Preoperative Elevated International Normalized Ratio Cannot Increase Transfusion or Complication in Primary Total Hip Arthroplasty: A Retrospective Study of 552 Cases

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Research article

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Abstract

Background: Verify if the elevated preoperative International Normalized Ratio (INR) can increase transfusion and complication rate in primary total hip arthroplasty.

Methods: We retrospectively reviewed the database of adults who underwent primary total hip arthroplasty between 2014 to 2018 by the same surgeon. 552 cases were assigned into 3 groups by preoperative INR class: $\text{INR} \leq 0.9$, $0.9 < \text{INR} \leq 1.0$, and $\text{INR} \geq 1.0$ eventually. We regarded the transfusion rate as the primary outcome. We also included perioperative blood loss, maximum Hb-drop, postoperative anemia needs medicine, length of stay (LOS), re-operation, the complication rate in 90 days and mortality as the secondary outcomes. Univariable analyses were utilized to compare baselines and outcomes between groups. Binary Logistic Regression was used to adjust differences of baselines among groups.

Results: All the cases had an $\text{INR} \leq 1.5$. Among all the cases, 93(16.8%) had $\text{INR} \leq 0.9$, 268 (48.6%) had $0.9 < \text{INR} \leq 1.0$, and 191 (34.6%) had $\text{INR} \geq 1.0$, respectively. In the univariable analyses, with the INR elevated, The transfusion rates increased from 1.08% for $\text{INR} \leq 0.9$, 1.12% for $0.9 < \text{INR} \leq 1.0$ to 5.76% for $\text{INR} \geq 1.0$ ($p = 0.05$). The overall complication rate increased from 10.8% for $\text{INR} \leq 0.9$, 16.4% for $0.9 < \text{INR} \leq 1.0$ to 22.5% for $\text{INR} \geq 1.0$ ($p = 0.05$). When controlling for the demographics and comorbidities characteristics, there was no statistically significant difference when evaluating the odds of transfusion nor overall complication rate between the groups ($p = 0.05$).

Conclusions: The transfusion and complication rate cannot increase along with the INR elevated in primary THA. With the improvement of arthroplasty protocol and use of tranexamic acid, the $\text{INR} \leq 1.5$ was still a conventional safe threshold.

Background

Total hip arthroplasty (THA) is considered one of the most successful surgeries in the history of modern medicine[1]. With the aging population and the prevalence of obesity[2], the utilization and cost of THA have grown annually[3]. THA is associated with excessive perioperative blood loss and a high need for transfusion[4, 5], as well as THA related complications. Of all the reasons for THA revision, dislocation and mechanical loosening are the main indications [6].

INR refers to the ratio of prothrombin time to the normal prothrombin time[7] which were regarded as an ideal method for judging the anticoagulation effect[8]. It can overcome variability between different laboratories by thromboplastin sensitivity[9]. Among the warfarin used patients, INR was kept between 2.0 and 3.0 as the therapeutic range[10]. A preoperative international normalized ratio (INR) target < 1.5 is suggested by the guidelines[11]. INR was widely used in predicting mortality and bleeding in some diseases. Rudasill et al found that INR showed an important value in predicting mortality and bleeding in End-Stage Liver Disease[11]. Tan et al observed that patients who underwent endarterectomy with high preoperative INR (≥ 1.5) exhibited higher 90-day mortality than ones with low INR[12]. In another study

about manage heart failure with nonvalvular atrial fibrillation, abnormal INR also showed higher independent risks of mortality[13].

Some previous studies agreed that high INR values have a strong association with the risk of bleeding[14, 15]. A retrospective study found patients with $\text{INR} \geq 1.3$ had a higher transfusion rate in victims of abusive head trauma[16]. An elevated INR is also associated with increased complications after hand surgery[17].

Recently, a retrospective study of more than twenty thousand cases proved $\text{INR} \geq 1.25$ was tightly associated with bleeding, infection, and mortality in total knee arthroplasty[18]. The same author conducted another similar retrospective study in THA and found elevated INR increased bleeding and mortality again[19]. But the evidence for INR to predict perioperative bleeding, complication and mortality are still low.

Previous research mainly focuses on the comparison of high INR such as ≥ 1.25 , even ≥ 1.5 .

The predictive value of INR in conventional safe threshold ≥ 1.5 is still uncertain. The relationship between INR and some THA-related complications such as dislocation, fracture and vein thrombosis needs intensive studying too. The purpose of this retrospective study was to verify if the elevated preoperative INR can increase transfusion and complication in primary total hip arthroplasty when INR was in conventional safe threshold ≥ 1.5 .

Methods

We retrospectively identified a database of adults who underwent total hip arthroplasty between October 15, 2014, to October 14, 2018, by the same senior surgeon(B.S). We obtained relevant in-hospital data by checked medical records in our hospital system. We contacted the discharged patients to get their complication, re-operation, and mortality information after discharge. We brought adult cases (≥ 18 years of age) who underwent primary total hip arthroplasty into our study. We only included cases with enough relevant pre-operative laboratory data including INR, which was collected within three days preoperatively. Exclusion criteria included bilateral THA during the same hospitalization, THA after acute infection, revision operation, multiple fractures and patients without adequate data.

All the cases were divided into 3 groups by preoperative INR class: $\text{INR} \leq 0.9$, $0.9 < \text{INR} < 1.0$, and $\text{INR} \geq 1.0$. We regarded postoperative transfusion rate during the same hospitalization as the primary outcome. We also included perioperative blood loss, maximum Hb-drop, postoperative anemia needs medicine, length of stay (LOS), re-operation, the complication in 90 days, mortality in 90 days and mortality in 12 months as the secondary outcomes. Postoperative complications contained urinary tract infection, renal failure, stroke, cardiovascular accident, pneumonia, stroke, septic shock, pulmonary embolism (PE), deep venous thrombosis (DVT), superficial infection, deep infection, dislocation, fracture, muscular vein thrombosis, subcutaneous ecchymosis, hematoma and wound-healing delay, etc. Perioperative blood loss was calculated by the formulas described by Gross with preoperative hematocrit and the lowest postoperative

hematocrit during hospitalization[20-22]. All the complications, re-operation and complication data in the first 90 days postoperatively were collected. Mortality in 12 months was brought into the study.

We compared the demographics and comorbidities characteristics of cases by the INR group. Continuous variables were exhibited as the mean with the standard deviation or as the median with the interquartile range. Categorical variables were exhibited as the number of cases (the percentage). We analyzed continuous variables by one-way ANOVA with post-hoc Tukey test, and categorical variables by the chi-square test or Fisher test. We utilized Binary Logistic Regressions to evaluate the predictive value of INR for transfusion and complication. We put the independent variables of $p < 0.1$ into the regression model for adjustment. Regressions were adjusted for contralateral THA, ASA class, asymptomatic bacteriuria, cardiac pacemaker, pre-operative hemoglobin, hematocrit, WBC count and serum albumin eventually. In all the comparisons, $p < 0.05$ was considered statistically significant. We performed all the statistical analyses by SPSS (version 26; IBM).

Results

Demographic and comorbidities characteristics

From October 15, 2014, to October 14, 2018, 589 cases were screened for eligibility. 21 cases were excluded: 14 failed to meet the inclusion criteria, 7 were lack of adequate preoperative data. We allocated remaining cases into three groups by the class of INR. 3, 8, 5 cases lost follow-up information in the three groups respectively. There was no significant difference in the distribution of lost-to-follow-up cases among groups. 552 cases were included in our study finally (Fig. 1).

All the cases had an INR ≤ 1.5 , which was considered as a conventional safe threshold. Among all the cases, 93(16.8%) had $\text{INR} \leq 0.9$, 268 (48.6%) had $0.9 < \text{INR} \leq 1.0$ and 191 (34.6%) had $\text{INR} \geq 1.0$ respectively. With the INR elevated among groups, The American Society of Anesthesiologists(ASA) class increased gradually ($p \leq 0.05$). The proportion of contralateral THA was different among groups, which was (29.0%) for $\text{INR} \leq 0.9$, (16.8%) for $0.9 < \text{INR} \leq 1.0$, and (20.9%) for $\text{INR} \geq 1.0$ ($p \leq 0.05$). On the other hand, the preoperative hematocrit decreased from $0.415 \pm 0.037 \text{ L/L}$ for $\text{INR} \leq 0.9$, $0.406 \pm 0.041 \text{ L/L}$ for $0.9 < \text{INR} \leq 1.0$ to $0.398 \pm 0.045 \text{ L/L}$ for $\text{INR} \geq 1.0$ ($p \leq 0.05$). Serum albumin also decreased from $44.8 \pm 4.7 \text{ g/L}$ for $\text{INR} \leq 0.9$, $43.8 \pm 4.1 \text{ g/L}$ for $0.9 < \text{INR} \leq 1.0$, to $42.9 \pm 4.5 \text{ g/L}$ for $\text{INR} \geq 1.0$ ($p \leq 0.05$). The cases with cardiac pacemakers were different among groups as 0.0% for $\text{INR} \leq 0.9$, 0.0% for $0.9 < \text{INR} \leq 1.0$, and 2.1% for $\text{INR} \geq 1.0$ ($p \leq 0.05$). There were no statistical differences between INR groups in ages, genders, BMI, Comorbidities except cardiac pacemaker, pre-operative ESR, Platelet count, WBC count, or D-Dimer (Table 1).

Clinical outcomes

As presented in Table 2, With the INR elevated, The transfusion rates increased from 1.12% for $0.9 < \text{INR} \leq 1.0$ to 5.76% for $\text{INR} \geq 1.0$ ($p = 0.004$). There was no statistically significant difference about the transfusion rate in Group A vs. Group B or Group A vs. Group C ($p = 1.000$, $p = 0.112$, respectively). The blood loss increased from $895.6 \pm 378.3 \text{ ml}$ for $\text{INR} \leq 0.9$, $915.9 \pm 353.2 \text{ ml}$ for $0.9 < \text{INR} \leq 1.0$ to 978.7 ± 390.3

ml for $\text{INR} \geq 1.0$ in mean, but there were no statistical differences detected ($p=0.892$, $p=0.180$, $p=0.174$, respectively). The maximum Hb drop increased from 25.7 ± 10.5 g/L for $\text{INR} \leq 0.9$, 26.3 ± 9.9 g/L for $0.9 < \text{INR} < 1.0$ to 27.3 ± 9.9 g/L for $\text{INR} \geq 1.0$ in mean, which were not statistically different among the three groups ($p=0.857$, $p=0.406$, $p=0.553$, respectively). The incidence of anemia needs medication also increased gradually among groups with no statistical significance. Length of stay (LOS) in group C was 5.7 ± 2.2 days, which was statistically longer than ones in group A (4.7 ± 1.6 days, $p=0.000$) and group B (5.1 ± 2.0 days, $p=0.007$) (Fig.2).

Among all the cases, 10 (10.8%) in Group A, 44 (16.4%) in Group B and 43 (22.5%) in Group C had complications reported postoperatively. There was a statistical difference in complications between Group A and Group C ($p=0.017$). Continuous increasing trends were observed among groups about the incidence of cardiovascular accident, superficial infection, muscular vein thrombosis, subcutaneous ecchymosis, wound-healing delay and re-operation without statistical significance. We also found no statistical differences among groups about urinary tract infection, renal failure, stroke, pneumonia, stroke, septic shock, pulmonary embolism, DVT, deep infection, dislocation, fracture, hematoma, wound-healing delay, mortality in 90 days and mortality in 12 months ($p \geq 0.05$) (Table 3).

After adjusted for independent variables of $p < 0.1$ into the regression model, we found no statistical difference in transfusion (Table 4) and complication at 90 days (Table 5) among the three groups. We adjusted for contralateral THA, ASA class, asymptomatic bacteriuria, cardiac pacemaker, pre-operative hemoglobin, hematocrit, WBC count and serum albumin.

Discussion

Preoperative elevated INR had been confirmed to increase bleeding, complication and mortality in some diseases[11-17]. Measuring INR before joint surgery was a standard pattern in our institution. But few studies explored the relationship between elevated INR and postoperative outcomes in total joint replacement, which was related to the risk of transfusion closely. In this retrospective study of 552 cases, we found the transfusion and complication rate cannot increase along with the INR elevated in primary THA.

In the group of $\text{INR} \geq 1.0$, more cases had ASA class 3 and 4 with statistical significance ($p=0.005$), which was relatively high risk. Knol et al also found the proportion of high ASA class in the patients with $\text{INR} \geq 1.8$ was higher than ones with $\text{INR} < 0.8$ (69% and 48.7%, respectively, $p=0.036$)[23]. A larger proportion of cases (29.0%) in the $\text{INR} \leq 0.9$ group had contralateral THA than other groups with statistical significance. Some other studies showed contralateral surgery increases the risk of recurring complications in both THA and TKA[24, 25]. We did not find this trend in our study. Demographic data showed cases in high INR values had statistically lower preoperative hematocrit and serum albumin, Rudasill et al detected similar baseline data in THA and TKA[18, 19]. There were no statistical differences in other demographic and comorbidities characteristics among groups.

This is the first study, as far as we know, found the transfusion and complication rate cannot increase along with the INR elevated in primary THA. Our findings were different from a recent study of Rudasill SE [19], who retrospectively analyzed 17,567 patients by the National Surgical Quality Improvement Program (NAQIP). His team and he found increased bleeding risk with INR 1.25 to ≤ 1.5 (OR, 1.55 [95% CI 1.26 to 1.92]) and increased risk of mortality with $\text{INR} \geq 1.5$ (OR, 2.69 [95% CI, 1.07 to 6.76]) compared with $\text{INR} \leq 1.0$. There are several reasons account for these differences. First, Rudasill SE [19] focused their study on the patients between 2005 to 2016, while we included the latest cases between 2014 and 2018 only. With the improvement of arthroplasty protocol and use of tranexamic acid, our institute has greatly reduced transfusion, complication, and mortality in total joint arthroplasty [26-29]. Since 2012, almost all the patients who underwent TKA or THA surgery in our institution have received tranexamic acid during the perioperative period. In our institution, ESR and CRP must be controlled in not more than two times the normal range before the operation for most patients, and not more than three times for inflammatory disease patients such as rheumatoid arthritis and SLE. Asymptomatic bacteriuria must be cured before arthroplasty surgery. Thus, our average transfusion rate of all cases was 2.7%, which was largely lower than Rudasill SE (15.5%). The mortality in 90 days of Rudasill SE's study is 0.8%, while we have no patient died in three months after surgery. A ten-year national database from the UK also showed postoperative complications reduced year by year in THA, although the levels of comorbidity elevating [30]. Second, some THA-related complications such as dislocation, fracture, wound-healing delay, and vein thrombosis were not included by Rudasill SE. Also, we followed up the mortality rate in 12 months and found no statistical difference among the groups. The debate about INR security thresholds has been going on for a long time. Some previous studies agreed that high INR values have a strong association with the risk of bleeding in heart valve replacement and head trauma [14-16]. But some others observed that an elevated INR did not increase bleeding risk in chest tube placement and hand surgery [31, 32].

With the INR elevated by the class step, the length of hospital stay increased gradually compared with $\text{INR} \leq 0.9$ with statistical significance. Similar results can be found in other studies [18, 19, 33]. We included some minor complications in our study such as muscular vein thrombosis and subcutaneous ecchymosis, which were common in other studies [34-38]. In the aspect of specific complications, an increasing trend can be detected about the incidence of cardiovascular accident, superficial infection, muscular vein thrombosis, subcutaneous ecchymosis, and wound-healing delay. But there was no statistical difference in this growing trend. We detected no statistical difference in re-operation, mortality in 90 days or mortality in 12 months.

There are some limitations to the current study. First, because this was a retrospective study, there may be some nature bias about the data. Second, sixteen cases lost follow-up among them all, but there was no significant difference in the distribution of lost-to-follow-up cases among groups (3.1%, 2.9%, 2.6%, respectively). Thus we believed our lost-follow-up rate was acceptable for these parameters. Third, some patients failed to report adequate information because of forgetting, which may lower the complication rate. But we get most postoperative outcomes data during hospitalization. Other postoperative outcomes were mainly included major complications, re-operation, and mortality, which were unlikely to be forgotten

by patients and their families. Therefore, we did not think those limitations would affect the results severely.

Conclusions

In conclusion, the transfusion and complication rate cannot increase along with the INR elevated in primary THA. With the improvement of arthroplasty protocol and use of tranexamic acid, the INR ≤ 1.5 was still a conventional safe threshold for THA surgery

Abbreviations

INR, International Normalized Ratio; LOS, Length of Stay; THA, Total Hip Arthroplasty; TXA, Tranexamic Acid; PE, Pulmonary Embolism; DVT, Deep Venous Thrombosis; ESR, Erythrocyte Sedimentation Rate; CRP, C-reactive protein; TKA, Total Knee Arthroplasty; BMI, Body Mass Index; ASA, American Society of Anesthesiologists; COPD, Chronic Obstructive Pulmonary Diseases; SLE, Systemic Lupus Erythematosus; AS, Ankylosing Spondylitis; WBC, White Blood Cell.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethical Committee of West China Hospital of Sichuan University. And the written informed consent was obtained from each patients included in the study.

Consent for publication

Not applicable.

Availability of data and material

All data and materials are contained within the manuscript.

Competing interests

The authors Linbo Peng, Junfeng Zeng, Yi Zeng, Yuangang Wu, Jing Yang, and Bin Shen declare that they have no conflicts of interest.

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Authors' contributions

The following authors designed the study (BS), collected the data (LBP,JFZ), analysed the data (LBP, YGW), wrote the initial drafts (LBP), and ensured the accuracy of the data and analysis (BS, JY, YZ). All authors read and approved the manuscript.

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All authors have approved this study for publication.

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Tables

TABLE 1. Demographic and comorbidities Characteristics for cases of THA classified by INR

Demographics	Group A INR≤0.9 (n=93)	Group B 0.9<INR≤1.0 (n=268)	Group C INR>1.0 (n=191)	P Value
Age*(years)	55.1±11.6	54.8±11.4	56.1±12.4	0.457
Gender§				0.721
Male	41(44.1%)	118(44.0%)	91(47.6%)	
Female	52(55.9%)	150(56.0%)	100(52.4%)	
Contralateral THA§	27(29.0%)	45(16.8%)	40(20.9%)	0.039
BMI*#(kg/m ²)	23.4±2.9	23.4±3.3	23.4±3.5	0.976
ASA class§				0.006
1	18(19.4%)	26(9.7%)	13(6.8%)	
2	56(60.2%)	176(65.7%)	109(57.1%)	
3	18(19.4%)	62(23.1%)	64(33.5%)	
4	1(1.1%)	4(1.5%)	5(2.6%)	
Comorbidities				
Hypertension§	21(22.6%)	60(22.4%)	47(24.6%)	0.847
Diabetes mellitus§	4(4.3%)	14(5.2%)	11(5.8%)	0.904
COPD§	0(0.0%)	5(1.9%)	6(3.1%)	0.227
Heart disease§	2(2.2%)	5(1.9%)	5(2.6%)	0.925
Arrhythmia§	3(3.2%)	19(7.1%)	16(8.4%)	0.269
Cancer§	2(2.2%)	5(1.9%)	2(1.0%)	0.735
Renal insufficiency§	0(0.0%)	4(1.5%)	3(1.6%)	0.685
SLE§	3(3.2%)	8(3.0%)	7(3.7%)	0.948
AS§	1(1.1%)	9(3.4%)	7(3.7%)	0.541
Venous thrombosis§	1(1.1%)	5(1.9%)	4(2.1%)	1.000
Asymptomatic bacteriuria§	4(4.3%)	22(8.2%)	23(12.0%)	0.085
Cardiac pacemaker§	0(0.0%)	0(0.0%)	4(2.1%)	0.030
Pre-operative laboratory				
Hemoglobin* (g/L)	136.1±14.5	133.6±15.3	131.4±16.9	0.059
Hematocrit* (L/L)	0.415±0.037	0.406±0.041	0.398±0.045	0.006
ESR* (mm/h)	25.16±18.3	25.0±16.8	25.6±20.3	0.942
Platelet count* (×10 ⁹)	185.5±60.4	184.6±62.3	178.8±62.0	0.551
WBC count* (×10 ⁹)	6.1±1.6	6.2±2.1	5.8±1.8	0.076
D-Dimer* (mg/L)	0.73±1.0	0.73±0.9	0.9±1.0	0.314
Serum albumin*(g/L)	44.8±4.7	43.8±4.1	42.9±4.5	0.003

BMI, body mass index; ASA, American Society of Anesthesiologists; COPD, Chronic Obstructive Pulmonary Diseases; SLE, Systemic Lupus Erythematosus; AS, Ankylosing Spondylitis; WBC, White Blood Cell.

*Continuous variables are exhibited as the mean and the standard deviation, analysed by the one-way ANOVA.

§Categorical variables are exhibited as the number of cases (the percentage), analysed by the Pearson chi-square test or the Fisher exact test.

#Among the BMI, 11 cases in group B and 2 cases in group C did not acquire BMI data.

TABLE 2. Clinical outcomes for cases of THA classified by INR

Outcomes	Group A INR≤0.9 (n=93)	Group B 0.9<INR≤1.0 (n=268)	Group C INR≥1.0 (n=191)	P value A vs. B vs. C	P value A vs. B	P value A vs. C	P value B vs. C
Transfusion rate§	1(1.08%)	3(1.12%)	11(5.76%)	0.008	1.000	0.112	0.004
Blood Loss* (ml)	895.6±378.3	915.9±353.2	978.7±390.3	0.111	0.892	0.180	0.174
Maximum Hb drop* (g/L)	25.7±10.5	26.3±9.9	27.3±9.9	0.382	0.857	0.406	0.553
Anemia need medication§	15(16.1%)	56(20.9%)	45(23.6%)	0.350	0.319	0.150	0.497
Length of stay* (days)	4.7±1.6	5.1±2.0	5.7±2.2	0.000	0.243	0.000	0.007

*Continuous variables are exhibited as the mean and the standard deviation, analysed by the one-way ANOVA with post-hoc Tukey test.

§Categorical variables are exhibited as the number of cases (the percentage), analysed by the Pearson chi-square test or Fisher test.

TABLE 3. Complication and mortality outcomes in 90 days for cases of THA classified by INR

Outcomes	Group A INR≤0.9 (n=93)	Group B 0.9<INR≤1 (n=268)	Group C INR≥1 (n=191)	P value A vs. B vs. C	P value A vs. B	P value A vs. C	P value B vs. C
Any Complication§	10(10.8%)	44(16.4%)	43(22.5%)	0.040	0.187	0.017	0.101
Urinary tract infection§	0(0.0%)	0(0.0%)	0(0.0%)	NA	NA	NA	NA
Renal failure§	0(0.0%)	0(0.0%)	0(0.0%)	NA	NA	NA	NA
Stroke§	0(0.0%)	0(0.0%)	0(0.0%)	NA	NA	NA	NA
Cardiovascular accident§	0(0.0%)	1(0.4%)	4(2.1%)	0.157	1.000	0.307	0.166
Pneumonia§	0(0.0%)	0(0.0%)	1(0.5%)	0.514	NA	1.000	0.416
Stroke§	0(0.0%)	0(0.0%)	0(0.0%)	NA	NA	NA	NA
Septic shock§	0(0.0%)	0(0.0%)	0(0.0%)	NA	NA	NA	NA
Pulmonary embolism§	0(0.0%)	0(0.0%)	0(0.0%)	NA	NA	NA	NA
DVT§	1(1.1%)	0(0.0%)	0(0.0%)	0.168	0.258	0.327	NA
Superficial infection§	0(0.0%)	5(1.9%)	5(2.6%)	0.358	0.334	0.176	0.748
Deep infection§	0(0.0%)	0(0.0%)	0(0.0%)	NA	NA	NA	NA
Dislocation§	1(1.1%)	1(0.4%)	3(1.6%)	0.321	0.449	1.000	0.312
Fracture§	0(0.0%)	0(0.0%)	2(1%)	0.264	NA	1.000	0.173
Muscular vein thrombosis§	2(2.2%)	11(4.1%)	10(5.2%)	0.473	0.528	0.348	0.568
Subcutaneous ecchymosis§	6(6.5%)	21(7.8%)	17(8.9%)	0.769	0.662	0.478	0.683
Hematoma§	0(0.0%)	3(1.1%)	2(1.0%)	0.856	0.572	1.000	1.000
Wound-healing delay§	1(1.1%)	3(1.1%)	4(2.1%)	0.718	1.000	1.000	0.457
Re-operation§	0(0.0%)	2(0.7%)	4(2.1%)	0.272	1.000	0.307	0.239
Mortality in 90 days§	0(0.0%)	0(0.0%)	0(0.0%)	NA	NA	NA	NA
Mortality in 12 months	0(0.0%)	0(0.0%)	2(1.0%)	0.264	NA	1.000	0.173

DVT, deep venous thrombosis.

*Continuous variables are exhibited as the mean and the standard deviation, analysed by the one-way ANOVA with post-hoc Tukey test.

§Categorical variables are exhibited as the number of cases (the percentage), analysed by the Pearson chi-square test or Fisher test.

TABLE 4. Outcomes of Binary Logistic Regressions on Transfusion

Factor	Transfusion rate	
	OR (95% CI)	P value
Unadjusted		
INR class		
INR $\leq$ 0.9	Reference	-
0.9 < INR < 1	1.04 (0.11 to 10.14)	0.972
INR $\geq$ 1	5.62 (0.72 to 44.22)	0.101
Adjusted*		
INR class		
INR $\leq$ 0.9	Reference	-
0.9 < INR < 1	0.34 (0.03 to 3.90)	0.384
INR $\geq$ 1	1.11 (0.11 to 11.00)	0.929

*Adjusted for contralateral THA, ASA class, asymptomatic bacteriuria, cardiac pacemaker, pre-operative hemoglobin, hematocrit, WBC count and serum albumin.

TABLE 5. Outcomes of Binary Logistic Regressions on complication in 90 days

Factor	Complication rate in 90 days	
	OR (95% CI)	P value
Unadjusted		
INR class		
INR $\leq$ 0.9	Reference	-
0.9 < INR < 1	1.63 (0.79 to 3.39)	0.190
INR $\geq$ 1	2.41 (1.15 to 5.05)	0.020
Adjusted*		
INR class		
INR $\leq$ 0.9	Reference	-
0.9 < INR < 1	1.43 (0.67 to 3.02)	0.353
INR $\geq$ 1	1.93 (0.89 to 4.19)	0.096

*Adjusted for contralateral THA, ASA class, asymptomatic bacteriuria, cardiac pacemaker, pre-operative hemoglobin, hematocrit, WBC count and serum albumin.

Figures

Figure 1

Flow diagram of cases involved

Figure 2

Outcomes of the length of stay