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Original Research

Aspirin is Not for Everyone: Discharge to Non-home Facilities After Total Hip and Knee Arthroplasty Increases Risk of Venous Thromboembolism

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ABSTRACT

Background: Patients discharged to non-home facilities (NHD) after total hip arthroplasty (THA) and total knee (TKA) arthroplasty experience higher rates of adverse events and may require more aggressive venous thromboembolism (VTE) chemoprophylaxis. Our aim was to compare the rates of VTE in NHD patients and those discharged home (HD) after THA/TKA. Our secondary aim was to determine VTE rates within HD and NHD groups when stratified by chemoprophylactic regimen.

Methods: A retrospective cohort of primary THA and TKA patients were stratified into HD and NHD, then allocated into groups by chemoprophylactic regimen on discharge: aspirin alone (AA), more aggressive (MA) chemoprophylaxis, and other regimens (other). The primary outcome was VTE. Rates of VTE in HD and NHD patients, as well as AA and MA regimens, were analyzed using a generalized linear regression model.

Results: Six thousand three hundred seventy-nine patients were included with 1.03% experiencing VTE. HD had lower rates of VTE compared to NHD (0.83% vs 2.17%, $P < .001$). AA had similar rates of VTE compared to MA (0.99% vs 1.08%, $P = .82$). NHD patients had a lower VTE rate with MA vs AA prophylaxis (1.47% vs 3.83%, $P = .016$). HD patients treated with AA vs MA had no difference in VTE rates (0.76% vs 0.96%, $P = .761$).

Conclusions: NHD patients have higher rates of VTE than HD patients. However, NHD patients have significantly lower rates of VTE on MA chemoprophylaxis compared to those on AA. Providers should consider prescribing MA VTE chemoprophylaxis for NHD patients. Prospective, randomized studies are necessary to confirm these recommendations.

Introduction

Although total hip arthroplasty (THA) and total knee arthroplasty (TKA) are highly successful procedures, the risk of postoperative venous thromboembolism (VTE) is well established and increases patient morbidity, mortality, and costs to society [1]. Creation of clinical practice guidelines helps practitioners mitigate this risk [2]. Fortunately, the incidence of postoperative VTE has reduced with modern protocols including more rapid mobilization, mechanical prophylaxis, improved pain control, and increased use of regional anesthesia [3,4].

Discharge destination after total joint arthroplasty is most commonly home; however, a substantial portion are discharged to non-home facilities, including skilled nursing facilities or inpatient rehabilitation [5-8]. Predictors for non-home discharge (NHD) include older age, female sex, higher body mass index (BMI), increased comorbidities, American Society of Anesthesiology (ASA) class III or IV, smoking status, and preoperative functional status [6,7,9,10]. It has been shown that NHD patients have higher rates of adverse events and readmissions [5-8,11], and NHD is an independent predictor of 30-day complications [5]. Conversely, discharge to home is an independent variable shown to have

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decreased 30-day complication rates and readmissions [12]. Although many have reported on the increased risk that comes with NHD, the focus is often on combined adverse events [5,7,8,12] with no reports specifically highlighting the rates of VTE in NHD patients compared to home discharge (HD) patients. Given the current trend toward using less aggressive agents, such as aspirin, for chemoprophylaxis against postoperative VTE [13,14], it is possible that this higher-risk population may benefit from more aggressive (MA) anticoagulation. Therefore, we aimed to evaluate the risk of VTE in HD patients vs NHD patients and, secondarily to assess if choice of postoperative chemoprophylactic regimen is associated with VTE rates in the two groups of patients. We hypothesized that NHD patients would have higher rates of VTE. We also hypothesized that NHD patients on MA chemoprophylaxis would have lower rates of VTE compared to NHD patients on aspirin alone (AA) and that HD patients on MA chemoprophylaxis would have similar VTE rates to HD patients on AA.

Material and methods

Prior to study initiation, exempt status was received from our institutional review board. A retrospective cohort review of primary TKA and primary THA cases performed at a single institution from 2/1/2012 to 12/13/2020 was conducted. Potential subjects were identified utilizing the Michigan Arthroplasty Registry Collaborative Quality Initiative Database (MARCQI), and medical charts were reviewed using our institution's electronic medical record system. Cases were performed at a tertiary care hospital throughout the duration of the study period, as well as at an ambulatory surgery center beginning from 2/12/2019 onward. Minimum patient age was 18 years old. Bilateral cases, conversion arthroplasty, THA for femoral hip fractures, hemiarthroplasty, unicompartmental knee arthroplasty, and cases resulting in death were excluded. Unicompartmental operations did not have a high enough number of VTE occurrences to reliably complete this analysis and were thus omitted.

The primary outcomes of VTE such as deep venous thrombosis (DVT) and pulmonary embolism (PE) were identified. As prescribed by MARCQI, a DVT is defined as a blood clot below the diaphragm diagnosed with confirmatory imaging within 90 days after surgery, and a PE is defined as a blockage in a lung artery diagnosed with confirmatory imaging within 90 days of surgery. These VTE events are detected from diagnoses in the electronic medical record. Cases were stratified into home discharge (HD) and NHD. NHD was defined as a skilled nursing facility or an inpatient rehabilitation facility. Patients were then allocated into two groups by chemoprophylactic regimen on discharge: AA and MA chemoprophylaxis. MA chemoprophylaxis was defined as the use of warfarin, factor Xa inhibitor, direct thrombin inhibitor, low-molecular-weight heparin, pentasaccharide, and antiplatelet agents, with or without concurrent aspirin. Secondary variables collected include patient demographics (age, sex, BMI) and other factors (tobacco use, ASA classification, preoperative anticoagulation, procedure type (TKA/THA), and history of VTE).

Data was formatted and analyzed using Python 3 with semi-automated search and sort methods. Postoperative complications were searched for indications of VTE, and perioperative discharge data was sorted into HD and NHD supersets. Data was also sorted into groups based on chemoprophylaxis type, chronic smoking status (smoking/non), procedure type (primary THA/TKA), ASA group (I-II/III-IV), preoperative history of VTE (Y/N), and preoperative anticoagulation status (Y/N). The newly sorted columns were then analyzed using a generalized logistic regression in RStudio 1.4.1717. In this model, each of the independent variables listed were modeled as a 2-class discrete variable against the occurrence of VTE, with the exception of the continuous BMI data. The interaction term between discharge location and prophylaxis regimen was also measured. Demographic data and rates for each modeled variable were reported along with *P*-values, with $P < .05$ considered as the threshold for significance.

A total of 6379 patients were included, and corresponding demographic information can be found in Table 1. The mean age was 64.4 years, with 53.9% women. 2536 (39.76%) patients underwent TKA, and 3843 (60.24%) underwent THA. There were 5413 HD patients (84.9%), and 966 NHD patients (15.1%). Post-hoc sample size calculations ($n = 4638$, $n = 1538$, and $n = 848$) were estimated to detect 1%, 2%, and 3% change in rates, respectively, between groups with power = 80%, alpha = 0.05, and a baseline VTE incidence of 1%.

Results

Among all included patients, a total of 66 experienced a VTE event (1.03%), with 45 in the HD cohort and 21 in the NHD cohort. HD patients had significantly lower rates of VTE than NHD patients (0.83% vs 2.17%, $P < .001$) (Fig. 1). There were 37 patients with a VTE event in the AA group (0.99%) and 29 in the MA group (1.08%) ($P = .82$). Smoking status, preoperative BMI, procedure type (THA vs TKA), and preoperative anticoagulation status were not associated with a postoperative VTE complication.

Prophylaxis group showed a stronger effect on NHD patients than on HD patients ($P = .025$). When discharge location was held at NHD, there was a significant association with lower VTE rates for patients treated with MA compared to AA (1.47% vs 3.83%, $P = .016$) (Fig. 2). When discharge location was held at HD, a significant difference was not found between AA or MA (0.76% vs 0.96%, $P = .761$). This suggests a lower rate of VTE with NHD patients discharged on MA.

Our regression analysis found that ASA class III or IV (as opposed to I or II) and a preoperative history of VTE both independently and significantly increased the odds of postoperative VTE. After removing these factors (ASA class III or IV and a preoperative history of VTE) from the model, there was a change of <0.02 in the interactive *P*-value between discharge location and prophylaxis group, suggesting that ASA class and VTE history are effect modifiers rather than confounding variables. This robustness in the model suggests that the significant interactive effect between discharge location and prophylaxis group is less well explained by other factors in the model, including ASA class and VTE history.

Discussion

Discharge disposition to facilities other than home as part of the postacute care setting has significant implications on cost and outcomes. Multiple database studies have recently evaluated complications between discharge to skilled nursing facilities (SNF) and home. Total joint arthroplasty (TJA) patients discharged to SNF have decreased functional outcomes and increased complications and/or readmission [7,11,15,16]. Such studies, however, seldom directly compare single complications that have modifiable treatment options. The current study, to our knowledge, represents the first study specifically looking at VTE incidence between HD and NHD patients with respect to AA vs MA chemoprophylaxis while controlling for other perioperative and patient history factors.

We found patients discharged to non-home facilities to have higher rates of VTE than those discharged to home. This was illuminated in our statistical model by the interactive effect between discharge location and VTE group, suggesting that the presence of both factors together had a larger effect than the sum of each individually. Keswani et al. reported a similar finding in a retrospective review of over 100,000 TJA patients using the National

Table 1
Study demographics.

Variable	Unit	Population	AA | HD	MA |HD	AA | NHD	MA | NHD	*P* value
Group, N	n	6379	3427	1986	287	679	N/A
Age, mean (SD)	years	64.62 (11.77)	63.64 (10.79)	62.19 (12.65)	72.20 (10.76)	70.05 (10.76)	N/A
BMI, mean (SD)	kg/m^2	30.06 (5.02)	30.01 (4.90)	29.98 (5.05)	29.88 (5.47)	30.62 (5.32)	.120
Gender, n (%)	Female	3439 (53.91)	1805 (52.67)	968 (48.74)	215 (74.91)	251 (36.97)	N/A
Smoking status, n (%)	Smoker	3017 (47.30)	1594 (46.51)	921 (46.37)	150 (52.26)	352 (51.84)	.802
ASA score, n (%)	I-II	3628 (56.87)	2180 (63.61)	1069 (53.83)	119 (41.46)	260 (38.29)	.023
Preoperative history of VTE, n (%)	No	5879 (92.16)	3372 (98.40)	1675 (84.34)	276 (96.17)	556 (81.89)	.002
Procedure TKA/THA, n (%)	TKA	2536 (39.76)	1380 (40.27)	748 (37.66)	143 (49.83)	265 (39.03)	.328
Preoperative anticoagulation, n (%)	No	5908 (92.62)	3425 (99.94)	1641 (82.63)	287 (100.00)	555 (81.74)	.123

Surgical Quality Improvement Program database. They report a NHD VTE rate of 1.2%. This is lower than the 3.8% VTE occurrence in our NHD patient group and may possibly be attributed to geography-specific or database collection differences [7]. It is also possible that our NHD patients had a higher rate of detection of subclinical or asymptomatic VTE, which has been found to be as high as 6% in one study [17].

Our study found no difference in VTE rates between NHD patients on MA chemoprophylaxis and patients discharged home on MA chemoprophylaxis. However, patients discharged to non-home facilities on AA had higher rates of VTE than patients discharged to home on AA. The use of AA for VTE prophylaxis is becoming more popular and has proven to be safe and effective [13,14,18]. However, the previous studies that caused this shift toward favoring an AA regimen did not separate discharge disposition as a variable. The findings from the current study suggest AA may be inferior to MA chemoprophylaxis, specifically in patients who are discharged to non-home facilities.

Our study found an ASA class of III or IV to be an independent predictor of postoperative VTE. This is consistent with an earlier report in the literature that high ASA scores are risk factors for DVT or PE after primary THA and TKA [19]. However, once our study population's risk factors were appropriately controlled for and effect modifiers analyzed, we found that NHD independently predicted higher VTE rates regardless of ASA class. We determined that ASA class is an effect modifier rather than a confounder, as it may play a role in predicting VTE incidence but does not explain the causal relationship. A recent study comparing healthy patients treated with low-molecular-weight heparin to unhealthy patients treated with continued low-dose aspirin after THA and TKA showed similar results, where ASA class did not predict VTE complications within 30 days after surgery [20]. Clinically, the regression analysis in the present study suggests that NHD patients have an inherently higher risk of VTE and should be given MA prophylaxis rather than AA as opposed to HD patients ($P = .024$).

Owens et al. found that in a cohort of Medicare and SNF-eligible patients, SNF discharge was the strongest predictor of 30-day complications after TJA. They found a significant difference in DVT and PE rates between SNF and HD (DVT rate of 1.1 vs 0.7 $P < .001$; PE rate of 0.8 vs 0.6 $P = .003$) [5]. Their unique patient selection process of only selecting SNF eligible patients for inclusion and multivariate regression analysis highlights the increased risk of complication associated with SNF discharges compared to home for any health status. Our study corroborates these findings in that worse perioperative health status by itself does not completely account for NHD patients acquiring more VTEs [5]. Therefore, giving MA chemoprophylaxis to unhealthy patients only would not completely mitigate the VTE risk associated with NHD itself.

In a National Surgical Quality Improvement Program database study of 101,256 patients by McLawhorn et al., increased odds of respiratory, septic, thromboembolic, and urinary complications within 30-days postdischarge following TKA were discovered. Specifically, the authors found increased odds of VTE in patients discharged to non-home locations compared to those being

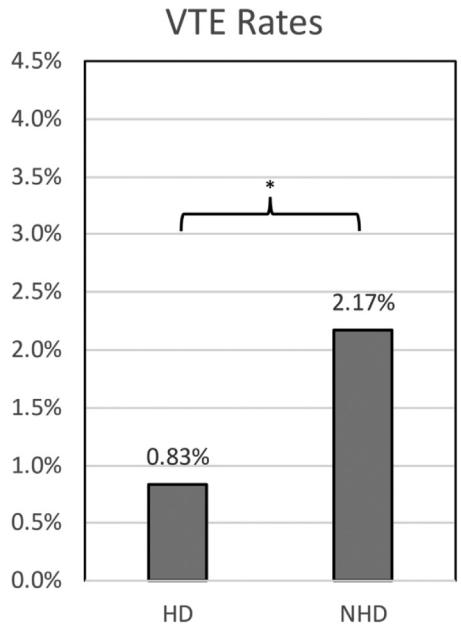

Figure 1. VTE rate in HD vs NHD. Postoperative VTE complications are significantly lower in the HD cohort, *$P < .001$.

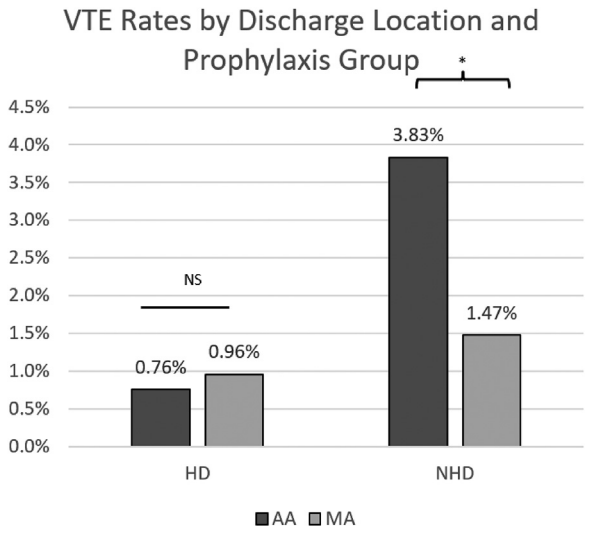

Figure 2. VTE rate by chemoprophylaxis regimen and discharge location. VTE complications are significantly lower in the MA NHD group compared to the AA NHD group, *$P < .016$. No difference was found in the MA group.

discharged to home (odds ratio = 1.58; 95% confidence interval, 1.34-1.85) [10]. After using propensity-adjusted multivariable logistic regression to account for predischarge confounding variables, they continued to find NHD as an independent variable associated with increased odds for VTE, which is similar to the findings in the present study. They concluded that NHD to skilled facilities after elective arthroplasty cases represented a low value service with inferior outcomes and increased cost during the postacute period of 30 days, as well as no long-term benefit. Thus, care pathways should be designed to support and encourage early HD. This can be accomplished with improved preoperative education, postoperative pain management, and early ambulation [11].

The findings by both Owens et al. and McLawhorn et al. corroborate our study results and indicate that MA chemoprophylaxis should be considered for patients discharging to a non-home location. Further, this suggests that while MA anticoagulation should be considered for NHD patients, there is also a protective benefit of encouraging discharge to home. This combination increases value through decreased complications, readmissions, and health care costs.

Readers may infer that patients discharged to home are more likely to ambulate early and mobilize by performing activities of daily living than NHD patients, though a quantitative analysis to prove this inference would be difficult to execute using the dataset available. The present study may serve as a lens into early mobilization and generate a new question: do patients who walk less after surgery require MA chemoprophylaxis? This opens the door for future studies regarding quantitative amounts of mobilization as a protective measure from VTE.

Our study is not without limitations. First, the data we present is from a quality improvement registry (MARCQI) from a single state (Michigan), where the data from participating institutions and surgeons is used and shared to help standardize best practice. Thus, our findings may not be generalizable to other populations. Moreover, this is a retrospective review of an infrequent complication, as we found the overall rate of VTE to be 1.03%. The small number of total VTE events limited our ability to stratify the studied cohorts by procedure type, as the analysis would have been underpowered. Further, the data completeness rate is not quantifiable within our data, as VTE events are captured only if they are available in participating electronic medical records. This may not include patients who have followed up elsewhere or have left the state. This likely has negligible impact on the study results given the infrequent occurrence of VTE and the robust MARCQI database. In addition, migration out-of-state within 1 year of TJA has been reported to be low in the literature [21]. Further, the potential adverse events related to using MA chemoprophylaxis were not assessed. A recent study comparing rivaroxaban to aspirin following TKA and THA demonstrated similar effects in prevention of VTE between the two regimens, although rivaroxaban corelated with increased need for blood transfusions [22]. Providers will need to weigh the risks of blood transfusions with the devastating risks of VTE, especially in a high-risk population, and may be compelled to prescribe chemoprophylaxis stronger than AA. Further research will need to be done to specifically identify patients who are discharged to non-home facilities on MA chemoprophylaxis and the rates of complications due to anticoagulation such as major bleeding, wound complications, and need for blood transfusion. As with the treatment plan in many studies, the prophylactic regimens in our study were at the discretion of the various treating surgeons, so protocols and durations of prophylaxis were not completely standardized. Since there has been a large push recently to prescribe only aspirin for DVT prophylaxis, we decided to use AA as one group compared to a group of other MA chemoprophylaxis to determine if this AA movement, irrespective of duration, is appropriate for all patients. Although the MA chemoprophylactic group was not separated based on individual chemoprophylactic agents and we are unable to determine which specific MA chemoprophylaxis regimen is most appropriate for this NHD population, we can confirm that AA is inferior in patients who discharge to non-home facilities. Over the course of the study period, perioperative protocols have been modified, and there may be an effect of surgical era, which we are unable to control. We have hopes that this present study and those similar will help to create improved guidelines for VTE chemoprophylaxis and therefore improve ongoing research with standardized medication regimen and durations.

Conclusions

Patients discharged to non-home facilities have higher rates of VTE than those discharged to home. Of patients discharged to non-home facilities, those discharged on AA have significantly higher rates of VTE than those discharged on MA chemoprophylaxis. However, there is no difference in VTE rates among HD patients between those discharged on AA and those discharged on MA chemoprophylaxis. Therefore, patients should be encouraged to discharge home when safe. Those discharged to non-home facilities after THA and TKA should be considered for MA chemoprophylaxis than AA. Further prospective, randomized studies are necessary to confirm these recommendations.

Conflicts of interest

E. Dailey receives partial support from the MARCQI joint registry for administrative work and is an editorial board member of Arthroplasty Today. All other authors declare no potential conflicts of interest.

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CRediT authorship contribution statement

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