QUERI

Effectiveness of Intermittent Pneumatic Compression Devices for Venous Thromboembolism Prophylaxis in High-risk Surgical and Medical Patients

June 2015

Prepared for:
Department of Veterans Affairs
Veterans Health Administration
Quality Enhancement Research Initiative
Health Services Research & Development Service
Washington, DC 20420

Prepared by:
Evidence-based Synthesis Program (ESP) Center
Durham Veterans Affairs Healthcare System
Durham, NC
John W. Williams, Jr., MD, MHSc, Director

Investigators:
Principal Investigators:
Juliessa M. Pavon, MD
John W. Williams, Jr., MD, MHSc

Co-investigators:
Soheir S. Adam, MD
Zayd A. Razouki, MD
Jennifer R. McDuffie, PhD
Paul F. Lachiewicz, MD
Andrzej S. Kosinski, PhD
Christopher A Beadles, MD
Thomas L. Ortel, MD, PhD

Research Associate:
Avishek Nagi, MS

VA HEALTH CARE Defining EXCELLENCE in the 21st Century

PREFACE

The VA Evidence-based Synthesis Program (ESP) was established in 2007 to provide timely and accurate syntheses of targeted healthcare topics of particular importance to clinicians, managers, and policymakers as they work to improve the health and healthcare of Veterans. QUERI provides funding for four ESP Centers, and each Center has an active University affiliation. Center Directors are recognized leaders in the field of evidence synthesis with close ties to the AHRQ Evidence-based Practice Centers. The ESP is governed by a Steering Committee comprised of participants from VHA Policy, Program, and Operations Offices, VISN leadership, field-based investigators, and others as designated appropriate by QUERI/HSR&D.

The ESP Centers generate evidence syntheses on important clinical practice topics. These reports help:

- Develop clinical policies informed by evidence;
- Implement effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures; and
- Set the direction for future research to address gaps in clinical knowledge.

The ESP disseminates these reports throughout VA and in the published literature; some evidence syntheses have informed the clinical guidelines of large professional organizations.

The ESP Coordinating Center (ESP CC), located in Portland, Oregon, was created in 2009 to expand the capacity of QUERI/HSR&D and is charged with oversight of national ESP program operations, program development and evaluation, and dissemination efforts. The ESP CC establishes standard operating procedures for the production of evidence synthesis reports; facilitates a national topic nomination, prioritization, and selection process; manages the research portfolio of each Center; facilitates editorial review processes; ensures methodological consistency and quality of products; produces “rapid response evidence briefs” at the request of VHA senior leadership; collaborates with HSR&D Center for Information Dissemination and Education Resources (CIDER) to develop a national dissemination strategy for all ESP products; and interfaces with stakeholders to effectively engage the program.

Comments on this evidence report are welcome and can be sent to Nicole Floyd, ESP CC Program Manager, at Nicole.Floyd@va.gov.

Recommended citation: Pavon JM, Williams JW Jr., Adam SS, Razouki ZA, McDuffie JR, Lachiewicz PF, Kosinski AS, Beadles CA, Ortel TL, Nagi A. Evidence Report: Effectiveness of Intermittent Pneumatic Compression Devices for Venous Thromboembolism Prophylaxis in High-Risk Surgical and Medical Patients. VA ESP Project #09-009; 2015.

This report is based on research conducted by the Evidence-based Synthesis Program (ESP) Center located at the **Durham VA Medical Center, Durham, NC**, funded by the Department of Veterans Affairs, Veterans Health Administration, Office of Research and Development, Quality Enhancement Research Initiative. The findings and conclusions in this document are those of the author(s) who are responsible for its contents; the findings and conclusions do not necessarily represent the views of the Department of Veterans Affairs or the United States government. Therefore, no statement in this article should be construed as an official position of the Department of Veterans Affairs. No investigators have any affiliations or financial involvement (*eg*, employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties) that conflict with material presented in the report.

ABSTRACT

Context: Venous thromboembolism (VTE), which encompasses deep vein thrombosis (DVT) and pulmonary embolism (PE), is a serious potential complication in hospitalized patients. Thromboprophylaxis regimens include pharmacological and mechanical options such as intermittent pneumatic compression devices (IPCDs). There are a wide variety of IPCDs available, but it is uncertain if they vary in effectiveness or ease of use.

Objective: To systematically review the literature on the comparative effectiveness of IPCDs for selected outcomes (mortality, VTE, symptomatic or asymptomatic DVT, major bleeding, ease of use, and adherence) in post-operative surgical and high-risk medical patients.

Data Sources and Study Selection: We searched MEDLINE (via PubMed), Embase, CINAHL, and Cochrane CENTRAL from January 1, 1995, to October 30, 2014, for peer-reviewed, English-language randomized controlled trials (RCTs). All searches used terms for IPCDs and the conditions of interest, along with validated search terms for RCTs. We also used terms to identify relevant observational studies on ease of use and adherence. Bibliographies of identified articles were further reviewed. To assess for possible publication bias, we searched ClinicalTrials.gov to identify completed but unpublished studies meeting our eligibility criteria.

Data Synthesis: Eighteen RCTs and 3 observational studies were eligible; most were conducted in patients undergoing joint replacement surgery. Our review considered 3 types of evidence: 1) head-to-head comparisons of IPCDs; 2) indirect comparisons of IPCDs to a common comparator (*eg*, foot vs calf devices, each compared to anticoagulation); and 3) data on ease of use or adherence from patients or staff. The methodological quality of the included studies was variable and generally suboptimal. The most commonly studied devices were the Kendall SCD™ and A-V Impulse System™. Only 3 trials compared different IPCDs directly. One showed lower VTE rates for a VenaFlow® compared to the Kendall SCD, but 2 other studies showed no difference between the PlexiPulse® and the Kendall SCD. IPCDs were comparable to anticoagulation for major clinical outcomes (VTE: risk ratio [RR] 1.39; 95% confidence interval [CI], 0.73 to 2.64). Limited data suggest that concurrent use of anticoagulation with IPCD may lower the risk of VTE compared to anticoagulation alone (RR 0.27; 95% CI 0.05 to 1.64) and that IPCD compared to anticoagulation may lower the risk of major bleeding (RR 0.33; 95% CI 0.07 to 1.51). Subgroup analyses did not show significant differences by device location, mode of inflation, or risk of bias elements. Overall, there were no consistent associations between specific brand-name IPCDs or sleeve location and ease of use or adherence. Chief limitations of the literature were the paucity of head-to-head comparisons between IPCDs in surgical and medical patients, and the identification of primarily asymptomatic DVTs of uncertain clinical importance.

Conclusions: IPCDs are appropriate for VTE thromboprophylaxis when used in accordance with current clinical guidelines. The current evidence base to guide selection of a specific device or type of device is limited. When choosing a specific IPCD, focusing on device flexibility, acceptability by nursing staff and patients, and the most frequently studied devices, as well as on cost, can help direct selection of appropriate IPCDs. Comparative effectiveness studies are urgently needed to address current gaps in evidence.

ABBREVIATIONS TABLE

ACCP	American College of Chest Physicians
CECT	Continuous enhanced circulation therapy
CI	Confidence interval
DVT	Deep vein thrombosis
ECRI	Emergency Care Research Institute
ESP	Evidence-based Synthesis Program
HSR&D	Health Services Research & Development
IPCD	Intermittent pneumatic compression device
ISTH	International Society on Thrombosis and Haemostasis
KQ	Key question
LMWH	Low molecular weight heparin
MeSH	Medical Subject Heading
n	Number
PE	Pulmonary embolism
PICOTS	Population, intervention, comparator, outcomes, timing, and setting
PTT	Partial thromboplastin time
QUERI	Quality Enhancement Research Initiative
RIAC	Rapid inflation asymmetrical compression
RCT	Randomized controlled trial
RD	Risk difference
RR	Risk ratio
SCD	Sequential compression device
THA	Total hip arthroplasty
TKA	Total knee arthroplasty
VA	Veterans Affairs
VHA	Veterans Health Administration
VISN	Veterans Integrated Service Networks
VTE	Venous thromboembolism
V/Q	Ventilation/perfusion