# Conversion of open varicose veins surgery unit into a modern one-stop shop endo-venous unit: strategies and cost-effectiveness

Mohammed Elkassaby[a], Ahmed Hassanin[b], Ahmed Elmallah[c]

[a]Faculty of Medicine, Mansoura University, Egypt, [b]Faculty of Medicine, Sohag University, Egypt, [c]Faculty of Medicine, El Menofia University, Egypt

Correspondence to Ahmed Elmallah, MD, FRCS, FEBVS, Mail: 64 Gamal Abdel Nasser street, Shebin El Kom, El Menofia, Egypt. Tel: +00353879012708; e-mail: asem1@yahoo.com

**Received:** 6 March 2023
**Revised:** 21 March 2023
**Accepted:** 3 April 2023
**Published:** 11 August 2023

**The Egyptian Journal of Surgery** 2023, 42:409–417

**Purpose**
to provide a road map for converting varicose veins service to endovenous ablation and assess its process and outcome on patients with varicose veins.
**Patients and methods**
Retrospective assessment of prospectively recorded data for converting vein unit which exclusively did open varicose veins surgery (OS) (39 patients from September 2019 to February 2020) to endovenous radiofrequency ablation (ERFA) service (44 patients from March 2020 to January 2021).
**Results**
There was no statistical difference in theatre time between both interventions despite dealing with more complex cases in the ERFA group with more truncal veins ($\chi^2$=11.950*, $P$<0.001*) and a higher number of stab avulsions (V number) ($\chi^2$=217.889, $P$<0.001*). On the other hand, the overall cost was significantly lower in open group compared to ERFA (Mean±SD 1261±386 US$ and 1519.2±392 US$ respectively, $P$<0.001*. This statistical difference was reduced to $P$=0.041 when subgroup analysis only included cases with higher number of avulsions. In multivariate analysis, cost was associated with surgical duration and using ERFA however, less complications were recorded in ERFA group ($\chi$2=4.419* $P$=0.036*) and recovery time was significantly longer in open group (8.90±2.44) than in ERFA group (6.0±1.06), $P$<0.001*
**Conclusion**
Converting varicose veins service to a modern ERFA is safe and effective when properly planned. ERFA is associated with shorter recovery and less theatre time and complications despite higher cost which becomes more cost-effective in cases with more truncal veins and avulsion sites.

**Keywords:**
endovenous unit, endovenous, radiofrequency, varicose veins

Egyptian J Surgery 42:409–417

1110-1121

## Introduction

Chronic venous disease of lower limbs is a very common condition, which affects nearly 25% of adults worldwide, with a higher incidence in developing countries compared to western ones. Even with mildest form of presentation, chronic venous disease can have a significant impact on patients' quality of life and functionality [1].

Treating varicose veins for either mere cosmetic benefits or alleviation of severe symptoms and treatment of extensive ulceration is a well-established part of vascular surgeons' daily practice, and may constitute up to 30% of the workload in a modern vascular surgery unit [2].

The advantages of endovenous ablation over OS for varicose veins are well established. Although success rates may be similar, endovenous interventions may provide quicker recovery and quicker return to work, with lower incidence of complication [3].

Unless the patient suffered from active skin ulceration, bleeding, or blood clotting in the veins, the condition is considered to be a very benign disease, with a very low risk of developing serious complications in the short term. Nevertheless, Patients with varicose veins usually suffer from pains, aches, and tiredness, in addition to being aesthetically concerning.

In most hospitals, varicose vein surgeries are carried out in the main hospital theatres, and frequently under general anaesthetic, which means that it would take a very precious theatre space and time that is often used to treat more urgent cases, or to perform surgeries for more complex conditions.

Despite the growing evidence that supports conversion of routine practice towards minimally invasive and

more cost-effective endovenous interventions, many vascular centres across the world seem to be reluctant to change their current practice. These trends may be related to slow learning curves, misconceptions about cost-effectiveness or lack of guidance.

***The aim of this work*** is to provide such step-by-step guidance to convert routine practice in any modern vascular unit from OS to Endovenous Radio-Frequency Ablation (ERFA) with practical tips and tricks, showing real life data on what results would be expected from such conversion on the patients and their recovery, the vascular unit, theatre time and set up, and overall cost.

## Patients and method

Relevant approval was obtained from the ethical committee, St. Columcille's Hospital, Dublin, Ireland. The study was designed retrospectively to evaluate a prospectively recorded varicose veins surgery service data in a level 2 hospital, St. Columcille's Hospital where varicose vein surgery was exclusively offered in the form of OS, to present a real world experience in setting up an endovenous service and re-evaluate the results of such conversions in terms of both patients' experience and cost-effectiveness.

### Setting up the endovenous service

It is important to be aware of where to start. There was an already established day case surgery unit. The service is public and patients are referred by general practitioner (GP) services covering about 500,000 populations.

To convert from OS to ERFA, the following modifications were addressed: Manpower, theatre setup, and Perioperative modification. The process of full conversion took 4 months to be completed in our centre.

**Manpower** includes training of the operating surgeon, assistant and nursing staff both scrubbed and circulating nurses. Operating surgeons would earn their training either during their training or in case of already qualified surgeons if not familial with procedure, they would need to either attend training sessions arranged by the manufacturing company and/or attend ERFA procedures at another institution with an already practicing colleague. This is important to start such a learning curve of ERFA. There is no set time or session episodes for such training however, previous knowledge of vascular ultrasound would help to develop such a learning process quicker even if an ultra-sonographer is planned to be helping. Once basic knowledge is achieved, starting to practice under the colleague's supervision in their already established ERFA operative room is the next step. The same would apply to operative assistance staff.

Nursing staff training is an essential step to establish ERFA service. While an already trained surgeon can depend on nursing staff training sessions arranged by the manufacturing company, attending and if possible scrubbing in ERFA cases in an already practicing institution is strongly recommended as there are certain details that won't be acquired through training sessions.

**Theatre setup** for ERFA does not require special operative room modifications as in endovenous laser ablation hence it got its popularity to be used even in a prepared office room. The following is needed as basic equipment: Radiofrequency ablation generator and ultrasound duplex with superficial vascular probe (3–5 mHz) are essential. Using a pump for Tumescent anaesthesia (TA) injection is strongly recommended. However, a 3-way valve connected to TA bag on one side, to a 20 ml lour lock syringe (with screw) on 2nd side and last tab is connected to a tube that is attached to a needle injecting TA into the patient can be used if pump is not available or in case the pump became broken while doing surgery.

The following basic kit is recommended to be on the instruments table: access needle, 7F Sheath, and dilator, short 0.035' guidewire, probe cover, sterile gel & tumescent tubing. There are a few extras that would make the procedure much smoother. This includes: an ultrasound Machine cover (so Surgeon can adjust controls and remain sterile), Microvascular access kit (to access smaller truncal veins), and 0.025 wire or 0.018 wire (which can be used if the RFA catheter cannot advance in a tortuous truncal vein). The last two are not required in all cases but should be available o room standby if needed.

**Perioperative modifications** include an already printed consent form specially designed for ERFA showing different risks, benefits and alternatives. A standard anaesthetist review is done if the procedure is under general anaesthesia. Day case staff should be oriented about the ERFA procedure to be able to communicate with patients and relatives in their simple questions and make sure that outpatient

medications and follow-up are arranged before discharge.

The first case of ERFA at the novice institution can start once everything is ready and training of both surgeon and nursing staff is achieved. Attendance of company representative in the first few weeks is essential. Attendance of a trained surgeon and nurses from the centre which hosted training is strongly recommended as non-scrubbed (for a session or two) but on standby to scrub in if needed.

While ERFA can be done under TA with or without oral sedation (5 mg diazepam oral 30 min to 1 h before surgery to reduce anxiety), general anaesthesia may be needed in the first few cases to make sure the learning curve of the newly trained staff is up to the proper level to allow the procedure to be done under TA to avoid hearing too much guidance around.

There are different formulas for TA. The main idea is to take off certain amount of normal saline bag then add 2% lidocaine with adrenaline and sodium bicarbonate (to reduce pain while injecting the solution as it neutralizes acidity of lidocaine). Calculation of toxic dose of local anaesthesia needs to be done for each patient individually so, TA should be prepared under surgeon guidance.

For cases when done under TA, a practical tip is to put a headphone on patient's ear to listen to whatever audio they like so, can dissociate them from noise and conversations in the operative room while allowing them to communicate their discomfort with the staff if they need to.

#### Patients' assessment

In the current Cohort, Patients were assessed in a dedicated vascular surgery outpatient clinic. History, comorbidities, and clinical examination were done and CEAP classification was recorded. For patients who were indicated for surgical intervention, a duplex ultrasound scan was arranged to define varicose veins anatomy and what would be the required surgery. Afterward, details of surgery including risks, benefits, and alternatives are discussed. To facilitate surgery duration calculation, an approximate number of needed stab avulsions was recorded as V number, and this was recorded beside the required truncal vein treatment. V1 is used when the number of avulsions is less than 10. V2 when 10-20 avulsions are anticipated and V3 if that was more than 20 sites.

Patients who had significant co-morbidities were referred to a preassessment clinic and optimized before they were cleared to proceed to surgery.

On surgery day, patients were admitted to the day surgical ward and seen by an anaesthetist. In this study, patients were stratified into 2 main categories for either OS or ERFA according to the time period before and after the introduction of ERFA and setting up the endovenous unit.

#### Surgical interventions

From September 2019 to February 2020 all patients had open surgical interventions exclusively. Afterward, ERFA was fully established in the unit. From March 2020 to January 2021, all patients had ERFA subject to inclusion criteria: primary varicosities with incompetent truncal vein(s). Secondary and redo varicose veins were excluded from the study. The device used was ClosureFast$^{TM}$ RFA System, Medtronic. The was a temporary halt of varicose veins service from mid-March 2020 to early May 2020 because of the 1st wave of Covid 19 Pandemic.

Patients in both groups had their surgery under general anaesthesia (GA). The rationale of using GA for ERFA for the first 6 months was to support the evolving unit practice till achieving full competency as explained above. ERFA patients had TA in form of: NACL 0.9% (470 ml), 2% Xylocaine with Adrenaline 1: 200,000 (25 ml), Sodium Bicarbonate 8.4% (5 ml).

Surgery times were recorded excluding anaesthesia and recovery time. In OS, junctional ligation and vein stripping were recorded. For ERFA, number of truncal veins and number of treated segments were recorded. Afterward, multiple stab avulsions were done in the same session using stab knife and Varady vein hook. Steri-strips were used to close stab wounds and waterproof dressing were applied then high thigh class II stocking is applied before applying wool and crepe bandage over stocking. Patient was sent to recovery then back to day ward and was sent home on same day after post-operative instructions are given.

#### Cost analysis

Cost was calculated for surgical intervention part only without calculating any preoperative assessment or postoperative follow-up as these were identical in both groups. Cost was based on theatre usage (980USD per hour) according to hospital records + the cost of consumables. That was 149USD for OS (132.5USD consumables (e.g. vein stripper) +16.5USD reserialization of reusable instruments) versus 395USD for radiofrequency consumables (350USD radiofrequency catheter + 28.5US$ for full procedure pack+ 16.5USD reserialization of reusable instruments). Radiofrequency generator and pump were available at no extra cost based on a business

case deal with the manufacturing company for facilitating that based on doing certain minimum of ERFA cases per year. Ultrasound device was already available in Theatre before conversion process.

#### Follow-up

Patients from both groups were seen at outpatient department routinely 6 weeks' post-surgery. Clinical exam was done, and any complication was recorded. Duplex ultrasound scan was arranged only if a complication was suspected such as DVT or failure of ERFA. Afterward, patient was discharged should there is no complications and no follow-up was needed for any other vascular condition.

#### Statistical analysis of the data

Data were fed to the computer and analysed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Categorical data were represented as numbers and percentages. Chi-square test was applied to compare between two groups. Alternatively, Fisher Exact or Monte Carlo correction test was applied when more than 20% of the cells have expected count less than 5. For continuous data, they were tested for normality by the Shapiro-Wilk test. Quantitative data were expressed as range (minimum and maximum), mean, standard deviation and median. Student t-test was used to compare two groups for normally distributed quantitative variables. On the other hand, Mann Whitney test was used to compare two groups for not normally distributed quantitative variables. Linear Regression was used to detect the most affecting factor for affecting estimated cost. Significance of the obtained results was judged at the 5% level.

## Results

The study included 39 patients in open group and 44 patients in ERFA group. Age, Male to female ratio, Surgery side & ASA grade were comparable in both groups with no statistical significance (Table 1).

In Table 2, specific characteristics of venous disease and required surgery was compared in both groups. There was no statistical significance apart from the higher number of V1 in OS group and higher number of cases who required more than one truncal vein treatment in ERFA group, mainly anterior thigh vein (ATV), $P$=0.012*. So, cases treated by ERFA were more complex compared to OS.

It is expected that cost will increase according to surgical time which is affected by number or treated truncal vein as well as number of avulsions needed (V number). To assess that, Patients were further divided into 3 groups accorded to the treated saphenous system as in Table 3. Most patients were in group A where long saphenous vein system were treated which included treating greater saphenous and or anterior thigh vein.

In Table 4, there was no statistical difference in surgery time between the 3 groups when OS is compared to ERFA. However, when cost was compared, Group A ERFA cost (1454±356US$) was significantly higher than open group (1290±391US$). The difference in cost was similar in group B without reaching statistical significance however, the in group C, ERFA was marginally cheaper than open group despite not statistically tested due to small number of cases in open group. The overall cost of ERFA cases was of high statistical significance compared to OS, P<0.001

**Table 1 Comparison between the two studied groups according to demographic data**

| | Open procedures ($n$=39) | ERFA ($n$=44) | Test of Sig. | $P$ |
|---|---|---|---|---|
| Age | | | | |
| Mean±SD. | 46.95±8.95 | 47.68±11.59 | $t$=0.319 | 0.750 |
| Median (Min.–Max.) | 45.0 (32.0–72.0) | 47.50 (21.0–72.0) | | |
| Sex | | | | |
| Male | 13 (33.3%) | 18 (40.9%) | $\chi^2$=0.507 | 0.476 |
| Female | 26 (66.7%) | 26 (59.1%) | | |
| Comorbidities | 19 (48.7%) | 26 (59.1%) | $\chi^2$=0.896 | 0.344 |
| ASA Grade | | | | |
| I | 19 (48.7%) | 17 (38.6%) | | |
| II | 20 (51.3%) | 25 (56.8%) | $\chi^2$=2.009 | $^{MC}P$=0.421 |
| III | 0 (0.0%) | 2 (4.5%) | | |
| Right | 17 (43.6%) | 19 (43.2%) | $\chi^2$=0.001 | 0.970 |
| Left | 22 (56.4%) | 25 (56.8%) | | |

$\chi^2$, **Chi square test**; MC, **Monte Carlo**; $P$, $P$ value for comparing between the **Open** and **Endovenous**; SD, **Standard** deviation; **t**, **Student *t*-test**.

**Table 2 Comparison between the two studied groups according to venous disease**

| | Open procedures (*n*=39) | Endovenous procedures (*n*=44) | $\chi^2$ | *P* |
|---|---|---|---|---|
| CEAP classification | | | | |
| 2 | 8 (20.5%) | 9 (20.5%) | | |
| 3 | 20 (51.3%) | 23 (52.3%) | | |
| 4a | 8 (20.5%) | 8 (18.2%) | 1.804 | $^{MC}P$=0.996 |
| 4b | 2 (5.1%) | 1 (2.3%) | | |
| 5 | 1 (2.6%) | 2 (4.5%) | | |
| 6 | 0 (0.0%) | 1 (2.3%) | | |
| V Number | | | | |
| V1 | 16 (41.0%) | 3 (6.8%) | | |
| V2 | 18 (46.2%) | 21 (47.7%) | 17.889* | <0.001* |
| V3 | 5 (12.8%) | 20 (45.5%) | | |
| Number of truncal veins treated | | | | |
| One vein | 38 (97.4%) | 30 (68.2%) | 11.950* | <0.001* |
| Two veins | 1 (2.6%) | 14 (31.8%) | | |
| GSV | 29 (74.4%) | 36 (81.8%) | 0.677 | 0.411 |
| ATV | 3 (7.7%) | 13 (29.5%) | 6.345* | 0.012* |
| SSV | 6 (15.4%) | 10 (22.7%) | 0.716 | 0.397 |

$\chi^2$, **Chi square test**; **ATV**, Anterior thigh vein; **GSV**, Greater saphenous vein; MC, **Monte Carlo**; *P*, *P* value. *: Statistically significant at $P \leq 0.05$. **SSV**, Short saphenous vein.

**Table 3 Descriptive operative interventions done**

| | Open procedures (*n*=39) | Endovenous procedures (*n*=44) |
|---|---|---|
| Group A | 31 (79.5%) | 33 (75.0%) |
| Group B | 7 (17.9%) | 3 (6.8%) |
| Group C | 1 (2.6%) | 8 (18.2%) |

**Group A:** Long saphenous vein disease group. **Group B**: Short saphenous vein disease group. **Group C:** Long and short saphenous disease group.

There was no mortality in either group. Complications were few and minor in both groups. Immediate complications in ERFA group were 3 minor anaesthetic complications (bradycardia, laryngeal spasm post-operative). Bleeding was minor and was related to stab avulsion sites and was managed by reapplying compression bandage. There was only one case who had superficial femoral vein DVT and asymptomatic minor PE (same patient) in the open group. Other complications were statistically higher in open group (*P*=0.036) but remained minor and non-required admission or return to theatre (3 residual thigh numbness at 6 weeks, 3 small groin haematoma 2 groin scar pain, and 1 delayed groin healing due to stitch sinus which eventually healed when stitch was removed in outpatient clinic. Recovery was defined as ability to resume routine daily activities and work postoperatively, ERFA was associated with a significantly shorter recovery compared to OS Table 4.

Table 5 showed that number of avulsion sites (V number) was not associated with statistical difference in cost except when V2 & V3 were combined (avulsions number more than 15, representing more extensive varicosities), *P* value=0.041.

To identify factors affecting cost, Uni, and multivariate analysis were done and included all potential factors (Table 6). It was found that more extensive varicosities either in multiple truncal veins and more extensive varicosities were associated with higher cost in both open and ERFA groups however, multivariate analysis confirmed ERFA and duration of surgery were the most contributing factors towards cost when compared to OS.

## Discussion

All public-access healthcare systems are currently under huge pressure in terms of waiting lists for elective procedures. This is a long-standing problem that has been furtherly worsened by the recent COVID pandemic, and the cancellation of almost all elective procedures. Long waiters pose a huge burden on the system in terms of both economic impact and patient satisfaction levels [4].

Varicose veins disease is a very clear example of this problem. It is by far the vascular condition with the longest waiting times to see a specialist and to have an elective procedure done. Unsurprisingly, it is also one of the most litigated procedures worldwide, representing nearly 50% of all successful medical litigations in the UK for example [4].

**Table 4 Comparison between the two studied groups according to different parameters**

| | Open procedures | ERFA | Test of Sig. | *P* |
|---|---|---|---|---|
| Surgery duration | | | | |
| Group A | (*n*=31) | (*n*=33) | | |
| Mean±SD. | 70.6±23.95 | 65.2±21.5 | U=423.5 | 0.235 |
| Median (Min. – Max.) | 70 (30–145) | 65 (35–145) | | |
| Group B | (*n*=7) | (*n*=3) | | |
| Mean±SD. | 52.14±13.18 | 55.0±8.66 | U=10.0 | 1.000 |
| Median (Min. – Max.) | 55 (30–65) | 60 (45–60) | | |
| Group C | (*n*=1[#]) | (*n*=8) | | |
| Mean±SD. | 108[#] | 91.9±22 | – | – |
| Median (Min. – Max.) | | 87.5 (65–125) | | |
| Overall | (*n*=39) | (*n*=44) | | |
| Mean±SD. | 68.3±23.96 | 69.32±23.44 | U=851.0 | 0.949 |
| Median (Min. – Max.) | 65 (30–145) | 65 (35–145) | | |
| Estimated cost in US$ | | | | |
| Group A | (*n*=31) | (*n*=33) | | |
| Mean±SD. | 1290±391 | 1454±356 | U=349.5* | **0.029*** |
| Median (Min. – Max.) | 1292 (639–2518) | 1456 (966–2763) | | |
| Group B | (*n*=7) | (*n*=3) | | |
| Mean±SD. | 1036±197 | 1233±244 | U=6.000 | 0.383 |
| Median (Min. – Max.) | 1048 (639–1210) | 1374 (951–1374) | | |
| Group C | **(*n*=1[#])** | **(*n*=8)** | | |
| Mean±SD. | 1945[#] | 1896±359 | – | – |
| Median (Min. – Max.) | | 1828 (1456–2436) | | |
| **Overall** | **(*n*=39)** | **(*n*=44)** | | |
| Mean±SD. | 1261±386 | 1519.2±392 | U=486.5* | **0.001*** |
| Median (Min. – Max.) | 1210 (639–2518) | 1456 (951–2763) | | |
| **Immediate complications** | 0 (0%) | 3 (6.8%) | $\chi^2$=2.759 | $^{FE}P$=0.244 |
| **DVT** | 1 (2.6%) | 0 (0%) | $\chi^2$=1.142 | $^{FE}P$=0.470 |
| **PE** | 1 (2.6%) | 0 (0%) | $\chi^2$=1.142 | $^{FE}P$=0.470 |
| **Bleeding** | 3 (7.7%) | 2 (4.5%) | $\chi^2$=0.362 | $^{FE}P$=0.662 |
| **Any other complications** | 9 (23.1%) | 3 (6.8%) | $\chi^2$=4.419* | 0.036* |
| **Recovery in days** | **(*n*=39)** | **(*n*=44)** | | |
| Mean±SD. | 8.90±2.44 | 6.0±1.06 | U=161.5* | <**0.001*** |
| Median (Min. – Max.) | 8 (6–15) | 6 (5–10) | | |

$\chi^2$, **Chi square test**; FE, **Fisher Exact**; *P*, *P* value for comparing between the **Open** and **ERFA**; SD, **Standard deviation**; U, **Mann Whitney test**. #: Excluded from the comparison due to small number of case (*n*=1). *: Statistically significant at $P \leq 0.05$.

**Table 5 Comparison between the two studied groups according to estimated cost in each V number**

| Estimated cost | Open procedures | Endovenous procedures | U | *P* |
|---|---|---|---|---|
| V1 | (*n*=16) | (*n*=3) | | |
| Mean±SD. | 1058±366 | 1129±216 | 19.0 | 0.634 |
| Median (Min. – Max.) | 1048 (639–2109) | 1048 (966–1374) | | |
| V2 | (*n*=18) | (*n*=21) | | |
| Mean±SD. | 1347±264 | 1394±234 | 151.0 | 0.294 |
| Median (Min. – Max.) | 1293 (1047–1945) | 1456 (951–1710) | | |
| V3 | (*n*=5) | (*n*=20) | | |
| Mean±SD. | 1603±521 | 1709±454 | 39.5 | 0.488 |
| Median (Min. – Max.) | 1374 (1292–2518) | 1579 (1115–2763) | | |
| V2+V3 | (*n*=23) | (*n*=41) | | |
| Mean±SD. | 1402±339 | 1548±388 | 326.0* | **0.041*** |
| Median (Min.–Max.) | 1293 (1047–2518) | 1538 (951–2763) | | |

*P*, *P* value; SD, **Standard** deviation; U, **Mann Whitney test**. *: Statistically significant at $P \leq 0.05$.

There are scarce reports in the literature describing the process of change from OS to an efficient endovenous ablation service, hence the importance of this section in our study. We present the transition to a dedicated endovenous ablation service in order to facilitate the next step, which is the ultimate goal of having an

**Table 6 Univariate and Multivariate Linear Regression analysis for the parameters affecting estimated cost**

| | Univariate | | Multivariate | |
|---|---|---|---|---|
| | *P* | B (LL-UL 95% C.I) | *P* | B (LL-UL 95% C.I) |
| CEAP classification | 0.788 | −14.88 (−124.4–94.67) | | |
| V Number | <0.001* | 309.8 (206.7–412.8) | 0.151 | −16.48 (−39.10–6.13) |
| Number of truncal veins treated | <0.001* | 596.6 (404.5–788.6) | 0.447 | 20.69 (−33.20–74.59) |
| GSV | 0.012* | 268.9 (59.68–478.2) | 0.446 | −16.56 (−59.62–26.51) |
| ATV | <0.001* | 476.6 (275.2–678.0) | 0.781 | −5.91 (−48.06–36.25) |
| SSV | 0.498 | 77.62 (−149.0–304.2) | | |
| Group A | 0.339 | −102.5 (−314.7–109.7) | | |
| Group B | 0.011* | −344.6 (−609.2–−79.89) | 0.954 | 1.55 (−52.27–55.37) |
| Group C | <0.001* | 564.9 (304.9–824.8) | 0.833 | 6.22 (−52.50–64.94) |
| Endovenous procedures | 0.003* | 258.2 (87.86–428.5) | <0.001* | 247.4 (215.7–279.2) |
| Surgery duration | <0.001* | 16.385 (15.14–17.629) | <0.001* | 16.44 (15.70–17.17) |

B, Unstandardized Coefficients; C.I, Confidence interval; LL, Lower limit; UL: Upper Limit. *: Statistically significant at $P \leq 0.05$.

office-based one-stop-shop service as reported recently in the UK health system [5]. This would lead to more cost-effective and timely service offerings.

Fine tweaks like the use of headphones aimed at distracting the patients from concentrating on pain with local anaesthetic are not entirely new but very effective and often overlooked. A recent study [6] went a step further by using virtual reality googles to alleviate anxiety and completely disconnect the patients from the operating environment. Although very successful, this might add significant cost currently and might not be easily available in every hospital.

Although compression is not necessary after endovenous ablation as shown by a recent meta-analysis [7], there is still a marginal benefit of reducing post operative pain, which facilitates patients' early discharge on a day-case base as reported in some randomized controlled studies [7,8].

A crucial advantage of endovenous ablation service over OS is the absence of need for follow up in the vascular clinic, or the need for routine follow up duplex scans except in very selected patients where Endothermal Heat induced Thrombosis or other significant complications are suspected during routine follow-up by the general practitioner as shown in very recent reports [9–11].

Our cost analysis only looked at the direct operative cost but did not include indirect costs related to hospital admissions and work absenteeism, which would have added to the superiority of endovenous ablation when compared to OS as shown in various studies [12,13]. Even with these limitations, endovenous ablation showed relative cost reduction, especially when performed for patients with more truncal varicosities and in presence of extensive avulsions that would extend the procedural time.

**Propositions to improve the service:**

In order to improve the varicose vein surgery service, there is a wide array of tools that could be used. In order to fix this health service, we must apply three important concepts at three parts of the service circle. The three concepts are:

*Evidence based medicine*

Any change in practice must be based on rigorous data from trusted published research and international guidelines. Current practice has changed from OS under general anaesthetic, to office based keyhole interventions under local anaesthetic. This has dramatically improved operating time, cost and recovery time required after surgery. Success rates are still equivalent to old standard open surgeries [14].

*Trial and error*

The improvement of healthcare service is a continuous and dynamic process. The application of theoretical improvements must be followed with data collection, feedback, and readjustment according to results. In this case, a clear example is to try and see if the scans are more efficiently performed by a radiology technician or the vascular specialist in terms of time, accuracy, relevance and cost effectiveness.

*Audit, application of quality improvement interventions then re-audit*

Collection of every day practice data are very essential for service improvement. Feedback from doctors, nurses and patients are equally important. Patient satisfaction levels are easily judged using short questionnaire forms. Doctors and nursing staff feedback is usually gathered during regular

departmental meetings. Data related to procedures numbers, quality, success and complications are discussed in monthly morbidity and mortality meetings.

#### Quality improvement interventions can be introduced at these three levels of the service

*First point of contact*

General practitioners are the first health care professionals to meet a patient with a possible complaint of varicose vein disease. It is very important to differentiate between a patient with varicose vein related symptoms, and another with varicose vein similar symptoms that are originating from another disease like osteoarthritis [15].

Also not all patients with varicose veins disease require the attention of a vascular surgery specialist. Conservative treatment methods, including compression stockings are completely acceptable alternatives, and could be prescribed and followed up at primary healthcare levels by general practitioners [16].

Continuous medical education for general practitioners is essential to avoid unnecessary referrals to specialists. It is quite easy to filter more than 50% of these referrals at this level. This will hugely impact waiting times and will help avoid patient frustration.

*Dedicated venous disease unit*

The concept of '***A hospital within the hospital***' could be applied here very efficiently. A one-stop varicose vein surgical unit is not an entirely new concept. Some public hospitals and many private clinics have a similar setting, where outpatient clinics, imaging duplex scan facilities, and dedicated operating theatre are all combined in a single unit or building. The result of dedicated vascular specialist time and imaging technician is a very efficient process and a very short time interval from first review to surgery decision-making.

Dedicated surgical theatre will allow smooth flow of procedures, where surgery is almost always performed under local anaesthetic and light sedation using laser or radiofrequency ablation techniques [17].

*Closing the circuit*

In our study, follow up after varicose vein surgery was in most cases very straightforward. The patient is given clear instructions after surgery. An information leaflet is also advised to be given. The patient is educated about the warning symptoms and when to seek urgent medical attention after surgery for fear of development of complications. These are quite rare. A visit to the local general practitioner can also resolve most of post procedure concerns. Any concerns raised are then dealt with by booking the patient to be seen again by the vascular surgery specialist. This protocol will also eliminate more than 90% of the post-procedure routine visits, as complication rates for this procedure are well less than 5% [18].

## Conclusion

Conversion of varicose veins service from OS to minimally invasive endovenous interventions is safe and effective if planned for according to individual institution resources and challenges. It is a multilevel process that requires looking at the modification of all aspects of patient care. ERFA is associated with shorter recovery and less theatre time and complications despite the higher cost which becomes more cost-effective in cases with more truncal veins and avulsion sites to be treated.

#### Financial support and sponsorship

Nil.

#### Conflicts of interest

There are no conflicts of interest.

## References

1 Kemp MT, Obi AT, Henke PK, Wakefield TW. A narrative review on the epidemiology, prevention, and treatment of venous thromboembolic events in the context of chronic venous disease. J Vasc Surg Venous Lymphat Disord 2021; 9:1557–1567.

2 Epstein D, Bootun R, Diop M, Ortega-Ortega M, Lane TRA, Davies AH. Cost-effectiveness analysis of current varicose veins treatments. J Vasc Surg Venous Lymphat Disord 2022; 10:504–513. e7. doi: 10.1016/j.jvsv.2021.05.014. Epub 2021 Aug 25. PMID: 34450353

3 Siribumrungwong B, Noorit P, Wilasrusmee C, Attia J, Thakkinstian A. A systematic review and meta-analysis F of S randomised S controlled S trials S comparing S endovenous S ablation and surgical intervention in patients with varicose vein. Eur J Vasc Endovasc Surg 2012; 44:214–23. doi: 10.1016/j.ejvs.2012.05.017. Epub 2012 Jun 15. PMID: 22705163

4 Markides GA., Subar D, Al-Khaffaf H. Litigation claims in vascular surgery in the United Kingdom's NHS. Eur J Vasc Endovasc Surg 2008; 36:452–457. doi: 10.1016/j.ejvs.2008.06.018

5 Somasundaram SK, Weerasekera A, Worku D, Balasubramanian RK, Lister D, Valenti D, *et al.* Office based endovenous radiofrequency ablation of truncal veins: a case for moving varicose vein treatment out of operating theatres. Eur J Vasc Endovasc Surg 2019; 58:410–414. doi: 10.1016/j.ejvs.2019.05.020. Epub 2019 Jul 24. PMID: 31351830

6 Brewer MB, Lau DL, Chu EA, Millan AT, Lee JT. Virtual reality can reduce anxiety during office-based great saphenous vein radiofrequency ablation. J Vasc Surg Venous Lymphat Disord 2021; 9:1222–1225. 2213-333X https://doi.org/10.1016/j.jvsv.2020.12.081

7 Hu H, Wang J, Wu Z, Liu Y, Ma Y, Zhao J. No benefit of wearing compression stockings after endovenous thermal ablation of varicose veins: a systematic review and meta-analysis. Eur J Vasc Endovasc Surg 2022; 63:103–111. doi: 10.1016/j.ejvs.2021.09.034. Epub 2021 Nov 11. PMID: 34776296

8 Onwudike M, Abbas K, Thompson P, McElvenny DM. Editor's choice-role of compression after radiofrequency ablation of varicose veins: a randomised controlled trial*. Eur J Vasc Endovasc Surg 2020;

60:108–117. doi: 10.1016/j.ejvs.2020.03.014. Epub 2020 Apr 8. PMID: 32278637

**9** Woodhouse E, DiMusto P. Outcomes of a single-center experience in eliminating routine postoperative duplex ultrasound following endovenous ablation. J Vasc Surg 2022; 07:128. DOI:https://doi.org/10.1016/j.jvs.2022.07.128

**10** Suarez LB, Alnahhal KI, Salehi PA, King EG, O'Donnell TFJr, Iafrati MD. A systematic review of routine post operative screening duplex ultrasound after thermal and non-thermal endovenous ablation. J Vasc Surg Venous Lymphat Disord 2023; 11(1):193–200. S2213-333X(22) 00321-3. doi: 10.1016/j.jvsv.2022.06.006. Epub ahead of print. PMID: 35940446

**11** O'Banion LA, Siada S, Cutler B, Kochubey M, Collins T, Ali A, *et al.* Thrombotic complications after radiofrequency and cyanoacrylate endovenous ablation: Outcomes of a multicenter real-world experience. J Vasc Surg Venous Lymphat Disord 2022; 10:1221–1228. IS SN 2213-333X https://doi.org/10.1016/j.jvsv.2022.05.009

**12** Lin JC, Nerenz DR, Migliore P, Young R, Shepard AD, Weaver WD. Cost analysis of endovenous catheter ablation versus surgical stripping for treatment of superficial venous insufficiency and varicose vein disease. J Vasc Surg Venous Lymphat Disord 2014; 2:98–103. doi: 10.1016/j.jvsv.2013.08.005. Epub 2013 Oct 25. PMID: 26992979

**13** Butt A, Kopriva D. Economic implications of endovenous great saphenous ablation in a public health care system. J Vasc Surg Venous Lymphat Disord 2018; 6:471–476. e6. doi: 10.1016/j.jvsv.2017.12.055. Epub 2018 Mar 27. PMID: 29602759

**14** Hartmann K, Stenger D, Hartmann M, Rafi-Stenger L. [Endovenous ablation versus open surgery for varicose veins: An attempt at an evaluation]. Hautarzt 2017; 68:603–613. doi: 10.1007/s00105-017-3996-2

**15** Piazza G. Varicose Veins. Circulation 2014; 130:582–587. doi: 10.1161/CIRCULATIONAHA.113.008331

**16** Lim CS, Davies AH. Graduated compression stockings. Can Med Assoc J 2014; 186:E391–E398. 2014/03/03. doi: 10.1503/cmaj.131281

**17** Pavlović MD, Schuller-Petrović S, Pichot O, Rabe E, Maurins U, Morrison N, Pannier F. Guidelines of the First International Consensus Conference on Endovenous Thermal Ablation for Varicose Vein Disease-ETAV Consensus Meeting 2012. Phlebology 2014; 30:257–273. doi: 10.1177/0268355514524568

**18** Joh JH, Kim W-S, Jung IM, Park K-H, Lee T, Kang JM, and Consensus Working Group. Consensus for the treatment of varicose vein with radiofrequency ablation. Vasc Specialist Int 2014; 30:105–112.