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Comparison of Conventional Technique and Ultrasonographic Mapping in Saphenous Vein Harvesting

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ABSTRACT

Background: Saphenous vein mapping provides accurate identification of the graft diameter, location of the harvest side, and quality of graft and also led to a selective leg skin incision. In this article, we aimed to compare patients who underwent coronary artery bypass graft (CABG) surgery with or without vein mapping.

Methods: Patients who underwent CABG surgery with saphenous vein grafts (SVG) between January 2005 and January 2010 in our service were analyzed retrospectively. One hundred seventy-eight 178 SVGs were harvested with classical methods (Group A), and 136 SVGs were harvested after Doppler ultrasonography (USG) mapping (Group B).

Results: In Group A, 6.7% of patients needed additional incisions for graft harvesting than planned before CABG surgery due to unsuitable vein grafts. In Group B, SVGs were harvested from left lower extremity in 16 patients, and the saphenous vein was not suitable for grafting in 1 patient due to Doppler examination. In the postoperative period, complications at the incision site were reduced in Group B.

Conclusion: Preoperative vein mapping for harvesting SVGs is an effective method in reducing wound site complications, hospital stay, and hospital costs and in increasing patient comfort and satisfaction.

INTRODUCTION

Venous grafts are often used in patients undergoing coronary artery bypass graft (CABG) surgery. Long saphenous vein (LSV) is the most commonly used conduit for coronary artery bypass grafting, but the region for venous harvesting is determined by the preoperative examination and the surgeon's preference. After CABG surgery, wound healing disturbances such as infection, skin necrosis, hematoma, and neuropathy increase the length of hospital stay and hospital costs [Athanasiou 2003]. In order to reduce these complications, intermittent skin incision or endoscopic saphenous vein harvesting is of preference in reports [Perrault 2004; Yun 2005; Markar 2010; Accord 2011]. Long-term graft patency after CABG surgery is the most important factor affecting postoperative mortality and morbidity. During the harvest, excessive traction, surgical trauma, or keeping the vein outside the body for a long time prior to anastomosis might cause formation of free oxygen radicals that can lead to ischemia-induced endothelial damage [Thatte 2001]. Endothelial damage affects the graft patency negatively. Intermittent incisions or endoscopic saphenous vein harvesting might increase the risk of endothelial damage, which can affect long-term results negatively [Cooper 1996; Markar 2010]. In our department since 2008, routine Doppler ultrasonography (USG) has been used to evaluate and determine the appropriate diameter, location, and quality of the saphenous vein for grafting in order to reduce complications and wound healing disturbances in incision sites. After the decision of the saphenous vein to be harvested for grafting, Doppler USG was used for marking the incision line. In this study, we report the results of our patients, either with or without preoperative mapping of the graft with Doppler USG.

MATERIALS AND METHODS

Patients in whom LSV used as a conduit for coronary artery bypass grafting between January 2005 and January 2010 in the Department of Cardiovascular Surgery, Gulhane Military Medical Academy, Haydarpasa Training Hospital, were retrospectively reviewed. All patients provided written informed consent before participation, and the study was conducted in accordance with the principles described in the Declaration of Helsinki. Exclusion criteria for our study were emergency surgery and additional cardiac pathology to coronary artery disease. Data from 314 patients who underwent elective isolated CABG surgery were investigated. Of the patients, 66.9% (n = 210) were male, and 33.1% (n = 104) were female. In 178 patients (Group A), classical methods were used for harvesting the saphenous vein of the right lower extremity above the knee without preoperative saphenous vein mapping with Doppler ultrasound between January 2005 and January 2008. If required, additional incisions were

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Table 1. Preoperative Patient Characteristics

	Group A (n = 178)	Group B (n = 136)	*P*
Women, n (%)	43 (24.2%)	25 (18.4%)	.218
Men, n (%)	135 (75.8%)	111 (81.6%)	
Age, y (mean ± standard deviation)	64.2 ± 10.4	61.6 ± 11.6	.034
Diabetes, n (%)	51 (28.7%)	50 (36.8%)	.127
Peripheral arterial disease, n (%)	14 (7.9%)	10 (7.4%)	.866
Chronic obstructive pulmonary disease, n (%)	32 (18%)	14 (10.3%)	.056
Hypertension, n (%)	106 (59.6%)	65 (47.8%)	.038
Smoking history, n (%)	59 (33.1%)	58 (42.6%)	.084

made and the incision site was extended down below knee level. If the saphenous vein of the right lower extremity was sclerotic, the counter side saphenous vein was harvested. In our department, from January 2008 to January 2010, Doppler USG mapping was used routinely in 136 patients (Group B) for harvesting the saphenous vein for CABG surgery. A Toshiba SSA-680A (Xario XG) ultrasound device (Toshiba Medical Systems, Tochigi-ken, Japan) with a PLT-1204AT linear probe was used for preoperatively optimizing saphenous vein site selection in these patients. In the presence of phlebitic changes of the saphenous vein, another site was determined for harvesting the saphenous vein as a conduit for CABG surgery. Saphenous veins with an internal diameter of 3 to 5 mm were harvested. Larger or smaller caliber veins were not preferred because of the coronary artery and vein graft incompatibility. In case of both saphenous veins not being suitable as conduits, they were not harvested. The determined anatomical course of the saphenous veins by ultrasonography was drawn on the skin with a waterproof pen, and the patients were transferred to the operating room. Saphenous veins were harvested according to the marks by means of classical incision. Following the exploration for bleeding with heparinized blood, the saphenous vein was extracted. Following the evacuated hemovac drain placement in the incision of leg, the incisions were closed with stiches. Then, 1 g of cefazolin sodium was administered intravenously for prophylaxis at each 8-hour interval for 48 hours. The amount of leg drainage, saphenous incision site complication, and duration of hospitalization were evaluated in both groups.

The data were evaluated with the SPSS (Statistical Package for Social Sciences) 17.0 program for Windows (IBM; Armonk, NY, USA), and the differences between the 2 groups were compared using a t-test.

RESULTS

There was no statistically significant difference between the 2 groups in terms of sex, chronic obstructive pulmonary disease (COPD), peripheral arterial disease (PAD), diabetes, and smoking history ($P > .05$). The mean age of patients and rate of hypertension in Group A were higher than in Group B ($P < .05$) (Table 1). The amount of drainage was found significantly reduced in Group B ($P < 0.05$). The length of hospital stay was reduced in Group B, but the difference was not statistically significant ($P > .05$) (Table 2). When operative data were analyzed despite there being no history of phlebitis in Group A, 12 patients (6.7%) required an additional incision.

The saphenous vein was sclerotic in the first incision region, so an additional incision was performed on the other leg. The saphenous vein was also sclerotic in 2 of these patients, so the radial artery was harvested for grafting. In 2 patients in Group A, the LSV was varicose and with pronounced tortuosity above the knee level bilaterally, so the saphenous vein below the knee level was harvested. Preoperative Doppler USG in 16 patients of Group B revealed a better internal diameter of the saphenous vein of the left lower limb compared to the right lower extremity, so the left extremity saphenous vein was harvested. The internal diameter of the saphenous vein was also insufficient for grafting in a patient, so LSV was not harvested. No additional incision was needed for additional graft harvesting during surgery for any patient in Group B. Wound healing disturbances and complications at the incision site and treatment methods are presented in Table 3. In 21 patients of Group A, saphenous vein incision site wound-healing disturbances and complications were seen in the postoperative follow-up.

Table 2. Wound Complications according to the Vein Harvest Method and Perioperative Findings

	Group A (n = 178)	Group B (n = 136)	*P*
Drainage of leg incision, mL (mean ± standard deviation)	13.5 ± 11.3	2.9 ± 5.8	.001
Length of hospital stay, d (mean ± standard deviation)	13.6 ± 5.9	12.4 ± 4.9	.065
Complication of incision site, n (%)	21 (11.8%)	3 (2.2%)	.002

Table 3. Wound Healing Disturbances and Complications at Incision Site and Treatment Methods

Wound Healing Disturbances and Complications	Group A	Group B	Treratment Methods
Superficial tissue infection	8	3	Antibiotics
Deep tissue infection	3	—	Debridement
Skin wound dehiscence	2	—	Primary repair
Hematoma	2	—	Hematoma drainage
Neuropathy	5	—	Medical follow-up
Skin necrosis	1	—	Debridement and skin graft

Superficial tissue infection, deep tissue infection, skin wound dehiscence, hematoma, skin necrosis, and neuropathy were incision site wound-healing disturbances and complications in 3 patients, so debridement and primary repair were implemented. In 2 patients, hematoma drainage was implemented for incision site wound-healing disturbances and complications; a skin graft was used in 1 patient, and antibiotherapy was used in another patient. In Group B, 3 patients developed saphenous incision site wound-healing disturbances and complications, and antibiotherapy was implemented for superficial tissue infection. No additional complication was seen in any patient. Incision site wound-healing disturbances developed in 11.8% of patients (n = 21) in Group A and 2.2% of patients (n = 3) in Group B, and the difference between the 2 groups was statistically significant (Table 2).

DISCUSSION

Saphenous vein grafts are still important conduits used in CABG surgery. The great saphenous vein is often evaluated preoperatively by physical examination in cardiovascular surgery clinics. In cases where the saphenous vein diameter and the quality are improper, additional incisions are made for saphenous vein or other vascular grafts as a different strategy. Especially in obese patients, increased dissections in harvesting the saphenous vein may lead to soft tissue damage that needs a skin flap in treatment [Luckraz 2008]. The risk of developing wound-healing disturbances and complications has been reported as 7% in conventional saphenous vein harvesting, and this is responsible for 15% of the morbidity developing after CABG surgery [Perrault 2004].

For reducing morbidity associated with saphenous vein harvesting, intermittent incisions or endoscopic vein harvesting (EVH) can be made. EVH is a method used with increasing frequency in recent years [Markar 2010]. EVH reduces the development risk of infection, hematoma, seroma, and postoperative pain in the incision site [Perrault 2004; Yun 2005; Markar 2010; Accord 2011]. Early mobilization of patients reduces the length of hospital stay. EVH decreases the risk of trauma and maintains tissue perfusion by consequently reducing the wound-healing disturbances and complications and the need for a skin flap [Accord 2011]. Further manipulation and distension during the harvest of the saphenous vein with side branch ligation may cause endothelial damage [Cooper 1996]. The most significant doubt in the EVH technique is the effect on the graft patency [Markar 2010]. During endoscopic or intermittent saphenous vein harvest distension, endothelial damage might occur and affect long-term patency of the graft. In the EVH technique, the risk of graft occlusion in 12 to 18 months, death in the third year, myocardial infarction, and revascularisation risk were higher [Lopes 2009]. Even though histologic examination of traditional "open" vein harvest (OVH) and EVH techniques revealed no difference in previous studies, the risk of endothelial damage of the saphenous vein in the EVH technique was shown in a study carried out in 2009 in Boston [Accord 2011].

Preoperative evaluation with Doppler USG and marking the segments of the saphenous vein provide a no-touch technique for harvesting and minimizing the risk of endothelial damage. Preoperative evaluation and marking the segments of the LSV with USG are important factors in reducing the surgery time and the wound-healing disturbances and complications in the incision site [Lemmer 1988; Luckraz 2008]. Doppler USG is a highly effective method for the evaluation of the lower extremity venous system. Condition of deep veins, valve insufficiency, and venous reflux can be evaluated extremely well with Doppler USG. Incisions made by determining venous anatomy reduce the risk of hematoma and a skin flap. Large side branches, duplication and venous insufficiency, and the segment for harvesting can be determined before the surgery with preoperative Doppler USG; skin incision is also shorter in these patients. This shortens the duration of the surgery, and wound-healing disturbances and complications are reduced in the mapping group [Luckraz 2008]. A standard Doppler USG procedure is a time-consuming procedure and needs a vascular laboratory. Intraoperative Doppler USG is useful in determining the surgical incision site in the majority of cases by harvesting better quality of grafts by means of avoiding dissection of the branched vessels, bifurcation, and small vessels [Cohn 2005], but it may prolong the operation.

In our department, we evaluate the saphenous vein with Doppler USG and then decide the vein for the graft. On the morning of the operation, we marked the incision site for harvesting, and the patient was then transferred to the operating room. In our study, we found that wound-healing disturbances and the amount of drainage were statistically reduced in the Doppler USG group. Congestive heart failure and a large venous diameter affect graft occlusion in negative terms. A high venous graft flow rate has a positive impact on graft patency [Yun 2005]. The diameter of the graft significantly affects patency. Grafts with a thick wall and large diameter have a poor patency rate [Shah 2003]. Postoperative

computed tomography (CT) angiography at the end of the first year was revealed in 83% of patients; with the saphenous vein diameter greater than 5 mm, blood flow normally continues and 7.8% develop graft occlusion. Although this ratio was 63.8% and 20.2%, respectively, in patients with a saphenous vein diameter less than 3 mm, the blood flow rate was normal in patients with a saphenous vein diameter between 3 and 5 mm, and no occlusion was detected. [Sarzaeem 2010]. Doppler USG in the preoperative period helps determination of the available diameter of the graft and contributes to the long-term survival.

We evaluated that the available vascular grafts can be used with a diameter of 3 to 5 mm in saphenous veins. In order to reduce edema in the postoperative period and neurological complications, harvesting saphenous veins below knee level is not preferred because venous flow on the back foot is toward the deep veins, to the superficial veins, and is in close proximity to the saphenous nerve. Preoperative evaluation of saphenous vein harvesting with Doppler USG is an effective method in determining the selection of the graft in cardiovascular surgery departments. Doppler ultrasound for determining the incision site reduces the complications and wound-healing disturbances, reduces morbidity in the postoperative period, increases patient comfort and satisfaction, and also possibly reduces the length of hospital stay and costs.

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