

Nov. 2019—Rapid Review Evidence Summary

McGill University Health Centre: Division of Nursing Research and MUHC Libraries

What evidence exists that describes the comparative efficacy of using calf-high or thigh-high graduated compression stockings (GCS) for venous thromboembolism (VTE) in adult surgical patients?

This report aims to summarize the best available evidence around comparing the efficacy between the use of calf-high and thigh-high graduated compression stockings (GCS) in the prevention of VTE, specifically deep vein thrombosis (DVT) and pulmonary embolism (PE) in adult surgical patients undergoing general anaesthesia, during postoperative hospitalization and following discharge. This information is to guide clinical and materials management decision-making for including the appropriate GCS in the MUHC VTE prophylaxis guidelines, taking into account economical and patient outcomes. This report builds on the foundation laid down by Sonia Castiglione and Tara Landry's previous report (written in 2015) on the proven effectiveness of mechanical prophylaxis methods in prevention of VTE.

Key Messages:

- Venous thromboembolism (VTE) including deep vein thrombosis (DVT) and pulmonary embolism (PE) remains one of the most common and preventable hospital-acquired complications in the surgical population.
- Pharmacological and mechanical interventions, alone or in combination, are currently recommended by clinical practice guidelines as prophylaxis in the prevention of VTE during hospitalization and once the patient is discharged home.
- Overall, the evidence on mechanical methods, including intermittent pneumatic compression (IPC), graduated compression stockings (GCS) and venous foot pumps (VFP), indicates that they are effective in VTE prophylaxis.
- Specific to this Rapid Review:
 - Thigh-high GCS were found to be slightly more effective in preventing DVT (4 studies), but these benefits only reached statistical significance in one of the 4 studies for patients at high risk of having a DVT, over the use of knee-high GCS;
 - Three studies considered patient preference and comfort in GCS adherence; all of them found that patients prefer wearing knee-high GCS, which may potentially discourage any additional benefit obtained by wearing thigh-high GCS;
 - The only study that analyzed both prevention of DVT and PE did not compare the use of thigh-high vs. knee-high GCS, and was therefore not included in this rapid review;
 - The overall quality of the reviewed evidence was moderate. Although a few good systematic reviews and Randomized Controlled Trials (RCT) were found, they were few in number and relied on old data and/or poor sampling.
- The use of mechanical methods in the clinical setting is challenged by a number of issues, including lack of clarity around fit, timing/frequency of administration, duration of administration and compliance by patients and healthcare professionals.

Who is this summary for?

This summary was requested by Debbie Watson, Enhanced Recovery Pathway Coordinator & Dr. Liane Feldman, Director of the Division of General Surgery at the MUHC.

Information about this summary:

This report covers a broad collection of literature and evidence sources with a search emphasis on systematic reviews.

This summary includes:

Key findings from a broad collection of recently published literature (from 2012-2019) and evidence sources.

This summary does not include:

Recommendations, additional information, or detailed description of the interventions in the studies.

1. Background:

Venous thromboembolism (VTE) which includes deep vein thrombosis (DVT) and pulmonary embolism (PE) has been identified as one of the most preventable causes of hospital death. A massive PE has been identified as the cause of death in about 10% of hospitalized patients. In addition to risk of mortality with VTE, the risk of long term consequences to patients has also been identified and can include bleeding, future thrombus formation and post-thrombotic syndrome. Primary VTE prophylaxis includes early and frequent mobilization, pharmacological/chemical prophylaxis, mechanical methods or a combination of the above. Mechanical methods include intermittent pneumatic compression (IPC) devices, graduated compression stockings (GCS) and venous foot pumps (VFP). They function by compressing the thigh, calf or foot muscles in an active or passive manner to increase blood flow.

If we focus more specifically on the use of GCS, different sizes and compressions strengths are available for patients. When considering size, available ones include a shorter size, also called calf high or knee high GCS, and a longer size, also called thigh high GCS. At the MUHC, these different sizes are purchased from the company Cardinal Health (T.E.D. stockings with a specific compression strength), and present a substantial price difference between them (\$3.75/pair for knee-high GCS vs. \$10.66/pair for thigh-high GCS).

As part of a Quality Improvement initiative to reduce cost while obtaining optimal patient outcomes, the question was posed to consider whether there is a difference in VTE prevention between the use of knee-high GCS and thigh-high GCS. The following PICO framework was determined for this question:

P (Population concerned) = patients undergoing surgery under general anesthesia

I (Intervention) = calf high T.E.D stockings

C (Comparison) = thigh high T.E.D stockings

O (Outcome) = DVT (lower extremity) and PE

It is important to note that issues with compliance for use during hospitalization and after discharge are significant and relate to the nature of the evidence as well as patient, healthcare professional and organizational barriers. As well, in all studies found which evaluated a comparison with knee high and thigh high GCS, DVT was almost exclusively measured as an outcome, without measuring PE outcomes. These need to be considered when weighing the evidence around different-sized GCS prophylaxis in adult surgical patients.

This rapid review will present summaries of the best available evidence for adults (over 18) who underwent any surgical procedure requiring general anaesthesia, and where the specific mechanical prophylaxes of knee-high and thigh-high graduated compression stockings (GCS) were used and compared with each other in terms of patient outcomes in VTE prevention, patient comfort and preference. Detailed search strategies were developed by an experienced librarian (A. Bergeron). Sources include: Medline via Ovid SP, PubMed, Embase, CINAHL and The Cochrane Library. The concepts were searched using both Subject Headings and text words (specific search terms are available upon request). Guideline sources were also searched, namely: ECRI Institute, Trip, and GuidelineCentral. The search date was November 14, 2019. Initial screening and deduplication were done by the librarian, with a result of 24 articles for the Evidence informed Decision Making-Advisor (EIDM-A) to further screen. Articles that were out of scope, and studies with poor or poorly described methodology were discarded by the EIDM-A. 8 relevant articles were retained for analysis. The analysis of studies and the report were prepared by the EIDM-A and reviewed by the librarian.

Contents:

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2. Summary of findings
3. Additional sources
4. References

The studies that were reviewed range from 2012-present, and are mainly systematic reviews and RCTs of moderate quality, including important Cochrane reviews. As well, other evidence-based guidelines were summarized. A list of all the articles found and reviewed is available upon request (marie-linda.boghdady@muhc.mcgill.ca).

Levels of Evidence (adapted from OHRI KTA Evidence Summary document)

Each piece of evidence presented in this summary is assigned a level.

This assignment is based on the evidence being presented and not on the claim made by the authors.

☀ **Platinum:** systematic reviews and meta-analysis

✳ **Gold:** Randomized controlled trials

★ **Silver:** Observational studies (non-randomized trials, case-control, time-series, cohort studies, case series, literature reviews, qualitative studies.)

✧ **Bronze:** Expert committee guidelines, reports or opinions, commentary or editorials.

● **Level of evidence** cannot be determined.

2. Summary of Findings:

a. Evidence specific to comparing the use of knee high vs. thigh-high GCS for most effective VTE prophylaxis

☀ A 2015 systematic review done by Ros Wade and her colleagues is probably the most solid evidence found within this Rapid Review. 23 RCT were considered to compare the effectiveness of knee-high vs. thigh high GCS to prevent DVT. Five RCTs that directly compared knee length with thigh length GCSs in surgical patients were pooled; the summary estimate of effect indicated a trend favouring thigh length GCSs for the prevention of DVT, but the findings were not statistically significant. To add strength to the comparison of knee length versus thigh length stockings, a pooled analysis of four RCTs found statistically significantly fewer DVT events in patients receiving thigh-length GCS plus heparin compared to heparin alone. Finally, 13 trials contained data that directly or indirectly informed the relative effectiveness of knee length versus thigh length stockings for the prevention of DVT. There was significant statistical heterogeneity, as well as inconsistency reflecting clinical heterogeneity across the trials and indicating that there may be further underlying unknown clinical and methodological heterogeneity across the trials. Overall, thigh length stockings plus heparin was the most effective treatment combination, but with a 0.2–0.27 probability that it would not be the most effective treatment in a new trial of all the treatments; this uncertainty is because of the unexplained heterogeneity across the trials in the network. Although thigh-length stockings plus heparin is the most effective treatment, the incremental benefit of reducing the risk of DVT of adding thigh length stockings to heparin is less than adding heparin to no treatment, as heparin already reduces the risk of DVT significantly. This is the only evidence found that detected statistical significance in using thigh high GCS, but only when combined with a specific pharmacological prophylaxis (Wade, Sideris [1]).

Cost-effectiveness and Value of Information analyses were also performed in this systematic review, the results of which are not included in this rapid review.

- ☀ A 2012 Cochrane review done by Sajid et al. analyzed the results of 3 RCT including 496 patients to evaluate the effectiveness of knee high vs. thigh high GCS in the prevention of DVT. No significant difference was found between the 2 types of GCS in preventing DVT. However, the authors point out that too few RCT were found to be able to be included in this analysis. As well, there was significant heterogeneity among the included trials. They suggest that the lack of high quality evidence included in this review does not permit them to make a solid conclusion about which size of GCS is most effective in preventing DVT. They recommend performing a major multicentre RCT to test the comparative effectiveness of the 2 types of GCS to prevent DVT. They also suggest that other factors may have a greater influence on the choice of GCS, such as patient compliance, ease of use and cost implications (Sajid, Desai [2]).
- ☀ A 2016 systematic review and meta-analysis was done by Wade et al. to assess clinical effectiveness of thigh high vs. knee high GCS use in preventing DVT in adult surgical patients. This review could be considered an update to the review done in 2012 by Sajid et al. (see the point above). While the methodology of the systematic review and the meta-analysis were very thorough, the pool of RCT was considered weak, since many of them were old, poorly reported, and displayed substantial variation in patient characteristics and interventions used. Overall, thigh length GCS may have been considered more effective than knee length GCS in preventing DVT, but statistical significance was not reached. The authors suggest that patient preference for compliance may be a better guide for GCS size decision (Wade, Paton [3]).
- ☀ A 2012 meta-analysis was conducted by Loomba et al. to pool findings of studies comparing knee length and thigh length GCS for DVT prophylaxis, to see which size was more effective for this prevention in the surgical population. Results showed that thigh high GCS are considered slightly more effective in preventing DVT than knee high GCS, but that this benefit was not found to be statistically significant. However, this meta-analysis only included 5 studies, and it was not clear if all of them were RCT. Also, those 5 studies were not very current to 2012. Inclusion and exclusion criteria were also not explained in this study. This could be considered to be a weak meta-analysis (perhaps not as high-level evidence as it looks); however, it seems to corroborate with studies mentioned previously which come to similar conclusions (Loomba, Arora [4]).

b. Evidence specific to patient compliance for the use of different-sized GCS

Since many studies iterated the importance of the patient factor in the effectiveness of GCS for VTE prophylaxis, I included here results of relevant article considering their influence on GCS compliance.

- ✳ A 2015 RCT compared the comfort levels of patients regarding the use of 3 different types of GCS: low-pressure knee length GCS, low-pressure thigh high GCS and moderate-pressure knee length GCS (all prescribed for DVT prophylaxis). Patients were adults who had undergone abdominal surgery, undergoing low-molecular weight heparin (LMWH) and GCS prophylaxis. 219 patients were equally randomized into 3 different groups, corresponding to the 3 types of GCS described above (they all were administered the same LMWH, but GCS differed per group). DVT occurrence was measured as an outcome, as well as patient comfort level and detected patient problems (such as GCS rolling down, redness and indentation of the skin at the top end of the stocking, oedema and/or pressure ulcer of the toes found during neurovascular assessment). Findings for this RCT show that none of the patients experienced DVT, meaning all types of GCS were effective in preventing it. As well,

patients in the first group with low-pressure knee high GCS experienced fewer problems and were the most comfortable of the 3 randomized groups of patients. The group with the highest number of patient problems was found to be the group with the moderate-pressure knee high GCS, with the group with low-pressure thigh high GCS between these 2 groups in terms of amount and intensity of patient problems. Perhaps it could be argued here that GCS pressure was more the determinant in this study than GCS length; however, this RCT offers a good patient perspective for compliance and relative effectiveness for DVT, as long as a type of GCS is worn (Ayhan, Iyigun [5]).

☀ 2 systematic reviews were also done by Ros Wade (who seems to be an expert in this area of care), to consider patient preference in GCS size (Wade and Paton [6], Wade, Paton [7]). Both of them concluded that patient preference is for wearing knee length GCS. Authors suggested that efforts need to be made by clinical staff to improve patient adherence by ensuring correct use of GCS, identifying proper size and pressure, adherence while still in the hospital, as well as to pay attention to compliance post-discharge.

3. Additional Source

★ While this finding does not directly answer our quest for evidence regarding the use of knee high vs. thigh GCS, Güzelküçük et al. recorded a case study of a 46-year-old man whose knee high GCS was too tight for him, which serves to confirm the point above mentioned by Wade et al., that it is important to properly fit GCS on the patients. Due to poor fitting and late monitoring, he displayed markings at the top of his stockings. When the GCS was uncovered, it was found that this man suffered from total axonal degeneration, causing peroneal nerve palsy. Such events can be prevented by proper fitting, no matter what the size or compression strength offered by the GCS (Guzelkucuk, Skempes [8]).

4. References:

1. Wade, R., et al., *Graduated compression stockings for the prevention of deep-vein thrombosis in postoperative surgical patients: a systematic review and economic model with a value of information analysis*. Health Technology Assessment (Winchester, England), 2015. **19**(98): p. 1-220.
2. Sajid, M.S., et al., *Knee length versus thigh length graduated compression stockings for prevention of deep vein thrombosis in postoperative surgical patients*. Cochrane Database of Systematic Reviews, 2012(5): p. CD007162.
3. Wade, R., et al., *Thigh length versus knee length antiembolism stockings for the prevention of deep vein thrombosis in postoperative surgical patients; a systematic review and network meta-analysis*. BMJ Open, 2016. **6**(2): p. e009456.
4. Loomba, R.S., et al., *Thigh-length versus knee-length compression stockings for deep vein thrombosis prophylaxis in the inpatient setting*. Blood Coagulation & Fibrinolysis, 2012. **23**(2): p. 168-71.
5. Ayhan, H., et al., *A randomised clinical trial comparing the patient comfort and efficacy of three different graduated compression stockings in the prevention of postoperative deep vein thrombosis*. Journal of Clinical Nursing, 2015. **24**(15-16): p. 2247-57.
6. Wade, R. and F. Paton, *Surgical patients' adherence to the use of compression stockings*. Nursing Times, 2017: p. 166-166.

7. Wade, R., F. Paton, and N. Woolacott, *Systematic review of patient preference and adherence to the correct use of graduated compression stockings to prevent deep vein thrombosis in surgical patients*. *Journal of Advanced Nursing*, 2017. **73**(2): p. 336-348.
8. Guzelkucuk, U., D. Skempes, and W. Kummerdee, *Common peroneal nerve palsy caused by compression stockings after surgery*. *American journal of physical medicine & rehabilitation / Association of Academic Physiatrists*, 2014. **93**(7): p. 609-611.

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