

Relationship of Saphenous Magna Vein Diameter to Venous Occlusion & Revised Venous Clinical Severity Score (rVCSS) in Patients with Chronic Venous Insufficiency (CVI) Post-Endovenous Microwave Ablation (EMA)

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Abstract:

Chronic venous insufficiency (CVI) is characterized by impaired reverse blood flow in the lower extremities. Endovenous microwave ablation (EMA) is a minimally invasive procedure with advantages on large diameter veins. This study aimed to determine the relationship between the diameter of the great saphenous vein (GSV) and venous occlusion in the first week and the change in the Revised Venous Clinical Severity Score (rVCSS) in the first month post-EMA. This retrospective cohort design study involved 47 patients from RSCM, Hermina Bekasi Hospital and Hermina Depok Hospital for the January-December 2024 period. Data collection used medical record tracing, GSV diameter, GSV venous occlusion, rVCSS score. Bivariate analysis with Chi-Square or Fischer Test, multivariate analysis with multiple logistic regression while diagnostic parameter analysis with ROC curve. The venous occlusion rate reached 87.2%, and the change in rVCSS score was 63.8%. There was a significant relationship between GSV diameter and GSV occlusion [$p < 0.001$; MD -2.101 (95% CI: -2.84; -1.36)] and with changes in rVCSS score [$B = 1.188$; $p = 0.029$; OR 3.28 (95% CI: 1.13–9.53)]. The GSV diameter threshold value of 6.55 mm was a good predictor of occlusion (75.6% sensitivity, 100% specificity), but not good for rVCSS change (70% sensitivity, 52.9% specificity). Other factors such as gender, age ≥ 60 years, hypertension, diabetes, and obesity were not significantly related. GSV diameter was significantly associated with venous occlusion and changes in rVCSS scores post-EMA. A cut-off value of 6.55 mm can be a good predictor of occlusion.

Keywords: Revised Venous clinical severity score (rVCSS); Endovenous microwave ablation (EMA); Chronic venous insufficiency (CVI).

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INTRODUCTION

Chronic venous insufficiency (CVI) is a disorder of blood flow in the superficial or deep veins that causes venous hypertension and clinical manifestations such as leg edema, skin discoloration, as well as pain when walking (Patel & Surowiec, 2025). CVI is a prevalent condition globally and has a major impact on quality of life and productivity. The main cause is incompetent venous valves (Patel & Surowiec, 2025; De Maeseneer et al., 2022). It is estimated that about 10–35% of adults in the U.S. experience CVI, and 4% of those >65 years of age are at risk of developing venous ulcers. Globally, the prevalence is higher in developed countries due to sedentary lifestyles (Patel & Surowiec, 2025; De Maeseneer et al., 2022).

CVI management includes a conservative approach, surgical procedures such as high ligation and stripping (HLS), and endovenous interventions. Although HLS was once the gold standard, it has drawbacks such as longer recovery and a recurrence rate of 22%. Currently, the European Society for Vascular Surgery (ESVS) recommends endovenous thermal ablation (EVTA) as the first line, including endovenous laser ablation (EVLA), radiofrequency ablation (RFA), and endovenous microwave ablation (EMA), with a success rate of >90% (Patel & Surowiec, 2025; De Maeseneer et al., 2022; Choi et al., 2022).

EVTA works through a protein denaturation mechanism that causes thrombosis and eventually venous occlusion. EMA is a new technology that generates heat from microwave waves without direct contact with the venous wall, so it can be applied to spharyne veins with a large diameter (>12 mm). The working temperature of the EMA (85°C) is also lower than EVLA (800°C) and RFA (120°C), and does not require radiation protection. Therefore, EMAs have an advantage in patient comfort and safety (Tang et al., 2022).

As a relatively new method, the EMA still needs more data and research, particularly in Indonesia, to prove its effectiveness, safety, and economic viability. This local evidence is critical to support EMA's potential to become the standard of care in Indonesia, given its advantages in terms of faster recovery times, minimally invasive procedures, and its positive impact on patient productivity and healthcare cost efficiency in the long run.

Assessment of the success of CVI therapy is recommended using the Revised Venous Clinical Severity Score (rVCSS) and doppler ultrasound, both before and after the procedure (De Maeseneer et al., 2022; De Maeseneer et al., 2011). Several studies have shown a relationship between vein diameter and post-EMA occlusion success and changes in rVCSS scores, although the results have not been consistent. Li et al. (2021) reported a decrease in occlusion rates in GSVs >10 mm.⁷ Meanwhile, other studies have found the presence or absence of a relationship between vein diameter and rVCSS scores (Baccellieri et al., 2024; Huang et al., 2024; Samuel et al., 2013). Araujo et al. (2015) reported that GSV occlusion was associated with a decrease in rVCSS.

This research aims to fill several existing knowledge gaps. First, this study simultaneously evaluated the relationship between GSV diameter and two main outcomes, namely venous occlusion success and clinical score change (rVCSS) in one study. Second, the research was conducted in the context of the Indonesian population, which provides local evidence that is still very limited. Third, this study evaluated at a specific follow-up time (1 week and 1 month post-

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procedure) to capture short-term outcomes. Thus, this study is expected to provide a more comprehensive and contextual guide for clinicians in Indonesia in determining indications and predicting the outcome of EMA therapy. This research is useful for health practitioners as an evidence-based guide in clinical decision-making and patient counseling. For the development of science, this study contributes local Indonesian data on the effectiveness of EMA. Meanwhile, for policymakers, the results can be a consideration for health technology evaluation and standardization of procedures. Therefore, this study aimed to evaluate the relationship between the diameter of the Saphenous Magna Vein (GSV) and the success of occlusion and symptom improvement (rVCSS score) in CVI patients after the EMA procedure.

RESEARCH METHOD

This study used a prospective cohort design using primary data from CVI patients who were treated at RSCM, Hermina Bekasi Hospital, and Hermina Depok Hospital from January to December 2024 and managed using EMAs. Evaluation of the results of the study, in the form of GSV occlusion at 1 week and rVCSS score at 1 month post-action. The target population was CEAP stage CVI patients C2-C4 with a GSV diameter of ≤ 10 mm who underwent EMA surgery. Data collection will be carried out by extracting information from medical records, including demographic, pre-operative clinical data, GSV measurement results, rVCSS scores, and post-procedure ultrasound results. Data analysis using SPSS 26.0 will include descriptive analysis, bivariate analysis (with T-test, Mann-Whitney, Chi-square, or Fisher's exact tests), multivariate analysis using logistic regression, and ROC curve analysis to determine the optimal GSV diameter threshold value predictive of outcomes.

RESULTS AND DISCUSSION

In the initial recruitment, we got 47 patients consisting of 18 (38.3%) men and 29 (61.7%) women. The average age of patients was 55.85 ± 14.91 years, with the majority (66%) being < 60 years old. Patients who had hypertension, diabetes, and obesity, 28 (59.6%), 11 (23.4%), and 29 (61.7%) respectively. The patient's GSV diameter was 6.1 (4.8-9.2) mm. The pre- and post-operative VCSS are 8 (5-11) and 3 (2-10), respectively. Occlusion was found in 41 (87.2%) patients and changes in rVCSS scores were found in 30 (63.8%) patients. The demographic and clinical characteristics of patients can be seen in table 1.

Table 1. Demographic and clinical characteristics of patients

Characteristics	Total (n=47)
Age, mean $\pm$ elementary school	55.85 $\pm$ 14.91
Age, median (min-max)	57 (17-77)
Age, n (%)	
≥ 60 years old	16 (34)
< 60 years old	31 (66)
Gender, n (%)	

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Man	18 (38,3)
Woman	29 (61,7)
Hypertension, n (%)	
Yes	28 (59,6)
No	19 (40,4)
Diabetes, n (%)	
Ya	11 (23,4)
No	36 (76,6)
Obesities, n (%)	
Yes	29 (61,7)
No	18 (38,3)
Diameter GSV, median (min-max)	6,1 (4,8-9,2)
rVCSS pre-operation, median (min-max)	8 (5-11)
Postoperative rVCSS, median (min-max)	3 (2-10)
Occlusion, n (%)	
Yes	41 (87,2)
No	6 (12,8)
Change in rVCSS score, n (%)	
Yes	30 (63,8)
No	17 (36,2)

Source: Primary data of the study, 2024

In bivariate tests of sex, age, hypertension, diabetes, obesity with GSV occlusion after EMA, there was no significant association based on the Fisher exact test (Table 2).

Table 2. Relationship of sex, age, hypertension, diabetes, and obesity with post-EMA GSV occlusion

Characteristics	Occlusive		Total	p-value
Age, n (%)				1,000 [#]
≥60 years old	14 (87,5)	2 (12,5)	16 (34)	
<60 years old	27 (87,1)	4 (12,9)	31 (66)	
Gender, n (%)				0,662 [#]
Man	15 (83,3)	3 (16,7)	18 (38,3)	
Woman	26 (89,7)	3 (10,3)	29 (61,7)	
Hypertension, n (%)				0,378 [#]
Yes	23 (82,1)	5 (17,9)	28 (59,6)	
No	18 (94,7)	1 (5,3)	19 (40,4)	
Diabetes, n (%)				0,131 [#]
Yes	8 (72,7)	3 (27,3)	11 (23,4)	
No	33 (91,7)	3 (8,3)	36 (76,6)	
Obesities, n (%)				0,384 [#]
Yes	24 (82,8)	5 (17,2)	29 (61,7)	
No	17 (94,4)	1 (5,6)	18 (38,3)	

[#]Fisher Exact test, significant if p<0.05

Source: Primary data of the study, 2024

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In the GSV diameter bivariate test with GSV occlusion after EMA, there was a significant relationship based on the independent t-test [$p < 0.001$; MD -2.101 (95% CI: -2.84; -1.36)] (Table 3).

Table 3. Relationship of GSV diameter with post-EMA GSV occlusion

Characteristics	Occlusion (+)	Occlusion (-)	Mean Diff.	Sig.	95% CI for MD
Diameter GSV	5,932 ± 0,812	8,033 ± 1,044	-2,102	<0.001 [#]	-2,842 Wed -1,361

[#]Independent T-test, significant if $p < 0.05$

Source: Primary data of the study, 2024

In the receiver-operating curve (ROC) analysis, there was an area of 0.943 ($p < 0.001$) which means that GSV diameter is an excellent predictor variable for assessing GSV occlusion after the EMA (Figure 1 and Table 4). The best GSV diameter threshold value to be used as a predictor of GSV occlusion after EMA is 6.25 to 6.55 mm with a sensitivity of 65.9-75.6% and a specificity of 100% (Youden Index = 0.659 to 0.756). (Table 5).

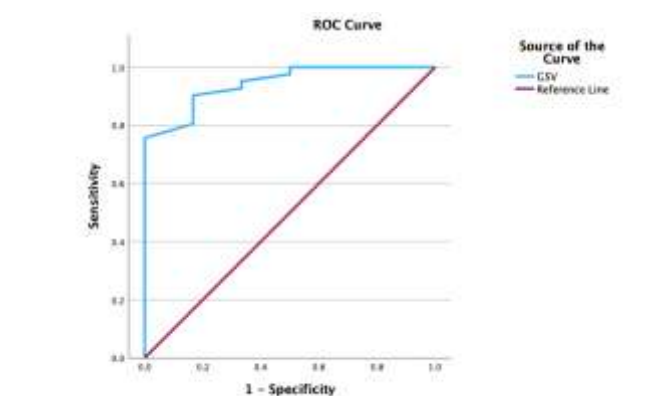


Figure 1. GSV diameter ROC curve against GSV occlusion post EMA

Source: Primary data of the study, 2024

Table 4. Area below the ROC curve for GSV diameter against post-EMA GSV occlusion

Area	Standard Error	Sig.	95% CI for Area
0,943	0,039	<0.001	0,866-1,020

Table 5. ROC curve coordinates for GSV diameter against GSV occlusion post-EMA

Occlusion if it is less than or	Sensitivity	Specificity	Youden Index
3,8	0	1	0
4,9	0,024	1	0,024
5,05	0,073	1	0,073
5,15	0,122	1	0,122
5,25	0,293	1	0,293
5,35	0,341	1	0,341
5,45	0,39	1	0,39
5,55	0,463	1	0,463

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5,7	0,488	1	0,488
5,9	0,512	1	0,512
6,05	0,561	1	0,561
6,15	0,61	1	0,61
6,25	0,659	1	0,659
6,35	0,707	1	0,707
6,45	0,732	1	0,732
6,55	0,756	1	0,756
6,65	0,805	0,833	0,638
6,75	0,878	0,833	0,711
6,9	0,902	0,833	0,736
7,1	0,927	0,667	0,593
7,6	0,951	0,667	0,618
8,05	0,976	0,5	0,476
8,3	1	0,5	0,5
8,7	1	0,333	0,333
9,05	1	0,167	0,167
10,2	1	0	0

Source: Primary data of the study, 2024

Relationship of demographic and clinical characteristics to changes in rVCSS score post-EMA

In bivariate tests of sex, age, hypertension, diabetes, obesity with changes in rVCSS scores after EMA, there was no significant association based on the Chi Square and Fisher Exact tests (Table 6).

Table 6. Relationship of sex, age, hypertension, diabetes, and obesity with changes in rVCSS score after EMA

Characteristics	rVCSS Score Change		Total	p-value
Age, n (%)				0,143 [#]
≥60 years old	13 (81,3)	3 (18,8)	16 (34)	
<60 years old	17 (54,8)	14 (45,2)	31 (66)	
Gender, n (%)				0,995 [#]
Man	12 (66,7)	6 (33,3)	18 (38,3)	
Woman	18 (62,1)	11 (37,9)	29 (61,7)	
Hypertension, n (%)				0,396 [#]
Yes	16 (57,1)	12 (42,9)	28 (59,6)	
No	14 (73,7)	5 (26,3)	19 (40,4)	
Diabetes, n (%)				0,171\$
Yes	5 (45,5)	6 (54,5)	11 (23,4)	
No	25 (69,4)	11 (30,6)	36 (76,6)	
Obesities, n (%)				<0.001 [#]
Yes	12 (41,4)	17 (58,6)	29 (61,7)	
No	18 (100)	0 (0)	18 (38,3)	

[#]Chi Square test, significant if p<0.05

\$Fisher test, significant if p<0.05

Source: Primary data of the study, 2024

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In the GSV diameter bivariate test with the change in rVCSS score after EMA, there was a significant relationship based on the independent t-test [$p=0.031$; MD -7.096 (95% CI: -1.35; -0.08)] (Table 7).

Table 7. Relationship of GSV diameter with change in rVCSS score post-EMA

Characteristi	Change in	Change in rVCSS	Mean Diff.	Sig.	95% CI for MD
Diameter GSV	5,943 ± 0,851	6,653 ± 1,334	-7,096	0,031 [#]	-1,351 Wed -0,068

[#]Independent T-test, significant if $p<0.05$

Source: Primary data of the study, 2024

In the multivariate test of GSV diameter, after adjusting for obesity and age, there was still a significant difference in the change in rVCSS score after EMA based on binary logistic regression [$B=1.188$; $p=0.029$; OR 3.28 (95% CI: 1.13-9.53)]. (Table 8).

Table 8. Relationship of GSV diameter, with obesity adjustment, and change in rVCSS score after EMA

Characteristics	B	Df	Sig.	Exp(B)	95% CI for Exp(B)
Age	-1,783	1	0,131 [#]	0,168	0,017 – 1,702
Obesity	21,951	1	0,998 [#]	3413116366	0.000 - NA
Diameter GSV	1,188	1	0,029 [#]	3,279	1,129– 9,529

[#]Binary Logistics Regression Test, significant if $p<0.05$

Source: Primary data of the study, 2024

In the receiver-operating curve (ROC) analysis, there was an area of 0.662 ($p=0.059$) which means that the GSV diameter is a poor predictor variable to assess the change in rVCSS after the EMA (Figure 2 and Table 9). The best GSV diameter threshold value to be used as a predictor of rVCSS change after the EMA is 6.25 mm with a sensitivity of 70% and a specificity of 64.7% (Youden Index = 0.347). (Table 10).

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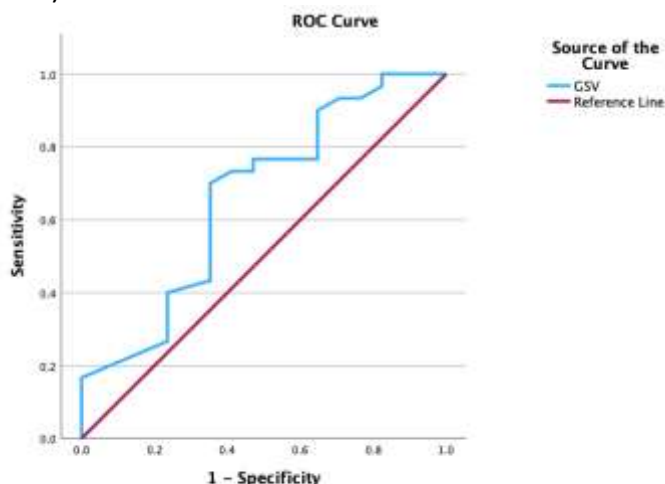


Figure 2. GSV diameter ROC curve against post-EMA rVCSS change

Source: Primary data of the study, 2024

Table 9. Area below the ROC curve for GSV diameter against the change in rVCSS post-EMA

Area	Standard	Itself	95% CI for Area
0,662	0,086	0,059	0,494-0,830

Source: Primary data of the study, 2024

Table 10. ROC curve coordinates for GSV diameter to post-EMA rVCSS change

rVCSS changes if less than or	Sensitivity	Specificity	Youden Index
3,8	0	1	0
4,9	0.033	1	0.033
5,05	0.1	1	0.1
5,15	0.167	1	0.167
5,25	0.267	0.765	0.031
5,35	0.333	0.765	0.098
5,45	0.4	0.765	0.165
5,55	0.433	0.647	0.08
5,7	0.467	0.647	0.114
5,9	0.5	0.647	0.147
6,05	0.567	0.647	0.214
6,15	0.633	0.647	0.28
6,25	0.7	0.647	0.347
6,35	0.733	0.588	0.322
6,45	0.733	0.529	0.263
6,55	0.767	0.529	0.296
6,65	0.767	0.353	0.12
6,75	0.867	0.353	0.22
6,9	0.9	0.353	0.253
7,1	0.933	0.294	0.227
7,6	0.933	0.235	0.169
8,05	0.967	0.176	0.143

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8,3	1	0.176	0.176
8,7	1	0.118	0.118
9,05	1	0.059	0.059
10,2	1	0	0

Source: Primary data of the study, 2024

In this study, the average age of patients was 55.85 ± 14.91 years, the majority were <60 years old (66%), female (61.7%), with hypertension (59.6%), without diabetes (76.6%), and obesity (61.7%). These findings are in line with previous research that showed varicose veins are more common in older age due to decreased venous elasticity and valve function, as well as decreased physical activity. In addition, a decrease in physical activity in old age inhibits the return of blood to the heart, increasing the risk of varicose veins forming. Additional factors such as hormonal changes, comorbidities, and accumulated risk exposure throughout life also play a role in the increased incidence of varicose veins in this age group. The prevalence of varicose veins also tends to be higher in women, which is most likely influenced by hormonal factors and pregnancy (Patel & Surowiec, 2025; De Maeseneer et al., 2022; Tkaczuk-Włach et al., 2011; Santler & Goerge, 2017).

Analysis of patient characteristics of GSV occlusion (Table 2) showed no significant association between age ($p=1.000$), sex ($p=0.662$), hypertension ($p=0.378$), diabetes ($p=0.131$), and obesity ($p=0.384$) and GSV occlusion. However, the diameter of the GSV is significantly related to the post-EMA occlusion [$p<0.001$; MD -2.101 (CI: -2.84; -1.36)]. The study by Baccellieri et al. (2024) cited GSV diameter >10 mm and other factors such as pregnancy history, CEAP C4, age >70 years, and incompetent perforators as predictors of recanalization (Baccellieri et al., 2024). Our study showed a negative linear relationship between GSV diameter and occlusion, although there were no patients with GSV >10 mm. Our findings are consistent with other literature showing large GSV diameters increase the risk of recanalization.

The results of the Fisher and Chi-Square tests (Table 5) showed that only obesity was significantly associated with changes in rVCSS scores ($p<0.001$). GSV diameter also showed a significant relationship with changes in rVCSS scores based on the t-test [$p=0.031$; MD -7.096] and multivariate logistic regression after age adjusted for obesity [$B=1.188$; $p=0.029$; OR 3:28]. A systematic review by Tan et al. showed a weak positive relationship between vein diameter and rVCSS, with correlations varying depending on the measurement location (Gibson et al., 2012; Lane et al., 2017; Mendoza et al., 2016). Some studies show a significant correlation, but not all. GSV diameter as an anatomical parameter has not been shown to be a strong predictor of quality of life, so its use as a single indicator of therapy is not recommended (Tan et al., 2019).

ROC analysis showed GSV diameter as an excellent predictor for post-EMA GSV occlusion (AUC 0.943; $p<0.001$), with an optimal threshold of 6.55 mm (75.6% sensitivity; 100% specificity). However, for rVCSS changes, AUC was only 0.662 ($p=0.059$), so it was considered a weak predictor. The study of Bontinis et al. showed that large GSV diameters were negatively related to occlusion. The study of Suhartono et al. also stated that EVTA is less effective at GSV

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>10 mm (Suhartono et al. 2025). Our results support that the GSV >6.55 mm is a post-EMA non-occlusion risk indicator.

The limitations of this study include the small sample count, the absence of long-term evaluation (≥ 6 months), and the absence of important independent variables such as pregnancy history, CEAP staging, incompetent perforators, and safenofemoral relationships. Follow-up studies are planned to evaluate the relationship between occlusion and rVCSS scores with longitudinal quality of life in larger populations.

CONCLUSION

From 47 patients with chronic venous insufficiency (CVI) after endovenous mechanochemical ablation (EMA), this study found that GSV diameter was associated with GSV occlusion, where >6.55 mm diameter was an excellent predictor for non-occlusion with a sensitivity of 75.6%, 100% specificity (AUC = 0.943; $p < 0.001$). GSV diameter was also significantly associated with changes in rVCSS scores, where every 1 mm increase in diameter was associated with a 3.28 times chance of change in rVCSS score (95% CI: 1.13–9.53), although >6.55 mm diameter was only a poor predictor of rVCSS change (AUC = 0.662; $p = 0.059$). Other factors such as gender, age ≥ 60 years, hypertension, diabetes, and obesity were not associated with GSV occlusion or changes in rVCSS scores in CVI patients after EMA at RSCM and network hospitals. For further studies, it is recommended to increase the number and diversity of samples, conduct a medium-term evaluation ≥ 6 months after EMA, and include additional variables such as pregnancy history, CEAP staging, presence of incompetent perforators, and anatomical relationships between saphenous accessory and safenofemoral veins, in order to assess occlusion predictors and changes in rVCSS scores more comprehensively.

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