

Deep Vein Thrombosis Risk Prediction after Total Hip Replacement at Kandou Hospital

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ABSTRACT

Deep vein thrombosis (DVT) is a clinically significant complication following total hip arthroplasty (THA), requiring a clear distinction between observed postoperative events and model-based risk estimates. This prospective cohort study enrolled 62 patients who underwent THA at Prof. Dr. R. D. Kandou Hospital in Manado, Indonesia, between January 2023 and December 2024, with a 90-day follow-up period. Clinical characteristics, Wells scores, D-dimer levels, fibrinogen levels, and Doppler ultrasonography findings were recorded. Descriptive findings indicated that 46 participants (74%) were male, 48 (77%) had elevated D-dimer levels, and all documented Doppler ultrasonography examinations yielded normal findings. A Monte Carlo simulation comprising 10,000 iterations was also performed using a logistic regression equation with coefficients reportedly derived from published literature rather than estimated from the study cohort. The simulation yielded a median predicted DVT prevalence of 7.3%, with a 95% prediction interval of 0%–29%. However, this estimate represented a simulation-derived outcome rather than the observed incidence of postoperative DVT. The available manuscript did not report the actual number of incident DVT events during the 90-day follow-up and contained an unresolved inconsistency between the exclusion of patients with active cancer and the reported inclusion of seven participants with active cancer. [AUTHOR DATA REQUIRED: Confirm the number of observed DVT events during follow-up and clarify the eligibility criteria concerning active cancer.] Overall, the study provided descriptive information on clinical characteristics and potential DVT risk factors in a local THA population, alongside an exploratory simulation-based risk estimation framework. Nevertheless, cohort-specific predictive associations, model discrimination, and calibration could not be established without verification of the observed clinical outcomes, model coefficients, and estimation procedures.

INTRODUCTION

(Yilmaz et al., 2024) Venous thromboembolism (VTE), comprising deep vein thrombosis (DVT) and pulmonary embolism (PE), remains a significant and potentially preventable complication of major surgery because it can prolong hospitalization, increase the burden of treatment, and lead to fatal outcomes (Bozzato & Galli, 2012; Turetz & Sideris, 2018). Total hip arthroplasty (THA) is particularly associated with VTE risk because surgical tissue injury, temporary immobility, venous stasis, and postoperative hypercoagulability contribute to thrombus formation during the perioperative period (Oklu & Wicky, 2013). Although

contemporary thromboprophylaxis has reduced the incidence of symptomatic VTE, residual risk remains clinically significant, making individualized risk assessment and timely preventive interventions essential components of orthopedic care (Goldhaber, 2010; Bauersachs, 2012; Faria & Antunes, 2021).

Recent large-scale studies have demonstrated the relatively low incidence of clinically detected postoperative DVT under contemporary care while emphasizing the importance of individualized risk prediction (Lee & Gallus, 2017). A 2025 nationwide study involving 70,733 patients undergoing primary THA identified 317 postoperative DVT events (0.45%) and reported strong predictive performance of machine learning models, with length of hospital stay, coagulation parameters, and age identified as important predictors (Skeik & Smith, 2021). Another study conducted in 2025 involving 841 patients undergoing arthroplasty developed and validated a perioperative DVT prediction nomogram using demographic and laboratory variables selected through least absolute shrinkage and selection operator (LASSO) regression and multivariable logistic regression (Yang et al., 2025). These findings reflect a growing emphasis on validated, patient-specific prediction models rather than assessments based solely on conventional risk factors.

The pathophysiology of postoperative DVT is primarily explained by Virchow's triad, which consists of venous stasis, endothelial injury, and hypercoagulability (Skeik & Smith, 2021). Established clinical risk factors include advanced age, a history of VTE, obesity, malignancy, prolonged immobilization, surgical duration, type of surgical procedure, and underlying comorbidities. Among patients undergoing THA, these factors may interact with anesthesia techniques, surgical approaches, postoperative rehabilitation, and thromboprophylactic interventions. Given the multifactorial nature of DVT, individual clinical variables are unlikely to provide sufficient predictive discrimination when considered independently.

Clinical risk assessment is therefore generally supported by objective diagnostic investigations (McLendon & Goyal, 2023). The Wells score provides a structured assessment of the clinical pretest probability of DVT, while D-dimer testing may assist in excluding DVT in appropriately selected patients (Bell & Lutsey, 2016). However, D-dimer concentrations are frequently elevated following major surgery, limiting their specificity in the postoperative setting. Compression ultrasonography, often performed with Doppler assessment, is the principal imaging modality for diagnosing lower-extremity DVT (Skeik & Smith, 2021; Min & Kim, 2016; Goodacre & Sampson, 2005). Additional laboratory parameters, including fibrinogen concentrations and platelet indices, may provide supplementary information regarding coagulation status. Nevertheless, these parameters should not be considered independently validated predictors without evidence of their associations with clinical outcomes and their incremental predictive value. Furthermore, pharmacological thromboprophylaxis and mechanical preventive measures may influence postoperative DVT incidence and should be considered when interpreting observed outcomes (Kearon & Akl, 2016; Nadi & Vreugdenburg, 2019).

In Indonesia, evidence regarding VTE has been reported through the IDENTIA Registry, which documented DVT among high-risk hospitalized medical patients.¹¹ However, evidence specifically addressing prospectively monitored patients undergoing THA in North Sulawesi remains limited in the literature cited in this study. At Prof. Dr. R. D. Kandou Hospital in

Manado, locally derived evidence is important because patient characteristics, perioperative management protocols, thromboprophylaxis practices, referral patterns, and follow-up procedures may differ from those in populations used to develop international prediction models. Consequently, a prospective local cohort may provide valuable clinical information, provided that observed postoperative outcomes are clearly distinguished from risk estimates generated using externally derived prediction models (Ocak & Vossen, 2013).

This distinction is particularly relevant to the present study, which involved a prospective cohort of 62 patients undergoing THA who were followed for 90 days. Clinical characteristics, Wells scores, D-dimer concentrations, fibrinogen levels, and Doppler ultrasonography findings were collected to characterize DVT-related risk. The study also incorporated a Monte Carlo simulation based on a logistic regression equation with coefficients reportedly derived from published literature rather than estimated from the study cohort. (Skeik & Smith, 2021) Accordingly, the analytical approach combined observed clinical characteristics with simulation-derived risk estimates. This approach differed from recent prediction studies in which model coefficients were estimated and validated using observed clinical outcomes from large patient datasets (Huang et al., 2025; Yang et al., 2025).

The principal research gap concerned the limited availability of prospectively collected local evidence on postoperative DVT outcomes and the uncertain applicability of literature-derived prediction equations to patients undergoing THA at Kandou Hospital. Although the study incorporated a 90-day follow-up period, the available manuscript did not specify the number of incident DVT events observed during follow-up. An additional inconsistency was identified in the eligibility criteria, as active cancer was listed as an exclusion criterion despite seven participants being reported as having active cancer. These discrepancies require clarification using the original study records before reliable estimates of observed DVT incidence, cohort-specific associations, model calibration, or diagnostic performance can be established.

The clinical significance of this investigation lies in the need to identify patients at increased risk of postoperative DVT while maintaining a clear distinction between simulated risk probabilities and clinically observed thrombotic events. The potential contribution of the study is the integration of prospective clinical risk assessment, Wells scores, coagulation biomarkers, Doppler ultrasonography findings, and 90-day postoperative follow-up within a local orthopedic population. The inclusion of a literature-informed Monte Carlo simulation may also provide an exploratory framework for estimating potential DVT risk. However, without cohort-based model development or validation, these findings should be interpreted as descriptive risk characterization and exploratory simulation rather than evidence of a validated clinical prediction model.

Accordingly, this study aimed to characterize DVT-related clinical risk factors among patients undergoing THA at Prof. Dr. R. D. Kandou Hospital in Manado, document postoperative DVT outcomes during the 90-day follow-up period, and explore risk estimates generated through a literature-informed Monte Carlo simulation. The investigation also sought to examine the relevance of Wells scores, D-dimer concentrations, fibrinogen levels, ultrasonography findings, age, immobilization, and associated comorbidities in postoperative DVT risk assessment. However, independent predictive associations were not assumed in the absence of appropriate regression analyses based on observed clinical outcomes.

The anticipated contribution of this study was to provide preliminary evidence supporting postoperative DVT risk assessment in orthopedic practice and to clarify the methodological distinction between observed clinical outcomes and simulation-derived predictions. The findings may be relevant to orthopedic surgeons, perioperative care teams, and researchers involved in developing and validating DVT prediction models. Furthermore, the study may help identify clinical variables requiring closer postoperative monitoring and inform future external validation studies. Nevertheless, definitive clinical implications depend on verification of the observed DVT events, participant eligibility criteria, model coefficients, missing-data management procedures, ethical approval, and appropriate assessments of model discrimination and calibration.

METHOD

Research Design

This analytical observational study employed a prospective cohort design involving patients who underwent total hip arthroplasty (THA) at Prof. Dr. R. D. Kandou Hospital in Manado, Indonesia. Patients who met the study's inclusion criteria were enrolled and followed prospectively to assess the occurrence of postoperative deep vein thrombosis (DVT).

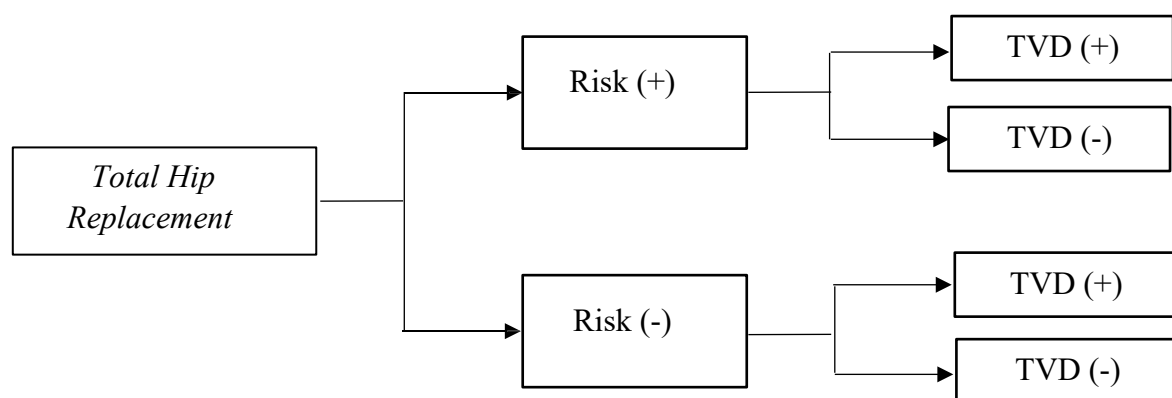


Image 1. Research Design

Source: Research design developed by the authors.

Place and Time of Research

This study was carried out in the Surgical Inpatient Installation and Intensive Care Room (ICU) at Prof. Dr. R.D. Kandou Manado Hospital. The data collection period in this study was for 12 months from January 1, 2023 – December 31, 2024. The *follow-up period* for each study subject was carried out until the subjects showed clinical outcomes in the form of *deep vein thrombosis* (DVT)/deep vein thrombosis and/or did not develop the condition within 90 days.

Population and Research Sample

The target population in this study is all patients who underwent *total hip replacement* (THR) surgery. The affordable population in this study is all patients who underwent THR surgery who underwent inpatient treatment at Prof. Dr. R.D. Kandou Manado Hospital during the *recruitment* and *follow-up* period of this study.

The sample of this study is part of the affordable population that was selected in a certain way and met the eligibility criteria of the subjects. The sample in this study was all patients

undergoing THR surgery who underwent inpatient treatment at Prof. Dr. R.D. Kandou Manado Hospital during the *recruitment* and *follow-up* period in this study and met the inclusion and exclusion criteria.

Sample size

The method of sampling in this study is to use *the consecutive sampling technique*, where every subject that meets the research criteria is included in the study until the *recruitment* period has been determined until the minimum number of samples has been determined based on the calculation of sample size.

Sample size is calculated using the sample size formula for prospective cohort research, which is as follows:

$$n1 = n2 \frac{(Z\alpha\sqrt{2PQ} + Z\beta\sqrt{P1Q1 + P2Q2})^2}{(P1 - P2)^2}$$

N1 : The number of subjects who underwent THR with risk factors accompanied by the incidence of deep vein thrombosis.

N2 : The number of subjects who underwent THR with risk factors without the occurrence of deep vein thrombosis.

Z α : Alpha standard deviation, set at 5% = 1.96 Z β : Beta standard deviation, set at 20% = 0.84

P : Total proportion = (P1 + P2)/2

P1 : Proportion of patients undergoing THR surgery with risk factors with the incidence of DVT

P2 : The proportion of patients undergoing THR surgery with risk factors without the incidence of DVT was 0.8.⁸⁴

Q2 : 1 – P2 = 1 – 0.8 = 0.2

RR : Expected relative risk magnitude = 2 P1 : RR x P2 = 2 x 0.2 = 0.4

Q1 : 1 – P1 = 1 – 0.4 = 0.6

P: (P1 + P2) / 2 = (0.4 + 0.8) / 2 = 0.6

Q : 1 – P = 1 – 0.6 = 0.4

By entering the above values in the formula, the minimum sample size for each group is 28 people for each group by taking into account the *drop out* case of 10%, then the number of samples for each group is set to be 31 samples, so that the overall minimum sample is 62 samples.

Criteria for inclusion

The inclusion criteria in this study are as follows:

- All patients who underwent *total hip replacement* (THR) surgery at the Hospital. Prof. Dr. R.D. Kandou Manado.
- Adult patients who are ≥ 18 years of age
- Ready Follow Research with Sign Consent Sheet/*informed consent*.

Exclusion criteria

The exclusion criteria in this study are as follows:

- Not currently on treatment for clinical indications of *total hip replacement* (THR).

- b. Not in a condition of severe infection.
- c. Not currently diagnosed with cancer or tumors.
- d. Refusing to participate in the study.
- e. Incomplete data.

Variables and operational definitions

Table 1. Operational Definition

Variable	Definition	Indicator	How to Measure	Measurement Result	Measurement Scale
Deep vein thrombosis	Deep Vein Thrombosis (DVT) is the formation of thrombus in the profunda vein, especially in the lower limbs.(Germini et al., 2016)	Wells score and D-Dimer increase	1. Wells score is calculated based on the patient's clinical criteria 2. D-Dimer is calculated by means of venous blood test	1. Wells score: • ≥ 2 points: High probability of DVT • < 2 points: Low probability of DVT 2. D-Dimer: > 500 ng/ml	Numerical
Age	The patient's age is the time difference between the subject being sampled and the subject's birthday rounded up in units of years	> 40 years increases the risk of developing deep venous thrombosis	Patient identity	0-100 years	Numerical
Gender	Biological differences between males and females	Male Women	Patient identity	Male Women are more at risk	Categorical Nominal
Immobilization	Immobilization refers to the process of limitation of the joints or bones on their axis that causes the subject to be immobile for a long time	Lying down > 3 days	Perform a physical examination	There are limitations in activities	Ordinal
History of deep vein thrombosis	History of DVT is a condition or diagnosis of DVT that has been experienced by the subject before starting the research.	Previous history of deep vein thrombosis	Anamnesis and physical examination	There is a previous history of deep vein thrombosis in the patient	Nominal
Obesitas	Obesity is a condition characterized by an excessive ratio of weight to height	BMI	BMI: BB/TB^2	Non-obesity: BMI < 30 kg/m ² Obesity: BMI ≥ 30 kg/m ²	Nominal

Source: Research protocol prepared by the authors.

Instruments and Ways of Working

The data collection tools and materials in this study include:

- a. Informed *consent*.
- b. Basic patient data.
- c. Patient medical records.
- d. Data collection sheets.
- e. Observation sheet of risk and clinical outcomes of deep vein thrombosis in patients after THR surgery.
- f. Physical diagnostic equipment, clinical examination (*Wells Score*), and laboratory examination equipment (D-dimer, fibrinogen, Doppler ultrasound) for risk evaluation of deep vein thrombosis in patients undergoing THR.

Aspects of Research Ethics

The subject agrees and fills out the consent sheet after the explanation marked by the signing *informed-consent*. Subjects have the right to refuse or resign to be included in the research without any consequences. This research is carried out based on the provisions of the implementation of related research and can be held accountable to every institution or hospital in accordance with several ethical principles, namely *anonymity* (anonymous) and confidentiality.

Data Processing and Statistical Analysis

Data processing is carried out using the main data processing and statistical analysis tool, namely SPSS 26 statistical software. Data obtained through observation and objective findings of the subject during the research as well as basic characteristic data through medical records are collected and recorded on the data collection sheet. The data is then input into *Microsoft Excel* as *data entry*.

The data that has been obtained from the sample is then entered (*data entry*) into a computer program. Data analysis is then carried out in several stages.

1. Univariate analysis was carried out to determine the characteristics of the research sample. In univariate analysis, data with a category scale were expressed in frequency distribution, cross-tabulation and percentage. Data with a continuous scale was expressed in mean $\pm$ SD if it was normal distribution and expressed in median $\pm$ Interquater Range (IQR) if the data was not normally distributed. The normality test to assess the distribution of data was carried out with the Kolmogrov-Smirnov test.
2. Bivariate analysis

The available manuscript does not document a cohort-estimated multivariable logistic regression model. Instead, the prediction section states that logistic coefficients were taken from the literature and then used in a Monte Carlo simulation of 10,000 replications. The simulation must therefore be described as literature-informed exploratory risk modelling rather than as regression estimated from these 62 patients.

Research Cost Budget

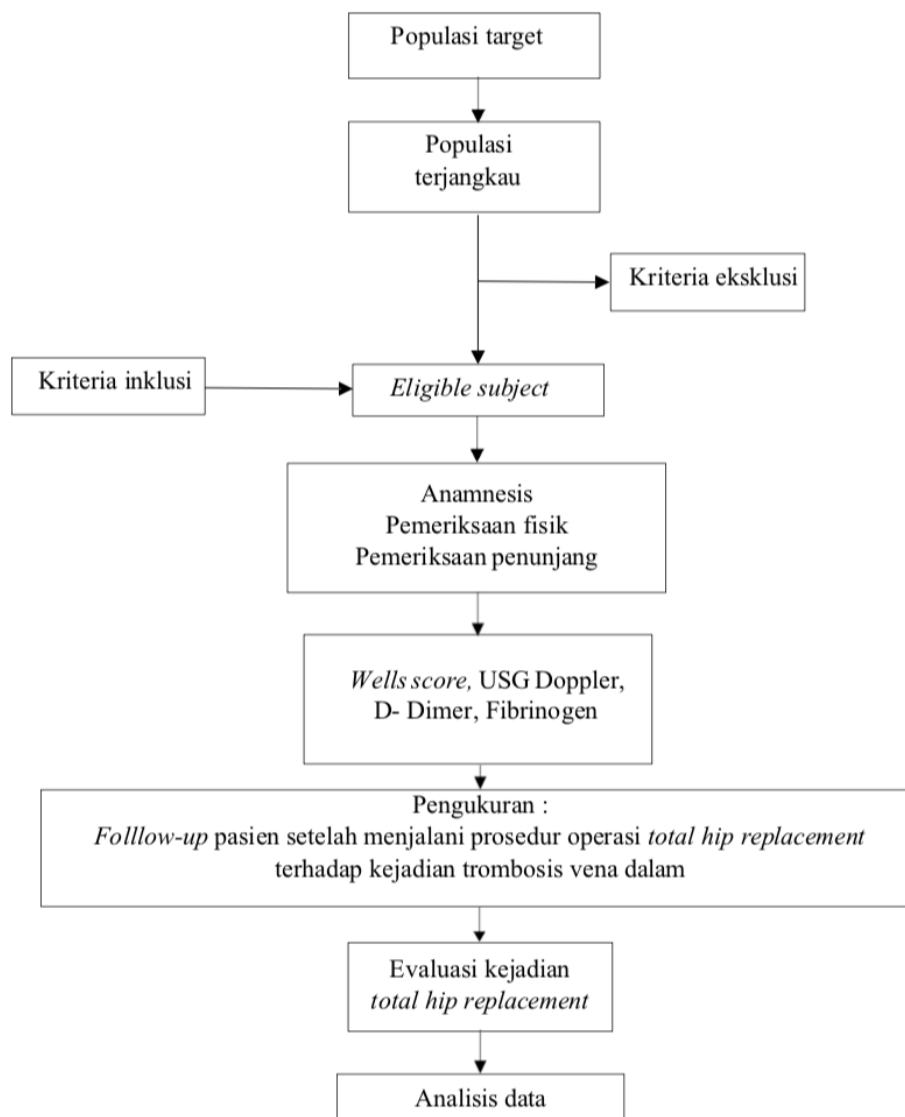
The cost of this research is obtained from the author's personal budget, and there is no special cooperation for this research from any funding institution in the public, commercial, or non-profit sectors.

Table 2. Research Cost Budget

No.	Activities	Units	Unit Cost (Rs)	Quantity (Rs)
1.	Transport Research ATK and Doubling	-	IDR 500,000	IDR 500,000
2.	a. Photocopy	20 copies	IDR 50,000	IDR 1,000,000
	c. Volume	20 copies	IDR 10,000	IDR 200,000
3.	Pembayaran Ethical Clearance	-	-	IDR 480,000
Total:				IDR 2,180,000

Source: Research budget prepared by the authors.

Research Flow

**Image 2. Research Flow Diagram**

Source: Research flow developed by the authors.

RESULTS AND DISCUSSION

Description of Research Variables

This study collected descriptive DVT-related risk data from 62 patients undergoing total hip replacement (THR). The median age was approximately 70 years (Q1-Q3: 63-77 years). Men comprised 46 participants (74%), whereas women comprised 16 (26%). Reported comorbidities included hypertension, diabetes, dyslipidemia, and active cancer. The active-cancer value must be interpreted cautiously because active cancer is also listed as an exclusion criterion in the Methods section and requires reconciliation with the original eligibility records.

The duration of THR surgery was optimal in 48 (77%) samples, although there were still 14 (23%) patients whose surgery took more than two hours. Almost half of the study samples were identified as experiencing prolonged immobilization (> 3 days).

Biomarker examination showed an increase in D-Dimer in 48 (77%) of the sample patients. Platelet counts were generally still within normal limits. Meanwhile, the median fibrinogen level was recorded at about 3 g/L. For the record, all (100%) subjects in the sample showed ultrasound results within normal limits.

Table 3. Descriptive Statistics of Research Variables, N = 62

Variable	n (%)	Med (Q1; Q3)
Demographers		
Age	-	70,0 (63,0 ; 77,0)
Sex		
Men	46 (74)	-
Women	16 (26)	-
Comorbidities		
Hypertension	22 (35)	-
Dyslipidemia	11 (18)	-
Diabetes	20 (32)	-
Active Cancer	7 (11)	-
Intra and Post-Surgical Factors		
Duration of Operation		
Optimal	48 (77)	-
Prolonged	14 (23)	-
Long Immobilization	29 (47)	-
Biomarker		
Platelets ($\times 10^3/\mu\text{L}$)	-	261,0 (228,2; 323,5)
Increased D-Dimer	48 (77)	-
Fibrinogen (g/L)	-	3,0 (3,0; 3,0)

NOTE: Median med, Q1 quartile I, Q3 quartile III

Source: Research data processed by the authors.

Observed 90-Day DVT Outcomes

Prediction of Deep Vein Thrombosis Risk

1. Prediction Model Settings

Prediction of DVT risk using the following logistic regression model with variable selection and estimated coefficient numbers following the literature¹⁰³⁻¹⁰⁶ :

$$\log \frac{p}{1-p} = -7.00 + 0.03(\text{Age}) + 1.25(\text{Cancer}) + 0.79(\text{High D-Dimer}) +$$

$$1,39(\text{Immobilization}) + 1,61(\text{Abnormal ultrasound})$$

where p is the risk of DVT. For the purposes of the Monte Carlo study, the coefficient

numbers above are equipped with a standard error for each variable. The normal distribution is the assumption of the distribution of all logistic regression coefficients. The simulation was carried out 10000 times, with the number of observations in each replication following the size of the study sample, which is 62.

2. Simulation Results

The simulation results are presented in Table 4 and Figure 4.1. Based on the numbers in the table and the histogram description, it is clear that the distribution of DVT predictions is tilted to the right. However, the calibration results show that most of the DVT predictions correspond to the target range as mentioned in the literature.¹⁰³⁻¹⁰⁶

Table 4. Monte Carlo Simulation of Predicted DVT Prevalence

Prevalence	Value
Median (IQR)	7,3% (1%-9,7%)
Red (SE)	7,3% (7,7%)
Minimum	0%
Maximum	62,9%
95% Prediction Interval	(0% - 29%)

Source: Monte Carlo simulation based on literature-derived coefficients and study inputs.

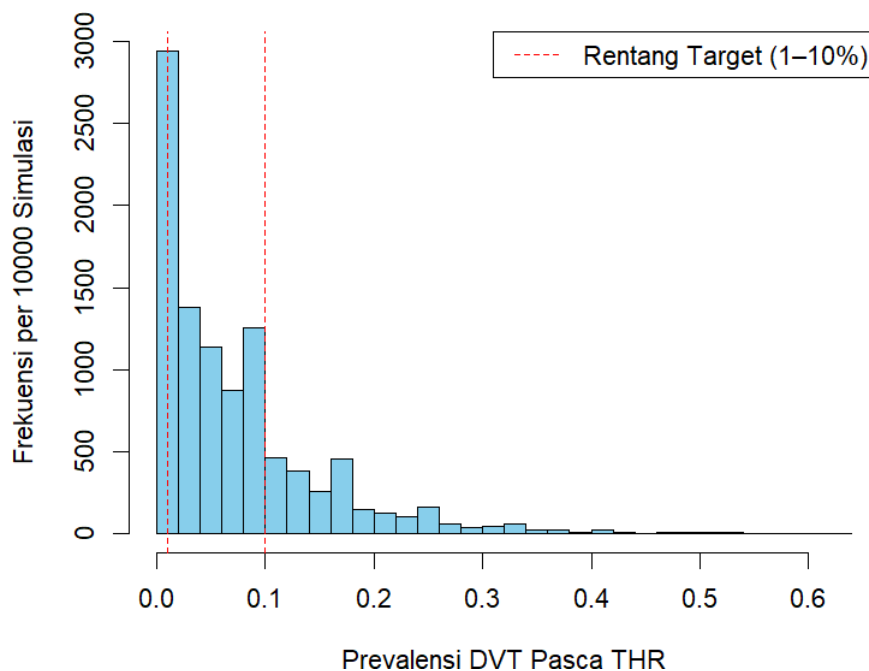


Image 3. Simulated DVT Prevalence Distribution (10000 Replications)

Source: Monte Carlo simulation output from the study model.

Analysis of the characteristics of the research subject

The results of the analysis of the research subjects were dominated by the male gender as many as 46 samples (74.2%). This is in line with Bragg's meta-analysis, in 2022 there were a total of 1110 men who experienced the incidence of DVT for the first time with a prevalence of 1.54 times more than women. 107 Androgen levels in men are much more than in women, in line with the increase in androgens, there is an increase in the formation and density of

thrombosan A2 receptors which increases the risk of blood clot formation. This is also aggravated by the existence of a secondary lifestyle, smoking habits, and alcoholism which increases the occurrence of atherosclerosis. 108

Demographic data on the age of > 50 years were obtained in a total of 56 samples (90.3%) with a peak age of 70 years. This is in line with Akrivou's 2022 research where the incidence of DVT in the elderly has increased 3 times since the age of 50, with a peak at the age of >65 years, and will continue to increase 0.5 times until the peak at the age of 80 years. This is exacerbated by comorbidity and lifestyle factors in the elderly. There are 3 important roles that cause high cases of DVT in the elderly, namely endothelial damage due to atherosclerosis, hypercoagulability due to comorbid factors such as diabetes mellitus, and the formation of prolonged venous stasis due to low mobility. 109

Comorbidity Characteristics Analysis

The results of the analysis of risk factor characteristics on interpretation can be assessed from the number of risk factor characteristics distribution by looking at the dominance of values and percentages of the total population of the study sample. Preoperative characteristics were obtained that most of the samples did not show risk factors that supported the incidence of deep vein thrombosis, with the observation results there were hypertension as many as 22 samples (35%), there was hyperlipidemia as many as 11 samples (18%), there was diabetes mellitus as many as 20 samples (32%), and active cancer as many as 7 samples (11%).

The data is in line with conventional pathophysiology, where comorbid factors will increase the incidence of DVT by >35%. According to Bhaskarwar data, in 2023 hypertension itself will increase the probability of DVT incidence by up to 35%, diabetes mellitus itself will increase the probability of DVT incidence by up to 5%, and hyperlipidemia itself will increase the probability of DVT incidence by up to 4%. When combined between the three, it will increase the probability of DVT incidence by almost 5 times the normal occurrence.¹¹⁰ Hypertension affects endothelial dysfunction due to increased intraluminal pressure, which is aggravated by the occurrence of atherosclerosis by diabetes mellitus and hyperlipidemia.

Patients with a history of cancer will increase the incidence of DVT up to 7 times higher, with a significant increase in the intervening months after diagnosis, especially cancers with metastasis.¹¹² Study results case-control found that cancer patients undergoing chemotherapy could increase the incidence of DVT 4 times higher than those who did not receive chemotherapy.¹¹³ The results of the retrospective study found that cancer patients with the incidence of DVT had a poor prognosis with a risk of mortality almost 3 times. The mechanism of thrombosis is very diverse, cancer causes compression of blood vessels resulting in prolonged venous stasis and triggers the activation of coagulation cascades produced by cancer procoagulants that act on factor Xa, in addition to anticancer therapy significantly increases the incidence of DVT.

Intra and Postoperative Factor Analysis

Intraoperative characteristics also provide data to support the reduction of the incidence of DVT in cases, where most of the samples obtained an optimal duration of surgery as many as 48 samples (77.4%). The results showed that after the duration of 100 minutes, every next 10 minutes would increase the incidence of DVT by 7%. This is related to the decrease in blood flow in the legs due to a decrease in muscle contraction and potential compression in the veins. This has an effect on inflammation and tissue damage after surgery. All samples received

replacement material in the form of stents in a total of 62 hip replacement samples (100%), which is very significant in reducing the incidence rate of DVT. A case report states that bone cement material can increase the incidence of DVT, there is intravasation of semen into the vasculature during the hemiartoplasty process, although this occurrence is very rare in the process of cement compression into the medull, but it can occur. Intravasation of semen into the vein accompanying the branch of the artery profunda femoris will lead to increased venous stasis and end the occurrence of latent DVT, and is detected by Doppler ultrasound examination.

All samples received epidural anesthesia at a total of 62 hip replacements (100%), which was significant in reducing the incidence of DVT. A case study showed that the group that received epidural anesthesia had a significantly lower incidence of DVT. One reason is that epidural anesthesia does not reduce the blood supply to the extremities below the blockade level, but rather increases it, thereby reducing blood viscosity and preventing venous thrombosis from forming. In contrast, general anesthesia can activate platelet membrane glycoproteins, which can trigger platelet function activation. General anesthesia also affects the endocrine system of surgical patients, especially in elderly patients with impaired cardiovascular system function, who are more sensitive to drugs and often experience intense stress reactions. These reactions have the potential to trigger activation of platelet function, leading to perioperative blood hypercoagulability.

All samples obtained standard postoperative procedures by administering fibrinolytic and compression to the extremities in all samples (100%). This is a strong factor related to the reduction in the incidence of postoperative DVT. The use of Low Molecular Weight Heparin (LMWH) is still considered the standard of major postoperative procedures, LMWH has an effective working system inhibiting the work of factor Xa, in addition the use of multi-level compression up to 6 weeks postoperatively has been shown to reduce the incidence of DVT by the absence of obstructions in the doppler ultrasound in almost 91.6% of the total population. The latest guidelines from the American College of Chest state that aspirin antithrombotic therapy is recommended as a prophylactic before major surgery, equivalent to the use of LMWH.

The dominance of the sample also carried out early immobilization which reduced the risk of DVT, as many as 48 samples (77%). This is in line with several studies that DVT can occur up to 40% of the total patients who undergo major surgery due to prolonged immobilization of the lower extremities. 120 According to Saragas, 2014 studies stated that DVT can occur in 8.46% of patients who have immobilized due to the installation of a cast after week 4. 121 Another study according to Sullivan, in 2019 as many as 25.4% of patients experienced the risk of DVT due to delay in exercise and mobilization of the limbs for 6 weeks after surgery. This is related to prolonged venous stasis that will create the formation of blood clots, as one of the strong risk factors for the formation of DVT.

Most cases have a supporting profile that does not have a risk of DVT, judging from serum platelet, D-dimer, and fibrinogen levels. The dominance of the sample had normal platelet levels of 61 samples (98.4%), normal D-dimer 51 samples (82.3%), and normal fibrinogen 51 samples (82.3%). These three substances have a great influence on the level of coagulability, which is one of the risks of DVT. Normal profile results will significantly reduce the incidence of DVT.

Analysis of Serum Platelet, D-Dimer, and Fibrinogen Biomarker Levels against Deep Vein Thrombosis

The cohort provides descriptive biomarker information but does not establish diagnostic performance. The descriptive table reports elevated D-dimer in 48 of 62 participants (77%), a median platelet count of approximately $261 \times 10^3/\mu\text{L}$, and a median fibrinogen level of approximately 3.0 g/L. Sensitivity, specificity, predictive values, or area-under-the-curve estimates cannot be attributed to these biomarkers unless they are calculated against confirmed observed DVT outcomes.

Platelet levels were obtained at a peak value of 261,000/ μL with the lower quartile at 228,200/ μL and the upper quartile at 323,500/ μL . Platelet distribution results were obtained on a normal scale. The discriminative ability of serum platelets in the prediction of DVT was rated low. A meta-analysis of 100 studies found an odds ratio (OR) of 1.50 (95% CI: 1.19–1.88) for the incidence of thrombosis with increased platelet count. However, this parameter has varying sensitivity and specificity, depending on the clinical context and type of disease diagnosis. Therefore, serum platelets are more appropriately used as an additional indicator in the risk assessment of thrombosis, rather than as a primary diagnostic test.

Fibrinogen results showed stable levels in this study, where there was no difference in peak values with the upper and lower quartiles. This indicates a very low discriminative capacity. The literature also suggests that although fibrinogen is an important component of the coagulation pathway and increases in acute inflammatory responses, its diagnostic value varies greatly between studies. Fibrinogen has an important role in the coagulation process and is often used as an indicator of acute inflammation. However, in the context of thrombosis, its diagnostic performance is limited. A meta-analysis showed that fibrinogen had a sensitivity of 75% (95% CI: 68–80%) and a specificity of 85% (95% CI: 82–88%) in diagnosing post-prosthetic joint infections. Although the specificity was high, the sensitivity was moderate, suggesting that fibrinogen was more effective as a confirmatory test than as a screening test.

Analysis of Wells Score Characteristics of Deep Vein Thrombosis

The Wells Score was collected as a structured clinical probability measure, but its performance cannot be evaluated from the available manuscript because the observed 90-day DVT event count and corresponding diagnostic-performance analysis are not reported. The 7.3% value presented in the simulation section is a model-derived median predicted prevalence, not an observed cohort prevalence. Wells Score should therefore be discussed as a clinical assessment tool used in this study rather than as an independently validated predictor in this cohort.

According to Xiang, the results of the meta-analysis study in 2025 were evaluated with scoring to assess the risk of superiority and practicality, an area under curve (AUC) of 0.072 was obtained, with DVT identification increasing to 13.1%, with the true probability increasing to 81.4%. The assessment according to scoring was considered more specific and easy to use in clinical practice, especially in patients with pelvic fractures. The results of the study confirmed that age was the main and independent risk factor, but the increase in clotting time was associated with the formation of post-fracture thrombus due to venous congestion, immobilization, or vascular injury due to primary fracture.

According to Xinyan, the results of the study in 2021 found an increase in the incidence of DVT by 14.13%–20.18%, the results of this study may be related to surgical methods and

the administration of perioperative anticoagulation. Related risk factors include the age of >70 years related to vascular endothelial elasticity and comorbidities, as well as bilateral surgical procedures that have a major effect on the formation of DVT. Prevention strategies by conducting preoperative evaluations to rule out personal risks and comorbidities, operative techniques with minimal duration of surgery and tissue damage, and postoperative rehabilitation are recommended early to improve vascular flow of the lower extremities with initial mobilization, limb lifts, and other functional exercises.

CONCLUSION

Among the 62 patients who underwent total hip arthroplasty (THA), the available data provided a descriptive profile of demographic characteristics, comorbidities, perioperative factors, coagulation biomarkers, Wells scores, and Doppler ultrasonography findings. The study also reported a Monte Carlo simulation that yielded a median predicted deep vein thrombosis (DVT) prevalence of 7.3%, with a 95% prediction interval of 0%–29%, based on literature-derived logistic regression coefficients. However, this simulation-derived estimate did not represent the observed incidence of postoperative DVT, as the number of incident DVT events during the 90-day follow-up period was not reported. Consequently, the available evidence was insufficient to establish independent predictive associations, diagnostic accuracy, or cohort-specific model performance (Sjoland & Lindgren, 2023; Sloan & Sheth, 2019).

The study's potential contribution lay in integrating prospective clinical data from a local THA population with an exploratory simulation-based approach to postoperative DVT risk estimation. Nevertheless, several methodological issues required clarification, including the inconsistency between active cancer as an exclusion criterion and the reported inclusion of patients with active cancer, verification of the original D-dimer measurements and observed DVT outcomes, documentation of the ethics approval number, and confirmation of whether a regression model was developed using the study cohort. Future research should involve larger prospective cohorts to develop and validate DVT prediction models, report adjusted odds ratios with 95% confidence intervals when statistically estimable, and evaluate model discrimination and calibration. Subsequent studies should also account for thromboprophylaxis, address missing data appropriately, and conduct external validation before implementing prediction models in clinical practice.

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