

Effect of Diameter of Saphenous Vein on Stump Length after Radiofrequency Ablation for Varicose Vein

Jusung Kim¹, Sungsin Cho¹, Jin Hyun Joh¹, Hyung-Joon Ahn², and Ho-Chul Park¹

¹Department of Surgery, Kyung Hee University Hospital at Gangdong, Seoul,

²Department of Surgery, Kyung Hee University Medical Center, Seoul, Korea

Purpose: Radiofrequency ablation (RFA) has gained popularity for treatment of varicose veins. The diameter of the saphenous vein should be considered before RFA because occlusion of the vein may differ depending on its diameter. Until now, however, there have been few data about the correlation between the diameter of the saphenous vein and the stump length after RFA. The purpose of our study was to investigate its correlation.

Materials and Methods: A retrospective review was performed from prospectively collected data of RFA patients between March 2009 and December 2011. Preoperatively, the saphenous vein diameter was measured. Ablation was initiated 2 cm distal from the junction. Postoperatively, stump length was measured at 1 week and 6 months. After 2 years, we measured the length from the saphenofemoral junction to the leading point of occlusion for great saphenous vein, and length from the saphenopopliteal junction to the leading point of occlusion for small saphenous vein. The paired t-test, independent t-test, and correlation analysis were used for statistical analysis. P-value <0.05 was considered statistically significant.

Results: During the study period, RFA was performed in 201 patients. Endovenous heat-induced thrombosis developed in 3 patients (1.5%). After 2 years, the stump length was obtained in 74 limbs. The mean diameter and stump length of the saphenous vein were 6.7 ± 1.8 mm and 12.5 ± 8.5 mm, respectively. Correlation analysis showed that the Pearson correlation coefficient of these factors was -0.017 .

Conclusion: There was no correlation between the diameter of saphenous vein and stump length.

Key Words: Varicose veins, Radiofrequency, Catheter ablation, Diameter

Received September 16, 2015

Revised October 8, 2015

Accepted October 14, 2015

Corresponding author: Jin Hyun Joh

Department of Surgery, Kyung Hee University Hospital at Gangdong, 892 Dongnam-ro, Gangdong-gu, Seoul 05278, Korea

Tel: 82-2-440-6261

Fax: 82-2-440-6296

E-mail: jhjoh@khu.ac.kr

Conflict of interest: None.

Copyright © 2015, The Korean Society for Vascular Surgery

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Vasc Spec Int 2015;31(4):125-129 • <http://dx.doi.org/10.5758/vsi.2015.31.4.125>

INTRODUCTION

Varicose veins are a common vascular disease. The reported incidence of varicose vein ranges from 1% to 73% for females and 2% to 56% in males [1]. It is part of chronic venous disease, which is reported to have a substantial negative impact on health-related quality of life [2]. Before the worldwide spread of endovenous therapy, high ligation

and stripping of the saphenous vein has been the standard treatment for patients with varicose vein.

Since late 1990s, endovenous treatment of varicose veins such as radiofrequency ablation (RFA) and endovenous laser ablation (EVLA) became available. Recent randomized controlled trials revealed that endovenous treatment showed better results than traditional high ligation and stripping in terms of reduced pain, better quality of life,

faster recovery, and lower rate of recurrence [3,4]. Although RFA and EVLA showed similar truncal vein occlusion, RFA was associated with less periprocedural pain, analgesic requirement, and bruising [5].

The ClosureFast™ (Covidien, Mansfield, MA, USA) catheter, which is used to perform RFA, treats a 7-cm vein segment in a 20-second energy cycle. The vein wall is heated conductively by a 7-cm coil at the distal end of the catheter. The diameter of the saphenous vein should be considered before RFA since a venous diameter >12 mm has been considered controversial when RFA was performed with the previously used ClosurePlus™ (VNUS Medical Technologies, San Jose, CA, USA) catheter. However, the 12-mm size limitation was no longer an issue in studies with the ClosureFast catheter. In the study from the ClosureFast Europe Group, exclusion criteria did not consider the venous diameter. The evaluation of occlusion status of the saphenous vein and the stump length of the remaining saphenofemoral or saphenopopliteal junction dependent on saphenous vein diameter may give us a clue for the proper indications of RFA in terms of the saphenous venous diameter.

Until now, however, there have been few data about the correlation between the diameter of the saphenous vein and the stump length after RFA. The purpose of our study was to investigate its correlation.

MATERIALS AND METHODS

A retrospective review was performed from prospectively collected data of varicose vein patients who underwent RFA between March 2009 and December 2011 in Kyung Hee University Hospital at Gangdong (Seoul, Korea). On the initial encounter at the outpatient office, we performed a history taking and physical examination.

Ultrasound examination was done with a colorized

duplex scan (Vivid E9 Ultrasound system; GE Healthcare, Waukesha, WI, USA). The diameters of the great saphenous vein (GSV) and the small saphenous vein (SSV) were measured in supine position. With B-mode imaging, the inner anechoic diameter of the GSV was measured from the saphenofemoral junction (SFJ) to 5 cm distal to the junction. The SSV diameter was measured in the same manner from the saphenopopliteal junction (SPJ) to 5 cm distal to the junction. The largest diameter was chosen to analyze the relationship between diameter and stump length. After evaluation of the diameter, SFJ, SPJ, and truncal vein reflux in response to a Valsalva's maneuver and/or manual distal compression followed by release with upper body elevation or with standing position were identified with duplex scanning. The saphenous reflux was defined as a reflux time ≥ 0.5 second.

Indications for RFA were clinical grade C2-C6 and patients with symptoms or cosmetic concerns. The RFA procedure was performed with general, spinal or tumescent anesthesia in the operating room in all patients. The detailed RFA procedure was performed as described in a previous report by us and according to the manufacturer's instructions [6]. A concomitant phlebectomy around and below the knee joint was performed simultaneously. At the completion of the procedure, all wounds were dressed with steri-strips and legs were placed in full-length with Cohesive elastic bandage (Karl Otto Braun GmbH & Co, Wolfstein, Germany). The bandage was exchanged for thigh-length compression stockings after 24 hours. This was then worn for a minimum of one week. Patients were discharged on postoperative one day with stockings. They were advised to use analgesics only when required and to return to work when comfortable.

Patients were followed up at 1 week and 6 months after surgery. At all subsequent visits, the patients were examined clinically and with duplex scanning. At 1 week,

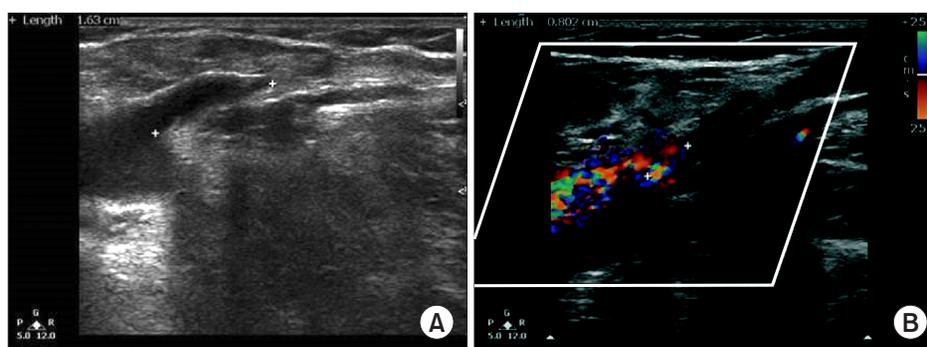


Fig. 1. Measurement of stump length after radiofrequency ablation. (A) For great saphenous vein, the length from the saphenofemoral junction to the leading point of occlusion was measured. (B) For small saphenous vein, the length from the saphenopopliteal junction to the leading point of occlusion was measured.

duplex scanning was performed to confirm saphenous vein occlusion and to evaluate any complications such as deep vein thrombosis, hematoma, endovenous heat-induced thrombosis (EHIT), or any complications related with surgery. For the analysis of relationship between diameter and stump length, length was measured as in Fig. 1. After 2 years, we measured the length from the SFJ to the leading point of occlusion for GSV, and length from the SPJ to the leading point of occlusion for SSV.

The paired t-test, independent t-test, and correlation analysis using IBM SPSS Statistics ver. 22.0 (IBM, Armonk, NY, USA) was used for statistical analysis. P-value <0.05 was considered statistically significant.

RESULTS

During the study period, 277 consecutive patients (346 limbs) underwent operation for varicose vein. Patient demographics are shown in Table 1. The mean age was 52.4 ± 11.9 years with a range of 19 to 84 years. The female to male ratio was 164:113. RFA was performed in 201 patients. The conventional high ligation and stripping was done in patients whose saphenous veins were shallow (less than 10 mm from the skin) or had a junctional aneurysm of more than 20 mm. This procedure was performed in 70 patients. If the cause of varicose vein was a reflux of perforator veins only, ligation of the perforator at the level

of the muscular fascia and stab phlebectomy was done (5 patients). EVLA was also done in one patient.

RFA was done simultaneously if the GSV and SSV in the same leg showed refluxes of ≥ 0.5 second. In one session, one truncal vein was ablated in 132 patients, 2 truncal veins in 64 patients, and 3 truncal veins in 3 patients. Four truncal veins were ablated simultaneously in 2 patients. After RFA, there were several types of complications (Table 2). The most common complication was paresthesia, which occurred in 18 patients (9.0%), followed by ecchymosis in 12 patients (6.0%), cord-like mass in 9 patients (4.5%), hyperpigmentation in 8 patients (4.0%), erythema over the ablated saphenous vein in 3 patients (1.5%), EHIT detected by postoperative duplex scanning in 3 patients (1.5%). Postoperative duplex scanning revealed class II EHIT in 2 patients and class III EHIT in one patient. All EHIT's resolved without anticoagulation.

After 2 years (mean follow-up, 13.9 ± 6.9 months), the stump lengths from the SFJ or SPJ to the leading point of occlusion were obtained in 74 limbs (52 patients), 56 limbs with GSV ablation and 18 limbs with SSV ablation. The mean length was 12.5 ± 8.5 mm. The preoperative duplex scans revealed that the mean diameter of the saphenous vein was 6.7 ± 1.8 mm (7.7-11.2 mm). The Pearson correlation coefficient for correlation analysis was -0.017 (Fig. 2). There was no correlation between the saphenous vein diameter and stump length.

Table 1. Patient demographics (n=277)

Variable	Data
Age (y)	52.4 ± 11.9 (19-84)
Sex (female:male)	164:113
Types of procedure	
Radiofrequency ablation	201 (72.6)
High ligation and stripping	70 (25.3)
Perforator ligation and phlebectomy	5 (1.8)
Endovenous laser ablation	1 (0.4)

Values are presented as mean \pm standard deviation (range), number only, or number (%).

Table 2. Complications after radiofrequency ablation (n=201)

Complications	Patient
Paresthesia	18 (9.0)
Ecchymosis	12 (6.0)
Cork-like mass	9 (4.5)
Hyperpigmentation	8 (4.0)
Erythema	3 (1.5)
Endovenous heat-induced thrombosis	3 (1.5)

Values are presented as number (%).

DISCUSSION

In 2006, the ClosureFast catheter was introduced. This catheter allowed for segmental ablation instead of a continuous pull-back needed for the previous ClosurePlus

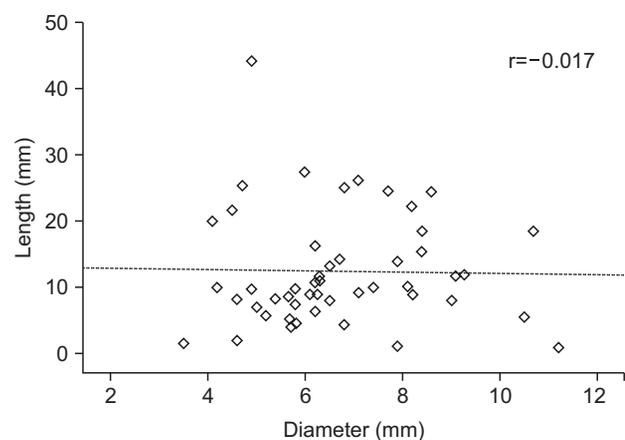


Fig. 2. Relationship between saphenous vein diameter and stump length. There was no correlation between the saphenous diameter and stump length (Pearson correlation coefficient = -0.017).

catheter. The manufacturer recommends that the catheter tip should be positioned 2 cm distal to the SFJ [1]. This procedure also entails two 20-second treatment cycles in the segment closest to the SFJ using external compression with the ultrasound probe. The complete occlusion of the proximal saphenous segment allows for hemodynamically effective control of truncal reflux.

The diameter of the saphenous vein was previously one of the criteria for RFA. The original device for RFA was a catheter which had extendable prongs which would make contact with the saphenous vein wall. In the fully deployed state, the larger of the 2 available devices was 12 mm in diameter. Thus, it was originally thought that the maximum diameter of a treated vein should be 12 mm [7]. The newer RFA device, ClosureFast catheter, no longer had extendable prongs making a maximum catheter contact diameter. In the study reported by Proebstle et al. [8], saphenous veins as large as 18 mm in diameter were treated with the ClosureFast catheter. There was an overall closure rate of 99.6% in their study. According to the study by García-Madrid et al. [9], the maximal venous diameter for RFA was 19 mm. The immediate occlusion rate was 100%.

However, there was no report about the relationship between saphenous vein diameter and stump length. García-Madrid et al. [9] reported that stump length was 13.9 ± 7.7 mm (range, 0–30 mm). However, they did not reveal the relationship between the saphenous vein diameter and the stump length. In that study, the mean preoperative diameter was 6.7–6.8 mm. In our study, the mean preoperative diameter of the saphenous vein was 6.7 ± 1.8 mm. The mean stump length was 12.5 ± 8.5 mm. Moreover, we analyzed the relationship between the two factors. On correlation

analysis, the Pearson correlation coefficient was -0.017 which means that there is no correlation between the saphenous diameter and stump length. One consensus for RFA suggests that the vein diameter for RFA could be as large as 20 mm [10].

There are several possible explanations about these results. Firstly, tumescent solution, injected around the saphenous vein, compresses the vein against the catheter, thus ensuring contact of larger veins. Manfrini et al. [11] reported the use of tumescent anesthesia during RFA. For obtaining this effect as well as anesthesia, most of trials used tumescent injection for RFA procedures [4,5,12,13]. Secondly, the delivery temperature for treatment is constant. The treatment temperature is 120°C (248°F) created by the proximal coiling 7 cm segment of the catheter [1]. If treatment were to be performed by continuous pull-back, the treatment temperature could change [14–16]. Thirdly, ablation at the proximal segment was started 2 cm distal from the SFJ or SPJ in all patients. According to the clinical practice guidelines of the Society for Vascular Surgery and the American Venous Forum, the tip of the catheter should be positioned 1 cm distal to the confluence with the superficial epigastric vein or 2 cm distal to the SFJ [17]. In our previous study, the stump had more than one branch in 85.7% of the cases.

CONCLUSION

In conclusion, the mean diameter of the saphenous vein was 6.7 mm. The mean length of stump after RFA was 12.5 mm. There was no correlation between saphenous vein diameter and stump length.

REFERENCES

- 1) Lohr J, Kulwicki A. Radiofrequency ablation: evolution of a treatment. *Semin Vasc Surg* 2010;23:90–100.
- 2) Carroll C, Hummel S, Leaviss J, Ren S, Stevens JW, Everson-Hock E, et al. Clinical effectiveness and cost-effectiveness of minimally invasive techniques to manage varicose veins: a systematic review and economic evaluation. *Health Technol Assess* 2013;17:i-xvi, 1–141.
- 3) Carradice D, Mekako AI, Mazari FA, Samuel N, Hatfield J, Chetter IC. Clinical and technical outcomes from a randomized clinical trial of endovenous laser ablation compared with conventional surgery for great saphenous varicose veins. *Br J Surg* 2011;98:1117–1123.
- 4) Rasmussen LH, Lawaetz M, Bjoern L, Vennits B, Blemings A, Eklof B. Randomized clinical trial comparing endovenous laser ablation, radiofrequency ablation, foam sclerotherapy and surgical stripping for great saphenous varicose veins. *Br J Surg* 2011;98:1079–1087.
- 5) Nordon IM, Hinchliffe RJ, Brar R, Moxey P, Black SA, Thompson MM, et al. A prospective double-blind randomized controlled trial of radiofrequency versus laser treatment of the great saphenous vein in patients with varicose veins. *Ann Surg* 2011; 254:876–881.
- 6) Choi JH, Park HC, Joh JH. The occlusion rate and patterns of saphenous vein after radiofrequency ablation. *J Korean Surg Soc* 2013;84:107–113.
- 7) Calcagno D, Rossi JA, Ha C. Effect of saphenous vein diameter on closure rate with ClosureFAST radiofrequency

- catheter. *Vasc Endovascular Surg* 2009;43:567-570.
- 8) Proebstle TM, Vago B, Alm J, Göckeritz O, Lebard C, Pichot O. Treatment of the incompetent great saphenous vein by endovenous radiofrequency powered segmental thermal ablation: first clinical experience. *J Vasc Surg* 2008;47:151-156.
 - 9) García-Madrid C, Pastor Manrique JO, Sánchez VA, Sala-Planell E. Endovenous radiofrequency ablation (venefit procedure): impact of different energy rates on great saphenous vein shrinkage. *Ann Vasc Surg* 2013;27:314-321.
 - 10) Joh JH, Kim WS, Jung IM, Park KH, Lee T, Kang JM; Consensus Working Group. Consensus for the treatment of varicose vein with radiofrequency ablation. *Vasc Specialist Int* 2014;30:105-112.
 - 11) Manfrini S, Gasbarro V, Danielsson G, Norgren L, Chandler JG, Lennox AF, et al. Endovenous management of saphenous vein reflux. Endovenous Reflux Management Study Group. *J Vasc Surg* 2000;32:330-342.
 - 12) Morrison N, Gibson K, McEnroe S, Goldman M, King T, Weiss R, et al. Randomized trial comparing cyanoacrylate embolization and radiofrequency ablation for incompetent great saphenous veins (VeClose). *J Vasc Surg* 2015;61:985-994.
 - 13) Proebstle TM, Alm BJ, Göckeritz O, Wenzel C, Noppeney T, Lebard C, et al. Five-year results from the prospective European multicentre cohort study on radiofrequency segmental thermal ablation for incompetent great saphenous veins. *Br J Surg* 2015;102:212-218.
 - 14) Merchant RF, Pichot O; Closure Study Group. Long-term outcomes of endovenous radiofrequency obliteration of saphenous reflux as a treatment for superficial venous insufficiency. *J Vasc Surg* 2005;42:502-509.
 - 15) Theivacumar NS, Dellagrammaticas D, Beale RJ, Mavor AI, Gough MJ. Factors influencing the effectiveness of endovenous laser ablation (EVLA) in the treatment of great saphenous vein reflux. *Eur J Vasc Endovasc Surg* 2008;35:119-123.
 - 16) Massaki AB, Kiripolsky MG, Detwiler SP, Goldman MP. Endoluminal laser delivery mode and wavelength effects on varicose veins in an ex vivo model. *Lasers Surg Med* 2013;45:123-129.
 - 17) Gloviczki P, Comerota AJ, Dalsing MC, Eklof BG, Gillespie DL, Gloviczki ML, et al. The care of patients with varicose veins and associated chronic venous diseases: clinical practice guidelines of the Society for Vascular Surgery and the American Venous Forum. *J Vasc Surg* 2011;53(5 Suppl):2S-48S.