ORIGINAL PAPER/PŮVODNÍ PRÁCE

Modern Approach to the Use of Aspirin in Prevention of Venous Thromboembolism Following Total Hip Arthroplasty or Total Knee Arthroplasty. A Retrospective Trial

Moderní přístup k použití aspirinu v prevenci žilního tromboembolismu po totální endoprotéze kyčle nebo totální endoprotéze kolena. Retrospektivní studie

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ABSTRACT

Purpose of the study

Given the risk of venous thromboembolism (DVT) and pulmonary embolism (PE) after large joint replacement, the role of thromboprophylaxis is crucial. This retrospective study aims to evaluate the effectiveness of aspirin as thromboprophylaxis in patients undergoing TKA or THA.

Material and methods

In this retrospective review of a database of patients who underwent total hip and total knee replacements between 2021 and 2023, we divided patients into two groups: those with no anticoagulation therapy before surgery and those on chronic anticoagulant use prior to surgery. The primary endpoint was the number of patients with complications after aspirin use in the postoperative period. We collected patient demographic information, history of anticoagulant use, postoperative anticoagulant usage, comorbidities, type of surgery, reactions to anticoagulants, complications related to thromboembolism, length of hospital stay, and hospital readmissions.

Results

For patients who underwent elective THA or TKA, no significant difference in overall VTE or PE rates was detected when comparing aspirin with other anticoagulants. No mortality events were reported. However, there were differences in bleeding event rates between the aspirin group and other anticoagulant groups.

Conclusions: Proper patient selection and early postoperative mobilization support the use of aspirin as a thromboprophylaxis therapy. The results of this study confirm that aspirin is a safe alternative to other anticoagulants in the postoperative management of THA and TKA.

Key words: total hip arthroplasty, total knee arthroplasty, thromboprophylaxis, aspirin.

INTRODUCTION

Total hip and knee joint replacement is increasingly being performed in modern orthopedics as a treatment for osteoarthritis. Current projections suggest a rise of over 600% in such procedures over three decades. For example, in the United States, the number of these operations is expected to reach 3.5 million annually by 2030 (15).

Although the complication rate for these elective surgeries remains low, venous thromboembolism (VTE) continues to pose a serious risk to patients. VTE can lead to severe consequences, including death, and imposes additional costs ranging from $15,000 to $30,000 per patient (6, 21).

Compared to other major surgeries, VTE occurs more frequently following total knee arthroplasty (TKA) or total hip arthroplasty (THA) (22).

Therefore, VTE prophylaxis is widely regarded as essential in these types of surgeries. VTE includes both deep vein thrombosis (DVT) and pulmonary embolism (PE). DVT typically

Acta Chir Orthop Traumatol Cech., 92, 2025, No. 1, p. 21–27

presents with acute pain, significant swelling of the affected limb, and fever. Furthermore, DVT can progress to PE if the venous clot detaches from its site of origin and lodges in the pulmonary vascular system, which can result in death (11).

The importance of an integrated approach and pharmacological prevention of VTE through inhibition of the coagulation cascade in the postoperative period is clear. Without anticoagulation prophylaxis, the incidence of DVT and subsequent PE has been reported to be as high as 50% (17).

This retrospective study aims to evaluate the effectiveness of thromboprophylaxis using aspirin in patients undergoing total knee or hip arthroplasty.

MATERIAL AND METHODS

All patients with coxarthrosis and gonarthrosis treated in the hip and knee surgery outpatient clinic participated in this study. The inclusion criteria were patients with primary or secondary coxarthrosis or gonarthrosis with an indication for total hip arthroplasty (THA) or total knee arthroplasty (TKA), aged 29 to 92 years, and of both sexes.

Exclusion criteria included patients with a history of infection in the affected joint or current joint infections, inflammatory joint diseases, active wounds on the operative limb, chronic alcoholism, hypoalbuminemia (below 3.5 mg/dL), anemia (hemoglobin ≤ 10 mg/dL), HbA1c levels above 7.5%, and a body mass index (BMI) above 42. Patients meeting these criteria were excluded from both surgery and this study. Patients were evaluated in our outpatient clinic, and data were collected on demographic information, history and type of anticoagulant use, chronic comorbidities, type of surgery, reactions to anticoagulants, complications of thromboembolism, hospital length of stay, and hospital readmissions.

All surgeries were performed by one lead surgeon assisted by eight team members. Incisions were dressed with sterile AQUACEL® Ag SURGICAL cover dressings, which were removed 14 days postoperatively. All patients underwent preoperative and postoperative radiographs of the affected joints in frontal and lateral projections. Magnetic resonance imaging (MRI) or computed tomography (CT) was used when additional assessment of soft tissue stabilizers or cartilage was required to determine the type of endoprosthesis. Patients were managed according to standardized guidelines, including antibiotic prophylaxis, discharge on the day of surgery, chemical anticoagulation protocols, and postoperative pain management. Antibiotic prophylaxis included administration of 2 grams of cefazolin and 240 mg of gentamicin 15 minutes before the first incision. Postoperative antibiotics included 1 gram of cefazolin every 8 hours for 24 hours, followed by oral cefuroxime 500 mg three times daily for three days.

Patients with severe penicillin allergies received vancomycin (1.5 g preoperatively and 1 g twice daily postoperatively) with gentamicin (240 mg preoperatively). Anticoagulation therapy consisted of Micropirin® (aspirin) 100 mg once daily for four weeks in low-risk patients. Patients on chronic anticoagulant therapy (e.g., Clexane, Eliquis, Pradaxa, Xarelto, Plavix, Coumadin) discontinued these drugs preoperatively, with therapy resumed postoperatively. Anesthesia was tailored to each procedure and included either general anesthesia with sevoflurane/isoflurane or spinal anesthesia with heavy marcaine 0.5% solution (2–2.5 mL) combined with propofol 2% (12–20 mL/h). Preoperative nerve blocks, such as adductor canal or low femoral triangle blocks, were performed under ultrasound guidance using marcaine 0.25–0.5% (20 mL).

The surgical approach for TKA was a medial parapatellar approach with a longitudinal midline incision extending from 5 cm above the patella to below the tibial tubercle. For THA, a posterior approach was used with an 8 cm curved incision centered on the posterior aspect of the greater trochanter. Re-evaluations were conducted one month postoperatively to assess for dehiscence, allergic reactions, surgical site infections (SSI), and major complications such as venous thromboembolism (VTE) or deep vein thrombosis (DVT). For analysis, patients were divided into two groups based on their preoperative anticoagulant use:

1. Patients without preoperative anticoagulation therapy.
2. Patients on chronic anticoagulant therapy before surgery.

Data were collected using Google Sheets and analyzed with Statistica 7.0 (StatSoft Inc., USA). Results are presented as mean ± standard deviation for normally distributed data or as median with 25th and 75th percentiles for non-normally distributed data. The chi-square (χ^2) test was used for qualitative variables (e.g., sex, age, BMI, operative side). Statistical significance was set at $p < 0.001$.

RESULTS

Between January 1, 2022, and October 1, 2023, a retrospective study was conducted with the approval of the Helsinki Committee. The study included 1,000 patients who underwent arthroplasty for hip osteoarthritis classified as Grade 2-3 according to the Tönnis classification (14) and knee osteoarthritis classified as Grade 3–4 according to the Kellgren and Lawrence classification (13).

Demographic and BMI

The age of patients in the 1st group ranged from 25 to 91 years, with a female-to-male ratio of 1.87:1. The body mass index (BMI) averaged 29.35 ± 4.42. The distribution of operated limbs was 295 on the left and 368 on the right. In the 2nd group, the age of patients ranged from 26 to 91 years, with a female-to-male ratio of 1.09:1. The distribution of operated limbs was 160 on the

Table 1. **Patient characteristics**

INDEX	1st GROUP (n = 663)	2nd GROUP (n = 337)	P
Age	67.94 ± 9.74	68.17 ± 7.81	0.757
Sex. w/m	432/231	176/161	0.0001
BMI	29.35 ± 4.42	30.22 ± 4.59	0.0008
Side of the operated limb	295 left / 368 right	160 left / 177 right	0.408

Table 2. **Characteristics of patients comorbidities**

INDEX	1st GROUP (n = 663)	2nd GROUP (n = 337)	P
Arterial hypertension	383	289	p < 0.001
Diabetes mellitus	90	80	p < 0.001
Hyperlipidemia	215	164	p < 0.001
Ischemic heart disease	0	218	p < 0.001
Atrial fibrillation	0	110	p < 0.001
Hypothyroidism	57	36	0.338
Episodes of DVT in the past	0	9	p < 0.001

left and 177 on the right. A comparison of the key indicators between the two groups is presented in Table 1.

Chronic failures

The comorbidities observed in the study groups included arterial hypertension, diabetes mellitus, hyperlipidemia, ischemic heart disease, atrial fibrillation, hypothyroidism, prostate hyperplasia in men, and previous episodes of deep vein thrombosis (DVT). The primary quantitative indicators of these chronic conditions are presented in Table 2.

History and type of use anticoagulants before and after operation

Table 3 presents the outcomes of anticoagulation therapy of 2nd group used as a preventive measure for various pathologies identified during the preoperative evaluation for planned knee and hip arthroplasty. Group 1 is not included in this table, as patients in this group received anticoagulation therapy exclusively in the form of 100 milligrams of aspirin once daily for four weeks postoperatively.

Table 3. **Characteristics of anticoagulation therapy before elective surgery in 2nd group**

2nd GROUP (n = 337)	PRIMARY PROPHYLAXIS WITH ASPIRIN 75/100 MG × 1 PER DAY	PRIMARY PROPHYLAXIS WITH XARELTO 15/ 20 MG × 1 PER DAY	PRIMARY PROPHYLAXIS WITH PRADAXA 75/110/150 MG × 2 PER DAY	PRIMARY PROPHYLAXIS WITH ELIQUIS 2,5/5 MG × 2 PER DAY	PRIMARY PROPHYLAXIS WITH CLEXANE 40/80 MG × 1 PER DAY	PRIMARY PROPHYLAXIS WITH PLAVIX 75 MG × 1 PER DAY	PRIMARY PROPHYLAXIS WITH COUMADIN 5 MG × 1 PER DAY
Ischemic heart disease	215	0	1	0	0	2	0
Atrial fibrillation or PAF	0	15	7	66	2	19	1
Episodes of DVT in the past	0	0	3	3	1	0	2

Table 4. **Characteristics types of surgery**

SURGERY TYPE	1st GROUP (n = 663) TIME OF SURGERY FROM ENTERING TO THE ROOM TO EXIT FROM THE ROOM	2nd GROUP (n = 337) TIME OF SURGERY FROM ENTERING TO THE ROOM TO EXIT FROM THE ROOM	P VALUE
THR Cementless , CORAIL® Total Hip System, DePuy Synthes	n = 207 79.4 ± 17.33 min	n = 134 80.2 ± 17.22 min	0.935
TKR Cementless Triathlon® Total Knee System, Stryker	n = 280 84.9 ± 1.12 min	n = 173 84.8 ± 0.56 min	0.110
TKR Cemented ATTUNE® Knee System, DePuy Synthes	n = 19 86.1 ± 2.78 min	n = 5 86.8 ± 3.31 min	0.327
Robotic TKR Cementless VELYS™ Robotic-Assisted Solution, DePuy Synthes	n = 67 93.12 ± 6.12 min	n = 36 94.1 ± 6.22 min	0.727
TKR Cementless Persona® The Personalized Knee®, Zimmer Biomet	n = 14 93.3 ± 1.77 min	n = 13 93.1 ± 1.89 min	0.619

Acta Chir Orthop Traumatol Cech., 92, 2025, No. 1, p. 21–27

Table 5. **Characteristics of reactions after receiving an anticoagulants and number of complications of thromboembolism's**

INDEX	TREATMENT DURATION		NUMBER OF VTES AND DVTS		RELEVANT BLEEDING WITH CHANGE OF BANDAGE	
Groups	1st group (n = 663)	2nd group (n = 337)	1st group (n = 663)	2nd group (n = 337)	1st group (n = 663)	2nd group (n = 337)
Aspirin – ASA	100 mg × 1 per day – 4 weeks after surgery	Continuous use with 100 mg × 1 per day before and after surgery	Absence	Absence	4 bleedings with change of bandage in early postoperative period	Absence
Xarelto – Rivaroxaban	Not relevant	Continuous use of medication before and after surgery with 15 or 20 mg × 1 per day	Absence	Absence	Absence	4 bleedings with change of bandage in early postoperative period
Pradaxa – Dabigatran	Not relevant	Continuous use of medication before and after surgery with 75/110/150 mg × 2 per day	Absence	Absence	Absence	2 bleedings with change of bandage in early postoperative period
Eliquis – Apixaban	Not relevant	Continuous use of medication before surgery with 5mg × 1/2 per day and after surgery 2,5 mg × 2 per day first week, then 5 mg × 2 per day in continuous use of medication	Absence	Absence	Absence	13 bleedings with change of bandage in early postoperative period
Clexane – Enoxaparin	Not relevant	Continuous use of medication before and after surgery with 40/80 mg × 1 per day	1 Episode of low-risk PE in the early postoperative period with treatment of Clexane 80 mg × 2 per day for 1 month	Absence	Absence	Absence
Plavix – Clopidogrel	Not relevant	Continuous use of medication before and after surgery with 75 mg × 1 per day	Absence	Absence	Absence	Absence
Coumadin – Warfarin	Not relevant	Continuous use of medication before and after surgery with 5 mg × 1 per day	Absence	Absence	Absence	Absence

Types of surgery

Both cemented and cementless fixation endoprosthesis were used for all hip and knee joint arthroplasty procedures. For total hip arthroplasty (THA), the CORAIL® Total Hip System (DePuy Synthes) was utilized. For total knee arthroplasty (TKA), various endoprosthesis systems were employed, including the Triathlon® Total Knee System (Stryker), ATTUNE® Knee System (DePuy Synthes), and Persona® The Personalized Knee® (Zimmer Biomet).In robotic-assisted total knee arthroplasty, the VELYS™ Robotic-Assisted Solution (DePuy Synthes) was used in conjunction with the ATTUNE® Knee System (DePuy Synthes). The quantitative distribution of arthroplasty types and the corresponding surgical times (from room entry to exit) are summarized in Table 4.

Reactions after receiving an anticoagulants and number of complications of thromboembolism's

In this segment of the study, our objective was to identify complications associated with the use of different types of anticoagulation therapy. Table 5 highlights several key parameters related to these complications. In Group 1, which did not receive anticoagulation therapy prior to surgery, there was only one complication: a low-risk pulmonary embolism (PE) episode occurring in the early postoperative period. This was effectively treated with Clexane 80 mg twice daily for one month after discharge. Additionally, four cases of bleeding were observed during the early postoperative period, requiring replacement of the AQUACEL® AG dressing. In Group 2, there were no episodes of venous thromboembolism (VTE) or deep vein thrombosis (DVT) during either the early or late

Table 6. **Characteristics of length of stay after surgery**

INDEX	1st GROUP (n = 663)	2nd GROUP (n = 337)	P VALUE
Length of stay in hospital in hours	8.53 ± 4.59	9.86 ± 5.67	0.076
Presence of readmission to our clinic	5	19	p < 0.001

postoperative periods, irrespective of the type of anticoagulation therapy used. However, postoperative bleeding necessitating bandage replacement was noted in several patients. The bleeding episodes were associated with the following therapy regimens:

Xarelto (15/20 mg once daily): 4 cases; Pradaxa (75/110/150 mg twice daily): 2 cases; Eliquis (2.5/5 mg twice daily): 13 cases. This analysis underscores the importance of monitoring for complications such as postoperative bleeding when selecting anticoagulation therapies for patients undergoing knee or hip arthroplasty.

Length of stay in hospital and presence of readmission to hospital

These indicators reflect the duration of hospitalization following surgery and the incidence of readmissions to our clinic for both groups. All readmissions were necessitated by dressing changes due to bleeding in the early postoperative period. The average statistical data, along with standard deviations, are presented in Table 6.

DISCUSSION

Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are common surgeries in which complications such as venous thromboembolism (VTE), deep vein thrombosis (DVT), and pulmonary embolism (PE) can occur. These complications are significant causes of long-term morbidity and represent a preventable cause of death in patients. It should be noted that all types of anticoagulation prophylaxis impose significant costs on the healthcare system. All patients undergoing major joint replacement are at some risk of VTE due to the duration of the operation and reduced postoperative mobility. As established in a study by Matharu et al. (16), almost all patients receive anticoagulation therapy within 35 days after surgery, almost all patients receive anticoagulation therapy within 35 days after surgery.

Current recommendations suggest that DVT prophylaxis should be administered for at least 14 days after surgery and may be extended up to 35 days for patients at high risk of VTE. Pharmacological anticoagulant therapy is the most common method for preventing DVT in orthopedic surgery (9).

Aspirin and other anticoagulants are commonly used to prevent venous thromboembolism (VTE) after major joint replacement surgeries in the United States and worldwide. As noted above, total hip arthroplasty (THA) and total knee arthroplasty (TKA) are associated with an increased risk of VTE. Historically, the incidence of these complications without anticoagulation therapy has been reported to range from 20% to 30%, with an ultimate mortality rate of up to 5%. Consequently, this type of prophylaxis has become a routine procedure, leading to the development of specific prophylaxis regimens tailored to these operations (16, 20).

A number of agents have been described in the current literature as effective in preventing VTE after elective hip and knee arthroplasty. This list includes aspirin (acetylsalicylic acid, ASA), vitamin K antagonists (warfarin), direct thrombin inhibitors (dabigatran), low-molecular-weight heparins (enoxaparin), and factor Xa inhibitors (rivaroxaban, apixaban, edoxaban, fondaparinux) (4). Currently, there are limited specific studies proving that the use of one particular group of anticoagulants is the safest and most effective for preventing thrombotic events after TKA or THA procedures (18).

A number of studies have evaluated the role of aspirin in the prevention of VTE and have demonstrated efficacy comparable to other anticoagulants, with fewer blood transfusions and less bleeding observed in the early postoperative period (1, 5, 12).

According to a study by Azboy et.al. (3), the correct dose of aspirin is a critical factor in its use. Studies have found no statistically significant difference between low-dose (< 162 mg/day) and high-dose (> 162 mg/day) aspirin in the incidence of DVT, 90-day PE, and major bleeding. A review of retrospective studies also demonstrated that low doses (81 mg) and high doses (325 mg) of aspirin in total hip arthroplasty (THA) and total knee arthroplasty (TKA) show no statistical difference in the occurrence of VTE complications (7, 8).

As noted in a review by Santana et.al. (19), thromboembolic prophylaxis with aspirin may be an excellent first-line option for patients identified as low risk prior to elective THA or TKA surgery. Moreover, considerable experience has been gained over the past decade in the use of aspirin as a prophylactic drug for thromboembolic complications. Current data indicate that its efficacy is comparable to other pharmacological agents in appropriately selected patients.

A recent review by Anderson et.al. (2) of aspirin use after THA/TKA also concluded that, in appropriately selected low-risk patients, aspirin administration after rivaraxoban is safe and effective. Also after accounting for surgeon selection bias, Heckmann et al. (10) found that aspirin was as effective as warfarin in preventing pulmonary embolism and deep vein thrombosis following total knee and hip arthroplasty. Additionally, aspirin was associated with a significantly lower risk of transfusion compared to warfarin.

In our study, we found that an inexpensive and widely available drug, such as aspirin (100 milligrams once daily for four weeks after surgery), did not lead to any VTE-related complications in patients without a history of preoperative anticoagulation, except for one episode of low-risk PE in the early postoperative period out of 1,000 cases (0.1%). Additionally, only four patients required dressing changes in the early postoperative period due to bleeding. Our findings indicate that, aside from one case of low-risk PE (0.1%), there was no statistically significant difference in the risk of VTE (including DVT and PE) when comparing aspirin with other anticoagulants for VTE prophylaxis in patients undergoing THA and TKA.

Notably, our study revealed a difference in the risk of adverse events, such as bleeding, between aspirin and other anticoagulants. Among patients receiving aspirin, the incidence of bleeding was 0.6% (n = 663). It is important to note that this figure applies specifically to patients without a history of anticoagulant use prior to surgery. In contrast, patients with a history of preoperative anticoagulant therapy (e.g., Clexane, Eliquis, Pradaxa, Xarelto, Plavix, Coumadin) and resumed therapy postoperatively experienced a bleeding rate of 5.63% (n = 337). Among these patients, those receiving Eliquis had a noticeably higher incidence of bleeding, accounting for 68.4% (n = 19) of cases. Another significant observation is that among the 23 cases of bleeding and postoperative dressing replacement, seven patients (30.43%) had undergone Robotic-Assisted TKA (RATKA). Our team attributes this to the use of navigation pins during surgery, with four pins (two in the tibial crest and two in the distal femur) potentially creating gaping holes in the bone, which may lead to additional bleeding.

CONCLUSIONS

In modern orthopedics, severe manifestations of VTE have become rare complications of total hip and knee arthroplasty. Ongoing research focuses on identifying the optimal dosages and types of drugs for prophylaxis. The findings of this study reinforce the conclusion that aspirin is a safe and effective alternative to other anticoagulants for use in the postoperative management of THA and TKA. ■

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