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Endoscopic versus Open radial artery harvesting for Coronary Bypass Grafting; one-year patency rates

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Abstract

Background: Research is ongoing on the effects of endoscopic radial artery harvesting (ERAH) on clinical outcomes and patient satisfaction. This study evaluated the clinical outcomes, patient satisfaction, and radial artery graft patency of ERAH compared with the open technique (ORAH) for coronary artery bypass grafting (CABG).

Methods: We conducted a randomized controlled clinical trial involving 100 patients who underwent on-pump elective CABG with three or four vessels. Patients were randomly allocated into two groups: the ERAH group consisted of 50 individuals who underwent radial artery harvesting via endoscopy, whereas the ORAH group included 50 patients whose radial arteries were harvested via the conventional open technique. The study outcomes included the length of radial artery harvest, operating time, and postoperative outcomes, including hematoma formation, wound infection, and local neurological issues related to lesions of the dorsal radial nerve.

Results: Hospital stays were significantly shorter in the ERAH group than in the ORAH group (7.06 ± 0.79 days vs. 7.9 ± 0.81 days, P < 0.001). Additionally, peripheral neurological complications were significantly different between the groups, occurring in none of the patients in the ERAH group but in 6 patients (12%) in the ORAH group. Wound healing was also significantly better in the ERAH group than in the ORAH group (100% vs. 88%, P = 0.027), with all patients in the ERAH group experiencing seamless wound healing. In the ORAH group, two patients (4%) had wound infections, and four patients (8%) developed hematomas. Both groups presented similar rates of perioperative ischemia and radial artery graft patency. Patient satisfaction was significantly better in the ERAH group (P<0.001).

Conclusion: After one year, the patency rates of ERAH and ORAH were similar. However, patient satisfaction and wound healing were better in the ERAH group.

KEYWORDS
Endoscopic; Radial Artery Harvesting; Open Harvesting; Coronary Bypass Grafting

Introduction

One of the most common cardiac disorders is coronary artery disease, which has an in-hospital death rate of 7–8% [1]. Research has demonstrated that in-hospital mortality rates are significantly lower for patients with ST-elevation myocardial infarction (STEMI) who receive percutaneous coronary intervention (PCI) or

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coronary artery bypass grafting (CABG) than for those who do not receive intervention [1]. Carpentier and colleagues initially reported the use of the radial artery for CABG in the early 1970s; however, owing to early poor outcomes, they discontinued the procedure [2].

When a young patient has significant coronary artery stenosis, radial artery grafting could lead to favorable long-term outcomes [3]. Regarding CABG, the radial artery offers several benefits. When bilateral internal mammary artery harvesting increases surgical risk, such as in individuals with chronic obstructive pulmonary disease (COPD), diabetes, or obesity, the right internal mammary artery (RIMA) can be substituted with the radial artery [4]. The radial artery should be placed on critical lesions with very faint native ante-grade flow because of its strong muscle wall, which makes it more prone to spasms from the competitive flow [5]. The radial artery can be anastomosed to the aorta or the internal mammary artery as a T or Y graft [6].

There are two methods for radial artery harvesting: endoscopic and open harvesting. A broad longitudinal forearm incision is required for an open radial artery harvest, which raises the possibility of wound problems and a prolonged harvest period [7]. The open non-touch method of radial artery harvesting (ORAH), altered by Reyes et al.[8], has gained popularity. Additionally, in recent years, endoscopic radial artery harvesting (ERAH) has been established [9]. Currently, endoscopic harvesting of both the saphenous vein and the radial artery is performed on approximately 80% of CABG patients in the US [10]. Endoscopic radial artery harvesting has recently been linked to improved wound healing and appearance. It has also been shown to be safe and effective and to cause less discomfort and complications from wounds [11]. The effects of ERAH on clinical outcomes and patient satisfaction are the subject of ongoing research. This research evaluated the clinical results, patient satisfaction, and radial artery graft patency of ERAH and ORAH for CABG.

Patients and Methods

Design and patients

We conducted an open-label, randomized, controlled clinical trial involving 100 patients who underwent on-pump CABG at two hospitals in Saudi Arabia from June 2017 to June 2022. The study included patients with multivessel disease undergoing elective CABG, utilizing either the left or right internal mammary artery (LIMA, RIMA), along with at least one radial artery (RA) graft. Prior to enrollment, all patients provided informed written consent, and the study received approval from the institutional ethical committee.

The exclusion criteria were as follows: patients who refused participation; individuals who had undergone nonelective surgery (such as urgent or emergency revascularization); those who had received robotic, minimally invasive, or repeat CABG; patients who underwent CABG in conjunction with any related surgical procedures; and those with renal failure, insufficient compensatory flow, or an incomplete palmar arch. Additional contraindications included a pathological Allen test, abnormal Doppler examination results, dialysis, Dupuytren's disease, carpal tunnel syndrome, and severe arterial occlusion.

Randomization

Patients were randomly allocated into two groups via a computer-generated random sequence with a 1:1 ratio. The ERAH group consisted of 50 individuals who underwent radial artery harvesting via endoscopy, whereas the ORAH group included 50 patients whose radial arteries were harvested via the conventional open method.

Data

Each patient received a 12-lead electrocardiogram and echocardiography. They also underwent a thorough medical history review, clinical assessment, and laboratory testing. The information gathered included age, sex, and any concomitant conditions such as diabetes and hypertension. The operative data collected included the length of the harvested radial artery and the operating time. Postoperative outcomes included hematoma formation at the wound site, the need for reexamination, wound infection, and local neurological issues resulting from nearby lesions of the dorsal radial nerve, which could cause numbness on the dorsum of the hand. The impact of these factors on hospitalization was also evaluated.

The total time spent in the procedure was measured from the patient's entry into the operating room until their exit. The conduit harvesting time was defined as the duration from skin incision to conduit readiness for implantation, excluding the time required for wound closure, patient realignment, or equipment reassembly [12].

Surgical procedures

Technique for endoscopic radial artery harvesting

Arm Harvesting Preparation

The entire donor arm was cleansed and prepared from the shoulder to the hand and fingers. A stockinet was placed as high as possible on the donor's arm, near the humeral epicondyles. An unpressurized tourniquet was then positioned over the stockinet and fastened to the insufflation device.

Skin incision

A longitudinal skin incision measuring 2 to 3 cm was made just proximal to the wrist crease, exposing the radial artery. The radial pedicle and both accompanying venae commitantes were visualized via a small arterial loop. The patient received 3,000 U of sodium heparin via central intravenous catheterization. Dissection at the incision released the superficial fascia and connective tissue from the anterior surface of the radial pedicle.

Two soft vascular clamps were applied at the distal end of the radial artery following a two-minute heparin delivery period. After a small arteriotomy was performed, 30 mg of intra-arterial papaverine was administered according to the surgeon's preference. An elastic bandage was then applied from distal to proximal over the entire hand and forearm, and the tourniquet was inflated to 200 mm Hg. After the soft vascular clamp was removed, the pressure was gradually increased until blood flow through the arteriotomy ceased. The maximum tourniquet time was limited to one hour and was not utilized during cardiopulmonary bypass. After the bandage was removed, the distal radial artery was sutured. The VasoView conical dissection cannula was then placed into the wound after preloading the BTT port.

Radial artery dissection

No more than 5 mL of air was required to inflate the BTT balloon to the minimum level needed to create an adequate seal. The endoscope-equipped blunt dissection cannula was positioned to maintain constant visibility of the radial pedicle. Using the endoscopic vein harvesting technique, CO_2 was introduced as the cannula was carefully advanced, pressurizing the tunnel to approximately 15 mm Hg. Continuous monitoring of expired pCO_2 was conducted, similar to standard endoscopic vein harvest practices. Bipolar scissors were used to make longitudinal cuts in the fascia of the brachioradialis muscle. The exposure was limited to the point where the brachial artery bifurcated, marking the origin of the radial artery.

Radial artery harvesting

The predissected tunnel was filled with VasoView UniProt Plus dissection cannula, featuring a conical tip and bipolar scissors. As with the open approach, all electrocautery procedures were performed at a safe distance from the artery, with the 30-watt bipolar electrocautery adjusted accordingly. The pedicle was stabilized with a cradle prior to coagulating the branches to minimize heat damage, maintaining a small distance between the bipolar scissors and the artery. With the use of the EVH technique, the full division of branches was confirmed by moving the vessel cradle longitudinally. Proximal radial artery ligation was performed under endoscopic view using an Endo-loop slipknot (Ethicon, Somerville, NJ) at the origin of the brachial artery. The radial artery was then cut with endoscopic scissors without coagulation.

Preparation of the radial artery graft involved canning the artery at its proximal end and flushing it with 30 mg of papaverine. Cauterization was performed as needed, and the radial artery was

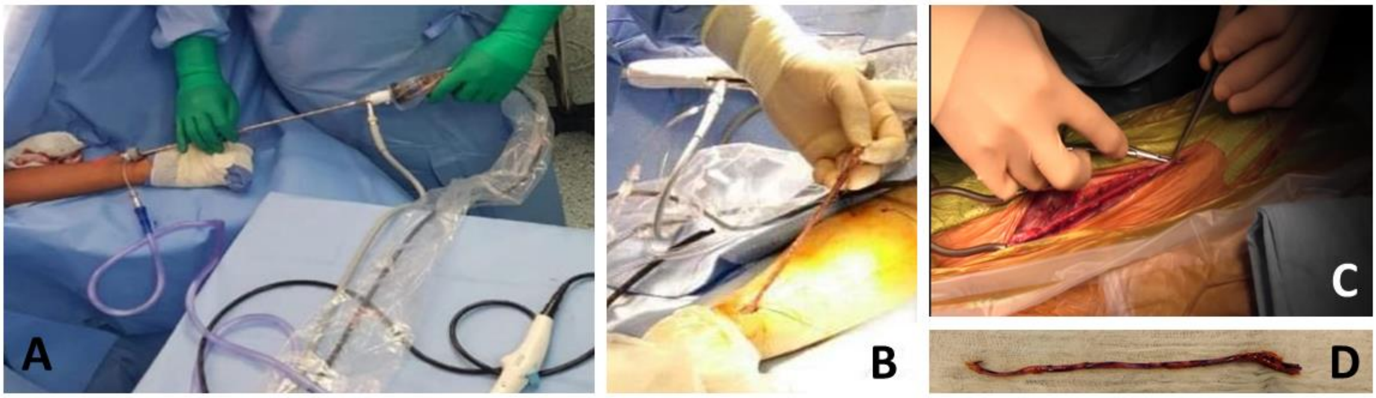

Figure 1: Techniques for radial artery harvesting. A: Endoscopic harvesting of the radial artery. B: Endoscopically harvested radial artery before ligation and division. C: Open radial artery harvesting (a longitudinal cut made along the radial artery in the forearm). D: Endoscopically harvested radial artery.

carefully inspected for arterial spasm, hemorrhage, and hematomas. Before grafting, the metal clips and/or arterial branches were ligated. The wound was closed via 3-0 and 4-0 Vicryl or Monocryl sutures. An elastic bandage was used to wrap the hand and arm securely. The tourniquet was then removed and deflated, and an abdominal pad was placed beneath the wrap. The total duration of the tourniquet was recorded. After the coronary grafting procedure and heparin reversal, the tight wrap was removed, and the entire arm was loosely rewrapped (Figure 1 and Figure 2).

Open harvesting

The procedure employed involves the traditional open radial artery harvesting approach via a forearm incision made along the path of the nondominant hand's radial artery. This incision begins at the felt pulse of the artery and extends to the brachial artery. To prevent direct, blunt trauma, the artery was extracted as a single pedicle along with its accompanying venae commitments, minimizing graft manipulation. Dissection of the pedicle was performed via low-intensity monopolar electrocautery or a harmonic ultrasound knife, and vascular clips were used to control any necessary side branches. The forearm was closed via Vicryl over a direct drain (only in certain obese patients), and one layer of subcutaneous tissue was used, while the fascia was left unclosed. After closure, the forearm was wrapped in a straight elastic bandage.

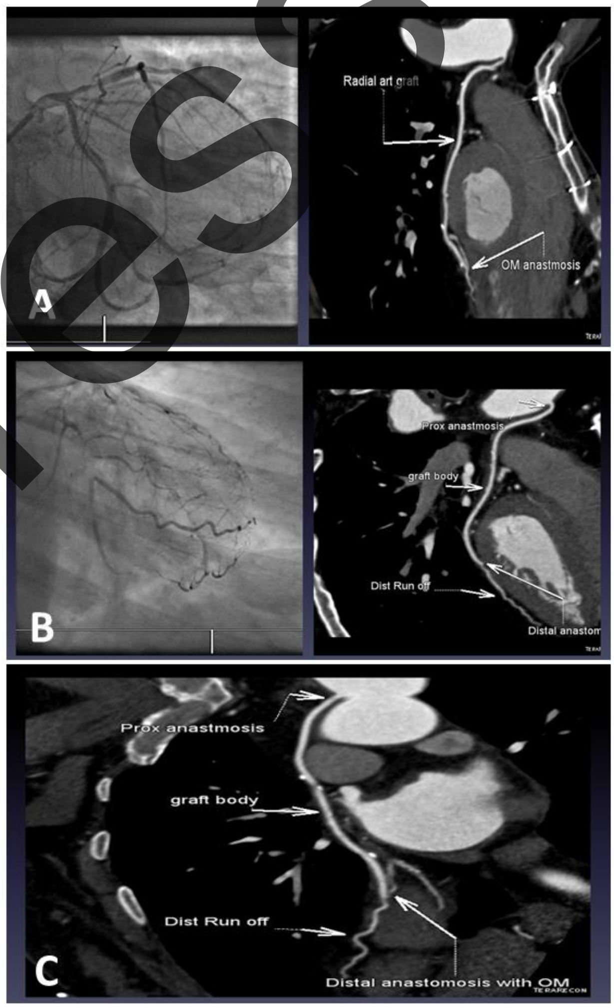

Figure 2: Follow-up image after 1 year of cardiac 64-slice CT. A: Preoperative coronary angiography and 1-year postoperative CT image showing good patent anastomosis (endoscopic harvesting group). B: Preoperative coronary angiography and CT image at follow-up after 1 year showing good distal anastomosis and good distal run-off (open group). C: CT image after 1 year showing bad distal anastomosis and poor distal run-off

Figure 3: Scars in both groups: A: ugly wound scar and granulation tissue 45 days after ORAH; B: gangrenous skin wound 3 weeks after ORH; C: ORAH wound keloid; D: wound of the endoscopically harvested radial artery (small incision, better cosmetic outcome)

Both methods involved dividing the radial artery after heparinization and performing dissection without systemic heparin. Once harvesting was complete, the incision on the forearm was closed, and if necessary, a direct drain was installed along with an elastic stock to cover the forearm.

Assessment of target vessel stenosis

Preoperative angiography provided information on the degree of stenosis in the target vessels for bypass grafting, allowing for a visual assessment of native coronary artery stenosis on the basis of these data.

Multislice Computed Tomographic Angiographic Analysis: A computed tomographic angiographic scan was typically performed within one year of CABG. The scanning range included the most proximal portions of the grafts at their subclavian origin as well as the entire course of the venous grafts. In the context of the initial CABG, two investigators independently assessed each bypass graft. Each investigator analyzed axial slices, multiplanar reformations, and three thin-slab maximum intensity projections of the contrast-enhanced MSCT scans. The maximal luminal diameter stenosis in a given plane was used to classify lumen narrowings [13].

Table 1: Demographic data, comorbidities, preoperative ejection fraction, and serum creatinine of the studied groups. Data are presented as the mean ± SD or frequency (%)

		EARH group (n=50)	ORAH group (n=50)	P value
Age (years)		61.3 ± 8.58	59.92 ± 9.41	0.445
Sex	**Male**	47 (94%)	45 (90%)	0.715
	Female	3 (6%)	5 (10%)	
BMI (Kgm2)		29.67 ± 1.95	29.32 ± 1.77	0.350
Hypertension		18 (36%)	14 (28%)	0.409
Diabetes Mellitus		20 (40%)	22 (44%)	0.702
COPD		5 (10%)	4 (8%)	0.501
Smoking		21 (42%)	17 (34%)	0.435
Hyperlipidemia		16 (32%)	20 (40%)	0.425
Congestive heart failure		1 (2%)	2 (4%)	0.558
PVD		2 (4%)	0 (0%)	0.153
Preoperative EF (%)		48.7 ± 2.36	48.96 ± 2.12	0.563
Serum creatinine (mg/dL)		0.53 ± 0.11	0.57 ± 0.11	0.104

ERAH, endoscopic radial artery harvest, ORAH, open radial artery harvest, BMI: body mass index, COPD: chronic obstructive pulmonary disease, PVD: peripheral vascular disease, EF: ejection fraction

Owing to the absence of localized bypass stenosis in this cohort, the bypass grafts were categorized as fully patent, partially patent, or occluded.

Echocardiographic analysis

A skilled cardiologist conducted every preoperative and postoperative echocardiogram. Along the long parasternal axis, measurements of left ventricular diameters were made. Visual evaluation was used to determine anomalies in wall motion and left ventricular function [14].

Outcomes

Postoperative nerve pain, hematoma, and vascular or wound complications were assessed. Both major (limiting normal hand or arm motor function) and minor neuralgias were recognized (brief tingling or numbness in the arm or hand). Major (blood accumulation at the incision site or throughout the arm) and mild hematomas were described (any hand or arm ecchymosis). Major wound problems (infections necessitating antibiotics) and minor wound issues were distinguished (any erythema in the hand or arm) [15]. The mortality rate was also evaluated. The assessment focused on the RA graft patency rate.

Twelve months after the procedure, patients completed a brief questionnaire to assess their level of satisfaction. They were asked to rank their overall experience with the RA harvesting procedure and put their arms into one of five groups: poor, average, good, very good, or outstanding, accounting for any additional symptoms such as tingling, numbness, neuralgia, hand function, or cosmetic results. Follow-up at 6 months and 1 year via cardiac echo and cardiac 64-slice CT, coronary angiogram to assess the graft patency rate (Figure 2), left ventricular (LV) function, complications, and mortality

Statistical analysis

SPSS v28 was utilized for the statistical analysis (IBM Inc., Chicago, IL, USA). Unpaired Student's t test was used to compare two groups on the basis of quantitative data, which are reported as the means and standard deviations (SDs). The frequency and percentage (%) of the qualitative variables were reported, and when suitable, Fisher's exact test or the chi-square test was used for analysis. Spearman correlation was used to determine the connection level between two variables. Logistic regression was also used to determine the link between a dependent variable and one or more independent variables. Statistical significance was defined as a two-tailed P value of less than 0.05.

Results

Among the 137 patients who underwent radial artery (RA) grafting, 14 refused to participate, and 23 did not meet the inclusion criteria for our study. Consequently, 100 patients were followed up and statistically analyzed: 50 underwent endoscopic RA harvesting (EARH), while 50 received traditional open harvesting (ORAH).

Table 2: Intraoperative data of the studied groups. Data are presented as the means ± SDs or frequencies (%)

	EARH group (n=50)	ORAH group (n=50)	P value
Operative time (min)	168.6±26.26	167.64±28.2	0.861
Length of incision (cm)	2.47±0.19	24.88±2.04	<0.001*
Length of graft (cm)	17.64 ± 1.06	17.4 ± 1.6	0.380
Need to repair	0 (0%)	2 (3.33%)	0.495
Harvest time (min)	37.82 ± 1.7	29.28 ± 2.37	<0.001*
CPB time (min)	105.6 ± 1.12	105.1 ± 0.79	0.012*
Aortic clamp time (min)	61.28 ± 1.01	60.82 ± 1.41	0.064
Graft flow	50.4 ± 1.14	50.62 ± 1.21	0.352
Pulsatility index value	2.49 ± 0.27	2.5 ± 0.28	0.971
Conversion to ORAH	1 (1.67%)	---	---

ERAH, endoscopic radial artery harvest; ORAH, open radial artery harvest; CPB, cardiopulmonary bypass time; *: statistically significant at P <0.05

Table 3: Outcomes of the studied groups. The data are presented as the means ± SDs or frequencies (%)

	EARH group (n=50)	ORAH group (n=50)	P value
Hospital stay (days)	7.06 ± 0.79	7.9 ± 0.81	<0.001*
Wound healing	50 (100%)	44 (88%)	0.027*
Wound infection	0 (0%)	2 (4%)	0.495
Hematomas	0 (0%)	4 (8%)	0.117
Peripheral Neurological complications	0 (0%)	6 (12%)	0.027*
Vascular compromise of the hand	0 (0%)	0 (0%)	--

ERAH, endoscopic radial artery harvest; ORAH, open radial artery harvest; *: statistically significant P value <0.05

Baseline Data

There were no significant differences between the groups concerning demographics, including age, sex, and body mass index (BMI), as well as associated comorbidities, preoperative ejection fraction (EF), and serum creatinine levels (see Table 1).

Intraoperative data

In terms of the intraoperative data, the length of the incision used for RA harvesting was significantly shorter in the EARH group than in the ORAH group (2.47 ± 0.19 cm vs. 24.88 ± 2.04 cm, P < 0.001). However, the harvesting time was substantially longer in the EARH group than in the ORAH group (P < 0.001). There were no significant differences between the two groups in terms of the operative time, cardiopulmonary bypass (CPB) duration, length of the graft, need for repair, aortic clamp time, graft flow, or pulsatility index value. Additionally, one patient (1.67%) in the EARH group required conversion to the ORAH technique (Table 2).

Outcomes

In terms of outcomes, the hospital stay was significantly shorter in the EARH group than in the ORAH group (7.06 ± 0.79 days vs. 7.9 ± 0.81 days, P < 0.001). Peripheral neurological complications—resulting from lesions of the dorsal radial nerve, which cause numbness on the dorsum of the hand—were significantly different between the two groups, occurring in none of the patients in the EARH group but affecting six patients (12%) in the ORAH group (P = 0.027).

Wound healing was significantly better in the EARH group than in the ORAH group (100% vs. 88%, P = 0.027), with smooth healing reported in all patients in the EARH group (Figure 3). In contrast, the ORAH group experienced complications, with two patients (4%) having wound infections and four patients (8%) developing hematomas (Figure 3). Both wound infections and hematomas were not significantly different between the groups. No vascular complications were reported in either group (Table 3).

Table 4: Patency and factors affecting RA graft patency in the studied groups and classification of patient satisfaction from the radial artery harvest procedure 12 months after surgery. The data are presented as the means ± SDs or frequencies (%)

	EARH group (n=50)	ORAH group (n=50)	P value
Patency rate at 6 months	46 (92%)	44 (88%)	0.741
Patency rate at 1 year	42 (84%)	38 (76%)	0.453
Patient satisfaction			
Poor	0 (0%)	5 (10%)	
Average	0 (0%)	19 (38%)	
Good	23 (46%)	16 (32%)	<0.001*
Very good	22 (44%)	7 (14%)	
Excellent	5 (10%)	3 (6%)	

ERAH, endoscopic radial artery harvest, ORAH, and open radial artery harvest

Table 5: Multivariable logistic regression analysis for the prediction of RA patency

	Coefficient	SE	P	Odds ratio	95% CI
Graft flow	-0.314	0.099	0.002*	0.730	0.6008 to 0.8874
PI value	-3.380	1.064	0.002*	0.034	0.0042 to 0.2738
Senior Surgeon	4.542	0.844	<0.001*	93.857	17.9537 to 490.6608
Surgical assistance	2.351	0.568	<0.001*	10.500	3.4491 to 31.9652
Hyperlipidemia	5.457	1.110	<0.001*	234.333	26.5895 to 2065.1805
Smoking	3.364	0.790	<0.001*	28.895	6.1390 to 136.0001
DM	2.833	0.677	<0.001*	17.000	4.5068 to 64.1259
HTN	3.571	0.705	<0.001*	35.546	8.9198 to 141.6493
EF %	0.220	0.092	0.017*	1.246	1.0408 to 1.4914

SE: standard error, EF: ejection fraction, DM: diabetes mellitus, HTN: hypertension, *: statistically significant, P value <0.05

Follow-up

At six months, the overall patency rate among the 100 patients was 90%. In the ERAH group, four patients experienced issues, including two with stents placed in the radial artery to the obtuse marginal artery (OM1). In the ORAH group, six patients had similar complications, with two having stents placed in the radial artery to the right coronary artery (RCA). At one year, the total patency rate for the 100 patients decreased to 80%. In the ERAH group, eight patients had issues (four in the ramus, two in the first diagonal artery [D1], and two in the posterior descending artery [PDA]), whereas in the ORAH group, twelve patients were affected (eight in the obtuse marginal artery [OM], two in D1, and two in the RCA). The patency rates at six months and one year were similar between the two groups. Factors such as ejection fraction (EF), diabetes mellitus (DM), hypertension (HTN), and hyperlipidemia did not significantly affect radial artery graft patency.

Patient satisfaction

In terms of overall patient satisfaction with the outcomes of the RA harvest at twelve months, the scores were as follows: low satisfaction was reported by zero patients in the ERAH group versus five patients (10%) in the ORAH group; average satisfaction by zero patients in the ERAH group versus 19 patients (38%) in the ORAH group; good satisfaction by 23 patients (46%) in the ERAH group versus 16 patients (32%) in the ORAH group; very good satisfaction by 22 patients (44%) in the ERAH group versus seven patients (14%) in the ORAH group; and excellent satisfaction by five patients (10%) in the ERAH group versus three patients (6%) in the ORAH group. Overall, patient satisfaction was significantly greater in the ERAH group than in the ORAH group (P < 0.001; Table 4).

Multivariate analysis

In the univariate logistic regression analysis, we identified several significant predictors of radial artery patency, including graft flow, the pulsatility index (PI) value, the seniority of the surgeon, surgical assistance, hyperlipidemia, smoking, diabetes mellitus, hypertension, and the ejection fraction (Table 5).

Discussion

In addition to the advantages of the RA as a bypass graft, such as its ideal length, ease of handling due to its robust muscle wall, and accessibility even for individuals with varicose vena comitantes, the endoscopic harvesting method provides supplementary advantages [16]. The harvest time was significantly greater in the EARH group than in the ORAH group (P<0.001). Data from the literature regarding the harvesting times for ERAH and ORAH are very different. Tamim et al. [17] reported that the harvest times were 31 and 28 min for ERAH and ORAH, respectively (P >0.05). In accordance with these findings, Patel et al. [15] reported that both groups' harvest times were comparable in their case series (26 vs 22 min). On the other hand, Kiaii et al. [18] reported that the harvest times for ORAH were significantly shorter in their prospective randomized study. In contrast, Rahouma et al. [19] reported that a prolonged harvesting time following ERAH with a steep learning curve in unskilled hands was discovered in their meta-analysis.

In terms of outcomes, hospital stay was significantly shorter in the EARH group than in the ORAH group. Additionally, neurological complications were significantly different between the two groups, as they did not occur in any patients in the EARH group but occurred in 6 (12%) patients in the ORAH group (P=0.027). Wound healing was significantly better in the EARH group than in the ORAH group (100% vs. 88%, P=0.027); healing wounds were smooth in all patients in the EARH group. In the ORAH group, 2 (4%) patients had wound infections, and 4 (8%) patients developed hematomas; both wound infections and hematomas were not significantly different. Vascular compromise of the hand was not reported in any patients in either group. The first meta-analyses on the topic were conducted in 2014, and they both reported that ERH had a lower rate of wound infection and fewer harvesting site problems [20].

Huang et al. [21], in their meta-analysis, assessed the more complex wound problems that arose throughout the healing process, such as hematoma, seroma, edema, inadequate wound edge healing, and wound infection. Seven trials were analyzed, and the results revealed that the EAH group had considerably fewer complications (RR = 0.33, 95% CI = 0.18 to 0.62, p <0.001). Anatomically, the RA harvesting location contains nerves. One of the primary issues with RA dissection is nerve damage. In the superficial antebrachial cutaneous nerve, the forearm wound incision may cause harm, and the superficial radial nerve is closely associated with the RA at the distal forearm [22]. The neurological consequences at the harvesting site include numbness, sensory abnormalities, neuralgia, and finger weakness [7, 23]. Additionally, Huang et al. [21] found that over the harvest site, the EAH group presented a considerable reduction in neurological complications—a reduction of 59% (RR = 0.41, 95% CI = 0.27 to 0.62, p < 0.001).

Prospectively randomized and case series studies from the literature documented fewer neurological problems with ERAH [15, 18, 24].

Conversely, in his retrospective analysis, Fouly [11] noted that, following ERAH vs. ORAH, there were greater incidences of superficial radial nerve damage and hand numbness (20% vs. 5.2%, P = 0.05), and he attributed this to his lack of endoscopic RA harvesting experience.

We found that overall patient satisfaction was significantly better in the ERAH group than in the ORAH group (P < 0.001). Tamim et al. [17] performed a prospective randomized clinical trial and demonstrated that all patients in the study experienced easy wound healing following ERAH, wherein an experienced center endoscopically harvested the RA. Previous studies have consistently reported improved wound healing with ERAH; the smaller dissection planes and shorter skin incisions needed compared with ORAH appear to be the causes [11, 25]. Because of the pleasing cosmetic outcome of the endoscopic harvest technique, neurovascular problems are rare, wounds heal easily, and ERAH is linked to high patient satisfaction [18].

Patency rates at six months and one year were comparable in the current study for both groups. Some research provides preliminary findings. Miles and associates [26] described how, at a 30-day follow-up, there was no readmission for postoperative angina that would have required recatheterization in the first 50 patients after endoscopic RA harvesting. Yokozaki and associates [27] described patent RA grafts in five individuals via postoperative angiography and endoscopic RA harvesting. In the series of Massetti and colleagues[28], all the RA grafts were patent postoperatively, as assessed by angiography.

A meta-analysis performed by Bleiziffer et al. [13] revealed that the group that underwent follow-up for a duration greater than or equal to one year demonstrated an "almost" significant benefit from EAH (RR = 0.87, 95% CI = 0.74--1.03, p = 0.10). In a study by Tamim et al. [17], the 90% total RA patency rate at the 1-year angiographic follow-up in this study (without distinctions between groups) was similar to earlier data on this conduit. Although Tamim et al. [17] investigated several preoperative, intraoperative, and postoperative characteristics for their potential impact on RA graft patency, under 90% natural coronary artery stenosis was found to be the sole significant factor negatively impacting RA graft patency (P <.0001). This conclusion is consistent with that of Tatoulis et al. [29], who reported that when anastomosed to a coronary artery with a luminal constriction of at least 80%, aorto-coronary RA graft patency is greatly improved. Bleiziffer et al. [13] were the first to report a prospective study examining the patency rate in a cohort of 50 patients one year following endoscopic RA harvest. They discovered that our series' perfect patency rate of 72% one year following endoscopic RA harvesting appears to be comparable to the patency rates following traditional RA harvesting, which has been documented in the literature. A control group of patients received traditional open RA harvesting simultaneously and were followed retrospectively. The two groups did not differ in baseline characteristics or target areas. However, there was no difference between perfect RA patency after endoscopic (72%) and open RA harvesting (74%, P=0.822).

Regarding patency-affecting parameters, we discovered that DM, hyperlipidemia, senior surgeon, EF, and surgical assistance significantly affected the patency of the RA grafts.

The variables determining patency following endoscopic RA harvesting were identified in a prior study. The learning curve and personnel variables, such as the graft harvester or graft implanting surgeon, had a significant effect on RA patency. Moreover, patency was unaffected by patient age or sex. In one case, there was a visible RA spasm upon harvest; one year later, the graft was patent. When the RA grafts were patent after one year, the intraoperatively measured graft flow and PI tended to be better; however, this difference was not statistically significant. Assessing a PI threshold value to forecast graft occlusion was not feasible. This difference may be due to different sample sizes [13,25].

We found that the patency rate increased with increasing stenosis in the target vessel (up to 90%). Furthermore, we discovered a strong positive connection between RA patency and target vascular stenosis (r= 0.669, P<0.001).

Bleiziffer et al. [13] reported that 90.3% of patients had excellent patency for their RA graft in a group with target artery stenosis of 90% or more. The rate of perfect patency was only 42% (6/17), with target artery stenosis of less than 90%, indicating that RA grafts can become occluded when there is competing coronary flow. This relationship was also observed in their retrospective control group, where complete patency was 92% (20/22) of the RA grafts anastomosed to target arteries with a stenosis of 90% or higher compared with 58% (13/23) when the stenosis of the target artery was less than 90% (P=0.006). Desai and associates [30] highlighted markedly reduced RA patency even in cases where the target vessel stenosis is less than 90%. They suggested RA grafting to targets with severe stenosis (90% or more) to enhance patency in different articles [30]. Research by Blebiffer et al. [13] revealed no clinical symptoms and an occluded RA graft, indicating a high rate of silent occlusion. The absence of dyspnea or angina does not imply patency of the RA graft.

Limitations

The study is limited by its small sample size, lack of long-term follow-up, and inclusion of only two centers. Longer follow-up studies are recommended.

Conclusion

After one year, the patency rates of the ERAH and ORAH groups were similar. ERAH improves patient satisfaction and wound healing. The greater the degree of target vessel stenosis, the greater the patency rate. A large-scale prospective randomized trial comparing EAH and OAH is needed to elucidate the favorable effect of EAH on the long-term patency rate of RA grafts.

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