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ARTICLE

# Comparison of Different Thromboprophylaxis Regimens in Elderly Patients Following Hip Arthroplasty

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## Abstract

**Aims/Background** Deep venous thrombosis (DVT) represents a significant postoperative complication after artificial femoral head replacement, with the incidence increasing proportionally with patient age. This study aimed to evaluate the effect of early postoperative use of intermittent pneumatic compression devices (IPC), followed by the combined use of low molecular weight heparin (LMWH) after 48 hours, for the prevention of postoperative lower limb DVT in elderly patients undergoing hip arthroplasty.
**Methods** The retrospective study included 100 elderly patients who underwent unilateral femoral head replacement. The control group (n = 55) received combined LMWH initiated 12 hours postoperatively, while the observation group (n = 45) started combined LMWH 48 hours postoperatively. Changes in coagulation parameters, perioperative complications, and the incidence of postoperative lower limb DVT were compared between the two groups.
**Results** Coagulation parameters showed significant changes post-intervention in both groups, with no statistically significant inter-group differences observed post-intervention ($p > 0.05$). The incidence of postoperative lower limb DVT did not differ significantly between the two groups ($p > 0.05$). However, the observation group demonstrated significantly lower postoperative blood loss, incidence of periwound hematoma, and transfusion rates compared to the control group ($p < 0.05$).
**Conclusion** The sequential application of IPC in the early postoperative period, followed by combined LMWH administration after 48 hours, demonstrates comparable efficacy in preventing lower limb DVT formation in elderly patients undergoing hip arthroplasty when compared to the initiation of combined LMWH starting 12 hours postoperatively. In addition, this approach significantly reduces the risk of postoperative bleeding and exhibits a high safety profile.

**Key words: intermittent pneumatic compression device; low molecular weight heparin; deep venous thrombosis; hip arthroplasty**

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## Introduction

Deep venous thrombosis (DVT) is a severe postoperative complication in patients undergoing hip arthroplasty. This thrombosis not only affects the patient's recovery process but can also lead to fatal pulmonary embolism (Huang et al, 2024). The probability of developing lower extremity DVT postoperatively increases significantly with patient age (Das, 2021). At present, the conventional methods to prevent DVT mainly include drug prevention and mechanical prevention. Drug methods include the administration of aspirin, unisolated heparin, low molecular weight heparin (LMWH), dose-regulated vitamin K antagonists, synthetic pentasaccharide factor Xa inhibitors (fondaparinux), and novel oral anticoagulants. Mechanical methods comprise grade elastic socks, plantar vein pumps, and lower limb vein pressure pumps. However, the practical application of these preventive measures has certain limitations and risks. For example, intermittent pneumatic compression devices (IPC) often has poor patient compliance due to its complex usage method (Greenall and Davis, 2020).

Studies have indicated that the combined use of these two methods might enhance the efficacy of DVT prevention (Hu and Wang, 2022; Kakkos et al, 2022). The prevention strategy of combining mechanical methods with anticoagulants is widely applied in major orthopedic surgeries and has achieved significant success. LMWH is currently the most common anticoagulant in orthopedic surgery, with advantages such as favorable anticoagulant efficacy and reduced adverse reactions (Alsheikh et al, 2021). However, there is still controversy regarding the optimal timing for its postoperative use. In North America, LMWH is usually initiated 12 to 48 hours after surgery to prevent venous thromboembolism (VTE) (Yorkgitis et al, 2022). A study has found that early postoperative LMWH administration may increase the risk of bleeding, especially during the critical period of surgical wound healing (Kerr et al, 2019). Conversely, other research suggests that postoperative LMWH administration does not induce hematoma enlargement and should be used for DVT prevention (Orken et al, 2009).

To address this issue, we designed a retrospective study comparing the effects of using LMWH combined with IPC at different time points to prevent lower extremity DVT after hip arthroplasty in elderly patients. The primary objective was to identify an optimal regimen that effectively mitigates postoperative bleeding risk while maintaining the efficacy of anticoagulant therapy. By reducing the incidence of postoperative complications, we aim to improve the overall patients' quality of life for patients and reduce associated medical costs. This study not only contributes to the optimization of clinical treatment protocols but also provides a foundation for more personalized patient care recommendations.

# Methods

## Study Subjects

This retrospective study collected data from 100 elderly patients with femoral neck fractures who underwent unilateral artificial femoral head replacement at Yantai City Yantai Shan Hospital from June 2022 to December 2023. Patients were divided into two cohorts based on the timing of LMWH administration: an observation group (n = 45) and a control group (n = 55). The study was approved by the Yantai City Yantai Shan Hospital Ethics Committee (approval number: 2024044). All participants provided written informed consent, and the study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Inclusion criteria: (1) participants aged $\geq$50 years; (2) unilateral artificial femoral head replacement performed using the Beijing Aikang double-acting femoral head prosthesis, and the left and right sides were randomized; (3) preoperative bilateral lower limb ultrasound showed no DVT.

Exclusion criteria: (1) patients having anticoagulant medications such as aspirin or clopidogrel within one month prior to the study; (2) patients with a history of DVT or development of DVT before intervention; (3) patients with abnormal coagulation function detected in preoperative tests; (4) patients with contraindications to low molecular weight heparin administration; (5) patients with severe lower limb vascular disease or presence of dermatitis, infection, or gangrene in the lower limbs; (6) patients with other severe heart diseases, tumors, or mental disorders.

## Intervention Methods

Postoperative patients received routine care, including guiding the patient to keep the operated limb in a neutral position with 30° abduction, facilitated by the placement of a trapezoidal pillow between the legs. Early active functional exercises were initiated, such as quadriceps contractions and ankle pump exercises, along with passive functional exercises like lower limb massage and squeezing. Patients were assisted with regular turning. Upon returning to the ward post-surgery, IPC (Venaflow Elite, DJO™, Vista, CA, USA) was immediately used on both the operated and healthy limbs with calf sleeves. The pressure was set at 35 mmHg for 3 seconds, and an interval between compressions of 15 seconds. Initially, IPC was used continuously. After 24 hours, the regiment was changed to twice-daily sessions, each lasting one hour.

The control group received routine care and IPC, along with LMWH administered subcutaneously at a dosage of 4100 IU once daily. LMWH administration was initiated 12 hours post-surgery and continued for one week. The observation group received the same treatment as the control group, except that LMWH was administered 48 hours post-surgery.

## Observation Indicators

### *General Data*

The clinical data were collected from the hospital's medical record system, including sex, age, body mass index (BMI), smoking history, alcohol consumption history, comorbidities (diabetes, hypertension), surgery duration, and intraoperative blood loss.

### *Perioperative Data*

Perioperative data included postoperative bleeding volume, incidence of hematoma around the incision, and postoperative blood transfusion rate.

### *Laboratory Indicators*

Fasting venous blood (5 mL) samples were collected from the elbow of all patients preoperatively and one-week post-intervention to detect coagulation indicators. An automatic blood analyzer was used to measure fibrinogen (FIB), prothrombin time (PT), and activated partial thromboplastin time (APTT). Plasma D-dimer (D-D) levels were quantitatively analyzed using immunoturbidimetry.

### *Incidence of Lower Limb DVT*

All patients underwent lower limb color Doppler ultrasound on the 7th postoperative day. DVT diagnostic criteria (Tritschler et al, 2018) included significant venous dilation, substantial echo within the venous lumen, and blood flow filling defects in the thrombotic segment on color Doppler imaging. Proximal DVT was defined as thrombi present in the iliac vein, femoral vein, superficial femoral vein, deep femoral vein, and popliteal vein. Distal DVT was characterized by thrombi in the anterior or posterior tibial veins, peroneal veins, and intramuscular veins of the calf. The incidence rate of DVT was calculated using the following formula: DVT incidence rate (%) = (Number of DVT cases/Total number of patients in the group) $\times$ 100%.

### Statistical Analysis

Statistical analysis was conducted using SPSS 26.0 software (IBM, Armonk, NY, USA). The Kolmogorov-Smirnov test was used to assess the normality of data distribution. Normally distributed continuous variables are expressed as mean $\pm$ standard deviation (SD) and compared between groups using independent sample $t$-tests. Paired sample $t$-tests were used for within-group comparisons before and after the intervention. Categorical variables are expressed as frequencies and percentages, with between-group comparisons performed using the Chi-square test or Chi-square test with Yates correction. Statistical significance was set at $p < 0.05$ for all analyses.

## Results

### Comparison of Baseline Characteristics

No statistically significant differences were observed in baseline characteristics, including age, sex, and comorbidities, between the observation and control groups ($p > 0.05$), making the two groups comparable (Table 1).

### Comparison of Perioperative Data

Compared with the control group, the observation group showed statistically significant decreased perioperative blood loss, lower incidence of hematoma around the incision, and a diminished postoperative blood transfusion rate ($p < 0.05$) (Table 2).

### Comparison of Coagulation Indicators

No statistically significant differences were observed in FIB, PT, APTT, and D-D levels between the two groups before surgery ($p > 0.05$). FIB and D-D were significantly decreased in both groups ($p < 0.05$), and PT and APTT were significantly increased in both groups ($p < 0.05$). There were no significant differences in postoperative FIB, PT, APTT, and D-D between the observation group and the control group ($p > 0.05$) (Table 3).

**Table 1. Comparison of baseline characteristics between the observation and control groups.**

| Item | Control group (n = 55) | Observation group (n = 45) | $t/\chi^2$ value | $p$ |
|---|---|---|---|---|
| Age (years) | 65.12 ± 5.08 | 63.96 ± 4.81 | 1.163 | 0.248 |
| Gender | | | 0.002 | 0.967 |
| Male | 34 (61.8%) | 28 (62.2%) | | |
| Female | 21 (38.2%) | 17 (37.8%) | | |
| BMI (kg/m$^2$) | 23.11 ± 2.18 | 22.89 ± 2.11 | 0.509 | 0.612 |
| Smoking history | | | 0.002 | 0.961 |
| Yes | 12 (21.8%) | 10 (22.2%) | | |
| No | 43 (78.2%) | 35 (77.8%) | | |
| Drinking history | | | 0.850 | 0.357 |
| Yes | 14 (25.5%) | 8 (17.8%) | | |
| No | 41 (74.5%) | 37 (82.2%) | | |
| Diabetes | | | 0.178 | 0.673 |
| Yes | 9 (16.4%) | 6 (13.3%) | | |
| No | 46 (83.6%) | 39 (86.7%) | | |
| Hypertension | | | 0.970 | 0.325 |
| Yes | 10 (18.2%) | 5 (11.1%) | | |
| No | 45 (81.8%) | 40 (88.9%) | | |
| Surgical side | | | 0.351 | 0.553 |
| Left | 31 (56.36%) | 28 (62.22%) | | |
| Right | 24 (43.64%) | 17 (37.78%) | | |
| Surgery time (min) | 63.59 ± 19.17 | 66.48 ± 20.06 | 0.735 | 0.464 |
| Intraoperative blood loss (mL) | 243.19 ± 41.83 | 249.54 ± 43.88 | 0.739 | 0.462 |

**Note**: BMI, body mass index.

### Comparison of DVT Incidence

In the observation group, a total of 5 cases (11.11%) of lower extremity DVT were found postoperatively, including 3 cases (6.67%) of distal lower extremity DVT and 2 cases (4.44%) of proximal lower extremity DVT. Similarly, the control group exhibited 8 cases (14.55%) of lower extremity DVT postoperatively, including 6 cases (10.91%) of distal lower extremity DVT and 2 cases (3.64%) of proximal lower extremity DVT. Notably, no cases of pulmonary embolism were found in either group. Statistical analysis revealed no significant difference in the incidence of lower extremity DVT between the two groups ($p > 0.05$) (Table 4).

## Discussion

In modern medicine, the increasing aging population has led to a growing demand for artificial femoral head replacement in elderly patients (Maffulli and Aicale, 2022). However, postoperative complications, particularly the incidence of lower extremity deep vein thrombosis (DVT), have significantly risen. DVT is the second most prevalent medical complication among hospitalized patients, severely impacting recovery and increasing hospital stay duration, costs, and mortality rates (Flevas et al, 2018). In the absence of thrombosis prevention, the incidence of

**Table 2. Comparison of perioperative data between the observation and control groups.**

| Item | Control group (n = 55) | Observation group (n = 45) | $t/\chi^2$ value | $p$ |
|---|---|---|---|---|
| Blood loss (mL) | 165.48 ± 17.91 | 105.76 ± 8.48 | 20.549 | <0.001 |
| Hematoma around incision | | | 4.040 | 0.044 |
| Yes | 9 (16.4%) | 1 (2.2%) | | |
| No | 46 (83.6%) | 44 (97.8%) | | |
| Blood transfusion | | | 4.423 | 0.035 |
| Yes | 10 (18.2%) | 2 (4.4%) | | |
| No | 45 (81.8%) | 43 (95.6%) | | |

**Table 3. Comparison of coagulation indicators between the observation and control groups.**

| Item | Control group (n = 55) | Observation group (n = 45) | $t$ value | $p$ |
|---|---|---|---|---|
| FIB (g/L) | | | | |
| Before intervention | 3.78 ± 0.82 | 3.52 ± 1.13 | 1.331 | 0.186 |
| After intervention | 2.11 ± 0.95* | 1.79 ± 0.90* | 1.716 | 0.089 |
| PT (s) | | | | |
| Before intervention | 12.01 ± 2.27 | 12.13 ± 1.93 | 0.281 | 0.779 |
| After intervention | 13.28 ± 2.15* | 13.17 ± 2.61* | 0.231 | 0.818 |
| APTT (s) | | | | |
| Before intervention | 26.09 ± 4.01 | 26.48 ± 3.85 | 0.493 | 0.623 |
| After intervention | 27.91 ± 4.12* | 28.33 ± 4.08* | 0.509 | 0.612 |
| D-D (mg/L) | | | | |
| Before intervention | 2.85 ± 0.88 | 2.77 ± 0.81 | 0.469 | 0.640 |
| After intervention | 1.19 ± 0.71* | 0.98 ± 0.74* | 1.444 | 0.152 |

**Note**: FIB, fibrinogen; PT, prothrombin time; APTT, activated partial thromboplastin time; D-D, plasma D-dimer; Compared with pre-treatment within the same group, * $p < 0.05$.

hospital-acquired DVT ranges from 10 to 40%, with 40–60% occurring in orthopedic patients (Duval et al, 2022). This not only affects the patient's recovery process but can also lead to fatal pulmonary embolism. Elderly patients, due to their physiological decline, have a higher incidence and more severe consequences of postoperative lower extremity DVT. The formation of postoperative lower extremity DVT is primarily related to venous endothelial damage, changes in blood rheology, and slow venous blood flow. First, tissue damage during surgery can directly cause venous endothelial injury, promoting platelet aggregation and fibrin deposition and leading to thrombosis. Second, postoperative patients often rest in bed for extended periods, slowing venous blood flow and increasing blood viscosity, thus promoting thrombosis formation (Gurunathan et al, 2022). These factors collectively make elderly patients more prone to lower extremity DVT after surgery. Despite the implementation of current clinical preventive measures such as preoperative anticoagulation and early postoperative mobilization, the results are still unsatisfactory (Zhao et al, 2022). Therefore, in-depth research on the pathogenesis

**Table 4. Comparison of DVT incidence between the observation and control groups.**

| Item | Control group (n = 55) | Observation group (n = 45) | $\chi^2$ value | $p$ |
|---|---|---|---|---|
| Overall DVT incidence | 8 (14.55%) | 5 (11.11%) | 0.258 | 0.611 |
| Proximal lower extremity DVT | 2 (3.64%) | 2 (4.44%) | 0.000 | 1.000 |
| Distal lower extremity DVT | 6 (10.91%) | 3 (6.67%) | 0.149 | 0.699 |

**Note**: DVT, deep venous thrombosis.

of postoperative lower extremity DVT and the development of more effective prevention and treatment strategies are crucial for improving postoperative recovery in elderly patients.

Currently, mechanical and pharmacological methods are the two main strategies for preventing lower extremity DVT after artificial femoral head replacement. Combining mechanical methods with early mobilization can shorten hospital stays and reduce complications. However, early mobilization alone is insufficient to prevent thrombotic events, as the majority of hospital-related thrombotic events occur after patients start mobilizing (Geerts et al, 2008). The advantages of mechanical prevention of VTE include the absence of bleeding risk, no need for laboratory monitoring, and no clinical side effects. IPC devices are a common mechanical prevention method. These devices apply periodic pressure to the patient's lower extremities, simulating the muscle pump's action, promoting venous blood return, and reducing blood stasis in the veins (Anderson et al, 2019). Additionally, IPC can stimulate endogenous fibrinolytic activity by lowering plasminogen activator inhibitor-1 levels, enhancing the effectiveness of anticoagulants (Santana et al, 2020). Research conducted by Tan et al (2006), demonstrated that IPC regulates nitric oxide synthase activity, promoting the release of nitric oxide by endothelial cells. This mechanism facilitates vasodilation and accelerates blood flow (Tan et al, 2006). However, mechanical methods also have some limitations. First, patients may experience discomfort during device usage, especially those with sensitive skin or lesions, as prolonged pressure may lead to cutaneous damage or impair tissue oxygenation. Furthermore, thigh-length IPC devices may interfere with postoperative wound dressings (Kakkos et al, 2022). Implementation challenges or limited patient mobility can result in suboptimal patient compliance (Santana et al, 2020).

Pharmacological methods primarily prevent thrombosis through anticoagulant medications. Low molecular weight heparin (LMWH), a derivative of standard heparin with an average molecular weight of 4000–6000 Da, is obtained through controlled depolymerization. It effectively prevents thrombosis by inhibiting the activity of thrombin and factor Xa, thereby reducing fibrin formation. Its advantages include its short half-life, stable anticoagulant effects, and a relatively lower risk of bleeding (Li et al, 2019). Palmer et al (1997) demonstrated that LMWH exhibits significantly superior efficacy in preventing DVT in orthopedic surgeries compared to warfarin. However, the use of LMWH also presents some challenges; its use can increase the risk of bleeding. Carlson et al (2017) reported that anticoagulant administration is associated with a 25-fold increase in bleeding risk. Further studies have indicated that the use of LMWH for DVT prevention is significantly correlated with increased all-cause mortality (Mai et al, 2020; O'Toole et al, 2021). If DVT prevention results in fatal bleeding complications, the risks of LMWH may outweigh its benefits (Gould et al, 2012). Most of the bleeding incidents reported occur within 12–24 hours postoperatively. The study found that initiating LMWH 12 to 48 hours after surgery was effective in preventing DVT as detected by venography (Suzuki et al, 2022). The timing of anticoagulant therapy initiation has also been identified as a predictive factor for bleeding events. Therefore, determining the optimal timing for administration is crucial for achieving a balance between effective anticoagulation and minimizing bleeding risk.

The efficacy of thrombosis prevention can be significantly enhanced by combining mechanical and pharmacological prophylaxis methods, as these approaches complement each other by reducing thrombosis risk through multiple mechanisms (Kakkos et al, 2022). In this study, we observed significant changes in postoperative coagulation indicators compared to preoperative values. However, no significant differences were found between the observation and control groups. These findings suggest that delayed administration of LMWH does not significantly affect the coagulation mechanism postoperatively. Coagulation indicators play a crucial role in postoperative management (Li et al, 2022). Thrombosis prevention methods aim to activate the fibrinolytic system and promote fibrinolysis to prevent DVT. Fibrinogen (FIB) is a key component in the blood coagulation process, and its increase can promote platelet aggregation and fibrin formation, thus increasing the likelihood of thrombosis (Hansen et al, 2021). Prothrombin time (PT) is an indicator that measures blood clotting time, primarily reflecting the activity of the extrinsic coagulation pathway. Changes in PT postoperatively can indicate the patient's coagulation status. Activated partial thromboplastin time (APTT) is another indicator used to measure blood clotting time, primarily reflecting the activity of the intrinsic coagulation pathway. Changes in APTT can serve as an indicator for monitoring the effectiveness of drugs, especially heparin anticoagulants. Postoperatively, PT and APTT may change due to surgical trauma and inflammatory response, serving as indicators to assess the patient's coagulation status (Oo et al, 2020; Tsuchida et al, 2024). D-dimer, a fibrin degradation product, is an important biomarker in the fibrinolytic system. Elevated D-dimer levels demonstrated a strong correlation with both thrombosis formation and dissolution. Consequently, D-dimer quantification plays a fundamental role in the diagnosis of acute DVT and pulmonary embolism. Monitoring D-dimer levels helps assess the patient's thrombosis risk and guide adjustments in anticoagulant therapy (Matharu et al, 2020). Changes in coagulation indicators suggest the feasibility of delayed LMWH use, allowing patients more time for early postoperative recovery and activity, thereby reducing postoperative complications. Additionally, it can reduce the side effects of the drug, which is significant for the overall recovery of postoperative patients.

This study indicates no statistically significant difference in postoperative DVT incidence between the observation and control groups. However, the control group experienced more perioperative postoperative bleeding issues, including a higher incidence of hematoma around the incision, and higher postoperative blood transfusion rates. These issues prompt us to deeply consider the potential risks of early use of LMWH. Postoperative bleeding is a complex phenomenon involving various factors. Surgical trauma and inflammatory responses trigger the release and activation of coagulation factors, promoting wound healing and hemostasis. However, the early administration of LMWH may potentially interfere with this natural process (Naeem et al, 2021). In the early postoperative period, patients' coagulation mechanisms are relatively fragile, and the premature use of LMWH may further disrupt coagulation mechanisms, affecting platelet function, reducing aggregation and adhesion, and increasing the risk of bleeding (Bienz et al, 2019; Yang et al, 2013). Individual patient differences may also affect the metabolism and excretion of low molecular-weight heparin, impacting its efficacy and safety. This variability is particularly pronounced in elderly patients, due to a decline in liver and kidney function, where the drug clearance rate is low, increasing the risk of bleeding (Samama, 2011). These factors underscore the necessity for a more cautious approach when using LMWH postoperatively in elderly patients. Additionally, postoperative bleeding-induced hematoma around the incision can affect wound healing, increase the risk of infection, prolong hospital stays, and consume more medical resources. Moreover, the increased likelihood of postoperative blood transfusion in some patients also heightens the risk. Therefore, controlling postoperative bleeding is crucial for overall patient recovery. LMWH has demonstrated efficacy in preventing deep vein thrombosis in orthopedic patients, offering precise anticoagulation with a favorable safety profile. LMWH does not require routine coagulation monitoring and is relatively easy to administer. However, careful consideration must be given to the potential postoperative bleeding when using LMWH for thromboprophylaxis.

While this study has yielded notable findings and implications, it is also necessary to objectively examine its shortcomings. First, this study is a single-center retrospective study with a relatively small sample size, limiting the generalizability and extrapolation of the findings. Future studies should consider multi-center, prospective large-sample studies to enhance the representativeness and reliability of the results. Second, the absence of follow-up data on the long-term prognosis of patients presents a significant limitation. Such data are essential for evaluating the long-term efficacy and safety of low molecular weight heparin in postoperative management. In addition, the potential synergistic anticoagulant effects resulting from the concurrent administration of low molecular weight heparin with acetylsalicylic acid and non-steroidal anti-inflammatory analgesics warrant further investigation. In order to further improve clinical efficacy, further research is needed to investigate the mechanism of mechanical compression combined with the postoperative administration of low molecular weight heparin to prevent DVT formation in elderly patients after hip replacement. Future research should strengthen long-term follow-up and collect patients' long-term health data for a more comprehensive evaluation.

## Conclusion

In conclusion, the combined application of early postoperative mechanical compression methods and low molecular weight heparin administration 48 hours postoperatively demonstrates comparable efficacy to low molecular weight heparin at 12 hours post-surgery in preventing lower extremity DVT formation after hip arthroplasty. This approach significantly reduces the risk of postoperative bleeding while maintaining high safety and convenient use. It can effectively reduce the risk of deep vein thrombosis in elderly patients after hip replacement during hospitalization and can be widely used in clinical practice. Future research should focus on elucidating the optimal timing and dosage of low molecular weight heparin in postoperative management. Such investigations would contribute to the development of safer and more effective postoperative management strategies, providing enhanced guidance and support for clinical practice.

### Key Points

- Early use of mechanical compression combined with low molecular weight heparin 48 hours after surgery is comparable to that of low molecular weight heparin 12 hours after surgery in preventing DVT formation in lower limbs after artificial femoral head replacement.
- Early postoperative application of IPC, combined with low molecular weight heparin 48 hours after surgery significantly reduced the risk of postoperative bleeding caused by DVT in the lower extremity of elderly hemijoint replacement patients.
- Early postoperative application of IPC, combined with low molecular weight heparin 48 hours after surgery to prevent lower limb DVT formation in elderly patients with hemijoint replacement demonstrates high safety.
- Early use of mechanical compression combined with low molecular weight heparin at 48 hours after surgery and low molecular weight heparin at 12 hours after surgery can effectively reduce the risk of deep vein thrombosis during hospitalization in elderly patients after hip replacement.

## Availability of Data and Materials

The data analyzed are available at the request of the corresponding author.

## Author Contributions

QZ and DL designed the research study. XS and JBP performed the research and analyzed the data. QZ wrote the original draft. All authors contributed to the important editorial changes in the manuscript. All authors read and approved the final manuscript. All authors participated sufficiently in the work and agreed to be accountable for all aspects of the work.

## Ethics Approval and Consent to Participate

The study was approved by the Yantai City Yantai Shan Hospital, ethics committee (approval number: 2024044). Written informed consent was obtained from all patients, and the study was conducted in accordance with the principles of the Declaration of Helsinki.

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## Conflict of Interest

The authors declare no conflict of interest.

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