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Age is not a barrier to good outcomes following ambulatory high ligation and stripping for varicose veins

A prospective cohort study

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Abstract

This was a prospective cohort study with a short-term follow-up. To explore whether age is a factor in the prognosis following high ligation and stripping (HLS) performed in an ambulatory care center. This study included 170 patients who underwent their first HLS for varicose veins in an ambulatory center from November 2016 to October 2017 at West China Hospital. The patients were categorized as two groups: the ≤60 years old group and the >60 years old group. We collected the two age groups data included Clinical, Etiology, Anatomy, and Pathophysiology (CEAP) classification, Venous Clinical Severity Score (VCSS), Visual Analogue Score (VAS), Aberdeen Varicose Veins Questionnaire (AVVQ), Quality of Recovery (QoR-15), and postoperative complications at predetermined time points. The clinical correlation between age and prognosis following HLS in an ambulatory care center was prospectively studied after adjusting for potential confounders. The distribution of age and prognosis were also compared in the AVVQ improvement and VCSS improvement of patients at 6 weeks and 6 months after surgery. Our research comprised a total of 170 patients (236 limbs), of which 86 (50.6%) patients were female and 66 (38.8%) patients received bilateral procedures. After multivariable risk adjustment for potential confounding factors, we observed that age was not associated with the improvement of AVVQ (OR 0.3, 95%CI (1.3, 0.7), $P = .54$) and VCSS (OR 0.2, 95%CI (0.2, 0.6) $P = .38$) at 6 months after HLS, as well as AVVQ (OR 0.5,95%CI (1.2, 2.2), $P = .57$) at 6 weeks after HLS. However, at 6 weeks after HLS, age was related to the improvement of VCSS (OR −0.6, 95%CI (1.2, 0.1), $P = .03$), with the >60 years old group having a lower VCSS improvement compared to the 60 years old group. In postoperative complications, there were no significant differences in terms of complications between the two age groups (all P value >.05). Therefore, in our opinion, age is not a barrier for good outcomes following HLS in an ambulatory care center.

Abbreviations: AVVQ = aberdeen varicose veins questionnaire, BMI = body mass index, CEAP = clinical etiology anatomy and pathophysiology, CI = confidence interval, DVT = deep vein thrombosis, GSV = great saphenous vein, HADS = hospital anxiety and depression scale, HLS = high ligation and stripping, OR = odds ratios, PI = P value for interaction, QoR15 = quality of recovery, VAS = visual analogue score, VCSS = venous clinical severity score.

Keywords: age, ambulatory surgery, great saphenous vein, high ligation and stripping, prospective cohort study

1. Introduction

Varicose veins disease is the most commonly treated disease in vascular surgery. The adult morbidity rate is 25% to 40%.[1,2] Though radiofrequency ablation or laser closure are currently recommended as the preferred methods for treating varicose veins,[3–5] these endovascular interventions have the disadvantages of being very expensive, covered only partially by medical insurance, and being ineffective for severely distorted veins. In comparison, High Ligation and Stripping (HLS), a classic procedure, still remains most commonly used for the treatment of varicose veins in developing countries.[6] In addition, HLS is also the best choice for patients with aneurysmal degeneration of veins or severely distorted veins.

At present, there are many reports on HLS performed in ambulatory surgery centers,[7–9] which have been found to be just as safe and feasible as HLS performed in hospitals. Furthermore, HLS performed in an ambulatory care center has several advantages: lower costs, quicker recovery, improved patient satisfaction and comfort, and much shorter hospitalization time.[7,10–14]

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However, while most of the studies have focused on demonstrating the safety and efficacy of HLS performed in ambulatory care, few reports have examined whether age is related to their prognosis. The effects of age on the outcome of HLS in an ambulatory center remain unclear. This study has analyzed the effect of age on the prognosis of HLS performed in ambulatory care. Our hypothesis was age had no effect on the prognosis of HLS performed in the ambulatory center.

2. Methods

2.1. Data source

Our research protocol was approved by the local Committee and all patients provided written informed consent. A prospective cohort study was performed with 170 eligible patients who underwent their first HLS for varicose veins in an ambulatory center from November 2016 to October 2017 in West China Hospital. We included patients with C2-4 classes of venous disease (advanced CEAP classification), less than 85 years old, diagnosed with varicose veins by ultrasound, and willing to sign an informed consent. Patients who met the following criteria were included in our study. Patients with any of the following criteria were excluded from this study:

1. Great saphenous varicose vein recurrence;
2. Secondary varicose veins (post-thrombotic syndrome);
3. Small saphenous varicose veins;
4. Acute deep vein thrombosis;
5. Superficial phlebitis;
6. Separate traffic branch varicose veins;
7. Varicose veins from trauma;
8. Severe comorbidity.

The patients were categorized as 2 groups: the $\leq$60 years old group and the $>$60 years old group.[15] We collected data before surgery and during postoperative follow-up visits using the Venous Clinical Severity Score (VCSS),[16] the Aberdeen Varicose Veins Questionnaire (AVVQ),[17] and the Clinical, Etiology, Anatomy and Pathophysiology (CEAP) classification.[18] Quality of life was assessed before and after the procedure according to the Visual Analogue Score (VAS)[19] and Quality of Recovery (QoR-15).[20] Improvement of VCSS and AVVQ were demonstrated using high to low scores. The improvement of VCSS and AVVQ were our primary endpoints. Incidences of systemic and leg-specific complications in both groups were our secondary endpoints and were recorded at 6 weeks and 6 months post-procedure. All outcomes were assessed by the same physician.

2.2. Surgical procedure

The standard HLS procedure was performed under general anesthesia by the same group of surgeons. The micro-incisions (2–3 cm) were made parallel to the dermatoglyphics with a proximal oblique incision in the groin and a distal transverse incision in the medial malleolus, when deemed necessary (i.e., when the great saphenous vein (GSV) was dilated with severe reflux all the way distally). The trunk and tributaries were systematically and thoroughly treated by ligation. A standard stripper was inserted in the GSV and the vein was stripped from the top down to just below the knee. Another stripper was inserted in the distal transverse incision of the GSV in the medial malleolus and the vein was stripped from the bottom upward to near the knee, when deemed necessary (i.e., when the GSV was dilated with severe reflux all the way distally). When indicated, phlebectomy of the marked varicose branches and ligation of the grossly incompetent perforators were performed simultaneously. The groin and distal incisions were closed by an intradermal continuous suture (Monocryl@ 5/0, Ethicon, Johnson & Johnson, Neuchâtel, Switzerland). After the procedure, the leg was wrapped in sterile absorbent bandages and covered with a single-layer elastic bandage. After 48 hours, the patient could remove the bandage and a Class II (30 mmHg) below-knee elastic stocking was used for three months during the daytime only.

2.3. Follow-up

Follow-up was performed at the sixth week and sixth month after the operation and included checking for postoperative complications (Systemic and leg-specific complications), CEAP class, VCSS score, AVVQ score, VAS score, and QOR-15 score. Follow-up methods included out-patient visits, interviews by telephone and email, as well as online forums.

2.4. Statistical analysis

We first described the clinical characteristics of the patients in Table 1. Univariate analysis, stratified analysis and multivariate logistic regression analysis were performed to detect the risk variables associated with the age group and the improvement of VCSS, as well as AVVQ, at 6 weeks and 6 months after surgery (Tables 2–4). The relationship between age and the improvement of AVVQ and VCCS at 6 weeks and 6 months after surgery was analyzed by Pearson's test (Figs. 1 and 2). A P value of $<.05$ was defined as statistically significant. All data were double entered and then exported to tab-delimited text files. All the analysis was performed with R (http://www.R-project.org) and EmpowerStats software (www.empowerstats.com, X&Y solutions, Boston, MA)

3. Results

A total of 170 ambulatory HLS procedures were performed from January 2016 to December 2017 and all patients have completed the follow-up. The mean age of the patients was 53.87 years old (53.87 ± 9.96, 24–80 years old), 50.6% (86) of the patients were women, and 66 (38.8%) patients received bilateral procedures (Table 1). Bilateral limb involvement was found more frequently in the $>$60 years old group of patients compared with the $\leq$60 years old group (32.5% vs 56.8%; $P=.004$). In addition, hypertension and diabetes were also more common in the $>$60 years old group (6.8% vs 0.8%, $P=.023$; 20.5% vs 8.7%, $P=.04$). Apart from these three factors, there were no noticeable differences in the basic characteristics of the age groups (Table 1).

The univariate regression analysis showed that the improvement of AVVQ at 6 weeks after surgery was significantly correlated with bilateral limbs (OR 4.6, 95%CI(1.9,7.2) $P<.001$) and CEAP classification 4 (OR 0.36,95%CI(0.7,6.5) $P=.02$), meanwhile the improvement of AVVQ at 6 months after surgery was significantly correlated with bilateral limbs (OR 4.6,95%CI(2.2,6.9) $P<.001$). In addition, CEAP classification 4 (OR 3.1,95%CI (0.5,5.7) $P=.02$) and Preoperative QOR15B

Table 1

Characteristics of participants.

Age · Tertile	≤60 years old	>60years old	*P* value
	X±SD /NO. (%) N=126 (74.12)	X±SD /NO. (%) N=44 (25.88)	
Age/years	49.9±8.1	65.2±4.5	<.001*
BMI.kg/m^2	23.7±2.7	24.3±3.5	.21
Gender			.19
Female	60 (47.6)	26 (59.1)	
Male	66 (52.4)	18 (40.9)	
Limbs			.004*
Unilateral	85 (67.5)	19 (43.2)	
Bilateral	41 (32.5)	25 (56.8)	
Diabetes			.02*
Non-diabetes	125 (99.2)	41 (93.2)	
Diabetes	1 (0.8)	3 (6.8)	
Hypertension			.04*
Non-hypertension	105 (91.3)	35 (79.5)	
Hypertension	11 (8.7)	9 (20.5)	
Preoperative CEAP classification			.15
2	48 (38.1)	10 (22.7)	
3	20 (15.9)	7 (15.9)	
4	58 (46.0)	27 (61.4)	
Preoperative VAS			.69
0	13 (10.3)	4 (9.1)	
1	55 (43.7)	22 (50.0)	
2	45 (35.7)	12 (27.3)	
3	7 (5.6)	2 (4.5)	
4	5 (4.0)	4 (9.1)	
5	1 (0.7)	0 (0.0)	
Preoperative QOR15A	80.3±15.3	79.1±14.6	.66
Preoperative QOR15B	42.8±7.2	43.4±5.7	.62
Preoperative AVVQ	13.7±6.7	15.5±9.8	.18
Preoperative VCSS			.14
Operative time			.053

AVVQ = aberdeen varicose veins questionnaire, BMI = body mass index, CEAP = clinical, etiology, anatomy, and pathophysiology, QoR15 = Quality of Recovery, VAS = visual analogue score, VCSS = venous clinical severity score.

* Statistically significant

(OR -0.2,95%CI (−0.4,0.0) $P=.01$) might also be associated with the improvement of AVVQ (Table 2).

The univariate regression analysis showed that the improvement of VCSS at 6 weeks after surgery was significantly correlated with Preoperative QOR15B (OR -0.1,95%CI (−0.1,0.0) $P=.04$). In addition, CEAP classification 3 (OR 1.4,95%CI (0.1,2.6) $P=.04$) and CEAP classification 4 (OR 2.5, 95%CI (1.6,3.5) $P<.001$) might also be associated with the improvement of VCSS. At 6 months after surgery, the univariate regression analysis showed that the improvement of VCSS was significantly correlated with QOR15B (OR −0.1, 95%CI (−0.1,0.0) $P=.0098$). In addition, CEAP classification 3 (OR 1.8,95%CI (0.7,2.9), $P=.0021$) and CEAP classification 4(OR 2.7, 95% CI (1.9,3.5), $P<.001$) might also be associated with the improvement of VCSS (Table 2).

We further applied a stratified analysis and to examine the potential confounding factors associated with the improvement of VCSS, as well as AVVQ, at 6 weeks and 6 months after ambulatory HLS (Table 3). The results of the stratified analyses of the association between the improvement of VCSS, as well as AVVQ, at 6 weeks and 6 months after ambulatory HLS were presented in Table 3. The improvement of AVVQ at 6 weeks and 6 months after ambulatory HLS were greater in bilateral lesions patients in the >60 years old group than those in the ≤60 years old group (OR 6.7, 95% CI (2.9, 10.5), $P<.001$; OR 6.0, 95% CI (2.6, 9.4), $P<.001$). Meanwhile, the improvement of VCSS, as well as AVVQ, at 6 weeks and 6 months after ambulatory HLS were significantly correlated with the preoperative CEAP classification (Table 3).

Interaction analysis revealed that hypertension influenced the association between the improvement of VCSS at 6 weeks after ambulatory HLS and age group (Table 3). The OR between the improvement of VCSS at 6 weeks after ambulatory HLS and age group was higher in the >60 years old group (OR 1.6,95% CI (−0.5, 3.6), $P=.01$) than in the ≤60 years old (Table 3).

After multivariable risk adjustment for potential confounding factors (Table 4), the improvement of VCSS at 6 weeks after surgery was negatively associated with age (OR -0.6, 95%CI (−1.2, −0.1), $P=.03$), with the >60 years old group having a lower VCSS improvement compared to the ≤60 years old group. However, at 6 weeks after HLS, age was not related to the improvement of AVVQ (OR 0.2, 95%CI (−0.2, 0.6), $P=.38$). At 6 months after surgery, the improvement of VCSS and AVVQ were independent of age after multivariable risk adjustment for potential confounding factors (Table 4). A nonlinear relationship between the improvement of VCSS and AVVQ at 6 weeks and 6 months after surgery and age is showed in Figures 1 and 2.

3.1. Postoperative complications

During our follow-up, there were no systemic complications and no patients received reintervention. We only observed one wound infection (2.27%) in the >60 years old group at postoperative sixth week. However, there were no statistically significant differences between the 2 age groups regarding wound infection ($P=.26$). Paresthesia was the most common complication in the two groups. At 6 weeks post-surgery, paresthesia occurred in 6 patients (4.76%) in the ≤60 years old group, three patients (6.82%) in the >60 years old group ($P=.70$). At 6 months post-surgery, there was only one case (2.27%) of paresthesia in the >60 years old group. Wound itching was the second most common complication in the two age groups. At 6 weeks post-surgery, wound itching occurred in four patients (3.17%) in the ≤60 years old group, one patient (2.27%) in the >60 years old group. At postoperative sixth month, one patient (.79%) in the ≤60 years old group and one patient (2.27%) in the >60 years old group experienced wound itching. Comparing the postoperative complications in the age groups at 6 weeks and 6 months, there were no statistically significant differences (*P* value >.05) (see Table 5).

4. Discussion

In this prospective cohort study, we examined whether age is associated with the prognosis of HLS performed in an ambulatory care center. After multivariable risk adjustment for potential confounding factors, we found that age was related to the improvement of VCSS at 6 weeks after surgery, and as expected, the >60 years old group had a lower VCSS improvement, compared with the ≤60 years old group. On the one hand, the varicose veins in the >60 years old group were more severe than those of the ≤60 years old group; and on the other hand, the postoperative recovery of the >60 years old group was slower than that of the ≤60 years old group. However, we did not find this phenomenon in the improvement of AVVQ at 6 weeks after

Table 2

Effects of risk factors on age and the improvement of VCSS and AVVQ at 6 weeks and 6 months after surgery by univariate analysis.

Exposure	Statistics (n = 170)	VCSS improvement (6W) OR (95% CI) *P* value	VCSS improvement (6M) OR (95% CI) *P* value	AVVQ improvement (6W) β (95% CI) *P* value	AVVQ improvement (6M) β (95% CI) *P* value
Age. year					
≤60 years old	126 (74.1%)	0	0	0	0
>60 years old	44 (25.9%)	0.2 (−0.8, 1.2) .72	0.8 (−0.1, 1.7) .08	2.4 (−0.6, 5.4) .12	1.6 (−1.1, 4.3) .25
Gender					
Female	86 (50.6%)	0	0	0	0
Male	84 (49.4%)	−0.4 (−1.3, 0.5) .43	−0.3 (−1.1, 0.5) .52	−0.3 (−3.0, 2.4) .82	−0.8 (−3.2, 1.6) .51
BMI.kg/m^2	23.9 ± 3.0	0.1 (−0.1, 0.2) .49	−0.0 (−0.2, 0.1) .58	0.3 (−0.1, 0.8) .18	0.3 (−0.1, 0.8) .09
BMI Tertile					
Low	57 (33.5%)	0	0	0	0
Middle	56 (32.9%)	−0.0 (−1.1, 1.1) .94	0.2 (−0.8, 1.1) .75	0.4 (−2.9, 3.7) .82	1.2 (−1.7, 4.2) .42
High	57 (33.5%)	−0.3 (−1.4, 0.8) .56	−0.8 (−1.8, 0.2) .10	−0.1 (−3.4, 3.2) .96	0.6 (−2.3, 3.5) .70
Limbs					
Unilateral	104 (61.2%)	0	0	0	0
Bilateral	66 (38.8%)	0.1 (−0.8, 1.0) .81	0.4 (−0.5, 1.2) .37	4.6 (1.9, 7.2) < .001*	4.6 (2.2, 6.9) < .001*
Diabetes					
Non-diabetes	166 (97.6%)	0	0	0	0
Diabetes	4 (2.4%)	−0.4 (−3.3, 2.6) .81	1.1 (−1.6, 3.7) .44	−5.8 (−14.6, 2.9) .20	−2.3 (−10.1, 5.6) .57
Hypertension					
Non-hypertension	150 (88.2%)	0	0	0	0
Hypertension	20 (11.8%)	0.2 (−1.2, 1.6) .77	0.5 (−0.8, 1.8) .44	0.9 (−3.2, 5.1) .66	0.5 (−3.2, 4.2) .80
Preoperative CEAP classification					
2	58 (34.1%)	0	0	0	0
3	27 (15.9%)	1.4 (0.1, 2.6) .040*	1.8 (0.7, 2.9) .0021*	2.4 (−1.6, 6.4) .25	2.8 (−0.8, 6.4) .13
4	85 (50.0%)	2.5 (1.6, 3.5) < .001*	2.7 (1.9, 3.5) < .001*	3.6 (0.7, 6.5) .02*	3.1 (0.5, 5.7) .02*
Preoperative VAS					
0	17 (10.0%)	0	0	0	0
1	77 (45.3%)	−0.0 (−1.6, 1.5) .97	0.6 (−0.8, 2.0) .42	1.1 (−3.5, 5.8) .63	−0.2 (−4.3, 3.9) .93
2	57 (33.5%)	−0.2 (−1.9, 1.4) .77	0.3 (−1.2, 1.7) .73	−0.1 (−4.9, 4.7) .96	−0.0 (−4.3, 4.3) .99
3	9 (5.3%)	1.9 (−0.6, 4.3) .13	1.7 (−0.5, 3.8) .14	−1.3 (−8.5, 5.8) .72	−0.3 (−6.6, 6.1) .93
4	9 (5.3%)	0.7 (−1.7, 3.2) .55	1.1 (−1.1, 3.3) .32	6.3 (−0.9, 13.4) .09	6.5 (0.1, 12.9) .05
5	1 (0.6%)	−3.6 (−9.6, 2.4) .24	−4.2 (−9.7, 1.2) .13	4.1 (−13.8, 22.0) .65	6.2 (−9.7, 22.1) .45
Preoperative QOR15A	80.0 ± 15.1	−0.0 (−0.0, 0.0) .56	−0.0 (−0.0, 0.0) .19	−0.0 (−0.1, 0.1) .99	−0.0 (−0.1, 0.1) 0.79
Preoperative QOR15A Tertile					
Low	54 (31.8%)	0	0	0	0
Middle	59 (34.7%)	−0.0 (−1.1, 1.1) .99	−0.5 (−1.5, 0.5) .33	−0.3 (−3.6, 3.0) .85	−1.6 (−4.5, 1.4) .30
High	57 (33.5%)	−0.1 (−1.2, 1.1) .93	−0.1 (−1.1, 0.9) .79	−0.6 (−3.9, 2.7) .71	−0.6 (−3.6, 2.3) .69
Preoperative QOR15B	42.9 ± 6.8	−0.1 (−0.1, −0.0) .04*	−0.1 (−0.1, −0.0) < .001*	−0.1 (−0.3, 0.1) .18	−0.2 (−0.4, −0.0) .015*
Preoperative QOR15B Tertile					
Low	51 (30.0%)	0	0	0	0
Middle	62 (36.5%)	−0.5 (−1.6, 0.6) .39	−1.0 (−2.0, −0.0) .05	−1.8 (−5.1, 1.5) .28	−1.8 (−4.7, 1.1) .23
High	57 (33.5%)	−1.2 (−2.3, −0.0) .05	−1.2 (−2.2, −0.2) .02*	−1.5 (−4.9, 1.8) .37	−2.4 (−5.4, 0.6) .12

β = beta coefficient, AVVQ = aberdeen varicose veins questionnaire, AVVQ improvement (6M) = the improvement of AVVQ at 6 months after surgery, AVVQ improvement (6W) = the improvement of AVVQ at 6 weeks after surgery, BMI = body mass index, CEAP = clinical, etiology, anatomy, and pathophysiology, CI = confidence interval, OR = odds ratios, QoR15A = quality of recovery part A, QoR15B = quality of recovery part B, VAS = visual analogue score, VCSS = venous clinical severity score, VCSS improvement (6M) = the improvement of VCSS at 6 months after surgery, VCSS improvement (6W) = the improvement of VCSS at 6 weeks after surgery.

* Statistically significant.

surgery. The reasons for these findings must be further explored in future research. At 6 months after surgery, there were no significant differences in the improvement of VCSS and AVVQ between the age groups. In conclusion, we found that age was not a barrier to good outcomes after undergoing HLS in an ambulatory care center, however, age was associated with early postoperative improvement.

The overall postoperative complications of all patients in this study were lowered and revealed no significant differences between the age groups. Analysis of the postoperative sixth week and sixth month data showed no significant differences in the systemic and leg-specific complications between the age groups. The incidence of wound infection was very low (2.27%), and was lower than the 3% to 6% wound infection previously reported in the literature.[21–23] The most common complication in the two groups was paresthesia, followed by wound itching, but there was no statistical difference between the age groups. We also compared the data from our center with the data of patients who received ambulatory HLS surgery at other centers and found that HLS performed at our center was as safe and effective as other centers.[5,22,24,25] Furthermore, our postoperative complications were lower than those reported in other literature.[22–24] We also compared the age-specific data of patients who received ambulatory HLS and those who received ambulatory radiofrequency/laser ablation and found that the safety

Table 3

Effects of risk factors on age group and the improvement of VCSS and AVVQ at 6 weeks and 6 months after surgery by stratified analysis.

Sub-group	Statistics N. (%)	VCSS improvement (6W) OR (95% CI) *P* value	VCSS improvement (6M) OR (95% CI) *P* value	AVVQ improvement (6W) β (95% CI) *P* value	AVVQ improvement (6M) β (95% CI) *P* value
Gender (PI)		0.18	0.13	0.68	0.16
Female	86 (50.6)				
≤60 years old	60 (69.8)	0	0	0	0
>60 years old	26 (30.2)	−0.5 (−1.9, 0.9) .50	0.2 (−1.1, 1.4) .78	1.8 (−2.2, 5.9) .38	−0.2 (−3.8,3.5) .93
Male	84 (49.4)				
≤60 years old	66 (78.6)	−0.7 (−1.8, 0.3) .19	−0.6 (−1.5,0.4) .25	−0.4 (−3.5, 2.7) .79	−1.7 (−4.4, 1.1) .24
>60 years old	18 (21.4)	0.2 (−1.3, 1.8) .77	1.1 (−0.4,2.5) .15	2.7 (−2.0,7.4) .26	2.0 (−2.1, 6.2) .34
Limbs (PI)		0.08	0.83	0.12	0.08
Unilateral	104 (61.2)				
≤60 years old	85 (81.73)	0	0	0	0
>60 years old	19 (18.27)	−0.4 (−1.9, 1.1) .63	0.7 (−0.7, 2.0) .33	−1.0 (−5.3, 3.3) .65	−1.8 (−5.6,1.9) .34
Bilateral	66 (38.8)				
≤60 years old	41 62.12)	−0.2 (−1.3, 0.9) .70	0.2 (−0.8, 1.2) .73	3.0 (−0.2, 6.2) .07	3.1 (0.3, 6.0) .03*
>60 years old	25 (37.88)	0.5 (−0.9, 1.8) .48	1.0 (−0.2, 2.2) .09	6.7 (2.9, 10.5) < .001*	6.0 (2.6,9.4) < .001*
Hypertension		.048*	0.15	0.61	0.14
Non-hypertension	150 (88.24)				
≤60 years old	115 (76.67)	0	0	0	0
>60 years old	35 (23.33)	0.3 (−1.4, 0.8) .63	0.5 (−0.5, 1.5) .34	2.7 (−0.7, 6.1) .12	2.5 (−0.5, 5.5) .11
Hypertension	20 (11.76)				
≤60 years old	11 (55)	−1.0 (−2.9, 0.8) .28	−0.4 (−2.1, 1.2) .60	1.3 (−4.1, 6.8) .63	2.5 (−2.4, 7.4) .31
>60 years old	9 (45)	1.6 (−0.5, 3.6) .013*	1.9 (0.1, 3.7) .04*	1.9 (−4.2, 7.9) .55	−0.7 (−6.1, 4.6) .79
Preoperative CEAP classification (PI)		0.43	0.57	0.98	0.98
2	58 (34.1)				
≤60 years old	48 (82.76)				
>60 years old	10 (17.24)	−0.1 (−2.0, 1.8) .88	0.1 (−1.5, 1.8) .87	2.4 (−3.6, 8.4) .43	1.7 (−3.7, 7.0) .54
3	27 (15.9)				
≤60 years old	20 (74.07)	1.8 (0.3, 3.2) .02*	1.9 (0.6, 3.2) .004*	2.3 (−2.3, 6.9) .33	2.8 (−1.3, 6.9) .18
>60 years old	7 (25.93)	0.1 (−2.1, 2.3) .90	1.5 (−0.4,3.4) .13	4.2 (−2.8, 11.2) .24	3.8 (−2.5, 10.0) .24
4	85 (50.0)				
≤60 years old	58 (68.24)	2.5 (1.4, 3.5) < .001*	2.5 (1.5, 3.4) < .001*	3.5 (0.1, 6.9) .04*	3.1 (0.1, 6.1) .04*
>60 years old	27 (31.76)	2.6 (1.3, 3.9) < .001*	3.2 (2.1, 4.4) < .001*	5.2 (1.0, 9.3) .01*	4.1 (0.4, 7.8) .03*
BMI Tertile (PI)		0.053	0.15	0.18	0.13
Low	57 (33.53)				
≤60 years old	45 (78.95)	0	0	0	0
>60 years old	12 (21.05)	0.4 (−1.5, 2.3) .65	0.5 (−1.2, 2.2) .55	3.4 (−1.7, 2.3) .46	3.2 (0.2, 5.9) .34
Middle	56 (32.94)				
≤60 years old	38 (67.86)	0.5 (−0.8, 1.8) .46	0.3 (0.3, −0.9) .63	1.9 (−1.9, 5.7) .32	2.8 (−0.6,6.2) .11
>60 years old	18 (32.15)	−0.9 (−2.5, 0.8) .30	0.2 (−1.2, 1.7) .75	1.3 (−3.5, 6.1) .60	1.2 (−3.1, 5.5) .58
High	57 (33.53)				
≤60 years old	43 (75.44)	−0.7 (−1.9, 0.6) .29	−1.2 (−0.5, 1.2) .56	0.7 (−3.0, 4.4) .71	1.2 (−2.1, 4.5) .47
>60 years old	14 (24.56)	1.1 (−0.7, 2.9) .24	0.8 (−0.8, 2.4) .31	3.0 (−2.3, 8.3) .27	3.0 (−1.7, 7.8) .21

β = beta coefficient, AVVQ = aberdeen varicose veins questionnaire, AVVQ improvement (6W) = the improvement of AVVQ at 6 weeks after surgery, AVVQ improvement (6M) = the improvement of AVVQ at 6 months after surgery, BMI = body mass index, CEAP = clinical, etiology, anatomy, and pathophysiology, CI = confidence interval, OR = odds ratios, PI = *P* value for interaction, VCSS = venous clinical severity score, VCSS improvement (6M) = the improvement of VCSS at 6 months after surgery, VCSS improvement (6W) = the improvement of VCSS at 6 weeks after surgery.

* Statistically significant

Table 4

Multivariate logistic regression model for risk factors associated with the improvement of VCSS and AVVQ at 6 weeks and 6 months after surgery.

Exposure	VCSS improvement (6W) OR (95% CI) *P* value	VCSS improvement (6M) OR (95% CI) *P* value	AVVQ improvement (6W) β (95% CI) *P* value	AVVQ improvement (6M) β (95% CI) *P* value
Age ·Tertile				
≤60 years old	0	0	0	0
>60years old	−0.6 (−1.2, −0.1) .03*	0.2 (−0.2, 0.6) .38	0.5 (−1.2, 2.2) .57	−0.3 (−1.3, 0.7) .54
Limbs				
Unilateral	0	0	0	0
Bilateral	0.0 (−0.5, 0.5) .96	0.1 (−0.2, 0.5) .44	−1.0 (−2.6, 0.5) .20	−0.7 (−1.6, 0.1) .10
Preoperative CEAP classification				
CEAP (2,3)	0	0	0	0
CEAP (4)	0.0 (−0.6, 0.5) .91	0.0 (−0.4, 0.4) .89	−0.2 (−1.9, 1.5) .82	−0.5 (−1.4, 0.4) .31
Hypertension				
Non-hypertension	0	0	0	0
Hypertension	0.0 (−0.8, 0.9) .99	0.3 (−0.3, 0.9) .31	1.0 (−1.7, 3.7) .46	0.0 (−1.4, 1.4) .99

β = beta coefficient, AVVQ = aberdeen varicose veins questionnaire, AVVQ improvement (6M) = the improvement of AVVQ at 6 months after surgery, AVVQ improvement (6W) = the improvement of AVVQ at 6 weeks after surgery, CEAP = clinical, etiology, anatomy, and pathophysiology, CI = confidence interval, OR = odds ratios, VCSS = venous clinical severity score, VCSS improvement (6M) = the improvement of VCSS at 6 months after surgery, VCSS improvement (6W) = the improvement of VCSS at 6 weeks after surgery.

* Statistically significant

a: Odds ratios/β were derived from multivariate logistic regression analysis. These factors were adjusted in the multivariate regression analysis = Gender; BMI; Limbs; Diabetes; Hypertension; Preoperative CEAP; Preoperative VCSS; Preoperative AVVQ; Preoperative QOR15A; Preoperative QOR15B.

Table 5

Complications after HLS in an ambulatory care at 6 weeks and 6 months after surgery.

Age· group	≤60 years old N = 126 No. (%)	>60 years old N = 44 No. (%)	*P* value - -
Six weeks after surgery			
Systemic complications			
DVT	0	0	-
Pulmonary embolism	0	0	-
Leg-overall complications	13 (10.32)	7 (15.91)	.41
Reintervention	0	0	-
Hematoma (thigh hematoma > 1 cm)	3 (2.38)	1 (2.27)	.99
Paresthesia	6 (4.76)	3 (6.82)	.70
Superficial phlebitis	2 (1.59)	0	.99
Lower limbs swelling	3 (2.38)	1 (2.27)	.99
Wound itching	4 (3.17)	1 (2.27)	.99
Skin blistering	0	0	-
Wound infection	0	1 (2.27)	.26
Six months after surgery			
Systemic complications			
DVT	0	0	-
Pulmonary embolism	0	0	-
Leg-overall complications	1 (0.79)	3 (6.82)	.054
Reintervention	0	0	-
Hematoma (thigh hematoma > 1 cm)	0	0	-
Paresthesia	0	1 (2.27)	.26
Superficial phlebitis	0	1 (2.27)	.26
Lower limbs swelling	0	1 (2.27)	.26
Wound itching	1 (0.79)	1 (2.27)	.45
Skin blistering	0	0	-
Wound infection	0	0	-

DVT = deep vein thrombosis.

and efficacy of the 2 procedures were similar, although the recovery was faster following radiofrequency/laser ablation.[26–29]

In order to reduce the postoperative complications, we made the following modifications: for patients with severe distal extension of the great saphenous vein, we did not use a top-to-down one-time stripping method, but rather stripped segmentally. A stripper with a medium-sized stripping cap was used to strip top-down to just below the knee, and another stripper with a small stripping cap was used to strip bottom-up to near the knee. This can reduce the damage to the saphenous nerve and significantly reduce the incidence of postoperative lower limb paresthesia. In addition, the main stem was stripped and pressed with gauze for 30 minutes before wrapping with a bandage, which can reduce the occurrence of postoperative hematoma. We recommend the use of postoperative elastic stockings for three months, which can improve the patients' quality of life after surgery.

Historically, it has been proven that surgery can be safely and efficiently performed in older varicose veins patients. A retrospective study by Danielle, et al. has compared under-65-year-old patients with over-65-year-old patients, and found that both age groups had similar outcomes following surgical treatment.[30] However, the study had included numerous minimally invasive procedures under local anesthesia and failed to consider ambulatory HLS. Christenson had previously demonstrated that bilateral HLS was safe and feasible during ambulatory care.[31] However, the patients in that study were aged from 40 to 50 years old. Therefore, it was not clear whether age was associated with the prognosis of HLS performed in an ambulatory care center. We used a prospective cohort study to investigate whether the prognosis of HLS performed in an ambulatory care center is related to age, and our preliminary study confirmed that age is not associated with the prognosis of ambulatory HLS. The findings of this study may provide clinicians with a more informed option of HLS in ambulatory settings for treating patients with varicose veins.

5. Conclusions

The age had no significant effect on the mid-term prognosis of HLS performed in the ambulatory center. Meanwhile, there was no significant difference in postoperative complications between the two age groups. However, the early results revealed that age a risk factor for prognosis. Therefore, in our opinion, ambulatory

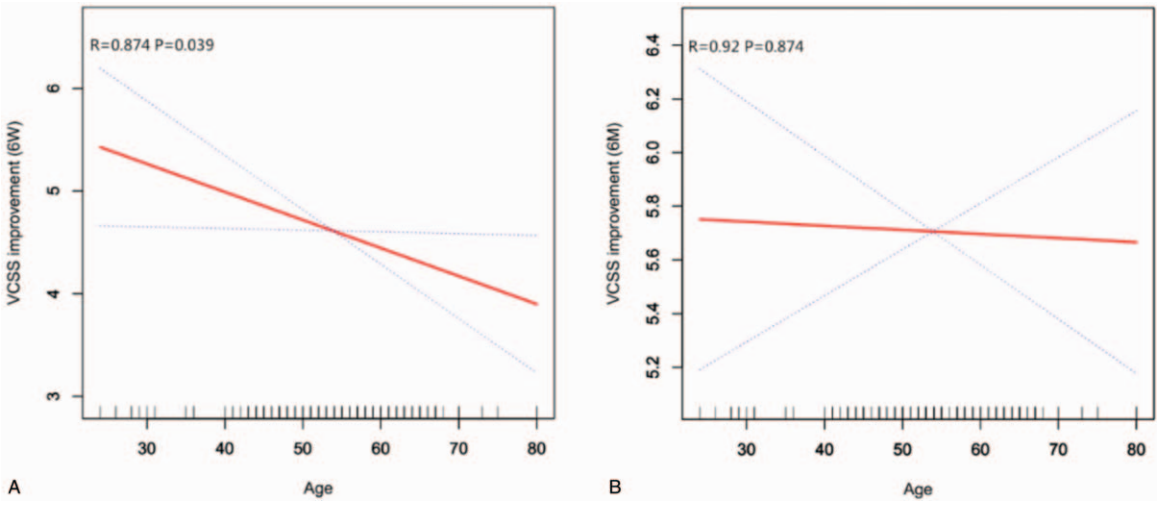

Figure 1. Smooth curve fitting for the relationship between age and the improvement of VCSS at 6 weeks and 6 months after surgery *. (A) The relationship between age and the improvement of VCSS at 6 weeks after surgery; (B) The relationship between age and the improvement of VCSS at 6 months after surgery. *: Adjust for: Gender; BMI; Limbs; Diabetes; Hypertension; Preoperative CEAP; Preoperative VCSS; Preoperative AVVQ.

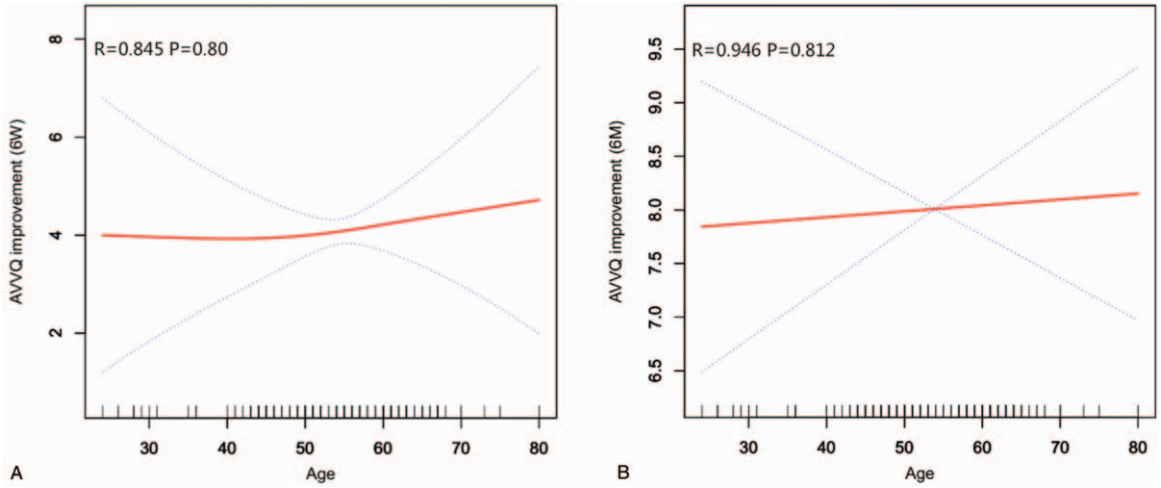

Figure 2. Smooth curve fitting for the relationship between age and the improvement of AVVQ at 6 weeks and 6 months after surgery *. (A) The relationship between age and the improvement of AVVQ at 6 weeks after surgery; (B) The relationship between age and the improvement of AVVQ at 6 months after surgery. *: Adjust for: Gender; BMI; Limbs; Diabetes; Hypertension; Preoperative CEAP; Preoperative VCSS; Preoperative AVVQ.

HLS for varicose veins is a safe and viable option for older patients. We hope that more studies will confirm these findings in the future.

6. Limitations

Despite our efforts to optimize our experimental design, there are still some deficiencies. The sample size was small, and the follow-up time periods were short. Unfortunately, we did not include ultrasound during the follow-up of the patients, which would have shed more light on the postoperative changes of the vein systems.

Author contributions

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References

[1] Rabe E, Berboth G, Pannier F. Epidemiology of chronic venous diseases. Wien Med Wochenschr 2016;166:260–3.
[2] Evans CJ, Fowkes FG, Ruckley CV, et al. Prevalence of varicose veins and chronic venous insufficiency in men and women in the general population: Edinburgh Vein Study. J Epidemiol Community Health 1999;53:149–53.
[3] van den Bos R, Arends L, Kockaert M, et al. Endovenous therapies of lower extremity varicosities: a meta-analysis. J Vasc Surg 2009;49:230–9.
[4] Siribumrungwong B, Noorit P, Wilasrusmee C, et al. A systematic review and meta-analysis of randomised controlled trials comparing endovenous ablation and surgical intervention in patients with varicose vein. Eur J Vasc Endovasc 2012;44:214–23.
[5] Murad MH, Coto-Yglesias F, Zumaeta-Garcia M, et al. A systematic review and meta-analysis of the treatments of varicose veins. J Vasc Surg 2011;53(5 Suppl):49S–65S.
[6] Zhang MY, Qiu T, Bu XQ, et al. A national survey on management of varicose veins in China. J Vasc Surg Venous Lymphat Disord 2018;6:338-+.
[7] Cohn MS, Seiger E, Goldman S. Ambulatory phlebectomy using the tumescent technique for local anesthesia. Dermatol Surg 1995;21:315–8.
[8] Yoh T, Okamura R, Nakamura Y, et al. Divided saphenectomy for varicose vein in ambulatory surgery. Ann Vasc Dis 2014;7:195–8.
[9] de Roos KP, Nieman F, Neumann HAM. Patient satisfaction after ambulatory phlebectomy of varicose veins in the foot. Dermatol Surg 2002;28:1027–30.
[10] Sadick NS. Advances in the treatment of varicose veins: ambulatory phlebectomy, foam sclerotherapy, endovascular laser, and radiofrequency closure. Adv Dermatol 2006;22:139–56.
[11] Muller R. Treatment of varicose external saphenous vein by ambulatory phlebectomy. Phlebologie 1991;44:687–92.
[12] de Roos KP, Nieman FH, Neumann HA. Ambulatory phlebectomy versus compression sclerotherapy: results of a randomized controlled trial. Dermatol Surg 2003;29:221–6.
[13] Kishore R, Sankar TB, Anandi A, et al. A Prospective study in comparison of ambulatory phlebectomy and duplex guided foam sclerotherapy in the management of varicosities with isolated perforator Incompetence. Indian J Surg 2016;78:356–63.
[14] Olivencia JA. Minimally invasive vein surgery: ambulatory phlebectomy. Tech Vasc Interv Radiol 2003;6:121–4.
[15] Khorev NG, Beller AV, Kon'kova VO, et al. Temporary tamponing of the canal while removing the great saphenous vein in elderly patients. Angiol Sosud Khir 2018;24:101–6.
[16] Rutherford RB, Padberg FTJr, Comerota AJ, et al. Venous severity scoring: An adjunct to venous outcome assessment. J Vasc Surg 2000;31:1307–12.
[17] Staniszewska A, Tambyraja A, Afolabi E, et al. The Aberdeen varicose vein questionnaire, patient factors and referral for treatment. Eur J Vasc Endovasc Surg 2013;46:715–8.
[18] Eklof B, Rutherford RB, Bergan JJ, et al. Revision of the CEAP classification for chronic venous disorders: consensus statement. J Vasc Surg 2004;40:1248–52.
[19] Knop C, Oeser M, Bastian L, et al. Development and validation of the Visual Analogue Scale (VAS) Spine Score. Unfallchirurg 2001;104:488–97.

[20] Stark PA, Myles PS, Burke JA. Development and psychometric evaluation of a postoperative quality of recovery score: the QoR-15. Anesthesiology 2013;118:1332–40.
[21] Chen K, Yu GF, Huang JY, et al. Incidence and risk factors of early deep venous thrombosis after varicose vein surgery with routine use of a tourniquet. Thromb Res 2015;135:1052–6.
[22] Christenson JT, Gueddi S, Gemayel G, et al. Prospective randomized trial comparing endovenous laser ablation and surgery for treatment of primary great saphenous varicose veins with a 2-year follow-up. J Vasc Surg 2010;52:1234–41.
[23] Rasmussen LH, Bjoern L, Lawaetz M, et al. Randomized trial comparing endovenous laser ablation of the great saphenous vein with high ligation and stripping in patients with varicose veins: short-term results. J Vasc Surg 2007;46:308–15.
[24] Lynch NP, Clarke M, Fulton GJ. Surgical management of great saphenous vein varicose veins: A meta-analysis. Vascular 2015;23: 285–96.
[25] Pan Y, Zhao J, Mei J, et al. Comparison of endovenous laser ablation and high ligation and stripping for varicose vein treatment: a meta-analysis. Phlebology 2014;29:109–19.
[26] Aber A, Poku E, Phillips P, et al. Systematic review of patient-reported outcome measures in patients with varicose veins. Br J Surg 2017; 104:1424–32.
[27] Belramman A, Bootun R, Lane TRA, et al. Foam sclerotherapy versus ambulatory phlebectomy for the treatment of varicose vein tributaries: study protocol for a randomised controlled trial. Trials 2019;20:392.
[28] Beteli CB, Rossi FH, de Almeida BL, et al. Prospective, double-blind, randomized controlled trial comparing electrocoagulation and radio-frequency in the treatment of patients with great saphenous vein insufficiency and lower limb varicose veins. J Vasc Surg Venous Lymphat Disord 2018;6:212–9.
[29] Olivencia JA. Ambulatory phlebectomy of the foot Review of 75 patients. Dermatol Surg 1997;23:279–80.
[30] Sutzko DC, Andraska EA, Obi AT, et al. Age is not a barrier to good outcomes after varicose vein procedures. J Vasc Surg Venous Lymphat Disord 2017;5: 647-657 e641.
[31] Gemayel G, Christenson JT. Can bilateral varicose vein surgery be performed safely in an ambulatory setting? Eur J Vasc Endovasc Surg 2012;43:95–9.