

How to Cite:

Ewida, A. M., Hammada, M. I., & El-Saied Ibrahima, A. I. (2022). Comparative study between using of radio frequency ablation and endovenous laser ablation in the treatment of primary lower limb varicose veins. *International Journal of Health Sciences*, 6(S5), 7138–7149.
<https://doi.org/10.53730/ijhs.v6nS5.11600>

Comparative study between using of radio frequency ablation and endovenous laser ablation in the treatment of primary lower limb varicose veins

Ashraf Mohamed Ewida

Professor of Vascular Surgery, Vascular Surgery department, Faculty of Medicine - Al-Azhar University, Cairo, Egypt

Mohamed Ibrahim Hammada

Lecturer of Vascular Surgery, Vascular Surgery department, Faculty of Medicine - Al-Azhar University, Cairo, Egypt

Ahmed Ibrahim El-Saied Ibrahima

M.B.B.CH, Egypt

Correspondence author email: ahmedibrahimelsaied@gmail.com

Abstract---Background: Varicose veins are a frequent vascular issue. Radiofrequency ablation (RFA) and Endo-venous laser ablation (EVLA) are endo-venous treatments for varicose veins. Endo-venous therapy demonstrated superior outcomes than standard high ligation and stripping in terms of pain, quality of life, healing, and recurrence. The RFA and ELA surpass vein stripping in morbidity, outcome, and neovascularization (recurrence), which is attributed for greater recurrence rates. Aim: We aim to compare between using of radio frequency ablation and endo-venous laser ablation in the treatment of primary lower limb varicose veins as regard to complications, treatment failure, recurrence. Methods: This prospective randomized controlled study was conducted in the vascular surgery department at Al-Azhar university hospitals (Al-Hussein and Sayed Galal), in the period from September 2020 to June 2022 (20 months). The study included 50 patients, males were 22(44%) while females were 28(56%), Presented by primary varicose veins. Results: In EVLA group Recanalization of short-segment occlusion was done in 4 patients, Recanalization of long-segment occlusion was done in 2 patients and recurrent varicose veins happened in 5 patients. In RFA group Recanalization of short-segment occlusion was done in 3 patients, Recanalization of long-segment occlusion was done in 3 patients and recurrent varicose veins happened in 6 patients. Conclusion: The

overall success rate of endovenous ablation techniques in occluding incompetent GSVs was 94% at 1 month. EVLT was associated with somewhat higher occlusion rates, but postoperative complications in our experience were more frequent after EVLT than after RFA.

Keywords---Radio Frequency Ablation, Endovenous Laser Ablation, Primary, Varicose Veins.

Introduction

Varicose veins are one of the most common vascular problems that appear in a large portion of population. The disease affects about 10-40% of 30-70 years old people (DePopas & Brown 2018). Most studies have suggested varicose veins are more common in women, with a female to male ratio 3:1 (Sharma, 2018). Varicose veins are the veins which permanently lost its valvular efficiency and as a result of continuous dilatation under pressure, in the course of time become elongated, tortuous and pouched (Khan & Ahmed 2019). The greater incidence of left sided varicose veins that has been reported by some literatures may be related to left common iliac vein compression because the venous return from the leg is always partially impeded where the right common iliac vein in front of the sacral promontory (Yang et al., 2018). Truncal varicosities mean that the patient has poor functioning valves and dilatation of one or more of the truncal veins, the great saphenous vein and the small saphenous vein. (Labropoulos et al., 2017)

The initial anatomic location of varicose veins is typically in the great and small saphenous distributions and their tributaries in the superficial system. Related risk factors are multiple, including primary etiologies associated with pregnancy, prolonged standing, female gender, and, rarely, congenital absence of valves. Valvular incompetence and venous hypertension have been considered primary processes of varicosis. The classic theory of descending valve incompetence has the support of famous physicians. Duplex ultrasonography of the extremities is one of the most critical studies for evaluating and diagnosing venous insufficiency and thrombosis; currently, this imaging method is the “gold standard” for superficial venous imaging. Proper evaluation includes assessment of both reflux and obstruction in the deep, superficial, tributary, and perforating veins. Varicose veins constitute a progressive disease, except after pregnancy and delivery. During its course the disease produces complications that usually prompt the patient to seek medical care. The most frequent complications are superficial thrombophlebitis, acute bleeding, eczema, and skin ulceration. (Bergan et al., 2018)

The standard treatment of varicose veins for many years surgical ligation and stripping of the affected vein. Although outcomes have improved in recent years because of enhanced understanding of lower extremity venous anatomy, the recurrence rate with this approach is frequently reported to be between 20% and 30%. The most notable endovenous advancements are the new widespread techniques of radiofrequency ablation (RFA) and endovenous LASER ablation (ELA). These methods may be demonstrated clinical superiority to stripping and surgical ligation as well as significantly less postoperative pain and recovery time.

The thermal energy generates heat and steam bubbles within the lumen of the target vessel, destroying the endothelial lining of the vessel. This causes an inflammatory reaction resulting in occlusion that effectively closes off the vein and eventually leads to fibrosis. (Proebstle et al., 2018) 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. (Ayman Essawy et al., 2020) The RFA and ELA outperforms not only regard to morbidity and outcome but also reduces the formation of neovascularization(recurrence) that is frequently blamed reason for the higher recurrence rates seen with the vein stripping.

Patients and Methods

This prospective randomized controlled study was conducted in the vascular surgery department at Al-Azhar university hospitals (Al-Hussein And Sayed Galal), in the period from september 2020 to june 2022 (20 months). The study included 50 patients, males were 22(44%) while females were 28(56%), Presented by primary varicose veins. All patients had symptomatic varicose veins with documented GSV incompetence and were classified according to the CEAP (clinical, etiologic, anatomic, pathophysiologic) classification. The severity and extent of GSV reflux were evaluated preoperatively with duplex scanning. Reflux in the superficial (GSV and small saphenous vein) and deep (femoral vein and popliteal vein) venous systems were assessed with patients in the standing position. Presence of incompetent perforators was not routinely evaluated.

Inclusion criteria: Patients with primary uncomplicated varicose veins, age from 18 to 60 years old, men and women, iIncompetent great saphenous vein, intact deep venous vein system, vein diameter at the GSV ≥ 5.5 mm and ≤ 15 mm, reflux in GSV >0.5 second and CEAP classification between C2 and C5

Exclusion criteria: Secondary lower limb varicose veins, lower limb lymphedema, recurrent varicose veins of lower limb, tortuous GSV rendering the vein unsuitable for endovenous treatment, acute superficial thrombophlebitis of lower limb, and congenital anomalies of venous system of lower limb, lower limb ischemia and lower limb malignancy.

Patient evaluation: After Informed written consent, patients were subjected to the following: Clinical evaluation and duplex assessment. Clinical evaluation was carried out for all patients according to the following scheme: Detailed history, detailed general examinations, lower limb examination to detect, distribution of veins affected, incompetent perforators and shape (spider, serpentine or saccular). Duplex was done as a routine to all patients to detect: Patency of the deep venous system, sapheno-femoral or sapheno-popliteal reflux, presence and number of perforators, diameter of GSV and distance from the skin, exclude any venous anomalies of L.L, exclude accessory GSV&mapping of it if present and mapping of superficial venous system of L.L

Treatment:

Endovenous Laser Ablation Procedure: EVLA can be performed with the patient under local tumescent anesthesia

Position: in supine position.

Sterilisation: sterilization of the affected limb with bovidon iodine then putting of sterilized towels.

Under local anaesthesia, venous access is obtained by a puncture with a 16F needle under US guidance. Most commonly, the insufficient GSV is entered just distal to popliteal area because of ease of access (i.e., large diameter and linear course) and the smaller risk of nerve injury.



Fig (1): (A) Laser device for endo venous ablation (B) Laser fiber



Figure (2): (A) puncture of G.S.V duplex guided and introducing of the guide wire (B): After introducing of the sheath,(C)Duplex ultrasound during introducing of laser catheter.

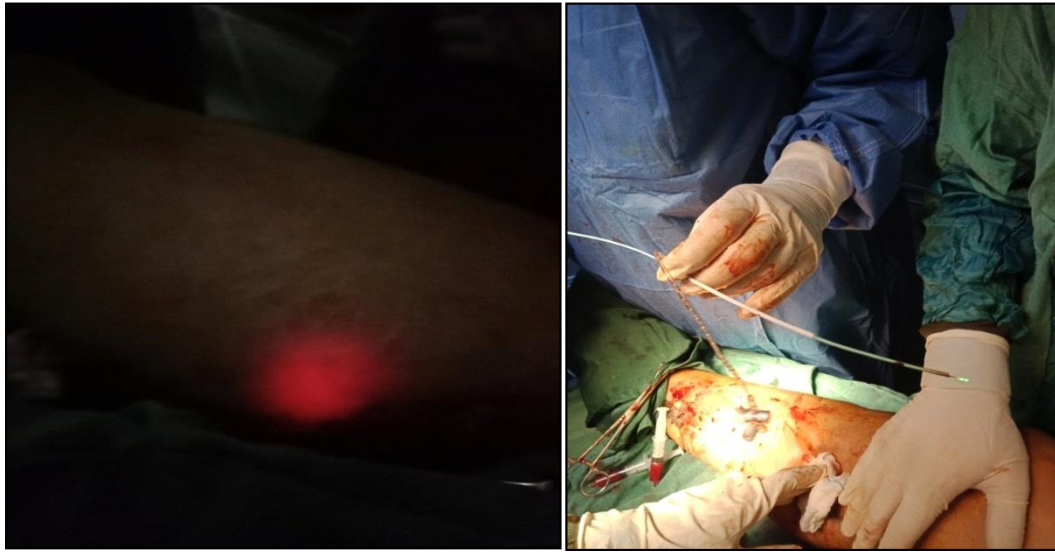


Figure (3): (A) Laser beam while in truncal varicosity (B) Laser beam after removal of the sheath

Radiofrequency ablation Procedure

In patients undergoing RFA tumescent fluid infiltration was not used routinely. Saline was infiltrated subcutaneously in these patients to reduce the risk of skin burn (mean volume 52 ml). A bandage was used to compress the limb during treatment. The generator was set to deliver a power of 23 W. The RFA catheter withdrawn at approximately 0.8 cm per second during treatment using audio feedback provided by the RFiTT system. Treatment stopped when the catheter entered the sheath so the vein containing the sheath was not treated.

Medical treatment: Anti-inflammatory drugs was advised post-operative for 3 days, Low- Molecular-weight heparin (enoxaparin sodium 40 mg administered for 7 days in selected high risk cases and the grade 2 postoperative compression therapy continued for 8 weeks were routinely used as a part of thrombosis prevention in both groups (EVLA and RFA).

Follow up and assessments: The patients were monitored postoperatively using the ultrasound scans performed at regular intervals on the day of surgery (day 0), at 1 week and 1 month following the surgery, and subsequently, every 6months. The patients were regularly monitored with clinical examinations and ultrasound scans for 5 years.

Results

Table (1): Distribution of studied sample according to patient's demographic data

	Number	Percent
Age (years)		
≤30	20	40.0

>30	30	60.0
Range	20-52	
Mean±S.D.	30.60±7.559	
Gender		
Male	28	56.0
Female	22	44.0

Table (1): shows demographic data of the studied group. Age ranged from 20-52 years with mean value 30.60±7.559 years. Males were 28(44%) while females were 22(44%).

Table (2): Distribution of studied sample according to patient's comorbidity

Comorbidity	Number	Percent
DM	4	8.0
HTN	1	2.0
Dyslipidemia	10	20.0

In our study, there are 4(8%) diabetic patients, 10(20%) dyslipidemic patients and one patient had HTN, as it's presented in table (2)

Table (3): Distribution of studied sample according to patient's limbs classified according to the CEAP

Limbs classified according to the CEAP	Number	Percent
C2	6	12.0
C3	25	50.0
C4	12	24.0
C5	7	14.0
Total	50	100

Table (3): In this study and according to CEAP classification we had varieties of patients from C2 to C6

Table (4): Healing was close in EVLA and RFA

Effect on healing of venous ulcer	Follow up	EVLA	RFA
	At 1 Months	0	0
	At 2 Months	1	1
	At 3 Months	2	1

Evaluation of effect on healing of venous ulcer with EVLA and RFA with time at 1, 2, 3 months

Table (5): Evaluation of saphenous nerve neuralgia with EVLA and RFA with 1, 2, 3 months:

Saphenous nerve neuralgia	Follow up	EVLA	RFA
	1 months	2	2
	2 months	1	1

	3 months	0	1
--	----------	---	---

Saphenous nerve neuralgia was close in EVLA and RFA. By the third month only one patient in RFA group was suffering from saphenous nerve neuralgia.

Table (6): Distribution of studied sample according to patient's return to daily activity

Return to daily activity	Number	Percent
≤5	20	40.0
>5	30	60.0
Range	4-10	
Mean± S.D.	6.10±1.876	

Patient could return to daily activities postoperatively from 4-10 days as Table (6)

Table (7): Evaluation of GSV diameter pre&post operatively after LASER ablation

GSV Diameter	Preoperative	Follow-up			
		1 week	1 month	3 months	6 months
Min – Max	4.50 – 9.50	3.20 – 8.50	1.30 – 6.40	0.60 – 4.30	0.10 – 0.90
Mean ± S.D	6.52±1.271	5.31±1.273	3.50±1.070	1.88±0.731	0.52±0.252

Table (7): shows that GSV diameter was ranged between 4.50 – 9.50 with a mean value of 6.52±1.271 and it was decreased significantly at postoperative time to reach after 6 months of follow up to be at mean value 0.52±0.252.

Table (8): Evaluation of GSV diameter pre& post operatively after RFA ablation

GSV Diameter	Preoperative	Follow-up			
		1 week	1 month	3 months	6 months
Min – Max	5.50 – 10.0	3.20 – 8.50	1.30 – 6.40	0.90 – 5.60	0.30 – 1.20
Mean ± S.D	7.12±1.271	5.31±1.273	3.50±1.070	2.28±0.731	0.82±0.252

Table (8): shows that GSV diameter was ranged between 5.50 – 10.0 with a mean value of 7.12±1.271 and it was decreased significantly at postoperative time to reach after 6 months of follow up to be at mean value 0.82±0.252.

Table (9): Evaluation of complications following both EVLA and RFA ablations

Complication Type	EVLA Group N(%)	RFA Group N(%)
Venous Thrombo-Embolism	0	0
Pulmonary Embolism	0	0
Persistent skin hyperpigmentation	2 (3.6)	3 (5.6)
Transient skin hyperpigmentation	3 (5.4)	2 (3.7)
Skin burns	0	1 (1.8)
Persistent saphenous nerve damage	1 (1.8)	2 (3.7)
Transient saphenous nerve damage	2 (3.6)	2 (3.7)

In EVLA group 2 patients were complicated with persistent skin hyperpigmentation, 3 with transient skin hyperpigmentation, 2 with transient saphenous nerve damage and only one with persistent saphenous nerve damage. In RFA group 3 patients were complicated with persistent skin hyperpigmentation, 2 with transient skin hyperpigmentation, one with skin burns, 2 with transient saphenous nerve damage and 2 with persistent saphenous nerve damage

Table (10): Evaluation of treatment failure in both EVLA and RFA ablations

	EVLA Group N(%)	RFA Group N(%)
Recanalization of short-segment (below 5cm) occlusion	4 (7.1)	3 (5.6)
Recanalization of long-segment (below 5cm) occlusion	2 (3.6)	3 (5.6)
Recurrent varicose veins	5 (8.9)	6 (11.1)

In EVLA group Recanalization of short-segment occlusion was done in 4 patients, Recanalization of long-segment occlusion was done in 2 patients and recurrent varicose veins happened in 5 patients. In EVLA group Recanalization of short-segment occlusion was done in 3 patients, Recanalization of long-segment occlusion was done in 3 patients and recurrent varicose veins happened in 6 patients.

Discussion

There are no reports of direct comparisons of laser ablation and RF ablation. However, the published data suggest slightly higher occlusion rates for laser ablation. For both treatments, long-term follow-up and quantification of 5- to 10 year recurrence rates will be important. Both techniques diverge from classical surgical teaching in that the SFJ tributaries are not treated and could therefore be a potential source of recurrence. (Fernández et al, 2018).

For the purposes of the analysis, we chose to differentiate between the short-segment (<5 cm) and long segment (≥5 cm) recanalization. Long-segment recanalization was diagnosed in patients with the confirmed active blood flow along the 5-cm or longer segment of the obliterated vessel and was often associated with the recurrence of varicose veins.

This was confirmed in (3.6%) patients after EVLA and (8.6%) patients after RFA. Thus, effective obliteration was achieved in 96.4% and 91.4% with EVLA and RFA, respectively. (Van Neer et al, 2019).

In our EVLA group, 4 of 5 participants with varicose vein recurrence were found to have type 3 anatomical failure, associated with insufficiency of the anterior (2 patients) or posterior (2 patients) accessory great saphenous vein. In 1 patient, the varicose vein recurrence was attributed to the great saphenous vein recanalization— type 2 anatomical failures. In the RFA group, type 3 anatomical failure was confirmed in 4 cases, including the insufficiency of the anterior (3 patients) and posterior (1 patient) accessory great saphenous vein. Type 2

anatomical failures were observed in 2 cases. We did not observe type 1 anatomical failure in any of our patients.

Impaired superficial sensation after GSV stripping due to saphenous nerve damage is a relatively common complication and has been shown to occur in 23% to 40% of patients undergoing total saphenectomy and 7% to 19% of patients undergoing subtotal saphenectomy (above the knee). Limited stripping reduces permanent damage of saphenous nerve and promotes its recovery. Persistent dysesthesia (altered sensation) in our study sample was observed in 3.7% of participants in the RFA group and 1.8% of participants in the EVLA group. Tumescence anesthesia has significantly reduced the neuropathy rates. At the early stages of RFA, performed without tumescence anesthesia, neuropathies tended to affect 25% of treated patients. A lower rate of sensation abnormalities observed in patients after EVLA as compared to RFA. (Vuytsteke et al, 2016).

Skin discoloration is a typical adverse event seen in patients after sclerotherapy; its rate can be as high as 30%. It occurs rarely after conventional varicose vein surgery, where it can be due to poststripping hematoma absorption. Hyperpigmentation in patients after EVLA and RFA is caused by thrombophlebitis. (King et al, 2017). In our study, hyperpigmentation occurred in as few as 3.6% and 6.8% of participants in the EVLA and RFA groups, respectively. Single case reports of burns in patients after endovenous thermal ablation have been published. Our case of a skin burn was in a slim patient undergoing the RFA.

This study found a higher need for repeated treatment of the saphenous vein during the same operation in the RFA group compared with the EVLT group (17% vs 0%) because of duplex evidence of patency after the first pass of the Closure catheter. This finding was more than the usual intraoperative residual flow and was considered as in a dequate closure, necessitating repeated obliteration during the same anesthesia.

The Endovenous Radiofrequency Obliteration (Closure) Versus Ligation and Stripping in a Selected Patient Population (EVOLVEs) study was designed to compare RFA with stripping of the GSV. Immediate success on the day of treatment was reported for 95% (42/44). A scan obtained 72 hours after the procedure showed flow in the proximal GSV in 16.3% (7/44) of limbs. Five of these segments had reflux in the open segment.

Two of these closed at 1 week, and an additional segment closed at 3 weeks. (Hingorani A. et al, 2020) Our data confirm these observations. When we compared intraoperative with postoperative duplex ultrasound findings, we found no apparent correlation between the presence of minimal GSV flow at the end of procedure and recanalization. Noncompliance with postoperative compression could have been one of the causes of early recanalization, but we were unable to monitor this.

Previous reports have also reported slightly higher occlusion rates with EVLT (98% to 100%) than with RFA (83% to 100%). (Jing, Z. et al, 2018) The higher occurrence of painful thrombophlebitis and cellulitis with the EVLT technique is

probably due to the incomplete vein emptying with intraluminal thrombus and surrounding inflammation. Other authors have observed similar complications after EVLT. Absence of flow proximal to the inferior epigastric vein at postoperative duplex scans is most likely due to the presence of thrombotic material that forms in the stump of the GSV above the treated area. (Lawrence P., et al, 2018).

Routine postoperative duplex scanning was initiated only after recent publications of thrombotic complications after RFA. Current rates of DVT pooled from large series are considered similar between EVLT and RFA (0.3% vs 0.4% to 2.1%) and stripping (5.7%). It is possible GSV thrombi caused by laser energy have different characteristics from those occurring after RFA. Pathologic examination of veins treated by EVLT shows homogeneous thrombotic occlusion of the vessel due to generation of steam bubbles, whereas RFA causes collagen shrinkage and fibrosis (Lurie et al , 2020).

A systematic literature review was published in 2018 showed that patients with grade C2 disease were the most numerous in most of recent studies, with the exception of 2 studies in which most had grade C4 disease. The assessment of post-operative improvement of venous symptoms was assessed by CEAP post-operatively which showed dramatic improvement in EVLA group as all patients turned to C1EpAsPr (100%) while RFA group only 88.9% turned to C 1 EpAsPr. In all studies that provided relevant data, there was significant resolution of venous symptoms (Venous Clinical Severity Score, CEAP) and improvement in quality of life from baseline, regard-less of the treatment used; however, Gale and colleagues reported no significant difference in improvement in quality of life between RFA and laser treatment (Raetz, J., Wilson et al, 2019)

There is no statistically significant difference between radiofrequency powered segmental ablation and endovenous laser ablation according to length of treated vein (cm). There is no statistically significant difference between radiofrequency powered segmental ablation and endovenous laser ablation according to GSV with incompetent terminal valve. There is highly statistically significant decrease severity score through the periods in group radiofrequency powered segmental ablation and group endovenous laser ablation. There is highly statistically significant decrease pain score through the periods in group radiofrequency powered segmental ablation and group endovenous laser ablation according to pain score .There is no statistically significant difference between radiofrequency powered segmental ablation (no medication) (75%) and endovenous laser ablation (no medication) (66.7%) according to postoperative pain medication. There is no statistically significant difference between radiofrequency powered segmental ablation at 0 2 (16.7%), at 1 month 0 (0%) and At 3 months 0 (0%) and endovenous laser ablation At 0 1 (8.3%), At 1 month 0 (0%) and At 3 months 0 (0%) according to Post-operative bruises and ecchymosis and skin burn (Chamanga et al, 2018).

Comparing Closure FAST RF catheter treatment versus 980-nm EVLA, we observed excellent correction of parameters linked to venous reflux, especially venous hypertension secondary to GSV incompetence irrespective of the device used for the treatment. All indices measuring post-inflammatory sequelae

demonstrated no difference favoring RF ablation versus EVLA. It is reported that patients better tolerate the RF procedure because controlled heating avoids the vein perforations often seen with EVLA (Fish et al, 2018). Our study failed to show any significant difference between the two groups. Our patient satisfaction, ease of use of RFA versus EVLA was not significantly different. As yet, there has not been any standardization in energy dosage delivered with EVL, but future studies are likely to focus on these technical issues. Comparing the 2 techniques in this study in the term of successful ablation, minor complication and improvement of symptoms, EVLA was superior to RFA. EVLT laser fiber is more expensive than the RFA catheter, the pullback treatment time is shorter, and the saphenous obliteration rates are likely higher.

Conclusion

The overall success rate of endovenous ablation techniques in occluding incompetent GSVs was 94% at 1 month. EVLT was associated with somewhat higher occlusion rates, but postoperative complications in our experience were more frequent after EVLT than after RFA. Complications of Endovenous ablation included the following: Deep vein thrombosis, pulmonary embolism, pain, abscess, seroma, hyperpigmentation, and burn of the skin. Compression treatment after endovenous saphenous ablation may be important. All patients who receive endovenous procedures should undergo early postoperative duplex scanning to rule out proximal extension of thrombus, confirm occlusion, and exclude more distal DVT. Our data suggest that older patients tend to develop more proximal GSV thrombi after ablation; thus DVT prophylaxis may be considered in patients more than 50 years old.

References

- Ayman Mohy Elden and moh.Agena (2020): Comparative study between conventional surgery, Endovenous LASER Ablation and Sapheno femoral Disconnection with Endovenous Chemical Ablation for Treatment of Lower Limbs Varicose Veins.AIM journal.
- Bergan JJ, and Yao JST (2005): Surgery of veins, Orlando, Grune and Stratton. : 275-356.
- Chamanga, E. T. (2018). Understanding venous leg ulcers. *British journal of community nursing*, 23(Sup9), S6-S15.
- DePopas, E., & Brown, M. (2018, March). Varicose veins and lower extremity venous insufficiency. In *Seminars in interventional radiology* (Vol. 35, No. 01, pp. 056-061). Thieme Medical Publishers.
- Ferna´ndez CF, Roizental M, Carvallo J (2018): Combined endovenous laser therapy and microphlebectomy in the treatment of varicose veins: efficacy and complications of a large single-center experience. *J Vasc Surg* 48:947–952
- Fish, J. H., & Lurie, F. (2018). Evaluation of Edema of the Extremity. In *Current Management of Venous Diseases* (pp. 51-63). Springer, Cham.
- Garcia, R., & Labropoulos, N. (2018). Duplex ultrasound for the diagnosis of acute and chronic venous diseases. *Surgical Clinics*, 98(2), 201-218.
- Hingorani, A., Chait, J., Kibrik, P., Alsheekh, A., Marks, N., Rajae, S., ... & Ascher, E. (2020). Spontaneous hemorrhage from varicose veins: A single-

- center experience. *Journal of Vascular Surgery: Venous and Lymphatic Disorders*, 8(1), 106-109.
- Jing, Z., Mao, H., Shi, M., Feng, X., & Song, C. (2018). Arteriovenous Fistula. In *Endovascular Surgery and Devices* (pp. 163-167). Springer, Singapore.
- Khan, S. M., & Ahmed, S. (2019). A prospective study on etiology and clinical features of varicose veins: A hospital based study. *International Journal of Surgery*, 3(4), 06-10.
- Khidoyatova, M. R., Kayumov, U. K., Inoyatova, F. K., Fozilov, K. G., Khamidullaeva, G. A., & Eshpulatov, A. S. (2022). Clinical status of patients with coronary artery disease post COVID-19. *International Journal of Health & Medical Sciences*, 5(1), 137-144. <https://doi.org/10.21744/ijhms.v5n1.1858>
- King T, Coulomb G, Goldman A et al (2017): Experience with concomitant ultrasound-guided foam sclerotherapy and endovenous laser treatment in chronic venous disorder and its influence on health related quality of life: interim analysis of more than 1000 consecutive procedures. *Int Angiol* 28:289–297
- Lawrence, P. F. (2018). Complications of the Treatment of Venous Insufficiency. In *Current Management of Venous Diseases* (pp. 207-215). Springer, Cham.
- Lurie, F. (2020). Advanced Stages of Chronic Venous Disease: Evolution of Surgical Techniques and Advantages of Associated Medical Treatment. *Advances in Therapy*, 1-7.
- Proebstle TM, Moehler T, Herdemann S (2012): Reduced recanalization rates of the great saphenous vein after endovenous laser treatment with increased energy dosing: definition of a threshold for the endovenous fluence equivalent. *J Vasc Surg* 44:834–839
- Raetz, J., Wilson, M., & Collins, K. (2019). Varicose veins: Diagnosis and treatment. *American family physician*, 99(11), 682-688.
- Sharma, A. (2018). Varicose veins. In *Peripheral Vascular Disease in Primary Care* (pp. 19-30). CRC Press.
- Suryasa, I. W., Rodriguez-Gámez, M., & Koldoris, T. (2022). Post-pandemic health and its sustainability: Educational situation. *International Journal of Health Sciences*, 6(1), i-v. <https://doi.org/10.53730/ijhs.v6n1.5949>
- Van Neer P, Kessels FG, Estourgie RJ et al (2019): Persistent reflux below the knee after stripping of the great saphenous vein. *J Vasc Surg* 50:831–834
- Vuylsteke M, Liekens K, Moons P et al (2016): Endogenous laser treatment of saphenous vein reflux: how much energy do we need to prevent recanalizations? *Vasc Endovascular Surg* 42:141–149.
- Yang, L., Liu, J., Cai, H., & Liu, Y. (2018). The clinical outcome of a one-stop procedure for patients with iliac vein compression combined with varicose veins. *Journal of Vascular Surgery: Venous and Lymphatic Disorders*, 6(6), 696-701.