

Practice Patterns in the Use of Venous Thromboembolism Prophylaxis After Total Joint Arthroplasty—Insights From the Multinational Global Orthopaedic Registry (GLORY)

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Abstract

The Global Orthopaedic Registry (GLORY) offers insights into multinational practice patterns of venous thromboembolism (VTE) prophylaxis in orthopedic surgery, based on data from 15,020 patients undergoing primary total knee arthroplasty or primary total hip arthroplasty from 2001 to 2004.

Registry data show that the first choice for in-hospital VTE prophylaxis was low-molecular-weight heparin. Multimodal prophylaxis was common. Warfarin was more widely used in the United States than elsewhere in the world. GLORY data suggest that real-world practice often fails to meet the standards for prophylaxis recommended in the American College of Chest Physicians evidence-based guidelines, particularly in the United States. However, many US orthopedic surgeons may follow other practice guidelines, causing an underestimation of prophylaxis use in this study. Warfarin use in the United States often failed to achieve recommended target international normalized ratio (INR) values.

This paper reviews the GLORY practice findings in light of the contemporary literature on best practices for VTE prophylaxis in orthopedic patients.

Orthopedic surgery carries a high risk of venous thromboembolism (VTE). Without prophylaxis, between 41% and 85% of patients who undergo high-risk procedures such as total hip arthroplasty (THA) or total knee arthroplasty (TKA) could

be expected to develop subclinical deep vein thrombosis (DVT) and up to 10% may develop the potentially life-threatening complication of symptomatic pulmonary embolism (PE).¹⁻⁴

For a number of years, evidence-based guidelines have been available to guide clinical practice on the use of VTE prophylaxis.^{1,2,5} Both the International Union of Angiology guidelines⁵ and the American College of Chest Physicians (ACCP) guidelines^{1,2} summarize the strong evidence base supporting the use of prophylactic drugs such as low-molecular-weight heparin (LMWH) and warfarin for the prevention of VTE associated with THA and TKA (Table I). Similarly, the American Academy of Orthopaedic Surgeons (AAOS) has released guidelines for the prevention of PE,⁶ recommending prophylaxis with aspirin, LMWH, synthetic pentasaccharides, or warfarin for patients undergoing THA or TKA and at standard risk of both PE and major bleeding.

However, the translation of evidence-based guidelines into everyday clinical practice is not immediate. In elective orthopedic surgery, as in other fields of medicine, adoption of recommendations relies on a combination of factors. These include the widespread distribution of guidelines and educational initiatives to reinforce the medical issues highlighted in published recommendations, together with ongoing audit and feedback to clinicians and surgeons on the impact and benefits of adopting new protocols and practices.⁷⁻¹⁰

In this paper we examine the practice patterns of VTE prophylaxis as analyzed in the multinational Global Orthopaedic Registry (GLORY). GLORY offers insights into “real-world” practice in 100 hospitals across 13 countries, and it provides data on large numbers of consecutively enrolled patients who have undergone elective THA or TKA and who have been followed up for a post-surgery period of 3 and 12 months. The findings of GLORY highlight both major differences and minor nuances in the use of VTE prophylaxis in different geographical regions, allow an assessment of how well current ACCP-guideline recommendations are being adhered to, and provide a valuable benchmark against which to review the contemporary literature providing guidance on VTE prophylaxis in orthopedic surgery.

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Table 1. Guideline Recommendations for the Prevention of Venous Thromboembolism According to the American College of Chest Physicians 2001 (Geerts¹)

Prophylaxis Method	THA	TKA
LMWH	Timing: started 12 h before surgery, 12 to 24 h after surgery, or 4 to 6 h after surgery at half dose and continuing full dose next day Duration: at least 7 to 10 days	
Warfarin	Timing: started preoperatively or immediately after surgery Duration: at least 7 to 10 days Target INR: 2.5; range, 2 to 3	
IPC	Not recommended	Optimal use is an alternative option

Abbreviations: INR, international normalized ratio; IPC, intermittent pneumatic compression; LMWH, low-molecular-weight heparin; THA, total hip arthroplasty; TKA, total knee arthroplasty.

METHODS

The methodology of data collection for GLORY is described in detail by Anderson.¹¹ In brief, the registry enrolled 15,020 patients from 100 hospitals in 13 countries (Australia, Brazil, Bulgaria, Canada, Colombia, Germany, Italy, Japan, Poland, Spain, Turkey, United Kingdom, United States) between June 2001 and December 2004. Patients eligible for enrollment in GLORY were those undergoing elective primary THA or TKA and for whom a 12-month clinical follow-up period was feasible. In GLORY, 70% of enrolled patients had completed follow-up at either 3 and/or 12 months.

Data on patient demographics, primary diagnosis, pre-existing comorbid conditions, length of hospital stay, type of anesthesia, VTE prophylaxis (including type and duration), in-hospital complications, discharge disposition, and patient self-reported quality of life were gathered using standard case report forms (CRFs). Analysis of in-hospital practices are based on the entire cohort of GLORY patients; however, analyses requiring duration of prophylaxis information are based on the 8,160 patients in GLORY with confirmed duration of prophylaxis as assessed by a completed follow-up form. As this data was only collected in version 2 of the CRF (from January 2002 onwards), these 8,160 patients with follow-up are taken from a population of 11,222 patients (73% follow-up rate). Chi-square or Fisher's exact test was used to test for rate differences in different groups. Wilcoxon's rank sum test or analysis of variance was used to test group differences between continuous variables.

RESULTS

Use and Type of Prophylaxis Against Venous Thromboembolism

Data from GLORY showed that over 99% of patients undergoing THA or TKA received some form of VTE prophylaxis.¹² The rate of use of prophylaxis was 99.5% in patients undergoing THA and 99.2% in patients undergoing TKA.¹² Furthermore, 95.4% of patients received some form of ACCP 2001–recommended prophylaxis (93.2% of THA patients and 97.6% of TKA patients).¹²

The most frequently adopted forms of in-hospital VTE prophylaxis were LMWH (given to 67% and 63% of THA and TKA patients, respectively), elastic stockings (57% and 58%), intermittent pneumatic compression (IPC) devices (40% and 47%), and warfarin (30% and 31%).

Clinical Practice Variations

Analyses of VTE prophylaxis choice according to geographical region reveal variations in practice between the United States and the other participating countries (Figure 1). Practice in the United States appears to rely on a number of different methods of prophylaxis, with LMWH being one of several methods employed. Furthermore, most physicians in the United States use more than one modality (mechanical and pharmacological) in combination. Intermittent pneumatic compression was used for only a short period in-hospital (median, 4 days for both THA and TKA) and tended to be used almost exclusively in combination with pharmacological prophylaxis (90% and 87% for THA and TKA, respectively). In the other participating countries, LMWH appears to be the cornerstone of VTE prophylaxis and is complemented by the use of stockings, while warfarin and IPC are rarely used. Data from GLORY on post-discharge VTE prophylaxis

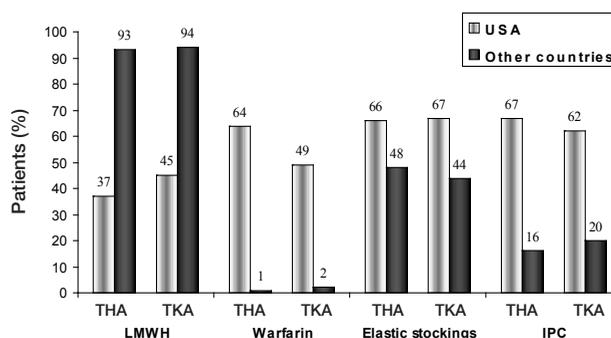


Figure 1. GLORY: Practice variation between the United States (USA) and the other participating countries for type of in-hospital VTE prophylaxis. Abbreviations: GLORY, Global Orthopaedic Registry; IPC, intermittent pneumatic compression; LMWH, low-molecular-weight heparin; THA, total hip arthroplasty; TKA, total knee arthroplasty.

Table II. GLORY: Compliance With the 2001 American College of Chest Physicians Guidelines for Pharmacological Thromboprophylaxis Following Total Hip Arthroplasty or Total Knee Arthroplasty¹²

	THA		TKA	
	USA	Other Countries	USA	Other Countries
Full compliance with ACCP guidelines	47%	62%	61%	69%
LMWH				
Full compliance (timing and duration)	63%	67%	72%	73%
Timing	91%	80%	90%	85%
Duration	70%	85%	80%	85%
Warfarin				
Full compliance (timing, duration, target INR)	33%	N/A	48%	N/A
Timing	96%	N/A	98%	N/A
Duration	85%	N/A	74%	N/A
Target INR	36%	N/A	54%	N/A

Abbreviations: ACCP, American College of Chest Physicians; GLORY, Global Orthopaedic Registry; INR, international normalized ratio; LMWH, low-molecular-weight heparin; N/A, not applicable; THA, total hip arthroplasty; TKA, total knee arthroplasty; USA, United States.

revealed that regional differences persist once patients leave hospital (Figure 2).

Use of warfarin is particularly high in the United States compared with other participating countries (55% vs 1% of patients received in-hospital warfarin, respectively), a preference that has been reported previously.¹³⁻¹⁵ Conversely, in the other countries represented in GLORY, LMWH is the anticoagulant of choice (93% and 42% of patients received in-hospital LMWH in the other countries and in the United States, respectively). Direct comparisons show that LMWH is at least as safe and efficacious as warfarin in THA,¹⁶⁻¹⁸ and is as safe as, and more efficacious than, warfarin in TKA^{19,20} or when compared across all orthopedic surgery.²¹ Reasons for the widespread preference for LMWH among European orthopedic surgeons may

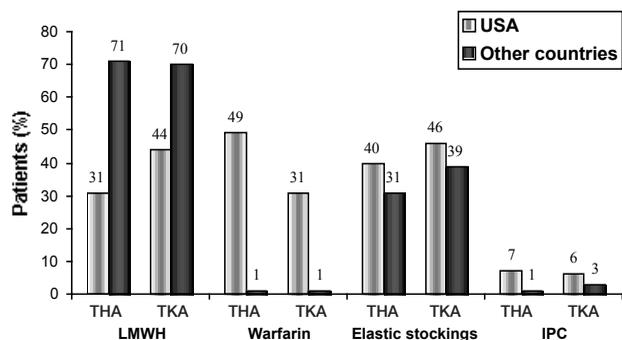


Figure 2. GLORY: Practice variation between the United States (USA) and the other participating countries for type of post-discharge VTE prophylaxis. Abbreviations: IPC, intermittent pneumatic compression; LMWH, low-molecular-weight heparin; THA, total hip arthroplasty; TKA, total knee arthroplasty.

Kaplan–Meier curves for cumulative VTE incidence within 3 months of surgery (n=8 post 3 mos.)

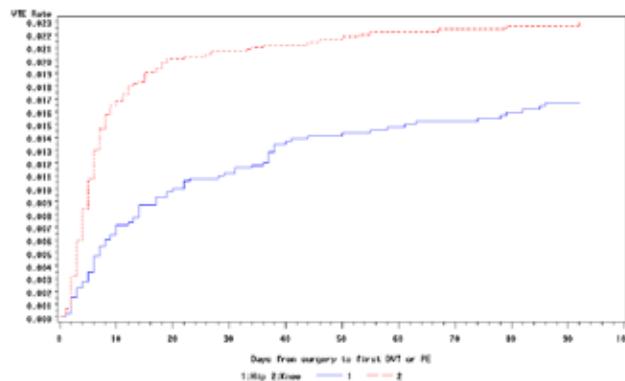


Figure 3. Kaplan–Meier curve for cumulative incidence of venous thromboembolism (VTE) events in total hip arthroplasty and total knee arthroplasty patients in GLORY. Abbreviations: DVT, deep vein thrombosis; PE, pulmonary embolism.

include concerns about the less predictable pharmacological and clinical profile of warfarin compared with LMWH. In addition to its well-known interactions with several commonly used drugs and some foods,^{22,23} warfarin is associated with a slow onset of antithrombotic activity (taking up to 60 hours to become effective),²⁴ displays a variable patient response that affects its therapeutic index,²⁵ and requires close assessment by frequent laboratory monitoring.²⁶

The use of elastic stockings in nearly 60% of THA and TKA patients in GLORY is interesting. Although elastic stockings can be used without safety risks to the patients, there have been few studies investigating the safety and efficacy of elastic stockings as prophylaxis in orthopedic surgery patients. In a placebo-controlled study of LMWH for prevention of VTE following orthopedic surgery in which both groups wore elastic stockings, the rate of VTE was 59% in the elastic stockings-alone group.²⁷ This suggests that elastic stockings alone can not be considered to be suitable prophylaxis in this surgical setting.

Duration of Prophylaxis Against Venous Thromboembolism

Data from GLORY showed that for patients undergoing orthopedic surgery, median duration of in-hospital prophylaxis was 5 days. When warfarin was used (almost exclusively in the United States), prophylaxis was continued after discharge in 72% of patients, for a median total duration of 34 days (3 days in-hospital and 30 days post-discharge). Although the median duration of warfarin was similar for TKA and THA patients, a higher proportion of TKA patients received prophylaxis for a shorter duration compared with THA patients. When LMWH was the preferred choice for prophylaxis, it was generally given for a longer period to THA patients (median, 29 days worldwide) than to TKA patients (median, 14 days worldwide).

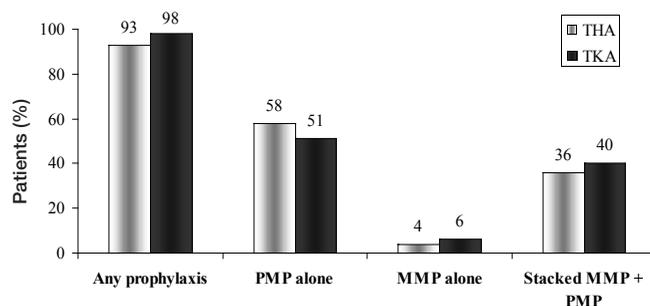


Figure 4. In-hospital Grade 1A recommended mechanical and pharmacological venous thromboembolism prophylaxis in THA/TKA patients. Patients received a grade 1A recommended prophylaxis type in-hospital according to Geerts and colleagues² (2004), but their care was not necessarily fully compliant with the guidelines regarding duration, dose, and timing. Abbreviations: MMP, mechanical methods of prophylaxis; PMP, pharmacological methods of prophylaxis; THA, total hip arthroplasty; TKA, total knee arthroplasty.

The differences in approach to duration of VTE prophylaxis following TKA and THA probably reflect an appreciation of the documented difference in time to a VTE event following these high-risk orthopedic procedures. In a large-scale community-based study, the median time to diagnosis of VTE following THA was 17 days after surgery, compared with 7 days after TKA ($P < .001$).²⁸ Furthermore, in placebo-controlled randomized trials, ongoing LMWH prophylaxis continued for 3 weeks after discharge effects a significant 65.5% relative risk reduction in VTE in THA patients compared with a shorter treatment duration ($P < .001$) and has less pronounced benefits in TKA patients.^{2,4,29} Similar findings were observed in GLORY, as has been previously published (Figure 3).³⁰ In GLORY, prophylaxis with LMWH seemed to reflect the VTE time course difference between THA and TKA more strongly than prophylaxis with warfarin.

Stacked and Sequential Modalities for Prophylaxis Against Venous Thromboembolism

Although clinical studies of VTE prophylaxis typically evaluate a single method or “modality” of prophylaxis, in everyday practice, several forms of prophylaxis (pharmacological and mechanical) are often used concurrently or consecutively to provide what may be optimal protection against VTE risk. This is termed multimodal prophylaxis. Concurrent use of modalities is termed “stacked” prophylaxis, while consecutive use of modalities is referred to as “sequential” prophylaxis. There are few studies available evaluating the safety and efficacy of multimodal prophylaxis in randomized controlled clinical trials. Data from GLORY showed that multimodal prophylaxis is commonly used in major orthopedic surgery, especially in the United States (Figures 4, 5).

Some 99% of patients in GLORY received at least 1 modality in the hospital, 68% of patients received more than

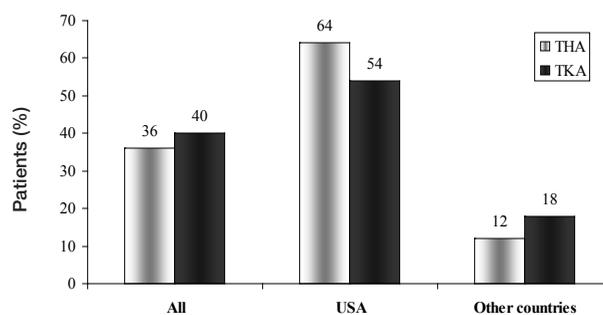


Figure 5. Concomitant mechanical and pharmacological venous thromboembolism prophylaxis in THA compared with TKA patients by region. Abbreviations: THA, total hip arthroplasty; TKA, total knee arthroplasty; USA, United States.

1 modality, and 38% were given stacked mechanical and pharmacological modalities of prophylaxis. Assessment according to type of surgery revealed that 40% of TKA patients and 36% of THA patients received stacked modalities, with large differences again noted between the United States and the other participating countries. US surgeons were much more likely to stack modalities for TKA and THA (54% and 64% stacking, respectively) than surgeons in other countries (18% TKA and 12% THA stacking, respectively; $P < .001$ for both).

It can be speculated that US surgeons stack prophylactic modalities in order to maximize protection of their patients during the postoperative window prior to initiation of LMWH prophylaxis or while waiting for an appropriate INR to be achieved through use of warfarin prophylaxis. Further studies in the form of controlled trials are however required to investigate the clinical safety and efficacy of multiple types of prophylaxis in patients undergoing total joint arthroplasty.

GLORY and Compliance With Guidelines on Prophylaxis Against Venous Thromboembolism

As described earlier, 2001 guidelines on VTE prophylaxis following orthopedic surgery recommended the use of LMWH for patients undergoing TKA or THA, with prophylaxis started preoperatively or postoperatively and continued for at least 7 to 10 days or the use of warfarin started preoperatively or immediately after surgery and continued for 7 to 10 days¹ in order to achieve target INR in the range 2 to 3⁵ (Table I). In the 2004 update of the ACCP guidelines, a minimum duration for prophylaxis of 10 days is indicated, with extension to 28 to 35 days recommended for total hip replacement.²

The GLORY data suggest that overall compliance with the 2001 ACCP recommendations was lower in the United States than in the other participating countries (Table II).¹² Full compliance with the ACCP recommendations on VTE prophylaxis in THA was just 47% in the United States compared with 62% in other countries, and while compliance was better in TKA management, the figure of 61% in the United States was still lower than the 69% rate achieved in other countries.

The literature suggests that in the management of general hospitalized medical and surgical patients, compliance with VTE prophylaxis guidelines varies greatly according to patient risk category, hospital, and country.³¹⁻³³ There is evidence that some physicians find it difficult to assess patient risk for VTE and often fail to choose appropriate prophylaxis even when a risk category is established.^{31,32} One historical cohort study noted that failure to give prophylaxis was the most common reason for otherwise preventable VTE cases, while inadequate duration of prophylaxis was implicated in a further 23% of patients, and incorrect choice of prophylaxis in 20%.³³ However, it is important to note that risk stratification is more applicable to medical patients than to orthopedic surgery patients, as pharmacological prophylaxis is recommended in all orthopedic patients except for individuals with a contraindication.²

In total hip and knee arthroplasty, compliance with VTE prophylaxis guidelines has been reported to be good. A survey of 10 teaching and community-based hospitals in the United States published in 2000 found that the 1995 ACCP guidelines for use of grade A prophylaxis (prophylaxis recommendation based on consistent results of randomized clinical trials) were followed in 84.3% of THA cases and 75.9% of TKA cases.⁷ A larger-scale registry study conducted in the United States during 1996 to 2001 that assessed data from over 9,000 THA patients and almost 14,000 TKA patients drawn from 319 hospitals (the Hip and Knee Registry) showed that compliance with ACCP recommendations for adequate VTE prophylaxis during in-hospital stay was 89% in THA patients and 91% in TKA patients; after hospital discharge, compliance was 67% in THA patients and 66% in TKA patients.^{1,14} When interpreting such database findings, it is important to consider the definitions applied to describe compliance. Ahmad and colleagues³¹ did not strictly define compliance with the guidelines, while the registry report of Anderson and colleagues¹⁴ based compliance on use of grade A recommended therapies. Other practice reviews went further in specifying that compliance must involve correct modality selection and adequate dosing,^{7,32} and one review also required compliance with guidelines on dosing, timing, and duration of prophylaxis.³³

In GLORY, prophylaxis was considered to be compliant with the 2001 ACCP guidelines if it matched the type, dose, frequency of dosing, starting time, and duration of prophylaxis. Additionally, in the case of warfarin, an INR of 2 to 3 had to be reached (Table I).

Using these criteria, GLORY shows compliance rates for US practice that appear to be much lower than those previously reported.^{7,14} This is probably not a reflection of a change in practice over time, but rather a stricter and more accurate view of compliance with all elements of the ACCP guidelines for VTE prophylaxis in THA and TKA patients. From the results described in this section, it would appear that the lack of compliance observed in the GLORY population is driven by physicians either not targeting an appropriate INR or failing to reach the target INR when using warfarin for VTE prophylaxis. It is also

important to note that the GLORY registry was compared with the ACCP guidelines for the prevention of VTE.¹ However, the AAOS has also released guidelines for the prevention of PE following TKA and THA.⁶ In this US-focused guideline, fondaparinux and aspirin are also recommended as appropriate prophylaxis. It is therefore likely that physicians who follow this guideline will be categorized as failing to meet guideline recommendations in our study. While there continue to be discrepancies between the guidelines, it is likely that there will continue to be an overestimation of the number of physicians who appear to not follow guidelines.

Compliance With Guidelines on Warfarin Use

GLORY data show that warfarin is more widely used in the United States (administered to 55% of THA and TKA patients in hospital; Figure 1) than elsewhere in the world (< 2% of THA and TKA patients). Despite a preference for use of warfarin, our registry data reveal that compliance in the United States with ACCP recommendations for the use of warfarin was especially low, with only 33% compliance following THA and 48% compliance following TKA (Table II).

Current ACCP guidelines recommend a target INR for warfarin of 2 to 3,² yet in GLORY patients in the United States the target INR was set at 1.5 to 1.9 for 52% of THA patients and 33% of TKA patients. Although no conclusive clinical evidence currently exists for the efficacy of an INR of 1.5 to 1.9, it would be interesting to see a clinical trial investigate whether this approach, which has been adopted in many US sites based on physician experience, produces sufficient efficacy. In a study on DVT resolution, Caprini and colleagues³⁴ demonstrated that the degree of resolution was significantly linked to the INR values. Among warfarin-treated subjects, only 36% of THA patients and 54% of TKA patients actually achieved the guideline-recommended INR of 2 to 3, representing a large gap between the evidence-based guideline recommendations and real-world orthopedic practice. Among GLORY patients in the United States who were given warfarin and achieved the target INR, over half (64%) achieved the target at day 3 or later following surgery.

Under-anticoagulation (INR < 2) has been reported during warfarin prophylaxis in a number of clinical settings, with practice reviews highlighting a failure to achieve the target INR values required for adequate therapeutic responses.^{23,35} Although VTE prophylaxis based on a low target INR of 1.5 to 1.9 has not been formally assessed in THA or TKA, it appears that achievement of target INR is likely to be important during the entire first 4 weeks following THA.³⁴ In this small-scale, open study assessing DVT incidence rates following THA in which warfarin prophylaxis was employed, patients who developed ultrasound-confirmed DVT had significantly ($P < .001$) lower INR values (< 2.0) during the second to fourth postoperative weeks.³⁴ This hypothesis-generating study suggests that there is a need to provide adequate prophylaxis throughout the entire period

during which patients are at risk. Furthermore, although early THA trials used a target prothrombin time of 14 to 16 seconds and thus a prothrombin ratio of 1.4 to 1.6,³⁶ this prothrombin ratio was not equivalent to the currently used INR measurement. In fact, a prothrombin ratio of 1.4 to 1.6 obtained using the strong laboratory thromboplastins then prevalent converts to an INR of 2.0 to 2.6.³⁷ Although it could be argued that ACCP evidence-based guidelines that explicitly recommend a target INR of 2.5 (range, 2.0-3.0),² may just reflect the current lack of clinical data regarding the safety and efficacy of a target INR < 2.0, there is extensive data from other clinical settings where an INR of 1.5 to 2.0 was less effective than an INR of 2.0 to 3.0.^{38,39}

Compliance With Guidelines on Use of Low-Molecular-Weight Heparin

GLORY data showed that compliance with ACCP 2001 recommendations for the use of LMWH prophylaxis was higher than that for warfarin (Table II). Full compliance with dosing and duration of LMWH was observed in 70% of patients (73% TKA and 67% THA in other participating countries; 72% and 63%, respectively, in the United States) and lack of compliance was driven more by shortfalls in duration of prophylaxis than by timing of administration.

Improving Compliance With Guidelines

As can be seen from the results above, guideline compliance was low in GLORY patients for prophylaxis following THA and TKA. Even if the issue of the target INR for warfarin is removed from consideration, in which case both warfarin and LMWH would achieve approximately 70% ACCP-guideline compliance, 70% remains a value that requires further improvement, since all patients without a contraindication should be receiving pharmacological prophylaxis after orthopedic surgery.

A number of factors may contribute to the underuse of guidelines in real-world practice. As discussed previously, one potential reason is that physicians are following alternative guidelines to the ones studied here—for example, the AAOS guidelines on prevention of PE following TKA and THA.⁶ Furthermore, according to a recent review, many physicians and surgeons continue to be unaware of the published guidelines on VTE prophylaxis.⁴⁰ Many surgeons continue to fear bleeding risks when using anticoagulant or antithrombotic drugs, and others consider the guidelines to be difficult to apply in everyday practice.⁴⁰ A meta-analysis of trials comparing warfarin with LMWH in THA patients has shown that the major bleeding rates are similar between these 2 treatments, with a slight excess of minor wound bleeding with LMWH.⁴¹ In TKA patients, total bleeding rates were not significantly different between patients receiving warfarin and LMWH.¹⁹ Furthermore, in a placebo-controlled study of LMWH in THA patients wearing elastic stockings, there was a similar rate of major bleeding in the 2 groups (2.5% and 2.4% in LMWH and placebo groups, respectively)²⁷ A recent meta-analysis of 11,485 combined THA and TKA patients found no significant difference in total bleeding rates between warfarin and LMWH (Relative Risk, 0.78 [95% CI 0.49-1.26]).²¹

Ahmad and colleagues³¹ advocate better medical education to emphasize and improve the understanding of DVT risk stratification and heighten knowledge of recommendations for VTE prophylaxis and their benefits. Clinical support systems such as those used in a French orthopedic surgery department, where computer-based systems help to assess patient risk, direct prophylactic choice in line with current guidelines, and remind physicians and surgeons of deviations in prophylactic management, have been found to increase compliance with VTE guidelines from 82.8% to 94.9%.⁴² Computer alert systems in the United States have also been shown to have a significant impact on VTE prophylaxis, almost doubling the use of pharmacological prophylaxis and reducing the risk of DVT and PE by 41% among high-risk hospitalized patients.⁴³

It should be noted, however, that GLORY is a voluntary registry, and as such, it is likely that many of the surgeons who agreed to provide registry data already pay special attention to VTE prophylaxis and may therefore be providing higher levels of prophylaxis than surgeons in a random “real-world” hospital. This may therefore result in an overestimation of global practices in VTE prophylaxis use following THA and TKA in the GLORY registry. Furthermore, comparing the GLORY registry of 100 hospitals in 13 countries with a US-specific survey of American Association of Hip and Knee Surgeons (AAHKS) members¹³ demonstrates discrepancies in the use of different pharmacological prophylaxis options. For example, in the US sites of the GLORY registry, 37% of THA patients and 45% of TKA patients received in-hospital LMWH. However, in the AAHKS survey, only 15.4% of THA patients and 18.0% of TKA patients received LMWH prophylaxis. Furthermore, 15.8% of THA patients and 18.4% of TKA patients received aspirin prophylaxis, a type of prophylaxis that was not often used in GLORY. It is therefore important to note that it may not be possible to generalize from the specific US hospitals in the GLORY database to the whole country.

Furthermore, it was compliance with the 2001 ACCP guidelines that was evaluated; the 2004 update, which recommends an increased duration of prophylaxis after THA,² became available only toward the end of the study period.

Screening for Deep Vein Thrombosis

The current ACCP guidelines give a grade 1A recommendation against routine screening for subclinical DVT before discharge from hospital.² This is based on large-scale trials that found routine screening to not be effective in the prevention of adverse clinical outcomes, or cost-effective.⁴⁴⁻⁴⁷ Data from GLORY showed that 13% of THA and TKA patients underwent routine screening for DVT, with this practice more common in the United States (18%) than in the other participating countries (7%).

CONCLUSIONS

The registry data show that most orthopedic surgeons are committed to VTE prevention, with 99% using some form of prophylaxis during hip or knee replacement. Multimodal

prophylaxis is common, with widespread use of both pharmacological drugs and mechanical devices. However, the registry highlights that real-world practice often fails to meet the standards for prophylaxis as prescribed in evidence-based guidelines. Strict compliance with recommended prophylaxis was lower in the United States than in the other participating countries, although this may be due to the presence of alternative guidelines for these surgeons. This failure to comply appears to be due in part to a continued preference in the United States for warfarin as prophylaxis, despite difficulties with achieving adequate INR values while using warfarin. In the other participating countries, LMWHs are the favored method of VTE prophylaxis, and registry data suggest that compliance with recommended regimens is better with these drugs than with warfarin. As noted above however, it is likely that GLORY surgeons, although selected from a variety of geographical locations and hospital environments, are likely interested in quality improvement and thromboprophylaxis. This in turn is likely to impact the results, perhaps leading to a higher rate of interest in thromboprophylaxis than would normally be observed. In a recent US study, 8% of THA and TKA patients received aspirin alone for prophylaxis and 3% received no prophylaxis at all.¹⁵

As more prospective data become available in the form of randomized controlled trials and registries, a corresponding shift to evidence-based medicine is needed. The gaps between recommended and real-world VTE prophylaxis practices have been recognized throughout the expanding literature in this field. New initiatives involving better continuing education of physicians, novel computer-based support and alert systems, and the continued appraisal of practice through databases and registries such as GLORY will continue to drive improvements in care that will ensure optimal VTE prophylaxis for high-risk patients such as those undergoing major orthopedic surgery.^{9,13,40,42,43} Although thromboprophylaxis should be systematic in surgical orthopedic patients, from the data presented in this paper, it seems clear that there is also an urgent need for education to improve the quality of prophylaxis, to ensure it is compliant with contemporary evidence-based medicine guidelines, in patients undergoing primary THA and TKA. It would also be interesting to re-analyze data from GLORY for compliance with other guidelines, such as the AAOS guideline for prevention of PE.

A great advantage of registries such as GLORY is their potential to gather information about the prevalence of real-life clinical practices that have not been validated. The frequent use of a low-target INR for warfarin prophylaxis after joint arthroplasty, and of stacked preventive modalities, indicates an urgent need for their formal evaluation through prospective clinical trials.

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