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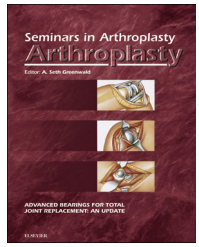

DVT prophylaxis strategies following total joint arthroplasty

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ABSTRACT

Routine prophylaxis against venous thromboembolism is indicated following total joint arthroplasty. Prophylactic strategies differ in efficacy and safety, and variable risk exists among patients. Many strategies have been successfully used for chemoprophylaxis as well as mechanical prophylaxis with the use of pneumatic compression. Advances in battery technology and pump miniaturization have expanded the use of pneumatic compression in the post-discharge setting with mobile devices. Pneumatic compression is contraindicated in certain patients, and not all patients tolerate the devices. Mobile pneumatic compression is a valuable adjunct to venous thromboembolic risk mitigation strategies, but does not eliminate the need for pharmacologic agents.

1. Introduction

The American Academy of Orthopaedic Surgeons (AAOS) and the American College of Chest Physicians (ACCP) have come to a consensus that the use of routine prophylaxis against venous thromboembolism (VTE) is indicated for patients undergoing total hip and knee arthroplasty. The new clinical practice guidelines acknowledge differences in efficacy of the various agents and the variable risk of VTE among patients [1]. Agents available for use in prophylaxis against venous thromboembolism include warfarin, low-molecular-weight heparins (LMWHs), aspirin, oral Xa inhibitors, and direct thrombin inhibitors. The use of pneumatic compression devices has been found to be effective in decreasing the risk of deep vein thrombosis (DVT) as a stand-alone strategy after total knee arthroplasty (TKA) and is given a level 1C recommendation by ACCP, while the data is less strong for use following total hip arthroplasty (THA) [2]. Mechanical devices are not associated with an increased bleeding risk, and address the concerns of some surgeons with regard to postoperative bleeding [3]. While mechanical compression has demonstrated efficacy in reducing VTE risk, its utility in the outpatient setting has been limited due to the size and wall power requirements of the pump units. The availability of mobile compression devices has expanded the indications for their use as a result of portability. Pneumatic compression is contraindicated in patients with severe peripheral vascular disease, arterial ulcers, dermatologic disorders, and any conditions where increased venous or lymphatic return is unwanted. The limb morphology of many obese patients also preclude fitting of the compression sleeves. While the use of mobile pump technology in DVT prophylaxis adds to the armamentarium of tools available for use in VTE risk mitigation, it does not eliminate the need for pharmacologic agents.

Dr. Louis Kwong wishes to disclose that he was a Steering Committee member and Principle Investigator in the Phase II and Phase III clinical trials that led to the development and approval of rivaroxaban—a pharmacologic antithrombotic. Additionally, he has provided consulting services to Bayer and Janssen who developed and market rivaroxaban for use in thromboprophylaxis.

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2. Venous thromboembolic risk following total joint arthroplasty

The performance of total hip and knee arthroplasty places our patients at risk for venous thromboembolism. In the absence of prophylaxis, approximately half of patients undergoing hip replacement, and approximately 60% of patients undergoing knee replacement will develop VTE [4]. However, VTE is a largely clinically silent disorder, with only approximately 5% of these patients becoming symptomatic [5]. When these patients do develop symptomatic VTE, they have a higher likelihood of prolonged hospital stay and a greater rate of re-hospitalization; thereby, reducing the quality of life and increasing health care expenditures [6]. Additionally, up to 2% of patients may die of fatal pulmonary embolism without prophylaxis [7] (Fig. 1). Only half of patients with fatal PE have any antecedent signs or symptoms preceding their demise. For these patients, the first presenting sign of VTE is the fatal event itself [8]. While VTE occurs more frequently in patients following total knee arthroplasty (TKA), there is a greater preponderance of distal thrombi in those patients. Conversely, although VTE occurs in a lower proportion of patients following total hip arthroplasty (THA), the thrombi that do occur are more likely to represent proximal thrombi—clots that are more likely to dislodge and embolize into the pulmonary circulation [8–10]. While all arthroplasty patients are at elevated risk of VTE, the highest risk is associated with those having a history of DVT or pulmonary embolism (PE), having had prior surgery within the preceding 3 months, requiring prolonged immobilization post-operatively for any reason, and with certain medical co-morbidities [2,11–13]. In one epidemiological study, patients with a history of venous thromboembolism were approximately eight times more likely to develop a new episode of DVT or PE during a subsequent high-risk period (e.g., following major orthopaedic surgery) compared with patients without a history of VTE [14]. Older patients with congestive heart failure undergoing hip or knee replacement and those patients with chronic obstructive pulmonary disease (COPD) undergoing TKR are also at an increased risk for the development of VTE [15]. A case–control study of consecutive patients with objectively confirmed DVT identified metabolic syndrome (a cluster of risk factors for atherosclerosis, including truncal obesity, hypertension, insulin resistance, and dyslipidemia) as being independently associated with DVT, and may play a role in the pathogenesis of venous thromboembolism [16]. Patient age alone is a risk factor, with the greatest interval increase in risk occurring after the age of 40 years, with the risk increasing approximately twofold with each subsequent passing decade of age [17]. Because many of our arthroplasty patients are older and less healthy, these factors, coupled with the pathophysiology of the surgical procedure itself, stratify them to the very high-risk population for the development of VTE.

Figure 1 – CT-angiography showing a left lingular segmental pulmonary artery embolism in a 74-year-old female postop day 1 after left total knee arthroplasty.

3. VTE risk mitigation strategies: Current standard of care

In the arthroplasty patient, prophylaxis with any of a number of strategies will play a valuable role in VTE risk reduction. Both the American Academy of Orthopaedic Surgeons (AAOS) as well as the American College of Chest Physicians (ACCP) agree that routine prophylaxis must be used in all patients undergoing hip and knee replacement to reduce the risk of DVT [13]. With regard to pharmacologic approaches, aspirin, warfarin, low-molecular-weight heparins (LMWHs), factor Xa inhibitors, and direct thrombin inhibitors have all been used to reduce the risk of venous thromboembolism (Table 1). It is readily acknowledged that variability exists among the various agents with regard to efficacy, safety, ease of use and potential complications. With regard to mechanical measures, pneumatic compression devices have been found to function as an effective stand-alone strategy following total knee arthroplasty, with less robust data supporting its effectiveness as a stand-alone strategy following total hip replacement [18–22]. The AAOS and ACCP consensus does not make recommendations with regard to any specific strategy, timing of initiation, or duration of prophylaxis. Current guidelines also acknowledge variable risk among patients undergoing arthroplasty with regard to not only venous thromboembolic events, but also with regard to individual bleeding risk independent from surgery. The practitioner must weigh these patient and disease state factors, along with agent specific efficacy and safety characteristics in making a decision with regard to the VTE prophylaxis strategy to use.

4. Pneumatic compression

4.1. *Benefits of pneumatic compression*

Pneumatic compression has several benefits with regard to VTE risk reduction. The squeezing imparted by the inflation of extremity compression sleeves alters the hemodynamics of the lower extremity venous system by enhancing venous return, with increases of up to 200% in peak flow velocity. The squeezing also reduces peripheral venous pooling and stasis through a reduction in venous capacitance. Additionally, it is theorized that the squeezing effect on any extremity (including an upper extremity in the face of lower extremity surgery) results in systemic humeral effects, with an increase in systemic fibrinolysis without incurring an increase in