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Original Article

Endoscopic Versus Open Saphenous Vein Harvesting in Coronary Artery Bypass Grafting

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Abstract

Background: Endoscopic saphenous vein harvesting has been acknowledged as a valuable method for mitigating postoperative wound scarring and associated problems.

Methods: We reviewed 60 patients who underwent coronary artery bypass surgery and had their vein graft harvested by open (OVH A, n = 30) versus endoscopic (EVH, n = 30) technique. Both groups were matched for age and sex. Wound complications were determined by the presence of ecchymosis, hematoma, keloids, dehiscence, infection, and the need for intervention. The time of harvesting was recorded routinely for each patient.

Results: When comparing open and endoscopic techniques for harvesting saphenous veins, ecchymosis was more in EVH, while wound dehiscence was more in the OVH group. Surprisingly, no significant difference between both groups re garding other wound problems, including purulent discharge. On follow-up, both groups did not show any significant difference in terms of readmissions for leg wound complications, need for plastic surgery, cosmetic satisfaction, bleeding, or recurrence of angina.

Conclusion: Endoscopic technique was associated with increased ecchymosis and reduced wound dehiscence incidence.

KEYWORDS

Endoscopic vein harvesting; Minimally invasive surgery; Great saphenous vein; Coronary artery bypass grafting

Article History

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Introduction

The most popular cardiac surgery carried out globally is coronary artery bypass grafting (CABG), which is the only effective treatment for ischemic heart disease [1]. Since its introduction in 1962, CABG has been the preferred treatment for coronary artery disease that necessitates surgery. One limitation of standard CABG is the requirement for a cardiac bypass and median sternotomy, which carry a high risk of coagulopathy and wound complications [2]. Since arterial grafts are more long-lasting than saphenous vein grafts, they have been recommended. However, the use of arterial grafts is restricted because of the risk of spasms and the unsatisfactory outcomes of less stenotic target vessels. The saphenous vein is still a crucial route for CABG [3,4].

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Traditionally, a continuous incision is made down the whole length of the saphenous vein in order to harvest it. This strategy has its advantage, including mitigating postoperative wound scarring and associated problems [5]; however, it has been linked to a higher risk of wound complications and, as a result, a lengthier hospital stay. Patients now have a safe substitute for invasive surgery because of advancements in medical treatment and endovascular procedures. Consequently, reduced morbidity for the patient is associated with the same therapeutic benefit when undergoing surgery for coronary artery disease [2].

Moreover, research has not demonstrated any appreciable differences between open vein-graft harvesting (OVH) and Endoscopic vein harvesting (EVH) in terms of the risks associated with major adverse cardiac events, in-hospital death, and all-cause mortality [6]. The aim of this study was to compare endoscopic versus open vein harvest for patients undergoing coronary artery bypass grafting.

Patients and Methods

Study venue and duration

The study was conducted in a Salalah Heart Center, Sultan Qaboos Hospital during the period from September 2023 to April 2024.

Study design

This study was designed as an ambispective study. At first, patients who already underwent the intervention and fulfilled the inclusion criteria were selected and put into consideration for the study. The decision to undergo open vein harvesting (OVH) or endoscopic vein harvesting (EVH) was dependent on each surgeon's preference. These patients were then contacted to take their approval to participate in the study, and upon acceptance to participate and taking the informed oral consent, the investigators started collecting their demographic, operative parameters as well as parameters related to wound condition from their electronic medical records (secondary data). To complete the required parameters and to achieve the required objectives of the study, the selected patients were on follow up for 3 months duration (Figure 1).

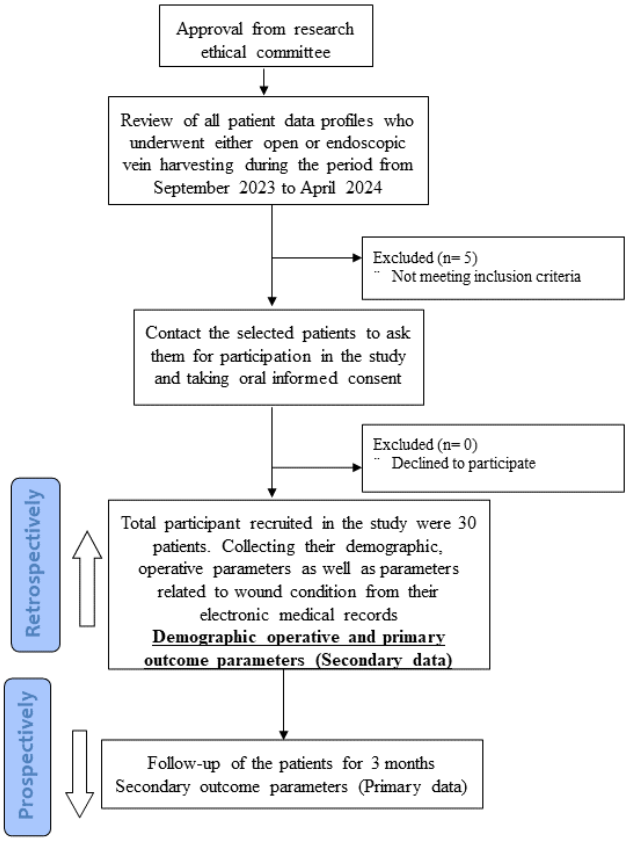

Figure 1: Flow chart of study

Data collection and study population

The participants were sub-classified into two groups. EVH (n=30) and OVH (n=30).

Participants had their first median sternotomy for coronary artery bypass grafting (CABG) or valve surgery, or both. However, patients with previous history of cardiac surgery, concomitant valve surgery, unstable angina, low ejection fraction <30%, emergency cases, patients requiring pre-operative chemical or mechanical support, patients who had combined EVH and OVH, patients having varicose veins, peripheral vascular disease, and those with elevated Society of Thoracic Surgery Risk Score (STS) were excluded from the study.

Studied clinical outcomes

Primary outcomes to be assessed directly after the operation during the patient's initial hospital stay were bleeding, ecchymosis, hematoma, wound dehiscence, and purulent discharge (Figure 2)

Secondary outcomes to be assessed within 3 months after surgery were keloid scar, edema, altered sensation, need for plastic surgery,

readmission to treat leg wound complications, recurrent angina, and satisfaction from leg wound (Figure 2).

Figure 2: Primary (after surgery during initial hospital stay) and secondary outcome (during follow-up period); a: ecchymosis for EVH group, b: small scar detected in EVH patient, c: large scar in a patient from OVH group

Operative details

Numerous disposable and reusable EVH systems with and without carbon dioxide insufflation are available. The most popular disposable systems are ClearGlideR (Sorin, USA), VirtuoSaph (Terumo Cardiovascular Systems Corporation, USA), and VasoView HEMOPROTM (Maquet Holding GmbH & Co.). The patient is positioned correctly, and the operator uses one hand to feel the thrill while gently "milking" the vein to locate the vein. If the operator is not able to palpate the vein, localization can be accomplished using osseous landmarks or a portable point-of-care ultrasound system (SonoSite Inc., USA). A three cm incision made just above the medial portion of the knee can be used to harvest 35 cm of the saphenous vein in the thigh leg. If the full 70 cm of vein is required, two choices are available: either start the vein harvesting process 2-3 cm above the medial malleolus and then make a second incision slightly above the knee to harvest the vein all the way to the groin, or repeat the process through the same incision in the opposite direction. A balloon tip trocar is placed into the incision once the vein has been located, and carbon dioxide is then pumped into the tunnel. Under videoscopic inspection, the conical dissection cone is advanced toward the groin on the vein's anterior surface. The vein is bluntly dissected circumferentially along its posterior and lateral sides. Bipolar electrocautery is then used to split and isolate the collateral branches. Constant vision, appropriate counter traction, and cautious hemostasis reduce vein trauma. At the tunnel's extremity, a second "stab and grab" incision is made to ligate the proximal saphenous vein. To prevent endothelial damage, the proximal end of the vein is cannulated and gradually dilated after it has been removed. Using tiny monofilament suture material, avulsions are healed and branches are double-clipped. To get rid of any potential clots, the vein is gently cleansed. Ultimately, any remaining blood in the tunnel is removed, a redivac drain is installed, and the leg is covered with a compression bandage for a minimum of 48 hours following wound closure (Figure 3).

Ethical consideration

An ethical approval was obtained from Ethical research Committee of DGHS, Dhofar, Sultanate of Oman, no. MoH/CSR/24/28423.An informed oral consent was also taken from patients who participated in the study.

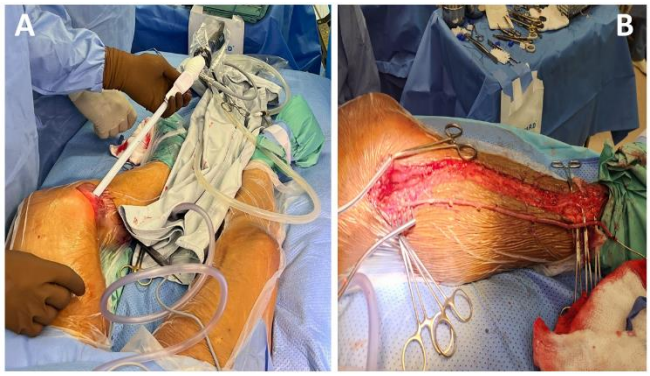

Figure 3: Saphenous vein harvesting a) Endoscopic, b) Open

Statistical analysis

Data was analyzed using SPSS version 27 and Prism GraphPad version 9.3.1. The data was tested for normality using Kolmogorov–Smirnov test. Continuous data were compared using the t-test

Table 1: Comparison between the studied groups regarding demographic data and clinical parameters

Variables	Total, n=60	OVH, n=30	EVH, n=30	*p* value
Demographic data				
Age, mean ± SD	58.4± 9.0	57.0 ± 9.1	59.8 ± 8.8	0.231ǂ
Sex, n (%)				
Male	53 (88.3)	26 (86.7)	27 (90.0)	1.000 ǂǂ
Female	7 (11.7)	4 (13.3)	3 (10.0)	
BMI, mean ± SD	29.8±2.9	29.7 ± 3.0	29.9 ± 2.9	0.781 ǂ
Clinical parameters				
Hypertension, n (%)	32 (53.3)	17 (56.7)	15 (50.0)	0.605 ǂǂǂ
Diabetes Mellitus, n (%)	31 (51.7)	16 (53.3)	15 (50.0)	0.796 ǂǂǂ
Dyslipidemia, n (%)	42 (70.0)	20 (66.7)	22 (73.3)	0.573 ǂǂǂ
Smoking, n (%)	41 (68.3)	21 (70.0)	20 (66.7)	0.781 ǂǂǂ

ǂ *Student t test,* ǂǂ *Fisher Exact test,* ǂǂǂ *Chi –square test. SD=Standard deviation, OVH=Open vein harvesting, EVH=Endoscopic vein harvesting*

or Mann-Whitney test and categorical data with chi-squared or Fisher exact test. A p-value of less than 0.05 was considered statistically significant.

Results

Table 1 explains that the mean age of OVH was 57.0 ± 9.1 years, and for EVH 59.8 ± 8.8 years. Males had the predominance in both groups, and mean BMI in the total studied sample was 29.9. Also, no significant difference between both groups for age, sex, or BMI. The proportion of HTN and DM in the total patients were 53.3%, and 51.7% respectively. Dyslipidaemia was found in 70.0% of patients, while 68.3% of them were active smokers during data collection period.

Table 2 clarifies that 73.3 of EVH, OVH, and whole studied sample had medium skin tune, and the mean number of veins grafted was 2.4 in OVH, and 2.6 in EVH and the relation was non-significant.

A statistically significant higher mean vein harvesting time was observed among EVH (155.9 ± 45.1) compared with OVH patients (117.0 ± 42.0, p<0.001).

Table 3 expressed the primary and secondary outcome stratified by groups (OVH and EVH). For primary outcome, the difference between groups was only observed in occurrence of ecchymosis and wound dehiscence (p<0.05). Half of EVH patients exhibited ecchymosis, while only 16.7% of OVH suffered from it; on the contrary, the incidence of wound dehiscence was higher in OVH compared with the EVH group. Interestingly, there was no significant difference between both groups regarding the occurrence of purulent discharge.

Table 2: Comparison between the studied groups regarding operative data

Variables	Total, n=60	OVH, n=30	EVH, n=30	*p* value
Skin tune, n (%)				
Dark	11 (18.3)	5 (16.7)	6 (20.0)	
Medium	44 (73.3)	22 (73.3)	22 (73.3)	1.000ǂ
Light	5 (8.3)	3 (10.0)	2 (6.7)	
Number of vein grafts, mean ±SD	2.5±0.8	2.4±0.7	2.6±0.9	0.293ǂǂ
Vein harvesting time (Min.), mean ±SD	136.5±47.4	117.0 ± 42.0	155.9 ± 45.1	**<0.001***ǂǂ

ǂ*Fisher Exact test,* ǂǂ *Student t test, *indicates significant p-value*

As regard secondary outcome, the table shows that when follow up was continued for 3 more months after surgery, no significant difference was observed between both groups. 2 patients out of 30 from OVH were re-admitted treating leg wound complications and needed plastic surgery for leg wounds. Surprisingly, 70.0% of OVH were satisfied from their wound, and 90.0% of EVH showed a complete satisfaction of their leg wound. When taking in consideration the comparison of the two techniques and testing if it affects the reoccurrence of recurrent angina which indicates failure grafting, no significant difference between groups. Also, no mortality has been recorded from both groups within 90 days (3 months) from surgery.

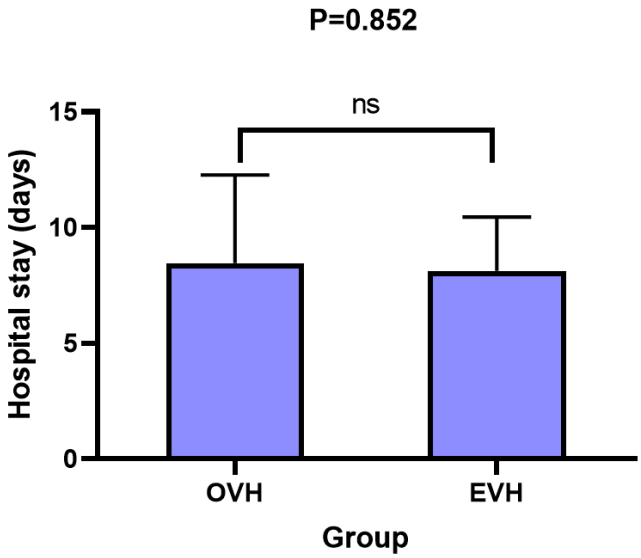

Figure 4: Length of hospital stay stratified by groups

Figure 4 shows that the mean length of hospital stay in OVH was 8.47±3.79, while it was 8.13±2.33 days in EVH patients; however, the observed difference was non-significant.

Table 4 found that OVH group, age, male gender, BMI, HTN, DM, Dyslipidaemia, or smoking was associated with the occurrence of wound purulent discharge, and only increased duration of harvesting had 1.048 odds of occurrence of purulent discharge (OR=1.048, 95%CI=1.012-1.086, P=0.008).

Discussion

One of the most prevalent chronic illnesses in the world that is linked to death is coronary artery disease, which claims the lives of 17.9 million people year worldwide [7]. A variety of treatment approaches, including guideline-directed medical therapy and several surgical procedures. Myocardial revascularization, a crucial therapeutic approach, greatly improves patient prognosis and survival rates. This includes CABG and percutaneous coronary intervention (PCI) [8].

This study aimed at comparing operative outcomes of open and endoscopic saphenous vein harvesting in patients with coronary artery disease. The preoperative demographic and clinical parameters showed no statistically significant difference between the two groups. This means that both groups were matched for age, sex, and other clinical parameters.

Similarly, Zenati et al. [9], who studied 1471 cases and ensured matching between the open and closed groups regarding age and sex. Andreasen and his colleagues [10] who studied 111 patients and considered matching between both groups regarding baseline characteristics. By matching, one may calculate and compare the average effect of intervention in the matched groups, and this, in turn, will reduce the source of bias. The phrase "bias due to incomplete matching" was first used by Rosenbaum and Rubin [11,12].

This current study found that the mean number of veins grafted was 2.4 in OVH and 2.6 in EVH, and the relation was non-significant. Zenati et al. [13] found that the mean number of grafts per patient in OVH was 3.1±0.8, and it was 3.2±0.8 in the EVH group, and the relation was non-significant. Also, Andreasen et al. [10] didn't find any significant difference between the two groups regarding the number of veins anastomoses. The mean number of veins anastomosis in EVH as well as OVH was 1.5 veins.

Grant et al. [14] stated that a median number of grafts was 3 in both groups was 3 per patient. Elhelw et al. [15] found no significant relation between OVH and EVH regarding the number of veins harvested. On the contrary, Ouzounian et al. [16] proposed that the mean vein graft in OVH was

Table 3: Comparison between the studied groups regarding primary and secondary outcome

Variables	Total, n=60	OVH, n=30	EVH, n=30	*p* value
Primary outcome (During hospital stay)				
Ecchymosis, n (%)	20 (33.3)	5 (16.7)	15 (50.0)	**0.006*** ⊦
Hematoma, n (%)	11 (18.3)	5 (16.7)	6 (20.0)	0.739 ⊦
Wound Dehiscence, n (%)	7 (11.7)	7 (23.3)	0 (0.0)	**0.011*** ⊦⊦
Purulent Discharge, n (%)	9 (15.0)	7 (23.3)	2 (6.7)	0.145⊦⊦
Secondary outcome (Follow up of the patients within 3 months)				
Keloid scar, n (%)	4 (6.7)	4 (13.3)	0 (0.0)	0.112 ⊦⊦
Edema, n (%)	11 (18.3)	6 (20.0)	5 (16.7)	0.739 ⊦
Altered Sensation, n (%)	11 (18.3)	6 (20.0)	5 (16.7)	0.739⊦
Readmission to treat leg wound complications, n (%)	2 (3.3)	2 (6.7)	0 (0.0)	0.492⊦⊦
Need for plastic surgery, n (%)	2 (3.3)	2 (6.7)	0 (0.0)	0.492⊦⊦
Satisfaction from leg wound (after 3 months), n (%)	48 (80.0)	21 (70.0)	27 (90.0)	0.053⊦
Revision for bleeding, n (%)	2 (3.3)	0 (0.0)	2 (6.7)	0.492⊦⊦
Recurrent Angina (within 3 months)	4 (6.7)	2 (6.7)	2 (6.7)	1.0 ⊦⊦
Mortalities	0 (0.0)	0 (0.0)	0 (0.0)	1.0 ⊦⊦

⊦ *Chi-square test,* ⊦⊦ *Fisher Exact test, *indicates significant p-value*

1.94, and in EVH was 2.03, and the difference was highly statistically significant.

Significantly, the mean vein-harvesting time in EVH was 155.9 minutes, which was more than OVH (117.0 minutes). Ouzounian et al., [16] found that in OVH, the median clamp time was 66 minutes while the median pump time was 106 minutes, while in the EVH group the median clamp time was 71 minutes while the median pump time was 108 minutes. Zenati et al.,[13] expressed that mean harvesting time was much less than our current study in both groups. Zenati et al., [13] claimed that in EVH, the mean vein-harvesting time was 57.5±24.4 minutes and differs significantly from OVH (61.4±28.7 minutes). Also, Mubarak & Abdeljawad, [17] reported that the mean harvesting time in OVH was 15.8 minutes which is highly statistically significantly different from EVH group (45.2 minutes).

The study identifies that the incidence of ecchymosis was 50.0% in EVH and only 16.7% in OVH, and the difference was statistically significant. moreover, no difference was seen between both groups regarding the incidence of hematoma, but its incidence is higher in EVH compared with OVH. The incidence of EVH and OVH was 20.0% and 16.7% respectively. Elhelw et al., [15] compared the ASEPSIS Scores of the OVH and EVH groups. They [15] stated that the EVH group's ASEPSIS Score was noticeably lower. Compared to the endoscopic approach, the open technique showed a much greater incidence of erythema and serous discharge. Multivariate regression analysis revealed a statistically significant correlation between the endoscopic method and the ASEPSIS Score.

ASEPSIS score is a scoring system for each surgical wound which is based on nine characteristics as follows: [need for additional treatment (e.g., antibiotics), drainage of pus, wound debridement, serous exudate, erythema, purulent exudate, separation of deep tissues, isolation of bacteria, prolonged stay as an inpatient. Ran and his colleagues conducted a study to review the effect of endoscopic vein harvesting in coronary artery bypass surgery. They followed the patient for about 12 months [4]. Ran et al. [4] clarified that, regarding the state of the wound, On the seventh post-operative day, patients in the EVH group reported significantly less leg pain than those in the OVH group (1.16±0.76 vs. 2.50±0.91, P<0.01). At three months, all patients' leg wound pain scores were no greater than 1, and more patients in the OVH group experienced numbness (20% in OVH vs.

Table 4: Predictors of occurrence of purulent discharge

Independent variables	Occurrence of purulent discharge			p-value
	OR	95% CI		
		Lower bound	Higher bound	
OVH group	0.235	0.044	1.241	0.088
Age	0.994	0.919	1.076	0.884
Male gender	1.067	0.113	10.086	0.955
BMI	0.860	0.652	1.136	0.289
HTN	1.111	0.267	4.620	0.889
Diabetes Mellitus	0.411	0.092	1.825	0.242
Dyslipidemia	0.833	0.184	3.777	0.813
Smoking	1.750	0.328	9.351	0.513
Duration of harvesting	1.048	1.012	1.085	**0.008***

*OR=Odds ratio, CI= Confidence interval, Univariate binary logistic regression was used (Dependent variable is Occurrence of purulent discharge), *indicates significant p-value*

6.1% in EVH, P=0.04). In the OVH group, four individuals had wound problems. Thirty-two days after the operation, one surgical wound gaped, and three wound problems occurred in the first week following the procedure. Patients in the OVH group were substantially more likely to have ecchymosis that extended 5 mm or more from the line of incision (26% in OVH vs. 4% in EVH,p<0.001).

The open harvesting technique's lengthy, continuous incisions disrupted the blood supply and fascial perforators in the lower leg skin and subcutaneous tissue, resulting in less healing than with EVH. Furthermore, the lengthy, continuous skin incisions made during the conventional approach raised the possibility of hemorrhage, ecchymosis, edema, and other wound problems.

Mubarak & Abdeljawad, [17] compared the healing process between EVH and OVH groups and found that 10 patients out of 50 in OVH and none of EVH had wound drainage. Also, ecchymosis, wound edema, and hematoma was reported more often in OVH compared with EVH. However, the difference was non-significant.

Wound dehiscence was significantly lower in EVH (0.0%) compared with OVH group (23.3%). Similarly, Mubarak & Abdeljawad [17] reported statistically significant lower rates of dehiscence in EVH compared with OVH groups. Our current study clarified that EVH showed a lower incidence of keloid scar, edema, and altered. sensation compared with the OVH group; however, the relation was non-significant. Also, 2 (6.7%) of the studied patients exhibited wound infection in EVH. However, 7 (23.3%) of the OVH group expressed wound infection, but the relation was non-significant.

A meta-analysis [19] was conducted in 2019 to compare midterm and long-term outcomes of endoscopic versus open vein harvesting for coronary artery bypass. The study examined 2572 articles and concluded that the incidence of leg-wound complications was significantly higher in OVH than in the EVH group. Also, Ouzounian et al. [16] showed that a statistically significant difference between EVH and OVH regarding the incidence of leg infection. Krishnamoorthy et al., [20] studied surgical site infection and compared it between EVH and OVH groups. Krishnamoorthy et al. found that no wound infection was reported in the majority of EVH and OVH groups (96.3% vs. 94.9%% respectively). But 2.6% of the OVH group reported leg infection, which is more than the EVH group, who reported leg infection only in 0.4% of them (p<0.001).

Ouzounian et al. declared that EVH was associated with reduced leg infections [16]. Previous studies highlighted the intricacy of wound healing and the fact that there is not a

single cause for every discrepancy [21,22]. This study identified no significant difference in the length of hospital stay between both groups. Similarly, [20] it was found that the length of hospital stay in EVH was 9.19 days and in OVH was 9.09 days, and the relation was non-significant.

Earlier mobilization of patients and a reduction of wound complications may result in a reduction of recovery time and, therefore, length of hospital stay. This study shows that none of the EVH group were readmitted to treat leg wound complications or needed leg plastic surgery; however, two out of 30 patients who underwent OVH were readmitted to treat leg wound complications and needed plastic surgery. In addition, the majority of both groups were satisfied with their leg wound, but the satisfaction was higher among the EVH group. Elhelw et al. [15] found that all EVH patients were extremely cosmetically satisfied with their leg wounds, but only 12.5% of the OVH group showed extreme satisfaction.

Our study found no significant difference between both groups regarding revision for bleeding, and only 2 from EVH and from the whole studied sample came for revision for leg bleeding. In the same line with our study was Zenati et al., [9] who found that 2.4% OF OVH and 2.5% of EVH were re-operated again for bleeding within 30 days from operation; however, the relation was non-significant.

Increased duration of vein harvesting time was significantly associated with increased risk of purulent wound discharge. Unosson et al. [23] found female sex, DM, high BMI, and duration of surgery, as well as the presence of peripheral vascular disease, to be a predictor for leg wound infection. Overall, Wang et al. [24] stated that, when comparing in-hospital outcomes, EVH and OVH are comparable. Furthermore, EVH is not linked to worse clinic outcomes (all-cause death, major cardiovascular events) compared to OVH in the three-year follow-up.

Also, Grant et al. [14] clarified that there was no correlation seen between EVH and a higher risk of midterm death, in-hospital morbidity, or in-hospital mortality) compared with the OVH group. This study found that overall, there was no significant difference in the occurrence of angina between both groups, yet the incidence of occurrence was 6.7%. Similarly, Andreasen et al. [10] clarified that there was no statistically significant difference between both groups in the occurrence of angina, and the incidence of occurrence was 16.3%.

Vascular surgery professionals are well aware that a variety of factors, including conduit quality and graft diameter, can lead to venous graft failure or occlusion, which in turn causes recurrent angina pains [3]. Our study had many limitations. One of these limitations was the small sample size and the study was single center. Moreover, the follow-up duration was only 3 months, which is a relatively short duration to investigate many other outcomes.

Conclusion

When comparing open and endoscopic techniques for harvesting saphenous veins, ecchymosis was more prevalent in EVH, while wound dehiscence was more prevalent in the OVH group. Surprisingly, both groups had no significant difference regarding other wound problems, including purulent discharge. On follow-up, both groups didn't show any significant difference in terms of readmissions for leg wound complications, need for plastic surgery, cosmetic satisfaction, bleeding, or recurrence of angina.

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Conflict of interest: Authors declare no conflict of interest.
Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request

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