



Thromboprophylaxis After Hospitalization for Joint Replacement Surgery

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ABSTRACT

Venous thromboembolism (VTE) is a leading cause of mortality during the perioperative period, with individuals who have undergone hip and knee arthroplasty at the highest risk for VTE. The American College of Chest Physicians recommends 35 days of postoperative thromboprophylaxis and the use of intermittent pneumatic compression (IPC) therapy for mechanical compression after major orthopedic surgery. However, little research has described adherence to these recommendations during recovery at home. The purpose of this cross-sectional descriptive study was to describe thromboprophylaxis prescription, use, and education among patients discharged home after major orthopedic surgery. We surveyed patients within 2 years of major orthopedic surgery. A total of 388 subjects completed the survey. More than three-quarters of respondents reported a thromboprophylaxis duration <35 days. Most (93.8%) respondents were prescribed a pharmacologic agent, while 55.9% were prescribed mechanical compression therapy. Of the respondents who were prescribed mechanical compression therapy, 13.4% were prescribed IPC. Adherence to mechanical compression therapy was moderate, with 63% of respondents wearing mechanical compression therapy $\geq 75\%$ of the time. The results of this study suggest a need for increased duration of thromboprophylaxis and increased use of IPC in the outpatient setting. Additional research describing prescribers' perceptions of thromboprophylaxis is also needed.

Keywords: thromboembolism, arthroplasty, postoperative care

Introduction

Venous thromboembolism (VTE) is a leading cause of morbidity and mortality during the postoperative period. In the United States, an estimated 60,000–200,000 individuals die of VTE annually,¹ with approximately one-third of those deaths occurring postoperatively.² In addition to its staggering human cost, VTE imposes a significant financial burden on the U.S. healthcare system in the amount of seven to 10 billion dollars each year.³ Without

thromboprophylaxis, an estimated 50% of surgical patients will experience VTE.^{4,5} In the orthopedic setting, individuals who have undergone total hip and knee arthroplasty are at the highest risk for VTE, with 40–60% developing deep vein thrombosis (DVT) and 4–10% developing pulmonary embolism in the absence of thromboprophylaxis.⁴ The risk of VTE is highest in the first 6 weeks after surgery,⁶ and about two-thirds of VTE cases occur in the outpatient setting.⁷ Although much attention has been paid to the issue of thromboprophylaxis in hospitalized patients, compliance to and promotion of thromboprophylaxis in the outpatient setting remain a significant public health concern.⁷

Thromboprophylaxis has been shown to substantially reduce the risk of VTE among surgical patients. Among patients undergoing major orthopedic surgery, use of thromboprophylaxis is associated with a reduction in VTE risk to 2.8% in cases of total hip arthroplasty and 2.1% in cases of total knee arthroplasty.⁸ Since the late 1980s, the American College of Chest Physicians (ACCP) has maintained evidence-based clinical guidelines for the prevention of VTE in a wide variety of surgical populations.^{2,9} In 2007, the American Academy of Orthopedic Surgeons (AAOS) released clinical guidelines

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specifically aimed at prevention of VTE among patients undergoing elective hip and knee arthroplasty.¹⁰ According to these guidelines, adequate thromboprophylaxis may entail pharmacologic therapy, mechanical compression therapy, or both.^{9,10} Ten days is the minimum duration of thromboprophylaxis recommended by the ACCP; in cases of major orthopedic surgery such as total hip and knee arthroplasty, the ACCP recommends extending the duration of thromboprophylaxis to 35 days.⁹ Pharmacologic therapy is characterized by the use of an anticoagulant or antiplatelet agent such as a low-molecular-weight heparin (LMWH), a Factor Xa inhibitor, dabigatran, low-dose unfractionated heparin, warfarin, or aspirin.⁹ Although these pharmacologic agents are effective at preventing VTE, their use is associated with a risk of minor and major bleeding and is contraindicated in patients with certain hematologic conditions and active liver disease.¹⁰

Mechanical compression therapy is achieved through the use of graduated compression stockings (GCS) and intermittent pneumatic compression (IPC) devices. Both the ACCP and AAOS recommend the use of mechanical compression therapy in lieu of pharmacologic thromboprophylaxis among postoperative orthopedic patients at increased risk for bleeding.^{9,10} Although complications of mechanical compression therapy are rare,¹¹ there are known differences in the safety and efficacy of different mechanical compression modalities. For example, the National Institute for Health and Care Excellence recommends the use of GCS only in the absence of several common comorbidities, including suspected or proven peripheral arterial disease, peripheral neuropathies, significant leg edema, and fragile skin conditions.⁹ Moreover, the efficacy of GCS in preventing VTE has been called into question by several authors¹²⁻¹⁴ and can even be associated with an increased risk of DVT if the pressure gradient is reversed.¹⁵ Conversely, data from randomized controlled trials suggest IPC alone is an effective therapy for thromboprophylaxis and may be comparable in efficacy to the use of pharmacologic agents.¹⁶⁻¹⁸ However, several authors have observed low rates of compliance to IPC, particularly when the IPC device requires an external power source such as a power outlet.^{2,19,20} For this reason, the ACCP specifically recommends the use of portable, battery-powered IPC devices capable of recording and reporting proper wear time for inpatients and outpatients alike.⁹

Despite the availability of clinical guidelines for thromboprophylaxis in the postoperative setting,

suboptimal implementation of recommended pharmacologic or mechanical compression therapies after hospital discharge remains a significant problem worldwide.²¹ Although the use of IPC therapy has been found to be cost-effective when compared with the use of an LMWH,²² battery-powered IPC devices remain underused in the outpatient setting. In addition, prescription of GCS for postoperative thromboprophylaxis among orthopedic surgery patients persists despite ACCP recommendations. Few studies have sought to characterize trends in the prescription of and compliance to thromboprophylaxis after hospital discharge among orthopedic surgery patients. The purpose of this study was therefore to describe current trends in thromboprophylaxis prescription, use, and education among patients discharged from the hospital after major orthopedic surgery.

Methods

In this cross-sectional descriptive study, we surveyed patients who underwent major orthopedic surgery for either hip or knee replacement regarding their experiences with thromboprophylaxis during and after hospital discharge. To improve recall accuracy, we only included individuals who had their surgery within the past 24 months. Subjects were recruited through BoneSmart, an online joint replacement community and advocacy group. With a focus on hip and knee replacement and a membership of more than 27,000, BoneSmart is the world's largest online community for orthopedic surgery patients.²³

BoneSmart sent out an announcement through their website inviting members to participate with a link to the online survey for those who were interested. Potential subjects were eligible to participate if they were at least 18 years of age and had joint replacement surgery (total hip, total knee, or partial knee) in the United States within the past 24 months. Eligible subjects were asked to complete an online survey comprised of 38 items addressing clinical characteristics, thromboprophylaxis education before discharge, prescription of thromboprophylaxis at discharge, and compliance to thromboprophylaxis after discharge. The survey took about 15 minutes to complete and subjects who completed the survey received a \$10 gift card in remuneration for their time.

Data were collected online using the Qualtrics survey tool and imported into SPSS for statistical

analysis. No patient identifying data were collected, and the research team did not have access to any patient contact information. Data were summarized using descriptive statistics. Human subjects' approval was provided by the institutional review board at Butler University.

Results

Respondent Characteristics

A total of 388 subjects completed the survey between August 31, 2018, and September 27, 2018. Given that eligible subjects had undergone orthopedic surgery

no more than 24 months before enrolling in the study, the range of possible dates of surgery was from August 2016 to September 2018. Respondents ranged in age from 27 to 80 (mean = 59, $SD = 8.98$) years. Most respondents (81.4%) were women, and 31 (8%) reported a personal history of VTE before the orthopedic surgery about which they were surveyed. Most participants had undergone either a unilateral total knee arthroplasty (55.2%) or total hip arthroplasty (35.3%). Respondent demographics are representative of the total population of joint replacement patients in the United States.²⁴ A summary of the sample characteristics is provided in Table 1.

Table 1. Sample Characteristics

	<i>N</i> = 388	Percent
Age in years (mean = 59.23, <i>SD</i> = 8.98, range 27–80)		
20–29	1	0.3
30–39	13	3.4
40–49	34	8.8
50–59	135	34.8
60–69	176	45.4
70–79	27	7
80–89	2	0.5
Sex		
Male	72	18.6
Female	316	81.4
Surgery type		
Bilateral total knee arthroplasty	22	5.7
Unilateral total knee arthroplasty	214	55.2
Total hip arthroplasty	137	35.3
Unicompartmental knee arthroplasty	8	2.1
Other	7	1.8
Personal history of VTE		
Yes	31	8
No	350	90.2
Unsure	7	1.8

VTE = venous thromboembolism.

Hospitalization and Discharge Experience

Respondents reported hospitalizations lasting for a mean of 43 hours ($SD = 35.38$, range = 2–432). Approximately half of respondents (49.7%) were discharged to home without home health services, while 43.3% were discharged to home with home health services. The majority (88.4%) of respondents reported receiving information about VTE at the time of discharge, and 83.8% either agreed or strongly agreed that their discharge instructions for thromboprophylaxis were clear. Likewise, 89.9% of respondents either agreed or strongly agreed that their instructions for exercise and mobility after discharge were clear, and 89.9% of respondents either agreed or strongly agreed that they were able to follow their mobility and exercise program after discharge. A summary of the hospitalization and discharge experience is provided in Table 2.

Pharmacologic Therapy

Ninety-four percent of respondents reported being prescribed a pharmacologic agent for thromboprophylaxis at the time of discharge. Aspirin was the most commonly prescribed pharmacologic agent, with 52.3% of respondents receiving a daily dose of either 325 mg (28.1% of respondents) or 81 mg (24.2% of respondents). The third and fourth most commonly prescribed agents were rivaroxaban (10.6% of respondents) and LMWHs (10.1% of respondents), respectively. Duration of pharmacologic therapy ranged from 2 to 180 days (mean duration = 28.4 days, $SD = 21.58$). Twenty-six respondents (7.7%) reported a pharmacologic therapy duration of fewer than 10 days, while 265 respondents (78.4%) reported a duration of fewer than 35 days.

Mechanical Compression Therapy

Two-hundred seventeen respondents (55.9%) reported being prescribed mechanical compression therapy for thromboprophylaxis at the time of discharge. Of these respondents, 86.6% were prescribed GCS, while 13.4% were prescribed IPC therapy. Of the 24 respondents who were not prescribed pharmacologic therapy, 14 (58.3%) were prescribed mechanical compression therapy, while 10 (41.7%) were not. Of the 14 respondents who reported being prescribed mechanical compression therapy as monotherapy, 12 (86%) were prescribed GCS and two (14.3%) were prescribed IPC. Among the 134 respondents who reported the duration of their mechanical compression therapy, duration

ranged from 2 to 68 days (mean = 21.86 days, $SD = 13.09$). Of these 134 respondents, 14 (10.4%) reported a duration of fewer than 10 days, while 109 respondents (81.3%) reported a duration of fewer than 35 days.

Of the 122 respondents who reported their compliance to mechanical compression therapy, 18% of respondents described wearing their mechanical compression therapy less than 50% of the time, while 63% of respondents described wearing their mechanical compression therapy at least 75% of the time. On average, respondents reported wearing their mechanical compression therapy for 71.3% of the time ($SD = 29.8%$); results were similar among respondents who were prescribed GCS (mean = 71.5%, $SD = 31%$) and those who were prescribed IPC (mean = 71.2%, $SD = 25.4%$).

Thromboprophylaxis in Patients with Previous Venous Thromboembolism

Of the 31 respondents who described a personal history of VTE, 30 (97%) reported being prescribed pharmacologic therapy for thromboprophylaxis on discharge, the duration of which ranged from 10 to 180 days (mean = 52.9 days, $SD = 53.7$). Among these 30 respondents, rivaroxaban was the most commonly prescribed pharmacologic agent (40%), followed by warfarin (26.7%). In addition, 14 (45%) of the 31 respondents with a personal history of VTE reported being prescribed a combination of pharmacologic and mechanical compression therapy. Of the 14 who were prescribed mechanical compression therapy, 13 (92.9%) were prescribed GCS and one (7%) was prescribed mobile IPC therapy. One respondent with a personal history of VTE was prescribed neither pharmacologic nor mechanical compression therapy. A summary of prescription and compliance to thromboprophylaxis is provided in Table 3.

Limitations

Limitations of this study include its cross-sectional descriptive design, reliance on subject recall, and use of a convenience sample. Although the characteristics of the study sample are representative of the total population of joint replacement patients in the United States,²⁴ individuals who chose to participate in an online forum dedicated to the discussion of orthopedic surgery experiences may have had more exposure to information regarding the importance of thromboprophylaxis than individuals who did not participate in an online forum.

Table 2. Hospitalization and Discharge Experience

	N = 388	Percent
Hours hospitalized after surgery (mean = 43.2, <i>SD</i> = 35.4, range = 2–432)		
≤12	31	8.03
13–24	108	28
25–36	61	15.8
37–48	96	24.9
49–60	28	7.3
61–72	32	8.3
≥73	30	7.8
Postoperative disposition		
Home without services	193	49.7
Home with services	168	43.3
Other	27	7
Received information about VTE at the time of discharge		
Yes	343	88.4
No	45	11.6
Unsure	0	0
My discharge instructions for anticoagulation therapy were clear		
Strongly agree	217	55.9
Agree	108	27.8
Neither agree nor disagree	42	10.8
Disagree	17	4.4
Strongly disagree	4	1
I was able to follow my exercise and mobility program after surgery		
Strongly agree	213	54.9
Agree	124	32
Neither agree nor disagree	17	4.4
Disagree	19	4.9
Strongly disagree	2	0.5
VTE = venous thromboembolism.		

Table 3. Prescription of and Compliance to Thromboprophylaxis

	N = 388	Percent
Anticoagulation therapy prescribed at discharge		
Aspirin 325 mg	109	28.1
Aspirin 81 mg	94	24.2
LMWH (Lovenox/enoxaparin)	39	10.1
Warfarin	30	7.7
Apixaban	21	5.4
Rivaroxaban	41	10.6
Other	8	2.1
Combination of fast- and long-acting	22	5.7
None	24	6.2
Duration of anticoagulation therapy, in days (mean = 28.35, SD = 21.58, range = 2–180)		
1–30	263	77.8
31–60	64	18.9
61–90	8	2.4
91–180	3	0.89
Compression therapy prescribed at discharge		
Compression stockings	188	48.5
Mobile compression	29	7.5
None	171	44.1
For how many days was compression therapy prescribed? (mean = 21.9, SD = 13, range = 2–68)		
≤7	14	10.4
8–14	56	41.8
15–21	10	7.5
≥22	54	40.3
What percentage of time did you wear your compression therapy? (mean = 71%, SD = 29.7%, range = 1–100%)		
0–25%	15	12.3
26–50%	24	19.7
51–75%	18	14.8
76–100%	65	53.3
LMWH = low-molecular-weight heparin.		

Discussion

The results of this study suggest a need for improved implementation of AAOS and ACCP guidelines for thromboprophylaxis in orthopedic surgery patients after hospital discharge. Less than a quarter of the current sample received thromboprophylaxis for 35 days as recommended by the ACCP guidelines, and between 7 and 10% of respondents received thromboprophylaxis for fewer than 10 days. In addition, the ACCP recommends only portable, battery-operated IPC devices for mechanical compression therapy; yet, 86% of respondents who reported being prescribed mechanical compression therapy were prescribed GCS.⁹ This finding is particularly concerning among patients who were not prescribed concurrent pharmacologic therapy, given that the efficacy of GCS is inferior to that of IPC.¹³ Although most patients were prescribed postoperative anticoagulation therapy, our survey found a wide range of options being used, with aspirin as the most common. Finally, although the AAOS recommends the use of both pharmacologic and mechanical compression therapies in patients with a personal history of VTE,¹⁰ in the current sample, fewer than half of respondents with a personal history of VTE reported being prescribed a combination of pharmacologic and mechanical compression therapy.

Results describing adequacy of discharge education are encouraging. Respondents largely felt that the instructions provided to them regarding thromboprophylaxis, exercise, and mobility at the time of discharge were clear. Respondents reported varied overall compliance to mechanical compression therapy, with rates of compliance similar in respondents prescribed GCS and IPC. Given these findings, there seems to be a need to increase the proportion of orthopedic surgery patients who receive thromboprophylaxis in accordance with the current guidelines. Because the number of respondents who were using IPC at home was so small, more research on this important aspect of patient safety after orthopedic surgery with a larger sample of respondents using IPC therapy is needed.

Conclusions

The results of this study suggest that duration of thromboprophylaxis and rates of IPC therapy use after hospitalization for major orthopedic surgery are suboptimal. These findings call attention to the need for improvements in clinical practice, postoperative home care, and patient education to better support best practices. In addition, innovation in IPC products for at-home use is needed to better support

both DVT prophylaxis and patient adherence to recommended use. If adopted, these changes could help improve the care of postoperative orthopedic patients at risk of VTE through increased use of IPC therapy in the home setting and decreased reliance on anticoagulants for VTE prophylaxis.

Implications

Clinicians who care for patients after hospitalization for major orthopedic surgery can improve care quality by ensuring adequate thromboprophylaxis during the postoperative period. Individual clinicians should emphasize to patients the importance of adherence to thromboprophylaxis therapy for the entirety of its prescribed duration. At the organizational level, healthcare quality professionals should evaluate provider adherence to evidence-based guidelines for the prescription of thromboprophylaxis. When necessary, healthcare quality professionals should also advocate for provider education and facilitate practice change.

Additional research is needed to describe healthcare providers' knowledge and perceptions of thromboprophylaxis recommendations after hospital discharge. In addition, potential barriers to increasing the uptake of IPC devices and extending the duration of thromboprophylaxis to 35 days should be explored. Research that directly measures adherence to prescribed thromboprophylaxis would likewise be beneficial. Improved understanding of the barriers to and facilitators of guideline-concordant thromboprophylaxis has the potential to reduce the burden of this largely preventable postoperative complication.

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