower extremities following joint replacement surgery. This discovery expands the traditional understanding of venous thrombosis risk factors, incorporating metabolic abnormalities into the perioperative risk assessment framework.As reported by Țăpoi et al., uric acid levels correlate with the incidence and recurrence of venous thromboembolism (VTE), representing an independent risk

factor unaffected by other risk factors[29] .Lara De Lucchi et al. further revealed that patients with SUA levels ≥ 4.38 mg/dL exhibited a threefold increased risk of VTE recurrence. Elevated SUA levels correlate with heightened VTE recurrence risk, independent of traditional risk factors[30] .Our literature review indicates that hyperuricemia primarily promotes deep vein thrombosis through three interrelated pathways: First, it directly damages vascular endothelium, impairing its anticoagulant function by activating pathways such as NLRP3 inflammasome[31] ; second, it triggers systemic inflammation and oxidative stress, elevating pro-inflammatory factors like IL-6 while suppressing protective nitric oxide production, leading to sustained vascular damage[29, 32] ; third, under the combined influence of hyperuricemia and the inflammatory microenvironment, platelets become more readily activated, with enhanced adhesion and aggregation capabilities, directly participating in the early formation and growth of thrombi[33] .In summary, hyperuricemia disrupts the coagulation-anticoagulation balance through a multi-pathway synergistic mechanism involving "damage to vascular endothelium, induction of inflammation and oxidative stress, and promotion of platelet activation," significantly increasing the risk of thrombotic events.This suggests that for joint replacement patients with concomitant hyperuricemia, perioperative thromboprophylaxis strategies should focus not only on conventional anticoagulation but also on comprehensive management of their metabolic and inflammatory states.

(5) Additionally, we found that preoperative hypoalbuminemia is one of the strongest independent laboratory predictors of postoperative DVT. Patients in the DVT group had significantly lower preoperative albumin levels than those in the non-DVT group (rank mean: 118.75 vs. 152.03, U = 3930.000, p = 0.021).Multiple studies indicate that preoperative hypoalbuminemia is a risk factor for predicting postoperative deep vein thrombosis[34]. This mechanism is primarily associated with the diminished multifunctional physiological roles of albumin: at physiological concentrations, albumin inhibits platelet aggregation and neutralizes coagulation factor Xa, thereby exerting anticoagulant effects; conversely, low albumin levels promote a hypercoagulable state and accelerate thrombus formation.Furthermore, Mendelian randomization studies have confirmed a causal association between hypoalbuminemia and venous thromboembolism. Its protective mechanism primarily mediates through regulating key inflammatory factors such as TP53, IL-6, and TNF-α, thereby mitigating systemic inflammation-induced damage to the vascular endothelium and coagulation system[35] .Regarding clinical prediction, a study in total knee arthroplasty patients found that combining the fibrinogen-to-albumin ratio effectively predicts DVT risk[36]. Another large non-cardiac surgery study identified preoperative albumin levels below 41.9 g/L as a significant risk stratification threshold[37].

(6) Furthermore, this study specifically examined the risk of venous thromboembolism (VTE) associated with unicompartmental knee arthroplasty (UKA), identifying some risk factors common to traditional total knee arthroplasty (TKA), though their risk spectrum and weighting may differ. Crucially, the patient's baseline condition is key.This study confirms that even for the less invasive UKA, a hypercoagulable state indicated by shortened preoperative prothrombin time (PT) remains a significant risk factor for postoperative DVT. This supports the universal necessity of assessing preoperative coagulation status in elective arthroplasty, with relevant mechanisms elucidated in UKA studies[10] .Second, the impact of surgical extent remains significant. This study found that bilateral UKA performed concurrently carries a

substantially higher DVT risk than unilateral surgery. Despite the shorter duration and lower trauma of unilateral UKA, performing both knees simultaneously exponentially increases the total trauma load, inflammatory response, and postoperative immobilization period, thereby accumulating thrombotic risk.This trend aligns with the established conclusion in TKA that "bilateral surgery carries higher risk than unilateral"[38, 39]. These findings indicate that while UKA carries a lower overall VTE risk than TKA, classic thrombotic risk factors remain critical in patient management and require individualized assessment and prevention.

Notably, this study identified surgical side and elevated uric acid levels as independent risk factors for postoperative DVT in UKA. Conversely, classic risk factors widely reported in TKA or broader orthopedic major surgeries—such as higher BMI, elevated preoperative D-dimer levels, and history of diabetes[40–42] —did not demonstrate independent predictive value in this cohort.This discrepancy may suggest that UKA, as a less invasive procedure with shorter operative times and generally better patient functional status, may exhibit distinct postoperative VTE pathogenesis compared to TKA. For instance, the overall BMI of UKA patients may be relatively lower, and postoperative inflammatory responses and coagulation activation levels may differ from those seen in TKA, thereby diminishing the impact of factors that are significant in major surgeries.These findings underscore the necessity of establishing a dedicated thrombosis risk assessment system for UKA, rather than simply applying conclusions derived from TKA.

Study Findings

Among the unicompartmental knee arthroplasty patients included in this study, the incidence of postoperative deep vein thrombosis (DVT) in the lower extremities was 13.51%.Multivariate logistic regression analysis revealed that the side of surgery (bilateral) and preoperative hyperuricemia were independent risk factors for postoperative DVT. Additionally, factors such as age ≥ 70 years, retired status, shortened preoperative prothrombin time, and reduced preoperative albumin levels were also statistically associated with postoperative DVT.

Limitations

This study is a single-center retrospective analysis, and its results are constrained by the inherent limitations of retrospective research. The retrospective design makes it difficult to completely exclude confounding factors. Although known variables were adjusted for in the multivariate analysis, some potential influencing factors (such as patients' daily activity levels and specific occupations prior to retirement) were not included in the analysis.Second, the conclusions are derived from a specific patient cohort and primarily reflect the characteristics of this group. Caution is warranted when extrapolating findings to other populations or different surgical procedures. Furthermore, the selection of anticoagulants in clinical practice is influenced by multiple factors, necessitating interpretation of relevant analyses within the context of specific clinical settings.

Abbreviations

UKA Unicompartmental knee arthroplasty

VTE Venous thromboembolism

DVT Deep vein thrombosis

BMI Body mass index

PT Prothrombin time

TT Thrombin time

FIB Fibrinogen

OR Odds ratio

CI Confidence interval

LMWH Low molecular weight heparin

PE Pulmonary embolism

TKA Total knee arthroplasty

KOA Knee osteoarthritis

Declarations

Ethics approval and consent to participate

This retrospective study was approved by the Ethics Committee of Hebei Provincial People's Hospital (Approval No. 2021-121). The requirement for informed consent was waived due to the retrospective nature of the study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to patient privacy concerns but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Hongfei Wang and Xiangling Xiao contributed equally to this work as co-first authors, responsible for study conceptualization, data curation, formal analysis, and manuscript drafting. Jingshuai Zhai, Zeyu Li, and Kai Zhang participated in data collection, software analysis, and validation. Xilong Sun, Baozhan Yu, and Yazhou Zhang were involved in investigation, resource provision, and validation.

Teng Huang and Wenyi Li are co-corresponding authors of this article. Teng Huang, as the primary corresponding author, oversaw the project, contributed to study design, and critically reviewed and revised the manuscript. Wenyi Li, as the chief of the department, provided overall supervision and administrative support. All authors read and approved the final manuscript.

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Table 2

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