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Can calf massage prevent deep vein thrombosis? A systematic review

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Abstract

Background: Deep vein thrombosis (DVT) is a condition in which blood clots form in deep veins, usually in the legs. The causes of thrombosis are divided into two, namely those related to immobilization and those related to hypercoagulation, both of which are related to genetic factors and acquired risk factors. DVT can be prevented by preventing recurrent DVT, patients must continue to exercise, and provide compression therapy and anticoagulation therapy with the right duration.
Purpose: To evaluate the efficacy of calf massage techniques in lowering the risk of deep vein thrombosis (DVT).
Method: The research design used is a systematic review method with article selection referring to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The article search stage is carried out systematically using keywords written manually or using the search facility available in each database. The keywords used in the article search are (massage OR therapy OR pressure) AND (calf OR foot) AND (Deep Vein Thrombosis (DVT)). Article searches are carried out electronically to filter relevant articles. Articles are sourced from the Google Scholar, PubMed, Science Direct, and ProQuest database search engines. The inclusion criteria for this literature review were articles published in the last ten years, namely 2013-2023, articles in Indonesian and English, interventions given to patients at risk of deep vein thrombosis (DVT), interventions using calf massage either with or without tools, randomized controlled trials, experimental/quasi-experimental, and full manuscripts available.
Results: Calf massage has been shown to be effective in reducing the risk of deep vein thrombosis (DVT). This is shown based on five journals that have been analyzed that there is a significant decrease in the risk of DVT in the results of the experimental group with the control group and there is only one journal that states that the use of foot pumps does not significantly reduce the incidence of DVT in patients undergoing total knee arthroplasty (TKA) with edoxaban thromboprophylaxis.
Conclusion: Massage interventions carried out using tools or without tools with various versions and methods have a positive impact on reducing the risk of DVT.

Keywords: Calf Massage; Deep Vein Thrombosis (DVT); Foot; Therapy.

INTRODUCTION

Deep vein thrombosis (DVT) is a condition in which a blood clot forms in a deep vein, usually in the leg. According to the American Society of Hematology, approximately 1 in 1.000 people in the United States experience venous thromboembolism (VTE) each year, including DVT and pulmonary embolism (PE) (Arnold, 2021; Olaf & Cooney, 2017; Fleck, Albadawi, Shamoun, Knuttinen, Naidu, & Oklu, 2017; Day, Tran, Chunilal, Bortz, & Esterman, 2022). DVT, including DVT and PE, occurs in 1 to 2

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people per 1.000 each year, equivalent to ~300.000 to 600.000 events in the United States each year. Several studies have shown that the incidence of DVT in ICU patients is approximately 8–40% (Ortel, Neumann, Ageno, Beyth, Clark, Cuker, & Zhang, 2020; Pai, Adhikari, Ostermann, Heels-Ansdell, Douketis, & Skrobik, 2018).

The causes of thrombosis are divided into two, namely those related to immobilization and those related to hypercoagulation, both of which are related to genetic factors or of acquired risk factors (Campello, Spiezia, Adamo, & Simioni, 2019). Venous thrombosis is a disease with multiple causes with several risk factors that often occur together at one time. Often the risk factors for thrombosis are hereditary and have been going on for a long time, then exacerbated by the presence of acquired risk factors (Malone & Agutter, 2006; Barfod, Nielsen, Olsen, Vinicoff, Troelsen, & Holmich, 2020; Reitsma, Versteeg, & Middeldorp, 2012). These risk factors can occur in patients undergoing immobilization treatment, prolonged bed rest, post-abdominal surgery, post-femoral orthopedic surgery, obesity (Heit, Spencer, & White, 2016).

DVT can be prevented by performing recurrent DVT prevention, patients should continue to exercise, and compression therapy and anticoagulation therapy for the right period of time. Compression stockings are one of the compression therapies that help prevent blood clots from forming in the legs by providing different pressure on each part of the leg (Najihah, 2018; Bircher & Chowdhury, 2020). In general, the role of nurses for DVT cases is to facilitate blood flow and circulation (Zhou, Zhang, Cai, Mei, Pan, Wang, & Shi, 2023).

Recommended activities for DVT patients include wearing socks below the knee, massage therapy, aerobic exercise (walking, running, and climbing), various exercise movements (leg pumps, ankle rotations) (Ratliff, Yates, McNichol, & Gray, 2022). Recommendations for interventional management that can be done for DVT cases include compression therapy, intermittent pneumatic compression devices, massage therapy, range of motion exercises (leg pumps, ankle rotations, leg lifts, shoulder rotations), strengthening exercises, stretching exercises, aerobic exercises (Berner, Geoghegan, Kyriazidis, Nanchahal, & Jain, 2021).

In some cases of DVT, patients will experience swelling and redness of the skin in the affected area (Kahn, Galanaud, Vedantham, & Ginsberg, 2016). The rest, ice, compression, elevation (RICE) method is a simple self-care technique that helps reduce swelling, relieve pain, and speed healing (Kumazaki, Imai, Sakagami, Hirano, Suzuki, & Endo, 2022; Panpikoon, Chuntaroj, Treesit, Chansanti, & Bua-Ngam, 2022).

RESEARCH METHOD

The research design used is a systematic review method with article selection referring to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The article search stage is carried out systematically using keywords written manually or using the search facility available in each database. The keywords used in the article search are (massage OR therapy OR pressure) AND (calf OR foot) AND (Deep Vein Thrombosis (DVT)). Article searches are carried out electronically to filter relevant articles. Articles are sourced from the Google Scholar, PubMed, Science Direct, and ProQuest database search engines.

The inclusion criteria for this literature review were articles published in the last ten years, namely 2013-2023, articles in Indonesian and English, interventions given to patients at risk of deep vein thrombosis (DVT), interventions using calf massage either with or without tools, randomized controlled trials, experimental/quasi-experimental, and full manuscripts available. Exclusion criteria for articles were articles in the form of systematic reviews or meta-analyses, inaccessible, discussing calf massage interventions but not in accordance with the topic of the literature review being compiled, not in Indonesian or English, and research methods other than randomized controlled trials (RCTs), experimental/quasi-experimental.

Article searches conducted by the author include identification, screening, article eligibility, and articles included in the review. The search process is carried out by collecting articles from several databases that match the keywords that have been set. Then the titles that have been obtained are filtered again, and adjusted to the inclusion and exclusion criteria that have been set by the researcher.

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RESEACH RESULTS

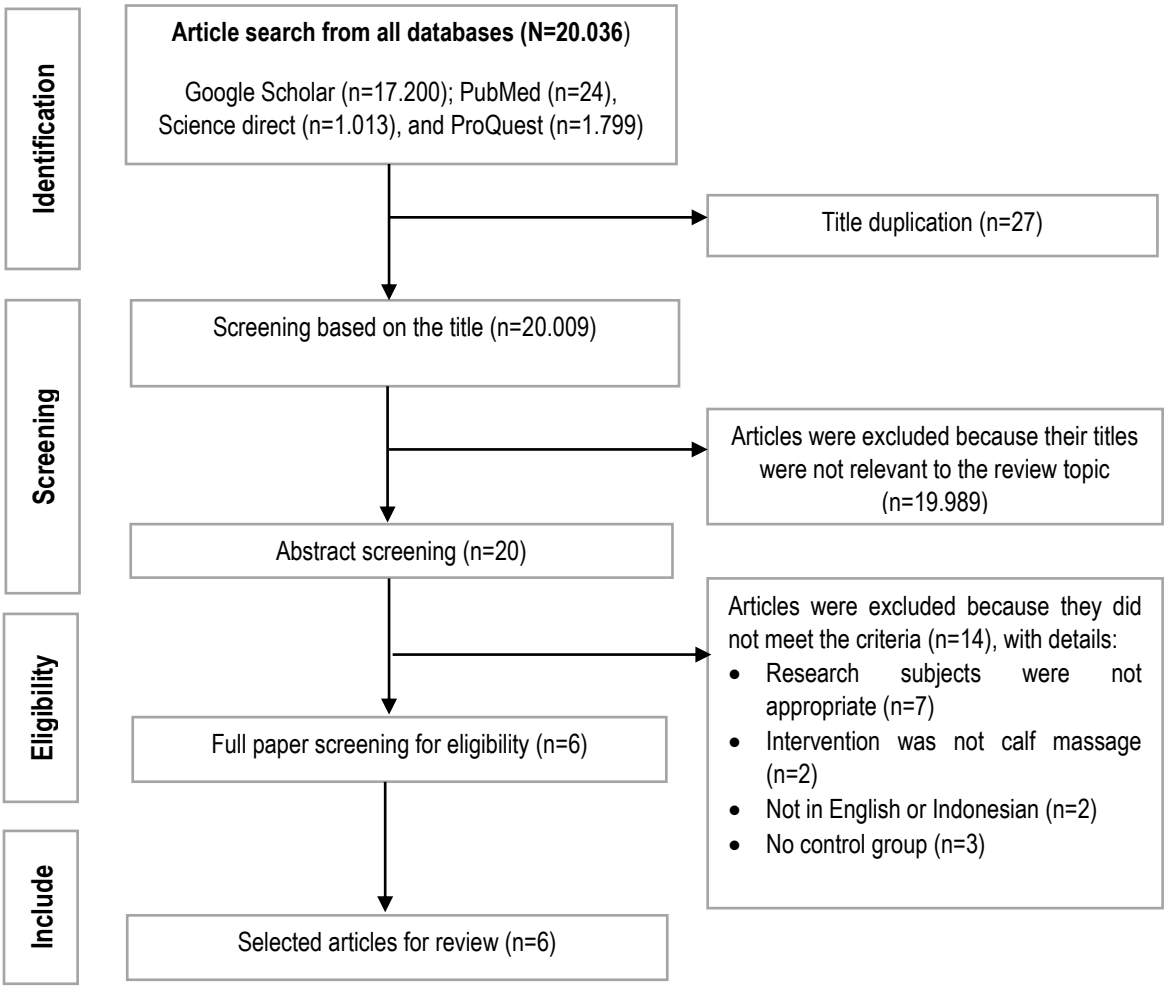

Figure PRISMA Flow Diagram

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Table Summary of The Articles' Review

(Author, Year) (Country)	Purpose	Method	Results
(Amanatullah et al., 2020) (California).	To determine the effectiveness of mechanical compression and intermittent pneumatic compression in improving venous flow.	Fifteen healthy participants underwent mechanical compression using Cirvo (Radial Medical, Mountain View, CA), pneumatic compression with four commercially available systems (VenaFlow Elite, Kendall SCD Compression System, ActiveCareDVT, Vasculaire Compression System), and manual calf compression. Peak flow velocity (PFV) was measured by femoral vein ultrasound during compression and at baseline.	Mechanical compression for 1 second resulted in a significant increase in femoral vein PFV to 107.8±38.2 cm/s from 17.1±4.7 cm/s at baseline (p< .001). Mechanical compression can increase venous flow above baseline, even matching or exceeding the flow of commercially available pneumatic compression systems. Overall, mechanical compression is better at mimicking the physiologic compression of native calf muscles than pneumatic compression systems. Mechanical compression has the potential to offer a wearable form of physiologic compression factor.
(Sakai et al., 2016) (Jepang).	To determine the effect of foot pump on the incidence of deep vein thrombosis after total knee arthroplasty in patients given edoxaban.	Patients were randomly assigned to two groups: those using a foot pump (n = 58) or those not using a foot pump (n = 62). Both groups were given prophylactic edoxaban. Edoxaban was started 12 hours after surgery. Patients were given either low-dose edoxaban (15 mg once daily for patients <60 kg) or high-dose edoxaban (30 mg once daily for patients weighing ≥60 kg). Foot pump sandals were placed on both feet in the recovery room, and the machine was turned on.	Foot pump use did not significantly reduce the incidence of DVT in patients undergoing TKA with edoxaban thromboprophylaxis. Although anti-PF4/heparin antibody seroconversion was confirmed in one-quarter of patients, the seroconversion rate did not differ between patients with (20.7%) or without (25.8%) foot pump use.

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(Author, Year) (Country)	Purpose	Method	Results
(Sultan et al., 2014) (United Kingdom).	To evaluate the role of elastic compression using ankle injury stockings (AIS) in the management of ankle fractures.	This was a prospective, single-center, randomized, stratified, single-blind trial to compare compression with the AIS plus Aircast shoe (DJO Global, Vista, California) with Tubigrip (Mölnlycke Health Care, Gothenburg, Sweden) and the Aircast shoe in 90 patients with ankle fractures.	Early AIS after ankle fracture may reduce swelling and improve functional outcomes. There were no significant complications associated with AIS use in this study, but larger definitive studies are needed to determine whether AIS reduces the frequency of DVT.
(Sakai et al.,2021) (Jepang).	To test whether the use of a mobile IPC device can effectively augment the peak velocity (PV) increase caused by AAE.	This single-arm prospective interventional study, with one experimental condition and two control conditions [AAE (heel lift) with IPC, AAE (heel lift) alone (AAE), and IPC alone (IPC)] in randomized order was conducted in accordance with the principles of the Declaration of Helsinki. The study population consisted of 20 healthy young adult men and women (10 men and 10 women).	Reduced calf muscle pump activity due to decreased walking ability reduces venous flow. Therefore, the use of mobile IPC devices during postoperative rehabilitation in the hospital and activities including self-exercise in the inpatient ward may improve venous flow compared with postoperative exercise without IPC. The use of mobile IPC devices significantly increased PV during AAE, and AAE combined with IPC may provide useful evidence for DVT prevention in the clinical setting, including after TJA.

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(Author, Year) (Country)	Purpose	Method	Results
(Oka et al., 2017) (Jepang).	To determine whether calf massage itself is effective in preventing DVT after TKA.	A total of 165 patients were randomly assigned to 2 groups, namely the calf self-massage group and the control group. In the control group, patients were given regular physical therapy, while the calf self-massage group, in addition to regular physical therapy intervention, was also instructed to massage their calf muscles 30 times from the distal to the proximal side. The intervention was repeated three times and completed within 2 minutes for 2 days after TKA. All patients were evaluated for DVT on the 3rd postoperative day using lower leg vein ultrasonography.	The incidence of DVT was significantly lower in the group performing calf self-massage compared to the control group. Calf self-massage was associated with a lower incidence of DVT, while age and female gender were risk factors for DVT.
(Li et al., 2017) (Tiongkok).	To investigate the benefits of preoperative thromboprophylaxis in patients.	A prospective randomized controlled trial was conducted in 80 patients with femoral neck fractures. Participants were assigned to receive rivaroxaban or conservative treatment before surgery. For all patients, color Doppler ultrasound of both lower extremities was performed immediately after hospital admission.	Compared with conservative treatment, rivaroxaban could significantly reduce the incidence of DVT from 19.5% (8/41) to 2.6% (1/39) (P = 0.016). Before surgery, there were a total of 9 DVT events including 8 DVT in the conservative treatment group and 1 in the oral rivaroxaban group. All cases of DVT were asymptomatic, 8 of which were diagnosed as isolated muscle calf vein thrombosis. This suggests that preoperative thromboprophylaxis with rivaroxaban can effectively reduce the risk of preoperative DVT for patients with femoral neck fractures without increasing the risk of bleeding.

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DISCUSSION

Based on the results of the review of the six journals, it was found that calf massage intervention had a positive impact in reducing the risk of deep vein thrombosis (DVT). The time required for calf massage is 1 to 3 days, during the calf massage intervention the participants were always accompanied by a therapist. Patients were instructed to massage the calf muscles 30 times from the distal side to the proximal side. This procedure was repeated three times and completed within 2 minutes for 2 days. This intervention lasted for 3 days. On the third day, an evaluation was carried out using lower extremity vein ultrasonography. As a result, the incidence of DVT was significantly lower in the calf massage group alone than in the control group. Performing passive manual calf massage and ankle movements immediately after surgery reduced the incidence of DVT from 6.5% to 0.8%. The incidence of DVT was associated with age (odds ratio [OR] = 1.1, 95% confidence interval [CI]: 1.04 – 1.16, p = 0.001), female gender (OR = 8.8, 95% CI: 1.9– 40.7, p = 0.005), and calf self-massage (OR = 0.4, 95% CI: 0.20 – 0.91, p = 0.03) (Oka, Wada, Nitta, Maruno, & Mizuno, 2020).

Another study showed that mechanical compression increased venous flow above baseline. It matched or exceeded the flow of commercially available pneumatic compression systems. Mechanical compression was better at replicating the physiologic compression of the native calf muscle than pneumatic compression systems. Mechanical compression has the potential to offer a wearable physiologic compression form factor (Amanatullah, Shah, Johnson, & Wall, 2020). On the other hand, one study examining the effect of a foot pump on the incidence of DVT events, stated that the use of a foot pump did not significantly reduce the incidence of DVT in patients undergoing TKA under edoxaban thromboprophylaxis (Sakai, Izumi, Kumagai, Kidera, Yamaguchi, Asahara, & Migita, 2016).

Elastic compression intervention using ankle injury stockings (AIS) reduced ankle swelling at all time points and improved the mean Olerud-Molander functional assessment (OMAS) score at six months to 98 (95% confidence interval (CI) 96 to 99) compared to a mean of 67 (95% CI 62 to 73) for the Tubigrip group (p < 0.001). Mean American Orthopaedic Foot and Ankle Society (AOFAS) and SF-12v2 scores at six months also improved significantly with compression. Of the 86 patients with duplex imaging at four weeks, five (12%) of 43 in the AIS group and ten (23%) of 43 in the Tubigrip group developed DVT (p = 0.26). Compression improves functional outcomes and quality of life after ankle fracture (Sultan, Zhing, Morris, Kurdy, & McCollum, 2014).

Intermittent pneumatic compression (IPC) intervention in total joint arthroplasty (TJA) patients significantly increased the peak velocity (PV) of venous blood flow tested using Doppler ultrasonography during active ankle exercise (AAE), and simultaneous AAE with IPC may be useful evidence for DVT prevention in clinical settings, including after total joint arthroplasty (TJA) (Sakai, Takahira, Tsuda, & Akamine, 2021). Other studies have also shown that intermittent pneumatic compression after high-intensity exercise improves cardiovascular recovery, thereby reducing cardiovascular strain. It is important to consider the effects on sympathetic-parasympathetic balance, such as heart rate variability, to further assess the relationship between IPC use and autonomic control. (Artés, Ferrer-Ramos, Javierre, Viscor, & García, 2024).

CONCLUSION

Based on the analysis that has been done on the six articles, it shows that calf massage interventions carried out using tools or without tools with various versions and methods have a positive impact on reducing the risk of DVT. Only one article stated that calf massage did not have a significant effect on reducing the risk of DVT, but this needs to be studied further in more depth because several previous randomized trials have shown that foot pumps are an effective tool for prophylaxis against thromboembolism in orthopedic patients.

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