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Strategies and challenges in the treatment of varicose veins and venous insufficiency

Treatment of varicose veins

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Abstract

Patients with varicose veins can be treated with conservative or surgical approaches based on the clinical conditions, and patient preferences. In recent decade, the recommendations for managing symptomatic varicose veins have changed dramatically due to the rise of minimally invasive endovascular techniques. The literatures were systematically searched on Medline without language restrictions. All papers on the treatment of varicose veins and venous insufficiency with different procedures were included and reviewed. Endovenous laser ablation (EVLA) and radiofrequency ablation (RFA) both are same safe and effective on clinical efficacy in terms of occlusion rate, time to return to normal activity. In comparison with RFA or EVLT, CHIVA may cause more bruising and make little or no difference to rates of limb infection, superficial vein thrombosis, nerve injury or hematoma. In terms of recurrence of varicose veins, there is little or no difference between CHIVA and stripping, or RFA or EVLT, respectively. Great saphenous veins recanalization is highest in the ultrasound guided foam sclerotherapy (UGFS) group (51%) during 1 year of follow-up. The 2013 National Institute for Health and Care Excellence clinical guidelines recommend surgery as third-line therapeutic option after EVLA or RFA and sclerotherapy. Although the mechanochemical endovenous ablation (MOCA) is a non-thermal-non-tumescent option, and appears to be of similar efficacy with stab avulsion with no potential risk of nerve damage, but, the overall success rate of MOCA is lower than other procedures such as EVLA, RFA or HL/S. Endovenous laser ablation (EVLA) is the most cost-effective therapeutic option, with radiofrequency ablation (RFA) a close second for the treatment of patients with varicose veins. Endovenous thermal ablation (EVLA or RFA) is recommended as first-line treatment for varicose veins and has substituted the high ligation of saphenofemoral junctional reflux and stripping of varicose veins. The 2013 National Institute for Health and Care Excellence clinical guidelines recommend surgery as third-line therapeutic option after EVLA or RFA and sclerotherapy. In terms of recurrence of varicose veins, there is little or no difference between CHIVA and EVLA, RFA or stripping, respectively. Ultrasound guided foam sclerotherapy is

associated with high recurrence rate and can be used in conjunction with other procedures. Mechanochemical endovenous ablation and cyanoacrylate embolization appear promising, but evidence on their effectiveness is required.

Key Words: varicose veins; venous insufficiency; high ligation and stripping; endovenous laser ablation; radiofrequency ablation; CHIVA

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Core Tip: Endovenous laser ablation (EVLA) is the most cost-effective therapeutic option, with radiofrequency ablation (RFA) a close second for the treatment of patients with varicose veins. Endovenous thermal ablation (EVLA or RFA) is recommended as first-line treatment for varicose veins and has substituted the high ligation of saphenofemoral junctional reflux and stripping of varicose veins. In terms of recurrence of varicose veins, there is little or no difference between CHIVA and EVLA, RFA or stripping, respectively. Ultrasound guided foam sclerotherapy is associated with high recurrence rate and can be used in conjunction with other procedures. Mechanochemical endovenous ablation and cyanoacrylate embolization appear promising, but evidence on their effectiveness is warranted.

INTRODUCTION

Varicose veins are tortuous, twisted, or elongated veins^[1] dilated to at least 3 mm in diameter evaluated when a patient in standing status with prevalence 10% in population, a serious conditions such as deep venous thrombosis (DVT) and pulmonary embolism may occur if untreated. Patients with varicose veins can be treated with conservative or surgical options based on the clinical conditions, and patient preferences^[2-7]. In recent decade, there has been a dramatic change in the recommendations for managing symptomatic varicose veins due to the rise of

minimally invasive endovascular techniques^[2-7]. Therefore, we searched literature and summarized the strategies and challenges in the ²⁹ treatment of varicose veins and venous insufficiency.

Strategies in the treatment of varicose veins and venous insufficiency

The decision and the choice of treatment for varicose veins are based on severity of the venous insufficiency, cost, risk of postoperative complications, and patient preferences. Management options for varicose veins include conservative treatment and surgical intervention. The asymptomatic patients with varicose veins are initially managed with conservative treatment options that include external compression, lifestyle modifications *e.g.* exercise, and avoiding prolonged standing and straining. While symptomatic patients are suggested to consider surgical intervention^[1] that include endovenous laser ablation(EVLA), radiofrequency ablation(RFA), high ligation and stripping (HL/S) of incompetent great saphenous vein(GSV), ²⁸ CHIVA (Cure conservatrice et Hemodynamique de l'Insuffisance Veineuse en Ambulatoire) , mechanochemical ablation (MOCA) and cyanoacrylate glue occlusion (CAE), etc(Table 1)^[2-8].

Compression Therapy

Compression therapy is the mainstay for conservative management, and is effective in the treatment of varicose veins with venous ulcers.^[9] Compression bandaging is helpful in managing ankle edema. However, many patients experienced difficult to tolerate bandaging because of itch, pain, and difficulty in putting shoes. Therefore, medical stockings is more welcomed than compression bandaging.^[10] Compression stockings with graduated compression produce graded external compression directly to lower extremities and oppose the venous blood pressure.

When choosing the compression stockings, the patients are educated to prefer compression stockings with graduated compression to nongraded ones. Patients with varicose veins involving the main axial superficial veins above and below the knee

should choose thigh-length graduated compression stockings rather than the Knee-length stockings. Stockings with moderate pressure (20-30 mmHg) are recommended for patients with varicose veins (C2 to C3), stockings with a pressure around 30 to 40 mmHg are suggested for people with skin change or an ulcer (C4 to C6), stockings with a pressure between 40 and 50 mmHg are recommended for patients with recurrent ulcer as an adjuvant treatment to prevent ulcer recurrence. [10, 11]

At least one week compression stocking therapy after EVLA is suggested, because a long time (1-2 wk) of using compression therapy is better than a short-term (24-48h) of using in terms of reducing postoperative pain at 1 wk and recovery for work[11]. Yet, a trial of compression therapy is unnecessary prior to endovenous thermal ablation[9] as there is no strong evidence to support compression stockings in the cure of varicose veins C1-C4[9].

Limitations to the use of compression stockings include arterial insufficiency, application difficulty and patient preferences. Some patients do not like continue compression therapy, even a short period after surgical intervention for varicose veins.

Medical therapy

Venoactive drugs are prescribed for symptomatic patents with varicose veins, ankle swelling, and venous ulcers to improve venous tone and capillary permeability. The commonly used drugs are spooning *e.g.*, horse chestnut seed extract, the micronized purified flavonoid fraction(MPFF), gamma-benzopyrenes (flavonoids)[12-15]. Pentoxifylline is reported to target inflammatory cytokine release, leukocyte activation, and platelet aggregation at the microcirculatory level. The use of pentoxifylline or MPFF in combination with compression therapy may improve closure of venous ulcers compared with compression and placebo[13]. A Cochrane meta-analysis shows that venoactive drugs may relieve pain and swelling due to chronic venous

insufficiency(CVI), but their precise mechanism is unknown, long-term studies of the safety and effectiveness of phlebotonics are warranted^[12-15].

Surgical therapy

Historically, surgery with high ligation of saphenofemoral junction (SFJ) ¹ or saphenopopliteal junction with or without vein stripping (HL/S) ² has been the gold standard of care for varicose veins.^[1] Specifically, following general or lumbar anaesthesia, an incision is made in the groin or upper calf, the great saphenous vein (GSV) is located and incised, the proximal end is ligated below the SFJ, and a stripping wire with a probe is put into the GSV and advanced forward distally, the proximal part of the GSV is tied to the wire and stripped *via* the calf incision. Recently, a growing number of literatures do not consistently favor surgery as the standard of treatment option due to the postoperative complications, ⁶ and the 2013 National Institute for Health and Care Excellence clinical guidelines recommend surgery as third-line therapeutic option after EVLA or RFA and sclerotherapy^[8, 16-18].

HL/S of the greater or lesser saphenous vein and their respective junctions are ¹¹ indicated when the saphenous veins themselves dilate greater than 1 cm in diameter. In a cohort study, Navarro, *et al*^[19] evaluated the relationship of GSV diameter measured in the thigh and calf to clinical severity of reflux in 112 Legs in 85 consecutive patients with SFJ ⁹ and truncal GSV incompetence^[19], found that a GSV diameter of 5.5 mm or less predicted having no abnormal reflux, with a sensitivity of 78 %, a specificity of 87%, positive and negative predictive values of 78 %, and an accuracy of 82 %^[19].

The surgical outcome of HL/S is relatively satisfactory, ²⁴ HL/S is associated with higher anatomic closure rates at 30 days and 5 years than RFA and UGFS, ^[8, 16] HL/S has similar long-term saphenous vein closure rates as EVLA at 5 years^[8, 16-18]. However, the postoperative complications are DVT, bleeding, hematoma, ecchymosis, wound infection, nerve injury, pain, and delayed return to normal activity. The injury of femoral artery, such as ligation and or stripping of femoral artery occurred in the hands

of inexperienced operators, which is underreported. Ligation alone is usually associated with a high recurrence rate of the varicose vein that may necessitate re-intervention^[20]. Stripping of the GSV below the knee or the SSV is not usually operated to avoid the high risk of nerve injury.

Ambulatory phlebectomy

Ambulatory phlebectomy (AP) also known as hook phlebectomy, mini-phlebectomy, microphlebectomy, or stab phlebectomy, is a minimally invasive procedure operated under local anesthesia as an outpatient procedure, it can excise most varicose veins except the proximal long saphenous^[21]. AP has a technically better outcome in terms of recurrence of GSV and SFJ reflux than UGFS in the long term. Specifically, a small stab wound or puncture with a blade is made to remove or retrieve varicose veins. Administering of certain volume of saline around the target veins prior to make stab may help retrieve longer section of unwanted vein. AP is usually performed in conjunction with other procedures in practice.

Notwithstanding, recurrence rates can be high if the junctional reflux is untreated^[21]. The junctional reflux should be managed by HL/S or EVLT rather than simple AP^[21]. Patients can walk right away after AP. The proportion of complications associated with AP such as localized thrombophlebitis, and hemorrhage are much less than HL/S. The use of broad compression pads following AP reduces the complications effectively.

CHIVA

¹⁸ CHIVA (Cure Conservatrice et Hemodynamique de l'Insuffisance Veineuse en Ambulatoire) is ambulatory conservative hemodynamic treatment of varicose veins that preserves deliberately the saphenous vein and collaterals based on venous hemodynamics^[22]. CHIVA is an office-based treatment for varicose veins performed under local anesthesia. ²⁷ The main advantages are preservation of the saphenous vein, ¹⁹ local anesthesia, low cost, low pain, less bruising, nerve damage and recurrence than

stripping saphenectomy^[23] (Figure 1).²² CHIVA seemed to have superior clinical benefits on long-term efficacy for treating varicose veins^[24]. Practically, CHIVA procedure is somewhat most like ambulatory phlebectomy. Patients can walk out the theatre immediately after CHIVA surgery and go home following observing for a while (video provided by Dr. Shiyan Ren).

Figure 1 A 56-year old man had varicose veins for 20 years, received day surgery with CHIVA procedure, the varicose veins disappeared on day 5 follow up (Figures are provided by Dr. Shiyan Ren).

However, the recent Cochrane review^[25] included six RCTs with 1160 patients, and compared CHIVA with RFA, vein stripping and EVLT, respectively for their effects. In terms of recurrence of varicose veins, there is little or no difference between CHIVA and stripping, or RFA or EVLT, respectively. In comparison with RFA or EVLT, CHIVA may cause more bruising and⁴ make little or no difference to rates of limb infection, superficial vein thrombosis, nerve injury or hematoma. Three RCTs comparing CHIVA with vein stripping demonstrated that CHIVA may reduce slightly nerve injury and hematoma in legs, but⁴ make little or no difference to the side effects of limb infection, and superficial vein thrombosis or bruising^[25]. One RCT comparing CHIVA with compression dressings in patients with venous ulcers shows uncertain if CHIVA reduced recurrence.

It is necessary to map and find the escape point (EP) of the veins prior to CHIVA. Most (82.3%) EP are located below the knee, 65.8% are located from knee to midcalf. The diameter of tributary veins (TVs) near EP²¹ is about 90% of that of the GSV. Thermal ablations of below-knee varicose vein may damage nerve^[26].

Transillumination powered phlebectomy

Transilluminated powered phlebectomy (TIPP) is reported as a minimal invasive procedure that is often performed under spinal or general anaesthesia for the treatment

of varicose vein [27], it was considered cosmetic for veins less than 2.5 mm in diameter due to the fewer incision. However, TIPP has associated with higher incidence of hematoma, postoperative pain, paresthesia[28] due to destructive damage to tissue and nerve around the veins, it has not been proven to be superior to other procedures to remove varicose veins[27]. Aremu *et al*[27] compared conventional stab avulsions to TIPP, found that recurrence at 52 wk in the TIPP group is higher than in the stab avulsions group (21.2% vs. 6.2%)[28].

TIPP can not be performed for all the varicose veins, especially for truncal varicose vein. In combination with RFA, a more satisfactory outcome at one year follow-up [29] can be achieved. In order to evaluate the effect of TIPP, Passman *et al* divided patients into 3 groups: saphenous stripping-stab avulsion phlebectomy (STRIP-AP), combined saphenous vein stripping-TIPP (STRIP-TIPP) and combined EVLT-TIPP. The complications was high in procedures involving TIPP (STRIP-AP 5.6%, STRIP-TIPP 6.5%, EVAB-TIPP 2.0%; $P = \text{NS}$), and more hematomas occurred in procedures involving TIPP (STRIP-AP 5.6%, STRIP-TIPP 16.3%, EVAB-TIPP 6.9%; $P < 0.05$)[30].

Endovenous thermal ablation therapy

Endovenous thermal ablation (EVLA or RFA) is recommended as first-line treatment and has substituted the surgical procedure to destroy the veins by heat and occlude the veins for symptomatic varicose veins[9, 31, 32].

EVLA was initially reported by Dr. Carlos Bone for the treatment of varicose veins at the International Union of Phlebology in 1999. The laser fiber is inserted into the target vein, a heat generator emits laser energy, the thermal light emitted out of the fiber tip induces local thermal injury to the veins leading to vein contraction, blood thrombosis, and venous fibrosis. EVTA with or without HL appeared to be a safe and effective treatment for patients with incompetent saphenous veins with an aneurysm close to the junction[33].

One systematic evidence review reported that the occlusion rates of the GSV and small saphenous vein within 6 mo after EVLA were all greater than 90%^[20]. A study by Wallace *et al*^[34] showed the SFJ anatomical success closure rate detected by DUS at 5 years after treatment is similar between HL/S (85%) and EVLA (93%). A meta-analysis by Kheirleiseid *et al* demonstrated no significant differences between HL/S in comparison to EVLA and RFA after 5 years^[35].

Both radiofrequency-powered segmental ablation (RPSA) and EVLA using bare-tip fibers have similarly high GSV obliteration rates in the first 5-year, and the treatments are equally effective clinically, and have similar minimal postoperative pain scores and short recovery times^[36].

A range of laser wavelengths can be used to achieve occlusion, the radial fibers and lasers with high wavelengths (1470–1940 nm) are recently introduced for homogeneous damage of the vein wall to improve the efficacy and reduce the side effect of procedures^[37]. The temperature produced by a 1470-nm laser with a radial probe is 120–140 °C (± 20 °C)^[37], less pain is noticed in the first week after use of a 1470-nm wavelength fiber than a 940-nm fiber. At the 48-month follow-up, the recurrence rate of treated veins followed with ultrasound was less with 1470-nm wavelength laser than with 940-nm fibers (8.3% vs. 15.9%, $P = 0.017$)^[38]. Another RCT indicated that patients treated with the 1470-nm catheter had higher occlusion rates than with the 1920-nm system (94.7% vs. 87.5%; $P = 0.05$) at 1-year follow-up. Patients treated with the 1920-nm EVLA catheter had less ecchymosis, induration and less analgesic use.

However, a systematic review and Meta-Analysis show that commonly used EVLA parameters do not influence efficacy, no particular wavelength is superior to any other^[20], no statistically significant differences were found for wavelengths (short [810, 940, and 980 nm], long [1470, 1500, and 1920 nm]), high or low administered energy (≤ 50 J/cm, > 50 J/cm), follow up (≤ 1 year, > 1 year). The overall success rate of EVLA was 92%^[39]. A RCT study by Malskat WS showed that treatment success and adverse

event rates between a 1470-nm wavelength fiber and a 940-nm fiber for the treatment of varicose veins were similar^[40].

The complications of EVLA are recurrence, thrombosis, skin burns and retained fragment of catheter^[41]. Recurrence can be treated with second ablation, the occlusion rate was 93.3% at 1 year after second ablation^{[42] [43]}.

Radiofrequency ablation

Radiofrequency ablation (RFA) is an ultrasonography guided minimally invasive treatment that ablates the refluxing vein segment using thermal energy delivered through a radiofrequency catheter. An ultrasonography is used to guide to insert a guide wire into the target vein, an introducer sheath is advanced through the guide wire which will be pulled away followed by inserting the RFA catheter into the sheath into the target position. A tumescent anaesthetic solution is injected around GSV to reduce pain, provide good hemostasis, prevent burn and nerve damage. After injection of tumescent solution, the RF generator is then activated and the catheter is slowly pulled along the length of the vein. compression therapy is used to reduce the risk of vein thrombosis, postoperative bruising and tenderness. Patients are encouraged to walk immediately after the procedure^[44]. RFA can be segmental procedures that induce heat to 120 °C in sections by which the veins are heated to 60–100 °C.

There is a difference among the RFA devices. F-care (F Care Systems, Antwerp, Belgium) is a relatively new RFA technique for the treatment of venous insufficiency. The 30-day total occlusion rates in the F-care and Closurefast groups were 96.2% and 98.1%, respectively ($P = 0.5$). The one-year full occlusion rates in the F-care and Closurefast groups were 71.7% and 90.6%, respectively ($P = 0.013$)^[45]. The 3-RF trial is the first RCT of Venefit, radiofrequency induced thermal therapy (RFITT), and endovenous radiofrequency (EVRF) to compare outcomes of RFA devices. At six months, complete GSV closure was significantly better after Venefit and RFITT

treatment (100% and 98%, respectively) compared with EVRF treatment (79%, $p < 0.001$).

But, clinical outcomes did not differ significantly at one year^[46].

RFA is associated with high satisfaction rate and quality of life score. Although operative timing in RFA was significantly longer than in surgery, recovery after RFA was significantly quicker than after surgery in terms of returning to usual activity and work at one week and less major adverse events. Complete obliteration of GSV was obtained in 98.2% of 135 patients (164 Limbs) at a median follow-up of 11 mo^[47]. RFA is usually performed in conjunction with other procedure such as HIPP to achieve a better outcome^[29]. RFA was showed to be noninferior in terms of recurrence to CHIVA and HLS at 2 years after treatment. No differences in postoperative complications or pain were found among HL/S, RFA and CHIVA^[48].

Comparison of RFA and EVLA

EVLA and RFA seem to be the same safe and effective on clinical efficacy in terms of occlusion rate, time to return to normal activity, and complications such as thrombophlebitis, hematoma and recanalization^[31, 49] ²⁵ ⁵ ^[50]. A 10-year follow-up with duplex ultrasound for **240 patients treated with 1470-nm diode laser with radial fibers** found a **stable and valuable long-term results.** ⁵ ^[37] **EVLA is the most cost-effective therapeutic option,** followed by **RFA, in patients** with incompetence of **the GSV**^[8]. RFA is used to ablate the truncal varicose vein above the knee, and cannot treat the varicose veins below knee that can be managed by EVLA. Therefore, EVLA can manage almost all the varicose veins both above and below the knee. RFA showed less pain, ecchymosis and hematomas, as well as provided better short-term quality of life^[50] ¹ ^[51].

A RCT comparing the **endovenous treatment of primary GSV in 159 patients, using RFA or 810 nm EVLT** showed complete occlusion (100%) by duplex ultrasound in both groups at 1 wk, 97% for RFA and 96% for EVLT at 3 mo follow-up. No significant adverse event was observed. RFA had less pain and bruising after procedure. Yet,

EVLA and RFA demonstrated comparable outcomes in terms of venous occlusion rates, and return to normal activities.

The common complication after EVLA are bruising (24-75%), thrombophlebitis (5%),² superficial vein thrombosis, DVT, hematomas and ecchymoses, skin burn, pigmentation, and nerve injury. Arteriovenous fistula has been reported after perforator ablation. The risk of nerve lesions increases when the endovenous treatment is carried out on the lower leg.

Sclerotherapy

Sclerotherapy is a less invasive percutaneous approach to administer sclerosants into the target veins^[36] that will be closed subsequently after immediate external pressure. Anesthesia is generally not required during sclerotherapy. Compression stockings or bandages should be applied immediately after sclerotherapy and patients should be encouraged to walk to reduce the complications of sclerotherapy.

Sclerotherapy is recommended to treat varicose tributaries or the incompetent saphenous vein^[9] and¹⁷ is considered cosmetic for treatment of veins less than 2.5 mm in diameter and for all other indications. As sclerotherapy alone has not been proven to be effective for treatment of SFJ or saphenopopliteal junctions reflux. Patients with reflux should be treated with endovenous ablation, or HL/S to reduce the risk of recurrence.

Currently available sclerosants include detergents(e.g.polidocanol, sodium morrhuate), osmotic agents, and chemical agents. No reliable evidence is available to support that one type of sclerosant is obviously better than any other. Instead of using sclerosant as a liquid, foam sclerotherapy(FS) is performed using mixed sclerosant with air (usually 1:4) with or without ultrasound guidance(UGFS), it is used primarily or in conjunction with other procedures with. The closure rate of veins with FS is higher (68%) than liquid sclerotherapy(17.5%) at 12 mo of follow-up^[52]. UGFS is¹ associated with a faster recovery and less postoperative pain compared with EVLA and surgical stripping. The

common complications are superficial venous thromboembolism, recurrence, hyperpigmentation, or telangiectasia matting, etc. Patients often complain of nodular or linear hardness along the varicose veins with tenderness. DVT, tissue necrosis or even arterial thrombosis have been observed after FS, especially with use of liquid sodium morrhuate.

GSV recanalization was highest in the UGFS group (51%) during 1 year of follow-up^[52].

A prospective RCT involving more than 580 Legs compared 4 treatments: EVLA, RFA, UGFS and surgical stripping for GSVs. UGFS was associated with a higher technical failure (16.3%) compared with other treatment ($p < 0.001$) at 5-year follow-up. A total of 288 Limbs of 233 patients were treated with UGFS, the mean follow-up interval was 37.8 mo. Occlusion was achieved for 89.6% of the incompetent veins in two sessions of UGFS. The internal diameters of the treated veins reduced to 66.9% at 3 mo and 32.7% at 12 mo. It is worthy to know that UGFS is unable to seal incompetent GSV segments completely and may be repeated several times in cases of recurrence^[53].

Mechanochemical endovenous ablation

Mechanochemical endovenous ablation (MOCA) was conducted in 2010 using the ClariVein device. A wire tip is introduced into the targeted veins and rotates to abrade the intimal layer of venous wall mechanically (3500 rpm), the liquid sclerosant is simultaneously injected into the damaged venous wall below the catheter tip to seal the veins. In 2016, National Institute For Health and Care Excellence issued interventional procedural guidance permitting the use of the MOCA for the treatment of varicose vein in the UK as a standard treatment.

The MOCA is a non-thermal-non-tumescent option (NTNT), and appears to be of similar efficacy with stab avulsion with no potential risk of nerve damage.

A recent multi-center randomized study comparing MOCA with RFA for truncal vein reflux demonstrated that MOCA was significantly less painful than RFA ($P = 0.003$).

There were no significant differences between MOCA and RFA for occlusion rates, clinical severity scores, or time to return to normal activities and adverse effects such as DVT, superficial thrombophlebitis^[54].

The anatomical closure rate of MOCA is higher²⁶ with 3% POL liquid than with 2% POL liquid at 6 mo follow-up. A multicenter RCA study showed that the technique success rate at 6 mo¹⁰ was 69.8% in 2%-group vs. 78.0% in 3%-group ($P = 0.027$). The overall closure rate was higher in GSVs < 5.9mm than in GSVs > 5.9mm (84.3% vs. 59.5%, $p < 0.001$). Regardless the concentration of sclerosant, the overall success rate of MOCA is lower than EVAL, RFA or HL/S^[54].

Cyanoacrylate Embolization

Cyanoacrylate embolization (CAE) is a novel endovascular NTNT ablation technique for treatment of incompetent truncal veins with *n*-butyl-2-cyanoacrylate (NBCA) glue^[55-57]. Multiple studies have showed the effective of CAE since its first use in 2013. Current available 2 techniques are the VenaSeal™ Closure System and the VariCloseR vein sealing systems^[55]. A catheter used is pulled back segmentally in former system or, continuously in latter technique. NBCA glue⁵ is an adhesive that rapidly polymerises during endovenous treatment to cause rapid occlusion of veins and initiate vein fibrosis.

In a review of 2910 patients (3220 veins) in 17 studies, 1981 were received NBCA, 445 RF, and 484 EVLA. Mean followed-up was 12.3 mo (1–36 mo). Two-year occlusion rates¹⁴ were 93.7, 90.9, and 91.5% for NBCA, RFA, and EVLA, respectively. ^[57] CAE had higher anatomic closure rates at 30 days than EVLA^[16]. Patients treated with CAE had less postoperative ecchymosis than those with RFA ($p < 0.01$). Pain during the procedure was comparable for both groups. Patients treated with NBCA had the least complications, e.g. bruising, phlebitis, and pain. ¹⁴ NBCA is simple to administer, safe, and effective even without compression stockings^[57].

However, complications of CAE treatment are phlebitis, cellulitis and DVT. The adhesive is presumably not degraded, remains in the vein over many years. In rare instances, cyanoacrylate glue embolisation can extravasate and cause chronic foreign body reaction necessitating surgical intervention.^[56, 57] ¹ A thread-like thrombus extension has been reported with the VenaSeal system, which resolved spontaneously without additional adjunctive treatment after 6 mo follow-up. ² Occlusion of the treated vein is incomplete with recanalization in the peripheral region after CAE. In this case, USFS can be used to achieve the complete occlusion of the veins. MOCA and CAE appear promising but evidence on their effectiveness is needed^[8].

CONCLUSION

⁵ Endovenous laser ablation (EVLA) is the most cost-effective therapeutic option, with radiofrequency ablation (RFA) a close second for the treatment of patients with varicose veins. Endovenous thermal ablation (EVLA or RFA) is recommended as first-line treatment for varicose veins and has substituted the high ligation of saphenofemoral junctional reflux and stripping of varicose veins. ⁶ The 2013 National Institute for Health and Care Excellence clinical guidelines recommend surgery as third-line therapeutic option after EVLA or RFA and sclerotherapy. In terms of recurrence of varicose veins, there is little or no difference between CHIVA and EVLA, RFA or stripping, respectively. Ultrasound guided foam sclerotherapy is associated with high recurrence rate and can be used in conjunction with other procedures. Mechanochemical endovenous ablation and cyanoacrylate embolization appear promising, but evidence on their effectiveness is required.

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