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Comparison of endoscopic and open saphenous vein harvesting: Impact on postoperative in-hospital outcomes

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ABSTRACT

Objectives: This study aimed to investigate the cost-effectiveness, technical feasibility, and potential benefits associated with endoscopic saphenous vein harvesting.

Patients and methods: This study included a total of 122 patients who underwent coronary bypass surgery with saphenous vein grafts between January 2022 and March 2023. Fifty-six (44 males, 12 females; mean age: 62.5±8.6 years; range, 43 to 77 years) of the patients were assigned to the endoscopic harvesting group, while 66 patients (57 males, 9 females; mean age: 60.1±9.1 years; range, 42 to 81 years) were assigned to the open harvesting group. This study compares endoscopic saphenous harvesting and open technique in terms of clinical implications, including wound healing and clinical recovery and patients' pain experiences.

Results: Among the comorbidities evaluated, the prevalence of hypertension, type 2 diabetes mellitus, and chronic kidney disease did not show statistically significant differences between the two groups. There were no reported cases of graft branch complications, graft-related bleeding, or graft thrombosis in either group. However, the occurrence of wound discharge was significantly lower in the endoscopic group (0%) compared to the open group (13.6%). Patients who underwent endoscopic saphenous vein harvesting also experienced less pain and had a significantly lower incidence of keloid scar formation at the wound site. Both groups had comparable rates of debridement, while systemic infection was observed in 0% of the endoscopic group and 1.5% of the open group. Wound site infection was lower in the endoscopic group (0%) compared to the open group (4.5%). The length of hospital stay in the ward did not show a significant difference between the two groups. However, the time required for wound dressing was significantly shorter in the endoscopic group compared to the open group.

Conclusion: These findings suggest potential advantages of endoscopic surgery in terms of reduced postoperative complications and faster wound healing.

Keywords: Coronary artery bypass surgery, endoscopic saphenous vein harvesting, endoscopic vein harvesting.

Coronary bypass surgery is still the most common surgical procedure in cardiac surgery. It involves the use of vascular grafts, such as the left internal mammary artery, radial artery, and saphenous vein. Among these grafts, the saphenous vein is commonly used due to its lower tendency to spasm compared to radial grafts and its relatively straightforward harvesting process. However, the harvesting of saphenous vein grafts requires careful attention due to their varying lengths (usually 35 to 70 cm) and the presence of multiple branches.[1]

Traditionally, the harvesting of the vena saphenous magna involved open surgery, a practice that had persisted worldwide from the early days of coronary surgery until recent decades.[1] However, this open surgery approach often resulted in a painful experience for patients, sometimes leading to infections and prolonged hospital stays, decreased quality of life, and increased effort in wound care.[2,3] Fortunately, the introduction of video-assisted saphenous vein harvesting in 1996 brought about a significant shift.[4] Since the demonstration of the superior healing properties of the endoscopic method in 1999,[5] accumulating evidence continues to support the notion that endoscopic vein harvesting (EVH) surpasses open saphenous harvesting in terms of improved quality of

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life and outcomes at the surgical site. According to the EACTS (European Association for Cardio-Thoracic Surgery)/ESC (European Society of Cardiology) and ACC (American College of Cardiology)/STS (Society of Thoracic Surgeons) guidelines, experienced surgical teams have the option to utilize EVH, emphasizing its advantages in terms of patient recovery and reduced wound complications.[6,7] However, some concerns persist regarding cost-effectiveness and cardiac outcomes.[8] Hence, this study focuses on examining the experience of endoscopic saphenous harvesting and its clinical implications, including wound healing and clinical recovery, within a single surgical team at our center.

PATIENTS AND METHODS

This retrospective, single-center, nonrandomized study included 122 patients between January 2022 and March 2023. The patients met specific criteria from the all patient who had undergone elective isolated coronary bypass surgery performed by the same surgical team. The selection criteria were as follows: patients who underwent coronary artery bypass grafting with saphenous vein grafts and patients without any prior diagnosis of peripheral artery disease or venous insufficiency.

An endoscopic harvesting system was routinely used since the beginning of the program if the endoscope was available. However, the endoscope was in common use with other departments. If the system was not available, the open technique was employed for saphenous vein harvesting. There were no selection criteria between harvesting methods. Among the selected patient group, 56 individuals (44 males, 12 females; mean age: 62.5±8.6 years; range, 43 to 77 years) underwent EVH, while the remaining 66 patients (57 males, 9 females; mean age: 60.1±9.1 years; range, 42 to 81 years) underwent the traditional open harvesting technique.

Data collecting

Preoperative medical histories and demographic data of the patients were meticulously gathered from patient files and the hospital's electronic system. These records included information on variables such as the type of surgery, age, sex, body mass index, smoking prevalence, hypertension, type 2 diabetes mellitus, chronic kidney disease, and the average number of venous grafts utilized.

Additionally, perioperative details, including operative time, wound drainage, debridement, systemic infection, wound infection, length of hospital stay, and duration of wound dressing, were also extracted from patient files. To evaluate their pain status and the presence of keloid scar formation, patients underwent teleconsultation assessments. Wound illustrations were also collected (Figure 1). To assess the pain status, a singular binary question utilizing a yes/no response format was utilized.

Endoscopic harvesting

All patients underwent preoperative routine ultrasound imaging. The VirtuoSaph+ (Terumo, Corporation, Tokyo, Japan) system was utilized for endoscopic extraction in all cases. As a standard procedure, a 2 to 3 cm oblique incision was made from the sub-knee region at the medial tibial border. Under the guidance of a conical-tipped camera dissection catheter, the saphenous vein and its branches were explored using the system's 10-15 mmHg 3 L/min carbon dioxide insufflation support. A closed cavity was created and dissected up to the groin. Subsequently, the second component of the system, an electrocautery device, was introduced to separate the branches from distal to proximal, and the saphenous vein was secured within the locking mechanism at the system's end. The device was then used to remove the saphenous vein from its distal and proximal ends. Afterward, a minimal incision with a diameter of 0.5 to 1 cm was made at the most proximal end at the groin using an 11 scalpel, and the saphenous vein was grasped with a mosquito forceps, pulled out from the skin, and divided. The liberated saphenous was pulled out through the distal incision. The free part, held with the distal mosquito forceps, was ligated, clipped, and buried under the skin. The extracted saphenous vein's branches were tied and clipped outside. Finally, the distal end was closed with sutures or staples (Figure 2).

Open surgical harvesting

The open method involved a standard procedure of creating a longitudinal incision over the medial malleolus. The saphenous vein was carefully dissected and separated from the surrounding tissue, ensuring the removal was done without adipose or surrounding tissue. Subsequently, subcutaneous 2/0 Vicryl sutures were used for closure, followed by closure of the skin using staples or 3/0 Vicryl skin sutures.

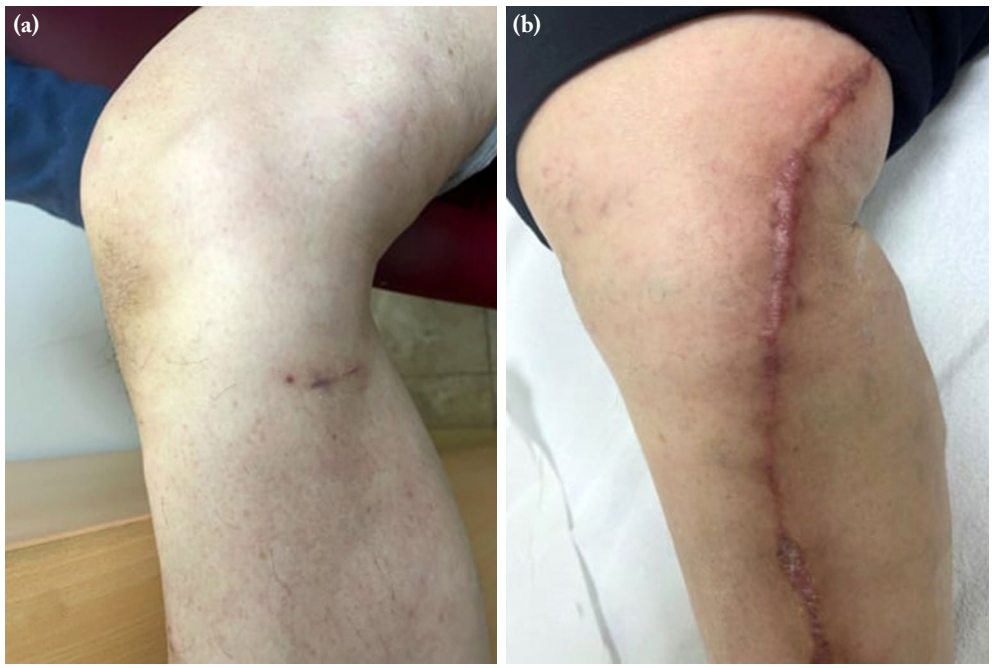

Figure 1. **(a)** Healed distal incision of a patient in the EVH group. **(b)** Healed incision of a patient in the open group.
EVH: Endoscopic vein harvesting.

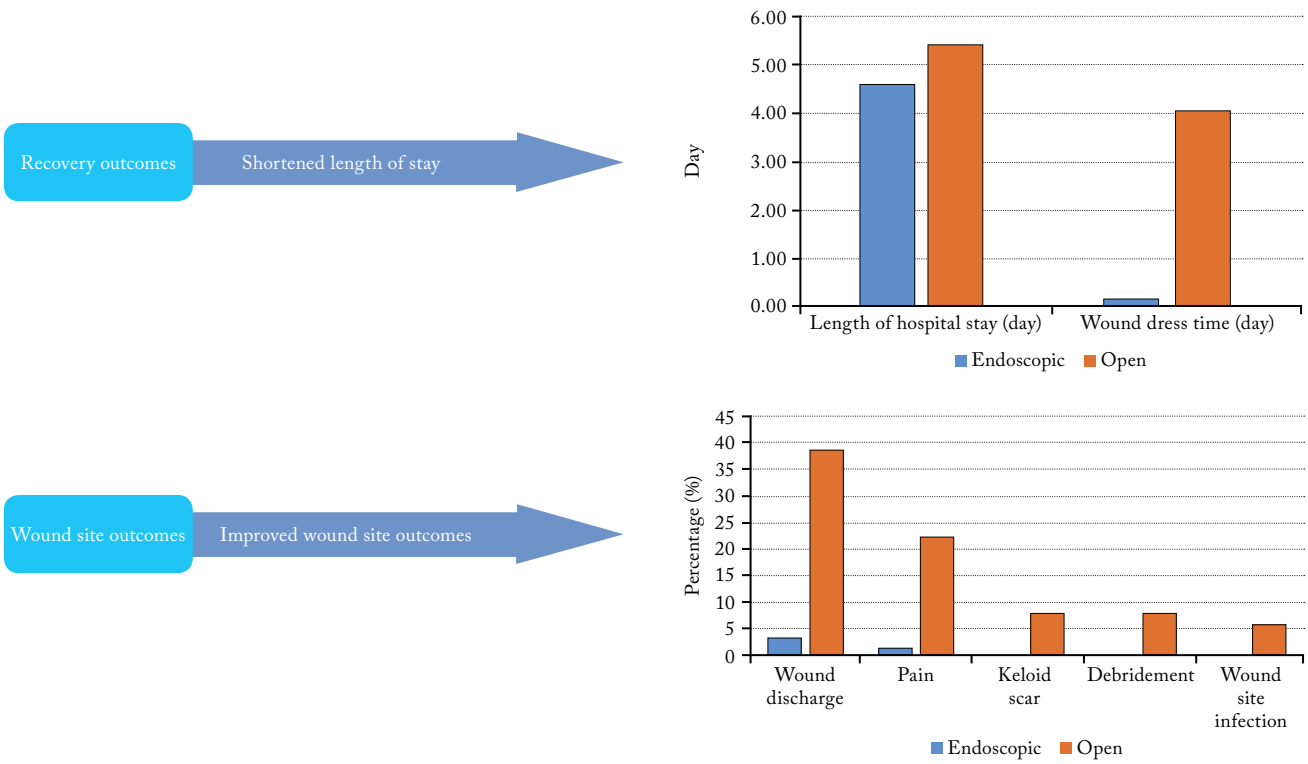

Figure 2. Central figure.

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 22.0 software (IBM Corp., Armonk, NY, USA). The categorical data were analyzed using the chi-square test, Fisher exact test, and the Phi-Cramér test, which are suitable for examining associations and dependencies between categorical variables. The numerical data were analyzed using the analysis of variance F-test and Student's t-test, which are appropriate for comparing means between groups. In addition, post hoc power analysis was performed to determine the power of the study. A *p*-value <0.05 was considered statistically significant.

RESULTS

The results presented in Table 1 compare the demographic and clinical characteristics between patients who underwent EVH and those who underwent open surgery. The mean age of the EVH group and the open surgery group did not statistically significantly differ (p=0.758). The percentage of female patients was higher in the EVH group at 21.4% (n=12) compared to 13.6% (n=9) in the open surgery group, although the difference was not statistically significant (p=0.256). Both groups had similar mean body mass index values, with the EVH group averaging 28.1±4.1 and the open surgery group averaging 27.7±4.8 (p=0.879). The prevalence of smoking was 33.9% (n=19) in the EVH group and 51.5% (n=34) in the open surgery group, showing a trend toward significance (p=0.051). The percentages of patients with hypertension, type 2 diabetes mellitus, and chronic kidney disease were comparable between the two groups, with no statistically significant differences observed (p>0.387 for all). Furthermore, the mean number of venous grafts used was 2.4±0.7 in the EVH group and 2.3±0.8 in the open surgery group, with a *p*-value of 0.138, indicating no significant difference.

Table 2 presents the outcomes of the endoscopic and open approaches for the variable studied. The mean operation time was similar for both groups, with 280±52 min in the EVH group and 276±53 min in the open group (p=0.739). There were no reported cases of graft side branch complications, graft-related bleeding, or graft thrombosis in either group. However, there were significant differences observed in several variables. The incidence of wound discharge was significantly higher in the open group (n=24, 38.7%) compared to the EVH group (n=2, 3.4%; p=0.017). Similarly, the open group had a higher prevalence of pain (n=14, 22.6%) compared to the EVH group (n=1, 1.7%; p=0.001). Keloid scar formation was also more common in the open group (n=5, 8.1%) compared to the EVH group (n=0; p=0.026). However, there were no significant differences in the rates of systemic infection (n=1, 1.5% in open *vs.* n=0 in EVH; p=0.355) or wound site infection requiring debridement (n=4, 6.1% in open *vs.* n=0 in EVH; p=0.061). The

Table 1
Patient characteristics

	Endoscopic group			Open group			
Variables	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (year)			62.5±8.6			60.1±9.1	0.758
Sex							
Female	12	21.4		9	13.6		0.256
Body mass index			28.1±4.1			27.7±4.8	0.879
Smoking	19	33.9		34	51.5		0.051
Hypertension	37	67.9		42	63.6		0.625
T2DM	27	48.2		37	56.1		0.387
Chronic kidney disease	3	5.4		4	6.1		0.868
Venous graft counts			2.4±0.7			2.3±0.8	0.138

SD: Standard deviation; T2DM: Type 2 diabetes mellitus.

Table 2
Outcomes of the procedures

	Endoscopic group			Open group			
Variables	n	%	Mean±SD	n	%	Mean±SD	*p*
Operation time (total)			280±52			276±53	0.7390
Graft side branch complications	0	0.0					-
Graft-related bleeding	0	0.0					-
Graft thrombosis	0	0.0					-
Wound discharge	2	3.4					**0.017**
Pain	1	1.7					**0.001**
Keloid scar	0	0.0					**0.026**
Debridement	0	0.0					**0.026**
Systemic infection	0	0.0					0.355
Wound site infection	0	0.0					0.061
LOS ward			4.6±0.9			5.4±3.0	**0.012**
Time of wound dress (day)			0.2±0.8			4.0±5.5	**0.002**

SD: Standard deviation; T2DM: Type 2 diabetes mellitus.

length of stay in the ward was significantly shorter in the EVH group (4.6±0.9 days) compared to the open group (5.4±3.0 days; p=0.012). Additionally, the time required for wound dressing was significantly shorter in the EVH group (0.2±0.8 days) compared to the open group (4.0±5.5 days; p=0.002). The post hoc analysis revealed that the study had a power of 0.99 for the wound discharge subject and 0.96 for pain assessment. However, the power was constrained to 0.47 in relation to the wound site infection.

DISCUSSION

Since its introduction in 1996, the video-assisted endoscopic method of saphenous harvesting has gained significant popularity in the coronary surgery.[4] Furthermore, by 2008, approximately 70% of saphenous harvesting in the UK was performed using this technique.[8] This rapid dissemination can be attributed to numerous benefits associated with endoscopic saphenous harvesting, as extensively documented in the literature.[8] These advantages include improved wound healing, reduced risk of infection, and shorter hospital stays. On the flip side, it is worth noting that some randomized controlled trials have reported poor cardiac outcomes associated with EVH compared to open saphenous harvest. These findings have raised certain concerns within the cardiac surgery community.[9,10]

Consistent with existing literature, our study demonstrated a significant reduction in wound dressing time and faster wound healing in the endoscopic harvest group.[11-13] Furthermore, the open group exhibited a significantly higher incidence of wound site discharge and requirement for debridement compared to the EVH group. However, contrary to the findings reported in the existing literature, we did not observe a statistically significant difference between the two groups regarding wound infection.[12,13] It is essential to acknowledge that although we did not experience any case of wound site infection in the EVH group, the limited sample size in our study might have contributed to the lack of a significant difference in wound infection rates. Additionally, it is worth highlighting that one patient in the open surgery group developed sepsis as a consequence of wound infection, underscoring the criticality of meticulous wound management in surgical procedures.

In our study, we rigorously implemented the enhanced recovery after surgery (ERAS) protocol, which is designed to optimize patient care and reduce hospitalization duration in both the endoscopic and open groups. Our efforts aimed to minimize hospital stays, particularly for patients undergoing multivessel coronary bypass surgery. This approach aligns with previous studies that have shown the benefits of shorter hospitalization periods for patients following ERAS

protocols.[14,15] Remarkably, the EVH group exhibited significantly shorter hospitalization durations and dressing times, suggesting that endoscopic harvesting is not only more cost-effective but also facilitates faster patient recovery. These findings underscore the potential advantages of adopting endoscopic techniques in saphenous harvesting for coronary bypass surgery.

Our study findings align with existing literature in terms of quality of life outcomes. Specifically, we observed consistent results regarding pain levels in the postoperative period, where the EVH group exhibited significantly lower pain in the saphenous harvest area compared to the open group. Moreover, the incidence of keloid scar formation at the wound site was significantly lower in the EVH group. These outcomes highlight the clear superiority of endoscopic saphenous harvesting in terms of pain management and minimizing keloid scar formation, which are important factors influencing the quality of life for patients undergoing this procedure.

Neither group exhibited any occurrences of graft thrombosis, bleeding from graft branches, or structural deterioration in the graft, which are considered important graft-related adverse event outcome parameters. These findings suggest that the technique of saphenous vein harvesting, whether endoscopic or open, can be safely employed with regard to cardiac considerations.

While the study holds significant value, there are two limitations that need to be acknowledged and addressed: the retrospective design and the absence of long-term results. Despite these limitations, the study offers a comprehensive and insightful real-world view of endoscopic harvesting, particularly within a region where such techniques are rarely employed. Additionally, it is crucial to emphasize that the statistical analysis yields a substantial power level of over 95% for wound discharge and pain assessment. This high statistical power underscores the robustness and reliability of the study's findings in these aspects.

In conclusion, our study compared the outcomes of endoscopic and open saphenous vein harvesting methods. The EVH group demonstrated favorable wound site outcomes, including faster healing, reduced dressing time, and lower incidence of wound discharge. Although no significant difference was found in wound infection rates, the limited sample size may have influenced this result. Both groups had comparable recovery outcomes, likely due to adherence to the ERAS protocol. Endoscopic harvesting showed superior quality of life outcomes, with lower postoperative pain and fewer keloid scars. Importantly, neither group experienced cardiac complications, such as graft thrombosis or bleeding. These findings support the safety and benefits of EVH, contributing to the existing knowledge and guiding surgical decision-making for optimal patient outcomes.

Ethics Committee Approval: The study protocol was approved by the Koşuyolu High Specialization Hospital Ethics Committee (date: 04.07.2023, no: 2023111/703). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Concept, design, literature review, writing the article: M.M.O.; Control, supervision: M.A., T.O.; Data collection: A.M.O.; Materials: H.H.; Critical review: K.K.

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