Patient ethnicity and use of venous thromboembolism prophylaxis

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Abstract

Objective. Patients at highest risk for developing venous thromboembolism include those undergoing major orthopedic surgery. However, physicians vary in their strategies to prevent venous thromboembolism. We evaluated whether the use of venous thromboembolism prophylaxis after orthopedic surgery is related to patient ethnicity.


Study participants. 1811 adults (1085 women; 743 Asians; 206 Pacific Islanders; mean age 70.6 ± 14.7 years) who underwent hip replacement, hip fracture surgery, or total knee replacement.

Main outcome measures. Use of venous thromboembolism prophylaxis as recommended by the American College of Chest Physicians. Multivariable logistic regression was used to identify factors associated with prophylaxis use.

Results. Overall, 49.4% of patients received venous thromboembolism prophylaxis. After adjustment for patient age, sex, thromboembolism and bleeding risk factors, type of surgery, and anesthesia, Japanese patients were less likely to receive prophylaxis [odds ratio (OR) = 0.7; 95% confidence interval (CI) = 0.5–0.9; \( P = 0.01 \)], whereas other ethnic groups were treated similarly to whites. Relative to patients undergoing hip replacement, those with hip fracture surgery were less likely (OR = 0.4; 95% CI = 0.3–0.5; \( P < 0.01 \)), and those receiving total knee replacement more likely (OR = 4.5; 95% CI = 3.6–5.7; \( P < 0.01 \)) to receive appropriate prophylaxis.

Conclusion. Despite consensus recommendations, venous thromboembolism prophylaxis use among high-risk patients remains low. Japanese patients and those undergoing hip fracture surgery are at particular risk for not receiving appropriate prophylaxis in our population. Further research is needed to clarify the reasons for our findings and to determine if this variation is associated with increased risk of thromboembolic complications.

Keywords: ethnicity, prophylaxis, thromboembolism, venous thrombosis

Patients at highest risk for venous thromboembolism include those undergoing major orthopedic surgery. Without prophylaxis, ~50–60% of these patients develop deep vein thrombosis (DVT) [1,2]. Practice guidelines recommend prophylaxis, such as low-molecular-weight heparin or warfarin, to decrease the risk of DVT by ~60–70% in these patients [1].

Despite such guidelines, patients are not consistently treated accordingly [3–5]. Among orthopedic surgery patients, use of recommended thromboprophylaxis has varied from 45.2% in hip fracture repair to, more recently, 89% in hip replacement and 91% in knee replacement [5,6].

Prior studies, however, have not identified patient-related factors associated with appropriate venous thromboembolism prophylaxis use, other than type of surgery. In particular, patient ethnicity has not been examined as a potential determinant of prophylaxis use.

Current information on the risk of venous thromboembolism among Asians and Pacific Islanders is conflicting. Some studies estimate the risk at one-fifth to half that of whites [7–9], whereas others suggest that the risk is similar to that of whites [10]. It remains unknown whether this information has affected the use of appropriate venous thromboembolism prevention strategies in high-risk patients. Furthermore, some studies have indicated that healthcare quality among Asians and Pacific Islanders in the US varies from that of whites [11,12]. We hypothesized that prophylaxis use in our population would vary according to patient ethnicity.

In this retrospective cohort study, we examined the use and determinants of venous thromboembolism prophylaxis in Asian Americans, Pacific Islanders, and whites who received elective hip replacement, total knee replacement, and hip fracture surgery. Identifying the factors related to variation in prophylaxis may lead to focused strategies in improving healthcare quality.

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Methods

Study population

We analyzed all patients hospitalized for hip replacement, total knee replacement, and hip fracture surgery at a large, university-affiliated hospital in Honolulu, Hawaii (September 1998-June 2002). We selected patients based on procedure and diagnosis codes from the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) [13]. Hip replacement was defined as total, partial, or revision hip replacement (81.51, 81.52, 81.53), without a diagnosis of hip fracture (820.XX or 733.14). Total knee replacement was identified as knee replacement or revision (81.54, 81.55). Patients receiving hip fracture surgery were identified if they had a diagnosis of hip fracture (820.XX, 733.14) and underwent either hip replacement (81.51, 81.52, 81.53) or hip fracture repair (79.15, 79.25, 79.35). Prior approval from the appropriate institutional review boards was obtained.

We excluded patients with incomplete laboratory or anesthesia data (n = 824), those less than 18 years of age (n = 18), and patients with hemophilia (n = 2) or central nervous system malignancy (n = 1). Patients with hip fracture who had suffered major trauma were excluded, given possible contraindications to venous thromboembolism prophylaxis (n = 236). We also excluded those who underwent two or more different orthopedic surgeries during the same admission (n = 15). For patients in whom the orthopedic surgery was repeated during the same admission, information regarding the second procedure was not included in the analyses (n = 32). Excluded patients did not differ statistically significantly from patients included in our analyses with respect to ethnicity, sex, age, or type of surgery received.

Measures of prophylaxis

We used data from our institution’s electronic database, which contains pharmacy and laboratory data, nursing and physician orders, discharge diagnoses, and procedure codes. Diagnoses are recorded using ICD-9-CM codes [13].

Data obtained included type and frequency of venous thromboembolism prophylaxis. Based on guidelines from the American College of Chest Physicians (ACCP), we identified appropriate venous thromboembolism prophylaxis as (i) subcutaneous injections of 30 mg enoxaparin (formulary low-molecular-weight heparin) twice daily, started on the day of or the day after surgery, or 40 mg daily, started the day of or the day before surgery; (ii) warfarin 5–10 mg given orally the day of or the day after surgery; or (iii) intermittent pneumatic compression as an alternative for those receiving total knee replacement. We did not require specific starting times for the definition of appropriate prophylaxis, given our attempt to identify appropriate prophylaxis liberally. Physician orders were used in determining medication use, rather than documentation of medication administration, as the former provided more complete information.

Additional data obtained included laboratory values, patient weights, demographics, and type of anesthesia. Patients were defined as having additional risk factors for venous thromboembolism if they had at least one of the following: obesity (defined as a discharge diagnosis of obesity or weight >90 kg, as patient heights were not available for body mass index calculation) or a discharge diagnosis of cancer, prior venous thromboembolism, lower extremity varicose veins or paralysis, hypercoagulable states, nephrotic syndrome, inflammatory bowel disease, or congestive heart failure [1,2,14]. Potential contraindications to venous thromboembolism prophylaxis included bleeding risk factors used as exclusion criteria in trials of low-molecular-weight heparin for venous thromboembolism prevention [15]. Patients were defined as having bleeding risk factors if they had at least one of the following: bleeding disorders (discharge diagnosis of coagulopathy, perioperative platelet count <100000/μL, or periperteative creatinine >2.0 mg/dL) or a discharge diagnosis of liver disease, gastrointestinal ulcer, bacterial endocarditis, gastrointestinal angiodysplasia, prosthetic cardiac valve, or active bleeding.

Statistical analyses

All analyses were performed using SAS Software Version 8.2 (SAS Institute, Cary, NC). We used chi-square and Fisher’s exact tests for univariate comparisons of categorical variables. Continuous variables (length of stay and age) were compared across surgery type with tests for analysis of variance. We performed logistic regression to identify predictors of appropriate venous thromboembolism prophylaxis, adjusting for patient age, sex, ethnicity, type of surgery and anesthesia, presence of ≥1 risk factor for venous thromboembolism other than orthopedic surgery, and presence of ≥1 bleeding risk factor.

Variables included in the models were chosen based on a P-value < 0.10 in the unadjusted analyses, as well as those variables clinically expected to be associated with prophylaxis use. We report adjusted odds ratios (OR) and 95% confidence intervals (CI) for adjusted analyses.

Results

Patient characteristics

We identified 2907 patients with hip replacement, total knee replacement, or hip fracture surgery. A total of 1096 patients were excluded based on the above criteria. Of the remaining 1811, 1085 (59.9%) were women, 207 (11.4%) Pacific Islander, and 743 (41.0%) Asian, including 22.3% Japanese, 8.1% Chinese, and 6.3% Filipinos. Mean age (±SD) was 70.6 ± 14.7 years (Table 1). We report results for Chinese (n = 147) and Filipino (n = 114) patients, with other ethnicities as a single ‘Other’ category, given their small numbers and similarities in characteristics and prophylaxis use between these groups.
Hip replacement was performed in 36.8% (n = 666), hip fracture surgery in 24.6% (n = 446), and total knee replacement in 38.6% (n = 699). Patient characteristics generally differed between surgery groups (Table 1). Women comprised 52.7% of those receiving hip replacement, as compared with 72.6% of those with hip fracture surgery (P < 0.001). Those receiving hip fracture surgery were also more likely to be older, of Japanese ethnicity, to have at least one bleeding risk factor, or to receive regional anesthesia alone, as compared with patients in other surgery groups. Conversely, they were less likely to be obese, of Pacific Islander ethnicity, or to have private insurance. At least one additional venous thromboembolism risk factor other than surgery was present in 22.9% of patients (n = 415), including 17.7% with obesity. At least one bleeding risk factor was present in 7.3% (n = 133).

Unadjusted rates of venous thromboembolism prophylaxis

Overall, 49.4% of patients (n = 895) received venous thromboembolism prophylaxis as recommended by the ACCP. Even after excluding patients with potential contraindications to prophylaxis, including those with bleeding risk factors (n = 244) and those treated with regional anesthesia (n = 753), only 52.5% (n = 512) received appropriate prophylaxis.

We found significant differences by surgery group in unadjusted rates of prophylaxis use (Table 2). Only 19.7% of hip fracture surgery patients received appropriate prophylaxis, as compared with 41.6% of those undergoing hip replacement, and 75.8% of total knee replacement patients (P < 0.001). Of those undergoing total knee replacement, 37.6% (n = 263) were treated with appropriate pharmacologic prophylaxis (low-molecular-weight heparin or warfarin), with or without intermittent pneumatic compression and 38.2% (n = 267) were treated with intermittent pneumatic compression alone.

Unadjusted overall rates of appropriate venous thromboembolism prophylaxis also varied significantly by patient ethnicity, with Japanese patients being less likely to receive prophylaxis than whites, whereas other ethnicities were treated similarly to whites (Table 2). Additional patient characteristics significantly associated with lower rates of prophylaxis overall included age >75 years, use of regional anesthesia alone, and the presence of bleeding risk factors. Obese patients and those with venous thromboembolism risk factors were more likely to receive prophylaxis. Overall, prophylaxis use was not related to patient sex or insurance status.

Among those undergoing hip replacement, Japanese patients, men, and those treated with regional anesthesia alone were significantly less likely to receive appropriate prophylaxis. Those with venous thromboembolism risk factors were more likely to receive prophylaxis. Among those receiving hip fracture surgery, Japanese patients were again less likely to be treated with appropriate prophylaxis than whites. Among total knee replacement patients, ethnicity was not associated with prophylaxis use, but women were significantly less likely to receive appropriate treatment than men (Table 2).

Table 1  Comparison of patient characteristics by surgery group

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All patients (n = 1811)</th>
<th>Hip replacement (n = 666)</th>
<th>Hip fracture surgery (n = 446)</th>
<th>Total knee replacement (n = 699)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female [n (%)]</td>
<td>1085 (59.9)</td>
<td>351 (52.7)</td>
<td>324 (72.6)</td>
<td>410 (58.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean age ± SD</td>
<td>70.6 ± 14.7</td>
<td>64.6 ± 14.6</td>
<td>79.9 ± 14.9</td>
<td>70.3 ± 11.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age &gt;75 years [n (%)]</td>
<td>765 (42.2)</td>
<td>178 (26.7)</td>
<td>328 (73.5)</td>
<td>259 (37.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Ethnicity [n (%)]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>803 (44.3)</td>
<td>338 (50.7)</td>
<td>188 (42.2)</td>
<td>277 (39.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Japanese</td>
<td>403 (22.3)</td>
<td>128 (19.2)</td>
<td>109 (24.4)</td>
<td>166 (23.7)</td>
<td>0.06</td>
</tr>
<tr>
<td>Pacific Islander</td>
<td>207 (11.4)</td>
<td>93 (14.0)</td>
<td>29 (6.5)</td>
<td>85 (12.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Other</td>
<td>398 (22.0)</td>
<td>107 (16.1)</td>
<td>120 (26.9)</td>
<td>171 (24.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Obese [n (%)]</td>
<td>321 (17.7)</td>
<td>123 (18.5)</td>
<td>23 (5.2)</td>
<td>175 (25.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Insurance [n (%)]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>511 (28.2)</td>
<td>268 (40.2)</td>
<td>60 (13.5)</td>
<td>183 (26.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Medicare</td>
<td>1111 (61.4)</td>
<td>316 (47.5)</td>
<td>352 (78.9)</td>
<td>443 (63.4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Other</td>
<td>189 (10.4)</td>
<td>82 (12.3)</td>
<td>34 (7.6)</td>
<td>73 (10.4)</td>
<td>0.04</td>
</tr>
<tr>
<td>Regional anesthesia alone [n (%)]</td>
<td>413 (22.8)</td>
<td>72 (10.8)</td>
<td>208 (46.6)</td>
<td>133 (19.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Venous thromboembolism risk [n (%)]</td>
<td>415 (22.9)</td>
<td>143 (21.5)</td>
<td>84 (18.8)</td>
<td>188 (26.9)</td>
<td>0.004</td>
</tr>
<tr>
<td>Bleeding risk [n (%)]</td>
<td>133 (7.3)</td>
<td>38 (5.7)</td>
<td>70 (15.7)</td>
<td>25 (3.6)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

1At least one of the following: obesity, cancer, prior venous thromboembolism, lower extremity paralysis, hypercoagulable states, varicose veins, nephrosis, inflammatory bowel disease, heart failure.

2At least one of the following: liver disease, gastrointestinal ulcer/angiodysplasia, endocarditis, prosthetic valve, bleeding, coagulopathy, platelet count <100000/μL, creatinine >2.0 mg/dL.
Multivariable analysis

We performed multivariable analyses of venous thromboembolism prophylaxis use, adjusting for patient age, sex, ethnicity, surgery, type of anesthesia, additional venous thromboembolism risk factors, and bleeding risk factors.

Overall, Japanese patients were significantly less likely to receive appropriate venous thromboembolism prophylaxis, as compared with whites (Table 3). Hip fracture surgery patients were less likely to receive appropriate prophylaxis than those undergoing hip replacement, whereas those receiving total knee replacement were more likely. Those with bleeding risk factors were less likely than other patients to receive appropriate prophylaxis. Sex, age, insurance status, anesthesia type, and presence of additional venous thromboembolism risk factors were not statistically significant predictors of overall prophylaxis use.

Among patients undergoing hip replacement, Japanese individuals were significantly less likely to receive appropriate prophylaxis than whites. Relative to those with general anesthesia, patients with regional anesthesia alone were less likely to receive appropriate prophylaxis. Women and those with venous thromboembolism risk factors were more likely than other patients to be treated appropriately. Age, insurance status, and presence of bleeding risk factors were not independently associated with prophylaxis among hip replacement patients (Table 3).

Among patients with hip fracture surgery, only Japanese ethnicity was a significant predictor of lower venous thromboembolism prophylaxis use (Table 3).

Among total knee replacement patients, women were significantly less likely to receive appropriate prophylaxis, including intermittent pneumatic compression or pharmacologic methods (Table 3). However, women were as likely as men to be treated with appropriate pharmacologic prophylaxis (low-molecular-weight heparin or warfarin).

Treatment in the absence of appropriate venous thromboembolism prevention

In the absence of appropriate venous thromboembolism prophylaxis, other forms of treatment were used in 25.1% (n = 454) of patients.
all patients, including 11.4% (n = 207) who received aspirin and 3.2% (n = 58) who received non-recommended anticoagulation regimens. Approximately 25% of all patients did not receive any type of prophylaxis. Those undergoing hip fracture surgery were most likely to receive non-recommended prophylaxis (48.0% versus 33.9% for hip replacement, 2.0% for total knee replacement, \( P < 0.001 \)), with 43.0% (n = 192) treated with intermittent pneumatic compression and 14.3% (n = 64) with aspirin. Patients having hip fracture surgery were also most likely not to receive any type of prophylaxis (32.3% versus 24.5% for hip replacement, 22.2% for total knee replacement, \( P < 0.001 \)). No patients received adjusted-dose heparin, designated by the ACCP as an acceptable but more complex alternative for patients undergoing hip replacement [1].

Japanese patients were significantly less likely than whites to receive appropriate venous thromboembolism prevention overall. After adjusting for other factors, Japanese ethnicity was also associated with lower venous thromboembolism prophylaxis use among those undergoing hip replacement or hip fracture surgery.

The lower use of prophylaxis among Japanese patients in our study has not been previously documented. Japanese patients were less likely than others to receive appropriate venous thromboembolism prevention when undergoing hip replacement or hip fracture surgery, but not total knee replacement. By contrast, Pacific Islanders and other Asian groups, including Chinese and Filipinos, received prophylaxis at rates similar to that of whites (data not shown). It is unclear from our study why Japanese patients appear to have been treated differently from other ethnic groups. Although possible, it seems unlikely that the disparities are due to unmeasured contraindications to prophylaxis, such as differences in bleeding or thrombotic risk factors between ethnicities, because we were able to adjust for multiple potential risk factors. Nonetheless, unmeasured confounding remains a possibility given our study’s observational design. Reasons for the lack of an observed disparity for Chinese and Filipino patients, as compared with Japanese patients, are unclear but may also be related in part to the smaller numbers of patients in these groups. The observed disparities may also be due to a perception among physicians of a lower risk of thromboembolic complications, or a higher risk of hemorrhage, among Japanese patients, with our findings reflecting systematic underutilization of appropriate prophylaxis for Japanese patients.

**Table 3** Multivariable-adjusted odds ratios (95% confidence interval) for appropriate venous thromboembolism prophylaxis use by patient characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All patients (n = 1811)</th>
<th>Hip replacement (n = 666)</th>
<th>Hip fracture surgery (n = 446)</th>
<th>Total knee replacement (n = 699)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female sex</td>
<td>1.1 (0.9–1.3)</td>
<td>1.7 (1.2–2.3)</td>
<td>1.4 (0.8–2.5)</td>
<td>0.6 (0.4–0.9)</td>
</tr>
<tr>
<td>Age ≥75 years</td>
<td>1.1 (0.9–1.4)</td>
<td>1.2 (0.9–1.8)</td>
<td>1.3 (0.7–2.4)</td>
<td>0.8 (0.6–1.2)</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Japanese</td>
<td>0.7 (0.5–0.9)</td>
<td>0.5 (0.3–0.8)</td>
<td>0.3 (0.2–0.7)</td>
<td>1.3 (0.8–2.1)</td>
</tr>
<tr>
<td>Pacific Islander</td>
<td>0.8 (0.5–1.1)</td>
<td>0.8 (0.5–1.3)</td>
<td>1.2 (0.5–3.2)</td>
<td>0.6 (0.4–1.0)</td>
</tr>
<tr>
<td>Other</td>
<td>0.9 (0.7–1.2)</td>
<td>0.9 (0.6–1.4)</td>
<td>1.0 (0.6–1.8)</td>
<td>0.8 (0.5–1.3)</td>
</tr>
<tr>
<td>Obesity</td>
<td>0.8 (0.4–1.3)</td>
<td>0.6 (0.2–1.7)</td>
<td>0.9 (0.3–2.9)</td>
<td>0.9 (0.3–3.3)</td>
</tr>
<tr>
<td>Regional anesthesia alone</td>
<td>0.8 (0.6–1.1)</td>
<td>0.5 (0.3–0.8)</td>
<td>0.9 (0.5–1.5)</td>
<td>0.9 (0.6–1.5)</td>
</tr>
<tr>
<td>Venous thromboembolism risk1</td>
<td>1.5 (0.9–2.4)</td>
<td>2.7 (1.0–7.2)</td>
<td>1.2 (0.6–2.4)</td>
<td>0.8 (0.2–2.7)</td>
</tr>
<tr>
<td>Bleeding risk2</td>
<td>0.6 (0.4–0.9)</td>
<td>0.7 (0.4–1.4)</td>
<td>0.6 (0.3–1.2)</td>
<td>0.5 (0.2–1.3)</td>
</tr>
<tr>
<td>Surgery type</td>
<td>–</td>
<td>1.0</td>
<td>0.4 (0.3–0.5)</td>
<td>4.5 (3.6–5.7)</td>
</tr>
</tbody>
</table>

Analyses adjusted for patient age, sex, ethnicity, type of anesthesia, presence of ≥1 risk factor for venous thromboembolism other than orthopedic surgery, presence of ≥1 bleeding risk factor, and type of surgery.

1At least one of the following: obesity, cancer, prior venous thromboembolism, lower extremity paralysis, hypercoagulable states, varicose veins, nephrosis, inflammatory bowel disease, heart failure.

2At least one of the following: liver disease, gastrointestinal ulcer/angiodysplasia, endocarditis, prosthetic valve, bleeding, coagulopathy, platelet count <100000/μL, creatinine >2.0 mg/dL.

**Discussion**

Although prior studies have documented variable adherence to venous thromboembolism prevention guidelines, predictors of appropriate prophylaxis have not been described. Moreover, associations of patient ethnicity with venous thromboembolism prophylaxis use have not been previously reported.

We found that, overall, only 49.4% of 1811 patients undergoing hip replacement, total knee replacement, or hip fracture surgery in our population received venous thromboembolism prophylaxis as recommended by the ACCP. Even after excluding patients with potential contraindications to prophylaxis, such as those with risk factors for bleeding complications and those receiving spinal or epidural anesthesia, only 52.5% were treated with recommended prophylaxis.
Although many risk factors for venous thromboembolism have been described, little is known about how risk varies between racial groups. Recent studies have provided conflicting information on the risk of venous thromboembolism among Asians and Pacific Islanders [7–10]. Guidelines do not include patient race as a modifying factor in the recommendations for venous thromboembolism prophylaxis [1]. It is unclear if a perception of a lower risk of venous thromboembolism in these patients led to lower rates of prophylaxis use in our study.

Our low overall rates of venous thromboembolism prophylaxis reflect the variation in practice patterns noted in previous studies. Surveys demonstrate that 55–96% of surgeons report using some type of venous thromboembolism prevention routinely for their patients [16–18]. Record reviews have shown that prophylaxis is used in 38–94% of surgical patients [3–5], with more recent studies noting rates of ACCP-recommended prophylaxis of 45–91% for major orthopedic surgery [5,6].

As expected, other factors associated with lower venous thromboembolism prophylaxis use included the presence of bleeding risk factors, whereas presence of additional thromboembolic risk factors was associated with higher prophylaxis use in hip replacement patients. Consistent with prior studies [5], patients undergoing hip fracture surgery were less likely to receive prophylaxis as compared with others. The lower rate of prophylaxis use for hip fracture surgery may be related in part to unmeasured contraindications in these patients. Although patients with major trauma were excluded, other minor trauma related to patients’ fractures, and a perception of higher bleeding risk in these patients, may have influenced the decision to avoid low-molecular-weight heparin or warfarin.

Also consistent with prior observations, regional anesthesia was associated with lower prophylaxis use among patients having hip replacement, possibly related to the greater complexity of the recommended regimens in these patients and the risk of epidural hematomas [6,19]. Treatment guidelines recommend that venous thromboembolism prophylaxis may be used with caution in patients with spinal puncture or epidural catheters [1].

In our population, men were less likely to receive appropriate prophylaxis than women when undergoing hip replacement. Reasons for this discrepancy are unclear but possibly related to differences in unmeasured comorbidities between men and women.

Possible explanations for the low overall rates of prophylaxis in our population also include inadequate physician awareness of the guidelines and the efficacy of prophylaxis. Educational interventions and clinical decision support systems have shown variable success in increasing the use of venous thromboembolism prophylaxis, although prophylaxis remained underutilized [20–22].

Several limitations should be considered in the interpretation of our findings. First, our study involved patients admitted to a single medical center, and our results may not be applicable to other populations. Second, because our data were obtained from an electronic database, information on diagnoses and contraindications were based on ICD-9-CM codes rather than abstracted medical record data or patient interviews. Additionally, prophylaxis use was based on physician orders rather than a direct assessment of drug administration. Third, we were not able in our retrospective design to evaluate patient and physician preferences influencing the use of prophylaxis, nor were we able to determine the incidence of thromboembolic complications, many of which occur in the outpatient setting. Lastly, although the identification of appropriate prophylaxis was based on consensus recommendations from the ACCP, surgical organizations such as the American College of Surgeons and American Academy of Orthopedic Surgeons currently do not have formal guidelines regarding venous thromboembolism prophylaxis.

**Conclusions**

To our knowledge, our study is the first to identify patient ethnicity as an independent predictor of lower venous thromboembolism prophylaxis use. We found persistently low adherence to ACCP-recommended guidelines for the prevention of venous thromboembolism, with Japanese patients being at particular risk for not receiving appropriate prophylaxis. This treatment disparity was not due to differences in patient characteristics such as age, sex, and thrombosis or bleeding risk factors. These findings, and data suggesting a lower risk of venous thromboembolism in Asians, may indicate a physician preference not to treat these patients. It remains unclear whether our observed lower rate of prophylaxis among Japanese patients translates into higher rates of postoperative venous thromboembolism complications. The ACCP has recommended that every hospital develop a formal strategy that addresses the prevention of thromboembolic complications [1,23]. Our findings highlight a need to evaluate the reasons for low venous thromboembolism prophylaxis use in our population, particularly among Japanese patients, and to determine what interventions might augment prophylaxis use most.

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