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Comparison of Great Saphenous Vein Occlusion and Venous Clinical Severity Score in Chronic Venous Insufficiency (CVI) Patients Using and Not Using Compression Stockings after Endovenous Microwave Ablation (EVMA)

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chronic venous insufficiency, EVMA, compression stockings, venous occlusion, VCSS

Abstract
Endovenous Microwave Ablation (EVMA) is a minimally invasive thermal technique for treating venous insufficiency, known for its low complication rates and fast recovery. While compression stockings are commonly recommended after other thermal ablation procedures such as EVLA and RFA, their effectiveness following EVMA remains unclear and lacks standardized guidelines. This study aimed to compare great saphenous vein (GSV) occlusion success and changes in Venous Clinical Severity Score (VCSS) between patients who used compression stockings and those who did not after EVMA. This prospective cohort study included patients with chronic venous insufficiency (CVI) who underwent EVMA at Cipto Mangunkusumo Hospital between September and November 2025. Data analysis was conducted using Fisher's exact test and the Mann–Whitney test. The results showed that all 40 patients achieved 100% GSV occlusion one week after EVMA, with no significant difference between the two groups (p=1.00). Preoperative VCSS scores were also comparable between the no-stocking group (10.40 ± 1.85) and the stocking group (11.25 ± 2.88) (p=0.274). Postoperatively, both groups experienced a decrease in VCSS scores; however, the reduction was significantly greater in the stocking group (median 6 vs. 8; p=0.015). The median decrease in VCSS was also higher in the stocking group (4 [2–10]) compared to the no-stocking group (2.50 [0–7]; p=0.012). Component analysis revealed that compression stockings significantly improved only the pain parameter (p=0.004). In conclusion, compression stockings do not affect GSV occlusion rates after EVMA but provide better clinical improvement, particularly in reducing postoperative pain.

INTRODUCTION

Chronic venous insufficiency (CVI) is a chronic disorder of blood flow from the limbs to the heart (Gore, 2023; Gujja et al., 2022). This condition is usually characterized by swelling of the lower extremities, hyperpigmentation of the skin, and ulcers due to venous hypertension. CVI-related disabilities can lead to a significant decrease in quality of life and loss of productivity. Epidemiologically, it is estimated that about six to seven million people in the United States have a diagnosis of advanced venous disease and meet the diagnostic criteria for CVI. Results from various studies suggest that in the general population, approximately 1% to 17% of men and 1% to 40% of women may develop CVI (Depopas & Brown, 2018).

At the beginning of the development of CVI treatment, the management of open surgery in the form of ligation and stripping of saphena magna veins was considered the gold standard. However, since the late 1990s and early 2000s, technological advances have led to the

emergence of minimally invasive procedures such as endovenous laser ablation (EVLA) and radiofrequency ablation (RFA). With rapid technological advancements, CVI disease management modalities are also increasingly developed and up-to-date. One of the ablation techniques that is currently developing rapidly is endovenous microwave ablation (EVMA). EVMA is a thermal ablation technique developed in recent years for the treatment of CVI in the lower extremities. This method utilizes microwave energy to generate heat that causes coagulation and obliteration of the veins that are experiencing insufficiency, thereby reducing venous reflux and increasing venous blood flow more efficiently. EVMA offers a minimally invasive procedure, with a lower potential risk of complications and a faster recovery time for patients (Zhao et al., 2024; Sevil et al., 2020). In addition, the technique has been shown to be on par with EVLA in treating varicose veins caused by chronic venous insufficiency with lower temperatures than EVLAs. With advantages in procedural efficiency and comparable therapeutic effectiveness, EVMA may be a promising alternative option in minimally invasive varicose vein therapy (Ivano Kalaij et al., 2025).

The EVMA procedure, although non-invasive, still has side effects to complications. Based on the findings of the study by Zhao et al., side effects after EVMA are pain (41.54%), ecchymosis (33.85%), paresthesia (9.23%), induration (2.31%), and thrombophlebitis (2.31%). Meanwhile, complications range from burns, nerve injuries to deep vein thrombosis. The post-procedure treatment protocol of endovenous thermal ablation usually involves compression stocking therapy with the theoretical aim of reducing edema, ecchymosis, pain and facilitating venous occlusion. Compression therapy is a therapy that emphasizes the surgical area or ablation procedure that aims to improve blood circulation and reduce swelling or inflammation. Compression therapy is usually done using special tools or clothing, such as compression stockings, elastic bandages, or other devices that apply measured pressure to the affected area (Sidawy & Perler, 2018).

Several studies of post-EVLA patients suggest compression therapy can help reduce pain and speed recovery.6–8 A meta-analysis study by El-Sheikha et al reported that there are various compression therapy modalities such as the use of elastic bands. However, all of these modalities provide different benefits related to pain reduction and recovery (El-Sheikha et al., 2015). Fischer et al.'s study states that the duration of use of compression stocking therapy for a week can provide pain reduction benefits (Fischer et al., 2021). These findings are also reinforced by the research of Fan et al. who reported that the use of compression therapy with elastic stockings after the EVLA procedure can reduce pain and significantly speed up the time to return to work (Fan et al., 2022).. According to Rutherford, The data showed no difference in patient-reported outcomes between patients who used compression stocking and those who did not post-course EVLA or RFA (Sidawy & Perler, 2018). Meanwhile, a meta-analysis published by Hu et al. (2022) reported conflicting results that the use of compression stocking provided no benefit in CVI patients after the EVLA procedure. A meta-analysis of these seven randomized clinical trials found that post-operative compression only slightly reduced postoperative pain with no significant improvements in quality of life, complication incidence, and return to work time (Hu et al., 2022). The study conducted by Ye et al. (2016) also reported similar results where the use of elastic compression stockings did not provide significant benefits regarding improved patient quality of life and return to work time. but only reduced pain and swelling after the EVLA procedure (Ye et al., 2016). Meanwhile, another study

conducted by Fischer et al reported that the use of compression stocking after EVLA also provided good results in terms of pain reduction and the success of blood flow occlusion therapy.6 Based on Ayo et al.'s research, compression therapy did not have a significant impact on the clinical outcomes and patient-reported outcomes after saphena magna vein ablation in patients with non-ulcerative venous insufficiency. 6In line with ESVS 2022, compression therapy after superficial venous intervention is still a controversial issue.

Various guidelines for the management of chronic venous disease discuss recommendations for the use of post-operative endovenous thermal ablation compression in general, but none provide specific recommendations for EVMA.10 In addition, the systematic reviews and clinical trials of EVMA available to date have only evaluated the efficacy of ablation, occlusion rate, and safety of the procedure without assessing the effects of using compression stocking after EVMA (Ye et al., 2016). EVMA procedures produce intraluminal heat lower than EVLA and RFA, this difference may have implications for variations in inflammatory responses after the procedure so that post-procedure stocking treatment cannot be generalized (Elderman et al., 2014; Eberhardt & Raffetto, 2014). Therefore, the authors wanted to conduct this study to further examine the benefits of using compression stocking in patients with CVI using the outcome assessment of saphena magna venous occlusion and VCSS after EVMA action was performed at RSCM.

METHOD

Research Design

This study was a prospective cohort study to compare saphena magna vein occlusion and VCSS score between the use of compression stocking compared to no compression stocking in CVI patients after EVMA action at Dr. Cipto Mangunkusumo National Hospital (RSCM) Jakarta. Place and Time of Research Patients with chronic venous disease who underwent EVMA examinations were followed up by ultrasound examinations at RSCM from September 2025 to November 2025.

Population, Samples, and Sampling Techniques

1. Population and Sample

The target population in this study is CVI patients who have undergone EVMA. Meanwhile, the affordable population in this study is data from patients who have experienced CVI and have undergone EVMA actions that meet the inclusion criteria and pass the exclusion criteria of the study.

2. Large Sample

The minimum sample size in this study was calculated using the following formula:

$$n_1 = n_2 = \frac{\left(Z_\alpha \sqrt{2PQ} + Z_\beta \left(\sqrt{P1Q1 + P2Q2}\right)\right)^2}{(P1 - P2)^2}$$

Description:

$Z\alpha = 1.96$ ($\alpha = 5\%$)

$Z\beta = 0.84$ ($\beta = 20\%$)

P1 = the proportion of success in the standard group, based on the study of Bakker et al. is 0.61 84

Q1 = 1-0.61 = 0.39

P2 = the proportion of success in the treatment group, based on the study of Elderman et al., which is 0.98 12

Q2 = 1-0.98 = 0.02

P = 1/2 (P1+P2) = 1/2 (0.61+0.98) = 0.795

Q = 1-0.795 = 0.205

The above numbers are fed back into the large formula of the sample:

$$n_1 = n_2 = \frac{\left(1{,}96\sqrt{2 * 0{,}795 * 0{,}205} + 0{,}84\ (\sqrt{0{,}61 * 0{,}39 + 0{,}98 * 0{,}02}\right)^2}{(0{,}61 - 0{,}98)^2}$$

Based on the calculation above, a minimum number of samples was obtained, which was 18 samples for each group.

3. Sample Selection Criteria

Kriteria Inclusive:

1. Patients with a post-EVMA CVI diagnosis without phlebectomy at RSCM
2. Willing to participate in research and sign informed consent

Exclusion Criteria:

1. Patients with coagulation disorders (blood clotting disorders)
2. Patients with a history of or presence of active Deep Vein Thrombosis (DVT)
3. CVI patients with clinical C6 (Active Ulcer)
4. Patients with deep vein insufficiency

4. Sampling Techniques

The study subjects were selected from patients who came to the vascular polyclinic of Cipto Mangunkusumo Hospital (RSCM) and were diagnosed with CVI disease. The sampling technique used is consecutive sampling, where all patients who meet the inclusion criteria and do not meet the exclusion criteria, and are willing to participate in the study, will be recruited in succession until the required number of samples is reached in the study period. Before further examination, the subject will be given an explanation of the objectives, benefits, research procedures, and rights of the subject. After understanding and expressing consent, the subject will sign a written consent form.

Research Variables

Independent variables : use of stocking and no stocking post-action EVMA

Variable dependen : Outcome oklusi vena saphena magna dan perubahahan skor Venous Clinical Severity Score (VCSS)

Confusing variables : Gender, age and obesity.

Research Procedure

This research begins with the process of making a research proposal. The research proposal is made by first compiling the background and formulation of the research problem. Furthermore, the research proposal is submitted by presenting it to the supervisor. After obtaining approval from the research supervisor, the process of submitting an ethics review to the Ethics Committee of the Faculty of Medicine, University of Indonesia continues.

Furthermore, research is carried out by first determining the research subject. The research subjects were determined based on predetermined inclusion and exclusion criteria. For subjects who meet the criteria, an explanation of the research will be carried out and their

willingness to participate in the research will be requested. If the subject is willing, then the subject is asked to sign an informed consent sheet.

The study began with the division of the stocking group and the non-stocking group. The group division was carried out randomly using the random number generator method to reduce selection bias. Thus, each subject has an equal chance of being included in one of the research groups. The cost of compression stocking will be borne by the researcher. To ensure compliance with the use of stocking in the intervention group, patients will be provided with education on how to use stocking correctly, the benefits of use, and the risks of not using it. Patients will also be asked to record the duration of daily stocking use in a compliance diary that is collected and checked at the control visit. During the clinical visit, a physical evaluation of the signs of wearing stockings is carried out to verify the patient's compliance.

Furthermore, the researcher will collect patient follow-up data in the medical record, namely data on Doppler ultrasound results and the patient's VCSS score before the EVMA action and 7 days after the EVMA action at the polyclinic. Data is collected and processed into numerical or categorical data for statistical analysis. After the data processing process is completed, a research report is prepared that includes the results and discussion of the results of this research. Furthermore, the research process continued with the presentation of research reports and publication of research results.

Data analysis was performed using SPSS 20.0 for Macintosh. Descriptive analysis was carried out to see the distribution of the data characteristics of each variable. The results of the descriptive analysis are then presented in the form of tabulers or graphs. Numerical data is tested for normality with the Shapiro Wilk *test*, if it is distributed normally, the data used is in the form of *mean*, while if the data distribution is abnormal, what is used is *the median*. Meanwhile, categorical data will be presented in the form of percentages and statistical tests will be carried out. If the results of the normality test are declared to be normally distributed data, then a statistical analysis test is carried out using *the Pearson correlation test*. If the results of the normality test are stated that the data is not distributed normally, then the data transformation is carried out as an effort to obtain a normal data distribution. If the transformation results indicate that the data remains abnormally distributed, a statistical analysis test is performed using the Spearman *correlation test* to assess the comparison of success between the group given *stocking* therapy and those who are not given *compression stocking*.

RESULT AND DISCUSSION

Characteristics of the research subject

This study involved 40 patients with chronic venous disease (CVI) undergoing EVMA, consisting of 20 patients without use *stocking* compression (group 1) and 20 patients with the use of *stocking* compression (group 2). The basic characteristics in the two groups showed no meaningful differences. In the sex variable, the group without *stocking* consisted of 15 women (75%) and 5 men (25%), while the *stocking* consisted of 11 females (55%) and 9 males (45%), with a p value of 0.185.

The age distribution was also meaningless, where patients aged <60 years amounted to 8 people (40%) in the group without *stocking* and 11 people (55%) in the group *stocking* (p=0.342). Obesity status was similar between groups, namely 14 obese patients (70%) in the

group without *stocking* and 12 patients (60%) in the *stocking* (p=0.507). Overall, there were no differences in basic characteristics between the groups, so the two groups could be considered comparable for further analysis.

Table 1 Distribution of subject characteristics

Variabel	**Group 1** Without *compression stocking* (n=20)	**Group 2** *Compression stocking* (n=20)	p-value
Gender			0,185
Women	15 (75%)	11 (55%)	
Male	5 (25%)	9 (45%)	
Age (years)			0,342
<60 years old	8 (40%)	11 (55%)	
≥60 years old	12 (60%)	9 (45%)	
Obesity			0,507
Ya	14 (70%)	12 (60%)	
No	6 (30%)	8 (40%)	

Venous occlusion results and VCSS score

Table 2 Venous occlusion output and VCSS score

Variabel	**Group 1** Without *compression stockings* (n=20)	**Group 2** *Compression stocking* (n=20)	p-value
Occlusion (frequency,%)			1,00
Ya	20 (100%)	20 (100%)	
No	0 (0%)	0 (0%)	
VCSS total score			
Pre-operation*	10,40 ± 1,85	11,25 ± 2,88	0,274
Postoperative†	8 (3 – 11)	6 (4 – 10)	0.015^
Differences†	2,50 (0 – 7)	4 (2 – 10)	0.012^

*Normal distributed data is presented in mean (SD)

† Abnormal distributed data is presented in median (min-max)

^ There was a significant difference (p<0.05)

In the first post-EVMA week, all patients in both groups showed saphena magna venous occlusion, with occlusion rates reaching 100% in the group without *stocking* or groups with *stocking* compression. The value of p = 1.00 indicates that there was no significant difference between the two groups, so it can be concluded that the success of venous occlusion was consistent with the action of EVMA and was not affected by the use of *stocking* compression.

Before the action, the average VCSS scores of the two groups showed no significant difference. Groups without *stocking* had a preoperative score of 10.40 ± 1.85, while the group with *stocking* It has a score of 11.25 ± 2.88, with a p value = 0.274. This shows that the initial condition of the patients in both groups is comparable.

After EVMA, postoperative VCSS scores decreased in both groups. In the group without *stocking*, the median postoperative score was 8 (3–11), whereas in the group with *stocking* is 6 (4–10). The value of p = 0.015 indicates a significant difference, where the group with *stocking* compression shows a lower (better) score.

The difference is even more evident in the VCSS score difference value. Groups without *stocking* experienced a median decrease of 2.50 (0–7), while the group with *stocking* shows a median decrease of 4 (2–10). A value of p = 0.012 indicates that the use of *stocking* compression provides a more significant improvement in VCSS score than without *stocking*.

Furthermore, a bivariate analysis was conducted to assess the relationship between confounding factors, namely age, sex, and obesity status on the outcome of changes in VCSS scores. Meanwhile, bivariate analysis of confounding factors for venous occlusion cannot be carried out because 100% venous occlusion is obtained, so there is no comparison. The results of the bivariate analysis are presented in table 3.

Table 3 Results of bivariate analysis of confounding factors on VCSS score difference

Variabel	VCSS score difference	Signifikansi (p-value)*
Gender		0,251
Women	4 (1 – 9)	
Male	3 (0 – 10)	
Age (years)		0,028†
<60 years old	4 (1 – 10)	
≥60 years old	3 (0 – 9)	
Obesity		0,943
Ya	4 (1 – 10)	
No	3 (0 – 9)	

*VCSS score difference data includes abnormal distributed numerical data types so it is tested with the Mann Whitney test

† There was a significant difference (p<0.05)

Bivariate analysis was performed to assess the relationship between confounding factors of age, sex, and obesity status with changes in VCSS scores. Based on the results of the Mann–Whitney test, no significant differences were found in changes in VCSS scores between men and women (p=0.251), as well as between obese and non-obese groups (p=0.943). These findings suggest that gender and obesity status have no effect on the magnitude of the decline in VCSS scores after the intervention. In contrast, the age variable showed significant results, where participants aged <60 years had a higher median decrease in VCSS scores compared to those aged ≥60 years (p=0.028). This indicates that age may affect response to therapy, with younger age groups showing greater clinical improvement. Since there are no minimum of two significant variables, no further multivariate analysis can be performed.

VCSS component changes

Table 4 VCSS component distribution

Components VCSS	Group 1 **Without** *compression stockings* **(n=20)**	Group 2 *Compression stocking* **(n=20)**	p-value
Nyeri			

Pre-operation	2 (2 – 3)	2 (2 – 3)	0,708
Post-operative	2 (0 – 2)	1 (0 – 2)	0,004*
Difference	0 (0 – 3)	1 (1 – 3)	0,003*
Varises			
Pre-operation	2 (1 – 2)	2 (1 – 2)	0,496
Post-operative	2 (0 – 2)	1 (0 – 2)	0,71
Difference	0 (0 – 1)	0 (0 – 2)	0,07
Edema			
Pre-operation	1 (1 – 2)	1,5 (1 – 2)	0,202
Post-operative	1 (0 – 2)	1 (0 – 2)	0,784
Difference	0 (0 – 1)	0 (0 – 2)	0,154
Pigmentation			
Pre-operation	1 (1 – 2)	2 (1 – 2)	0,06
Post-operative	1 (0 – 2)	1 (0 – 2)	0,298
Difference	0 (0 – 1)	0 (0 – 2)	0,604
Inflammation			
Pre-operation	2 (1 – 2)	2 (1 – 3)	0,157
Post-operative	1 (0 – 2)	1 (1 – 2)	0,671
Difference	1 (0 – 2)	1 (0 – 1)	0,144
Indurasi			
Pre-operation	1 (0 – 2)	1 (1 – 2)	0,520
Post-operative	1 (0 – 2)	1 (0 – 2)	0,270
Difference	0 (0 – 1)	1 (0 – 1)	0,200
Number of ulcers	0 (0 – 1)	0 (0 – 1)	0,708
Pre-operation	0	0	1,00
Post-operative	0 (0 – 1)	0 (0 – 1)	0,708
Difference			
Duration of ulcers	0 (0 – 2)	0 (0 – 2)	0,655
Pre-operation	0	0	1,00
Post-operative	0 (0 – 2)	0 (0 – 2)	0,655
Difference			
Size of the ulcer			
Pre-operation	0 (0 – 2)	0 (0 – 2)	0,724
Post-operative	0	0	1,00
Difference	0 (0 – 2)	0 (0 – 2)	0,724

*Categorical data presented in frequency (%)

Analysis of each component of the VCSS showed that the pain component was the most responsive parameter to the use of compression stocking. In the preoperative assessment, there was no difference in pain between the two groups (p=0.708). However, after the action, the pain score in the stocking group dropped more than in the non-stocking group (p=0.004). The difference in pain change value also showed a significant result with a p of 0.003. These findings suggest that the use of compression stocking provides a meaningful clinical benefit in lowering pain levels post EVMA.

In the components of varicose veins, edema, pigmentation, inflammation, and induration, no significant differences were found between the two groups (all $p > 0.05$). Although there was a tendency for improvement in both groups, the changes that occurred were relatively similar.

For the ulcer component (number, duration, and size), most patients did not have ulcers at baseline or at follow-up. Therefore, there was no significant difference between the two groups ($p > 0.65$ across all components).

In this study, the majority of patients were in the elderly age group, with a higher proportion of age ≥60 years than <60 years in both groups. These findings are in line with previous research in Indonesia by Wiradana et al., which reported that the average age of CVI patients is in the fifth to sixth decade of life (Wiradana et al., 2025). Likewise, the results of Ghorbanzadeh et al.'s study, in the United States, found that the average age of patients with CVI was 62 years (Ghorbanzadeh et al., 2025). Meanwhile, the study published by Prochaska et al. also stated that age is a significant risk factor for the severity of CVI (Prochaska et al., 2021). Increased prevalence of CVI in older age can be explained by degenerative processes that occur with age, including weakening of venous valves, decreased elasticity of venous walls, and increased hydrostatic pressure due to decreased calf muscle pump efficiency. These changes cause venous reflux to occur which contributes to CVI symptoms. In addition, exposure to long-term risk factors such as long standing jobs, obesity, or recurrent pregnancies also increases the incidence of CVI in the elderly population (Prochaska et al., 2021; Santos et al., 2023).

The gender distribution in this study also showed that women were the group that experienced more CVI than men. This distribution is in accordance with research by Wiradana et al. in Bali as well as global epidemiological studies, which stated that women have a biological predisposition to CVI. Hormonal factors such as increased progesterone can cause relaxation of the venous walls, thus facilitating venous dilatation and valve incompetence. In addition, recurrent pregnancies increase intra-abdominal pressure and venous blood volume, thus increasing the risk of CVI. Hormonal contraceptive use factors are also often associated with decreased vascular tone, thereby worsening CVI symptoms in women (Wiradana et al., 2025).

The obesity status in this study also showed a high prevalence in both groups. Obesity has been identified as one of the main risk factors for CVI, as shown by a study by Anru et al. at Siloam Hospitals Lippo Village that reported a meaningful association between BMI and CVI severity ($p < 0.001$). Increased body mass leads to high intra-abdominal pressure and increased hydrostatic load on the venous system of the lower extremities, thereby inhibiting venous backflow. This condition increases the risk of reflux, venous dilatation, and the progression of CVI symptoms (Anru & Damay, 2023). A similar thing was also reported by Mahapatra et al., who found a positive correlation between increased BMI and CVI clinical score as well as the incidence of venous reflux on Doppler examinations (Mahapatra et al., 2018).

This study showed that the rate of saphena magna vein occlusion in the first week after EVMA action reached 100% in both the group using compression stocking and the group without stocking. There was no difference between the two groups, so the use of compression stocking was not shown to affect the technical success of EVMA in producing venous occlusion (Ayo et al., 2017). These findings have important implications, as they suggest that the thermal ablation effect of EVMA is strong enough to produce full occlusion, so the use of compression stocking does not provide any additional benefit to procedural outcomes. The results of this study are in line with findings from Ayo et al. in 2017, who evaluated the use of

compression after EVLA and reported a GSV occlusion rate of 100% in both groups, both with and without compression. The study confirmed that compression did not affect the success of ablation, but only related to aspects of patient comfort, post-procedure symptoms, and quality of life. Although Ayo et al.'s study used other EVTA modalities such as RFA and EVLA, the results were consistent with this study which used EVMA as an ablation modality (Ayo et al., 2017).

Changes in VCSS scores are an important parameter in assessing clinical improvement of CVI after EVMA action. In this study, both groups showed a decrease in postoperative VCSS scores, but the group using compression stocking experienced a greater decrease. The median difference in VCSS score in the stocking group was 3 points (range 1–4), while in the non-stocking group it was only 1 point (range 1–5). This difference is statistically significant, suggesting that the use of compression stocking has a more significant clinical impact on symptom improvement.

The effectiveness of compression stocking on symptom improvement is mainly seen in the pain component. The stocking group showed a much greater reduction in pain than the non-stocking group, which was reinforced by statistical results with significant p-values. This effect can be explained by a compression stocking mechanism that helps reduce superficial venous dilation, facilitate venous backflow, and reduce venous pressure, thereby reducing the sensation of pain often caused by venous distension and local inflammation post-ablation (Fischer et al., 2021; Bakker et al., 2013; Su et al., 2024).

These findings differ slightly from the study by Ayo et al., which found that compression did not provide a significant difference in pain outcomes and quality of life after EVLA. However, there are some important differences to consider. First, the type of ablation modality used in Ayo et al.'s study was mostly RFA, whereas this study used EVMA which has different heat and energy distribution characteristics. The post-EVMA tissue healing process can provide a varied inflammatory response and may be more responsive to external pressures from the stockings. Second, the study population in Indonesia may have different clinical characteristics, lifestyles, and risk factors than the study population abroad, so the response to compression may be different (Ayo et al., 2017).

In addition, this study was conducted in a relatively early follow-up period (1 week), which is the phase when inflammatory symptoms and post-ablation pain are still prominent. In this phase, compression stocking plays a considerable role in suppressing local inflammation, tissue edema, and nociceptor stimulation, so that its effect on symptom reduction is more visible. Meanwhile, in the study of Ayo et al., the evaluation was carried out for up to 90 days so that the pain symptoms in the non-compression group may have subsided on their own in that phase (Ayo et al., 2017).

Although other components such as varicose veins, edema, pigmentation, inflammation, and induration did not show significant differences between groups, the overall improvement in the total value of VCSS remained greater in the group using compression stocking. This suggests that the stocking effect may not be dominant on venous structural changes, but rather on subjective symptoms such as pain and discomfort, which are important components of the VCSS assessment (Fischer et al., 2021).

This study has several advantages, especially because it is the first study in Indonesia to directly compare the use of compression and no post-EVMA stocking, thus making an

important contribution to the local literature and can be the basis for clinical recommendations in national vascular facilities. The prospective cohort research design allows for systematic assessment of outputs, including ultrasound evaluation and standardized VCSS scores. In addition, all subjects undergo procedures and follow-ups in tertiary service centers with experienced operators, thus minimizing technical variations. However, this study also has some limitations, including the relatively small sample size that may limit the statistical power of detecting differences in certain VCSS components. The sample size available is sufficient to provide a meaningful preliminary picture, although evaluation of some components of VCSS still requires confirmation in a wider study. The follow-up duration of only one week also led to findings reflecting more short-term outcomes, while the long-term effects of post-EVMA stocking use could not be evaluated, leaving room for further research to understand long-term changes. Nevertheless, the study still provides a strong preliminary picture of the benefits of compression in the early post-EVMA phase.

CONCLUSION

The findings of this study demonstrate that endovenous microwave ablation (EVMA) is highly effective in achieving great saphenous vein occlusion, as evidenced by a 100% occlusion rate in both groups regardless of compression stocking use. This indicates that the technical success of EVMA is independent of adjunctive compression therapy. However, the use of compression stockings contributes significantly to better clinical outcomes, particularly in reducing the Venous Clinical Severity Score (VCSS). The improvement is mainly driven by a significant reduction in postoperative pain, while other clinical components show no meaningful differences. These results suggest that compression stockings function more as a supportive therapy that enhances patient comfort and short-term recovery rather than influencing the primary procedural success of EVMA. For future research, it is recommended to conduct studies with larger sample sizes and longer follow-up periods to evaluate the long-term effects of compression therapy after EVMA, including recurrence rates, quality of life, and sustained symptom improvement. Additionally, randomized controlled trials comparing different durations, pressures, and types of compression modalities are needed to establish standardized clinical guidelines. Future studies should also explore patient-centered outcomes and subgroup analyses, such as age, severity of disease, and comorbid conditions, to identify which patient populations benefit most from compression therapy. Expanding multicenter and international research will further strengthen the generalizability and clinical applicability of findings in diverse healthcare settings.

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