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Early Outcomes of Endoscopic Vein Harvesting during the Initial Learning Period

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Background: The endoscopic vein harvesting (EVH) method has been used in coronary artery bypass surgery in many countries. We started using the EVH method recently, and investigated the results during the early learning period. ***Methods:*** Between March 2012 and June 2014, 75 patients (31 patients in the EVH method group, and 44 patients in the open method group) who underwent isolated first-time coronary artery bypass grafting using vein grafts were retrospectively analyzed with respect to the early outcomes including graft patency and risk factors for leg wound complications. For assessing the patency of vein graft, we performed coronary computed tomography angiography during the immediate postoperative period and 6 months later. ***Results:*** Mean harvesting time of endoscopic method was about 15 minutes. Patency rate during the immediate operative period and the 6-month patency rate were similar between the two groups (postoperative period: EVH 100% vs. open method 94.4%, p=0.493; at 6 months: EVH 93.3% vs. open method 90.9%, p=0.791). Leg wound complications occurred more frequently in the open method group (EVH 3.2% vs. open method 13.6%, p=0.127). According to the analysis, age was an independent risk factor for leg wound complications. ***Conclusion:*** EVH is a feasible method even for beginners and can be performed satisfactorily during their learning period.

Key words: 1. Endoscopic surgical procedure
2. Vein
3. Tissue harvesting
4. Coronary artery bypass

INTRODUCTION

In spite of several disadvantages, great saphenous vein grafts have frequently been used as a second conduit in coronary artery bypass surgery because they are easy to manipulate and harvest. However, the incidence of complications after use of the open harvesting method has been reported to be 24% in previous clinical studies. Instead of the open harvesting technique, endoscopic vein harvesting (EVH) is currently being performed in many centers [1]. Many studies have reported that EVH reduces postoperative pain, the incidence of wound complications, and the length of hospital stay, as well as eliminating the need for a large longitudinal incision and increasing patient satisfaction [2-13]. The short-term and long-term patency of vein grafts using EVH has been reported to be similar to the results achieved using the open method. However, many centers in South Korea use the traditional open method due to the high cost of EVH,

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which is not generally covered national insurance in South Korea. We started using EVH in April 2013, and in this study we present an analysis of our early results. Our findings suggest that there is no need to be concerned about EVH or delay its implementation, as EVH is capable of obtaining satisfactory results.

METHODS

1) Study population

Of the 192 patients who underwent primary isolated coronary artery bypass grafting (CABG) at St. Mary's Hospital in Seoul from March 2012 to June 2014, 75 patients who required at least one saphenous vein graft were retrospectively divided into an open vein harvesting (OVH) group and an EVH group. We reviewed their electronic medical records and coronary computed tomography (CT) angiograms. Between March 2012 and April 2013, 44 patients were included in the OVH group. Since April 2013, the EVH method has been performed on 31 patients elective CABG. EVH was attempted in a total of 34 patients between April 2013 and June 2014, but two patients were converted to the conventional open method and the vein graft of one other patient was injured during the procedure. These three patients were excluded from this study.

We performed follow-up coronary CT angiography postoperatively and six months after the operation, except for patients with elevated creatine levels and patients who required follow-up CT imaging sooner than six months after the operation for any reason. Patency analysis incorporated postoperative coronary CT angiography results from 57 patients (23 patients from the EVH group and 34 patients from the OVH group) and six-month follow-up coronary CT angiography results from 31 patients (11 patients from the EVH group and 20 patients from the OVH group).

2) Surgical technique

(1) Open vein harvesting: The greater saphenous vein was harvested by means of the open technique with a traditional longitudinal incision. This was performed by a physician's assistant who prepared the legs circumferentially and made an incision from the groin to the knee and, if necessary, to below the knee, exposing the entire vein by means of a continuous incision. The vein was then dissected with a combination of Metzenbaum scissors and electrocautery. The vein branches were clipped proximally and distally. Hemostasis was achieved with electrocautery and surgical clips. The wound was closed in a one-layer or two-layer fashion with absorbable sutures. The skin layer was approximated with continuous suturing using absorbable suture material or simple interrupted suturing using 2-0 nylon sutures.

Fig. 1. Postoperative scar after endoscopic greater saphenous vein harvesting is seen.

(2) Endoscopic vein harvesting: We used the VasoView 7 EVH system (Maquet Co., Wayne, USA). Before the vein harvesting procedure, the location of the greater saphenous vein was identified with venous ultrasonography. A 2-cm incision was then made above the knee for advancing the short port blunt tip trocar. During CO_2 insufflation, the saphenous vein was dissected with the conical tip. The VasoView 6 harvesting cannula was inserted in order to retract the saphenous vein, and the branches of the saphenous vein were cauterized with BiSECTOR bipolar ligating forceps. Another incision was made to expose and ligate the proximal vein graft. Both the proximal and distal ends of the vein graft were ligated with a silk tie and medium clips, and then the skin was sutured (Fig. 1).

We were not able to determine the operation time for the conventional OVH procedure because it was difficult to determine its exact end point. However, the operation time for the EVH procedure was roughly 15 minutes.

Table 1. Preoperative patient characteristics

Characteristic	Endoscopic vein harvest (n=31)	Open vein harvesting (n=44)	p-value
Age (yr)	64.9±8.1	66.3±9.3	0.50
Sex (female, %)	19.4 (n=6)	34.1 (n=15)	0.16
Diabetes mellitus (%)	45.2	31.8	0.23
Hypertension (%)	64.5	61.4	0.78
Dyslipidemia (%)	16.1	9.1	0.36
Body mass index (kg/m^2)	24.2	23.5	0.37
Myocardial infaction	12.9	27.3	0.14
Ejection fraction (%)	56.70	49.50	0.02
Euroscore	4.06±2.65	6.25±3.87	0.008

Table 2. Early patency of vein graft according vein harvesting method

Variable	Postoperative period		6 Month	
	Grafts no.	Patency (%)	Grafts no.	Patency (%)
Endoscopic vein harvest	32 (n=23)	100	15 (n=11)	93.3
Open vein harvest	36 (n=34)	94.4	22 (n=20)	90.9
p-value	0.493		0.791	

3) Data analysis

We analyzed patency of the grafts after the EVH and OVH procedures and compared the wound complication rates, risk factors for leg wound complications, and one-month mortality rates. Data are presented as mean±standard deviation for continous variables. The analysis of continuous variables was performed using the Student t-test, and the chi-square test was used to compare uncontinous variables. The risk factors for leg wound complications were analyzed with multiple regression analysis.

RESULTS

1) Demographics

The EVH and OVH groups were similar in terms of patient characteristics, except for ejection fraction values and EuroSCOREs (Table 1). The OVH group included a higher number of high-risk patients and patients who underwent emergency CABG than the EVH group, but other demographic factors did not differ between the two groups.

2) Early patency of the vein graft

Of the 68 grafts in the two groups, 32 grafts (from 23 patients) and 36 grafts (from 34 patients) obtained with the EVH and OVH methods, respectively, were subjected to patency analysis in the immediate postoperative period. The patency rate did not show a statistically significant difference between the two groups (100% vs. 94.4%, p=0.176) (Table 2). All grafts in the EVH group were patent, but two grafts showed partial stenosis. In the OVH group, two grafts were totally occluded in the postoperative period. Fifteen grafts (from 11 patients) and 22 grafts (from 20 patients) in the EVH and OVH groups, respectively, were analyzed six months later. The six-month patency rate was likewise similar between the two groups (93.3% vs. 90.3%, p=0.791) (Table 2). Statistical analysis showed that the patency rates in the immediate postoperative period and at six months after the operation did not differ significantly according to the vein harvesting method.

3) Postoperative morbidity and mortality

We investigated the postoperative morbidity and mortality of the patients in both groups. In the perioperative period, leg wound complications were more common after the OVH

Table 3. Wound complication and 1 month mortality according to vein harvesting method

Variable	Endoscopic vein harvest (n=31)	Open vein harvest (n=44)	p-value
Wound complication (%)	3.2 (n=1)	13.6 (n=6)	0.127
1 Month mortality (%)	0 (n=0)	5.6 (n=2)	0.389

Table 4. Logistic regression analysis for leg wound infection

Risk factor	p-value	Odds ratio	95% confidence interval
Age＞70	0.009	7.832	1.668-36.763
Sex (female)	0.591	0.521	0.048-5.619
Diabetes mellitus	0.471	0.421	0.040-4.438
Hypertension	0.375	2.817	0.285-27.808
Body mass index＜25	0.722	1.476	0.173-12.565
Myocardial infaction	0.550	2.269	0.155-33.295
Endoscopic vein harvest	0.823	0.736	0.050-10.847
Ejection fraction＜50%	0.827	1.321	0.109-15.985
Euroscore＞5	0.085	6.714	0.767-58.756

procedure. However, the difference was not statistically significant (3.2% vs. 13.6%, p=0.127) (Table 3). One patient in the EVH group was diagnosed with superficial cellulitis of the leg. In the OVH group, three patients were operated on for necrotic thigh wounds in the plastic surgery department. In two patients, the operative site was reopened because of wound dehiscence and continuous discharge from the wound.

We examined the factors that affected the occurrence of leg wound complications. According to our data, age was an independent risk factor for leg wound complications (Table 4). Diabetes mellitus and body mass index were not associated with leg wound complications. Although the leg wound complication rate was higher after OVH, the method of harvest itself was not found to be an independent predictive factor. There were no postoperative myocardial infarctions in the EVH group, but two patients in the OVH group expired during the perioperative period, with no relationship to whether the vein graft was occluded. High-risk patients, such as patients needing emergency CABG, as well as patients with lower ejection fractions and high EuroSCOREs, were included in the OVH group. However, the one-month mortality rate was not significantly different between the two groups (0% vs. 5.66%, p=0.389) (Table 3).

DISCUSSION

EVH is an accepted method for reducing leg wound complications and achieving graft patency. The Society of Thoracic Surgeons National Cardiac Database reported that EVH was used in approximately 70% of CABG procedures performed in 2008 [3]. In a survey from northern England between 2001 and 2004, EVH was found to be used in 75% of procedures [14]. However, EVH is used less frequently in South Korea than in other countries because of its high cost and several other problems. Our center adopted the EVH method in April 2013, after a period of training that involved simulations. Our early results with EVH were similar to those reported in previous studies. The six-month graft patency rate was 93.3% and there were no complications related to the vein graft. The wound complication rate was also reduced after the EVH method was adopted, but this change was not found to be statistically significant.

Since EVH has been introduced, many studies have assessed its short-term and long-term outcomes. Kiaii et al. [15] reported a lower incidence of leg wound complications at discharge (0% vs. 4%, p=0.12) and up to six weeks after surgery (4% vs. 25%, p＜0.001) among EVH patients. Kiaii et al. [15] and other researchers have investigated histological differences between the open method and EVH. However, no different findings have been observed under light or electron microscopy [16-19]. A meta-analysis by Athanasiou et al. [20] showed that the risk of wound complications after EVH was significantly lower than the risk of wound complications after OVH (4% vs. 13%, odds ratio 0.24). Yun et al. [1] also reported that EVH was associated with a reduced rate of leg wound complications (7.4% vs. 19.4%, p=0.014) and the overall occlusion rates at six months were not significantly different in their randomized trial of 200 patients (21.7% vs. 17.6%). Perrault et al. [21] assessed the early patency rate after EVH based on coronary angiography. They reported that

the rate of graft occlusion was similar in the EVH and OVH groups (15.4% vs. 14.8%), and there was no significant difference between these methods with regard to postoperative morbidity and mortality [21].

Davis et al. [4] analyzed the long-term (approximately three years) patency of vein grafts using contrast-enhanced electron beam CT. Their results showed that the graft patency rate after EVH was better than the graft patency rate after the traditional method (approximately after EVH) [4]. In 2011, Dacey et al. [14] presented results assessing the long-term outcome of EVH. They reported that the use of EVH was not harmful, and found that EVH was associated with a significant reduction in long-term mortality (hazard ratio 0.74) [14]. Recent studies have also suggested that EVH is equal or superior to OVH in terms of short-term and mid-term clinical outcomes such as in-hospital mortality, perioperative myocardial infarction, and need for reoperation [11,22].

However, three recent large randomized clinical trials have raised the question of whether EVH ensures the safety of the patients. The Prevention of Recurrent Thromboembolism IV trial (n=3,000 patients; 1,753 EVH patients and 1,247 OVH patients) demonstrated an increased rate of vein graft failure at 12 to 18 months in the EVH group compared to the OVH group (46.7% vs. 38.0%, $p<0.001$) [23]. Additionally, EVH was associated with higher rates of mortality, myocardial infarction, or repeat revascularization (20.2% vs. 17.4%; adjusted hazard ratio 1.22; p=0.04), and amortality (7.4% vs. 5.8%; adjusted hazard ratio 1.52; p=0.005) after three years [23]. A secondary analysis of the randomized comparison of on-pump versus off-pump CABG in the Randomized On/Off Bypass trial (n=894 patients; 341 EVH patients and 553 OVH patients), demonstrated that EVH was associated with a higher rate of graft failure (25.5% vs. 14.8%, $p<0.0001$) and repeat revascularization (6.7% vs. 3.4%, $p<0.05$) at one year after the operation [24]. Data from the Evaluation of 7E3 for the Prevention of Ischemic Complications trial demonstrated a lower graft patency rate at nine months after the operation in the EVH group compared to the OVH group (79.2% vs. 90.8%) [25].

Additionally, previous studies have not revealed any histological differences between the two techniques. Recently, Desai et al. [26] detected focal injuries to vein grafts obtained with EVH using optical coherence tomography in the intraoperative field. They reported that the rate of early graft failure was about 35% [26]. They demonstrated that the veins procured by novice EVH harvesters, who had performed <100 procedures, had nearly 50% more discrete injuries than the veins procured by experienced harvesters [26].

Many centers have rapidly adopted EVH as a popular vein harvesting method for CABG in spite of the debate about its outcomes. We likewise adopted EVH and surveyed the short-term outcomes of EVH based on our initial experiences. It was not difficult to perform EVH, and we were satisfied with the results.

There are several limitations to our study. Our study had a small sample size and it was a retrospective review. The duration of the study and follow-up was short. Moreover, the baseline characteristics of the patients were not similar with respect to EuroSCOREs and ejection fraction values, which may have affected the morbidity and mortality rates. Additionally, the patency of the vein grafts was assessed with coronary CT instead of angiography.

In conclusion, EVH is a feasible method, even for beginners, and it is possible for beginners to obtain results similar to those achieved by experienced surgeons who use the open method and by surgeons experienced at using EVH.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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