Respiratory Synchronized Versus Intermittent Pneumatic Compression in Prevention of Venous Thromboembolism After Total Joint Arthroplasty

A Systematic Review and Meta-Analysis

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KEYWORDS

• Total joint arthroplasty • Venous thromboembolism • Deep venous thrombi • Pulmonary emboli
• Thromboprophylaxis • Respiratory synchronized compression
• Intermittent pneumatic compression devices

KEY POINTS

- Mechanical compression devices serve as an alternative and conjunctive therapy to chemoprophylaxis in prevention of thromboembolic events after total joint arthroplasty. There is still uncertainty, however, regarding the safest and most effective thromboprophylactic strategy.
- Nonsynchronized intermittent pneumatic compression devices (NSIPCDs) function by providing pressure at a constant cycle, whereas continuous enhanced circulation therapy devices function in a synchronized manner with a patient's own respiratory cycle (respiratory synchronized compression devices [RSCDs]).
- RSCDs may be marginally more effective at preventing venous thromboembolism events (VTEs) than NSIPCDs. The addition of mechanical prophylaxis to any chemoprophylactic regimen further increases VTE prevention.
- Although the sole use of compression devices has been shown to decrease the risk of bleeding and other associated complications, there is not enough evidence to support mechanical compression as a sole means of VTE prophylaxis.

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INTRODUCTION

Venous thromboembolism (VTE), including deep vein thrombosis (DVT) and pulmonary embolism (PE), is a serious and potentially life-threatening complication after total joint arthroplasty (TJA).[1–10] Hip and knee replacements are at particularly high risk for VTE, largely due to obstructed venous blood flow during surgery and reduced patient mobility during recovery.[11] In current practice, nearly every patient undergoing TJA is prophylactically treated to prevent thromboembolic events with the use of anticoagulants and, in some cases, with or without mechanical prophylaxis, such as sequential or intermittent pneumatic compression devices.[12] There is still uncertainty, however, regarding the safest and most effective thromboprophylactic strategy after TJA.

Several studies have shown that the morbidity rate of chemoprophylaxis treatment may be equal or worse than the complications associated with perioperative thromboembolic events.[13–18] Pharmacologic prophylaxis (ie, low-molecular-weight heparin [LMWH], aspirin, or warfarin) is not a benign intervention and is often associated with an increased risk for major bleeding, wound drainage, and periprosthetic joint infection.[19] Many of these complications result in hospital readmission and additional surgical interventions for patients, resulting in a greater economic burden on the health care system.[20] As a result, the American Academy of Orthopaedic Surgeons has recently published conservative thromboprophylaxis guidelines supporting less aggressive chemoprophylactic regimens after TJA.[21,22] Mechanical compression devices serve as an alternative and conjunctive therapy to chemoprophylaxis. They function primarily by compressing blood vessels in the lower extremities, which decreases venous stasis and enhances fibrinolysis.

Different types of nonsynchronized intermittent pneumatic compression devices (NSIPCDs) have been used for thromboprophylaxis after TJA. These devices generally function by providing a pressure gradient that facilitates venous blood flow based on automatic or constant time lengths. In contrast, respiratory synchronized compression devices (RSCDs) function synchronously with a patient's respiratory phase.[23,24] The devices are capable of monitoring respiratory-related venous flow and do not pump during inspiration when levels of right heart filling are low but rather pump during the expiratory phase when levels of right heart filling are greater. Despite the widely accepted use of these modalities of mechanical prophylaxis, the effectiveness of these thromboprophylactic devices after TJA remains unclear. The aim of this systematic review was to comparatively evaluate the efficacy of RSCDs to NSIPCDs in prevention of thromboembolic events after TJA.

MATERIALS AND METHODS

Search Strategy

A systematic literature search was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (Fig. 1). Two reviewers independently searched 3 online databases (PubMed, Cochrane, and Embase) to identify all relevant articles published between January 2000 and August 2016. Reference lists of included studies were examined for additional articles that could have been missed. The search terms and inclusion/exclusion criteria were established a priori (Box 1, Table 1). Eligible studies were included based on the following criteria:

1. Levels I, II, and III evidence
2. Studies published in English
3. Human studies
4. Primary and revision TJA
5. Studies reporting DVT or PE
6. Full-text availability

Exclusion criteria were as follows:

1. Studies on any hip or knee arthroplasty secondary to trauma
2. Studies not reporting any VTE events
3. Potential overlap of patient populations when study was by same investigators or institutions
4. Nonhuman studies
5. Non–English language studies

Data Extraction

Two of the authors (A.M.E. and K.Y.K) reviewed all titles and abstracts independently to determine eligibility and extract relevant data, including number of patients and DVT/PE rate. In addition, any information on complications (eg, major bleeding) or adverse events was documented. Disagreements were resolved by discussion between the 2 authors, and, if a consensus could not be reached, a more senior reviewer (A.A.A. or R.I.) helped resolve the discrepancy. The final decision on inclusion was made based on the full-text article.

Qualitative Analysis

The quality of studies was assessed with the use of the Methodological Index for Non-Randomized Studies (MINORS) criteria.