Endoscopic saphenous vein harvesting: results of our initial experience

Endoskopik safen ven greft hazırlanması: İlk deneyim sonuçları

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Background: Traditional open surgical vein harvesting during coronary artery bypass grafting (CABG) is associated with considerable postoperative problems including discomfort, swelling, skin discoloration, wound drainage, superficial wound infections, and scarring. Minimally invasive endoscopic vein harvesting (EVH) technique has been widely accepted by surgeons and patients worldwide. The aim of this study was to review our initial experience with EVH in patients undergoing CABG at our center.

Methods: The study included 32 patients (6 women, 26 men; mean age 62±10 years; range 41-80 years) who underwent isolated CABG between December 2005 and June 2006. A standard 2-cm incision at the medial aspect of the knee was used for EVH. The mean follow-up was 5±3 months.

Results: Two patients required conversion to open technique due to bleeding and were not included in the evaluation. Endoscopic procurement of the saphenous vein was successful in the remaining patients. The mean number of bypass grafts used was 3.6±0.5. The mean length of vein conduit was 45.0±12.6 cm, which was 38.3±5.7 cm in the first 10 patients and 50.1±13 cm in the last 10 patients. The mean length of vertical incision was 4.1±2.0 cm. The overall mean harvesting time was 43.5±9.5 min. Harvesting time gradually decreased over time (from 90 to 25 min). The average time for closing the leg skin incision was 6.6±2.9 min. A drainage catheter was necessary in only two patients. Complications related to EVH were postoperative hematoma in two patients (6.7%) and superficial ecchymosis in one (3.3%). The mean hospital stay was 6.5±0.9 days. No wound infections were seen postoperatively. No early or late deaths occurred. All the patients expressed remarkable satisfaction with regard to mobilization and early healing of leg incisions.

Conclusion: Our initial experience supports the previously shown safety and efficacy of the EVH technique compared to the traditional open technique. High-satisfaction expressed by the patients should encourage the routine use of EVH during CABG.

Key words: Coronary artery bypass/adverse effects; endoscopy; saphenous vein/transplantation; tissue and organ harvesting.

Amaç: Koroner arter bypass grefti (KABG) ameliyatı sırasında klasik açık cerrahi yöntemle ven hazırlanması, ameliyat sonrasında rahatsızlık, şişlik, deri rengi kaybı, yarada akıntı, yüzeysel yara enfeksiyonu ve yara izi gibi sorunları beraberinde getirir. Son zamanlarda geliştirilen minimal invaziv endoskopik ven greft hazırlanması (EVGH) tekniği dünyada cerrahlar ve hastalar tarafından yaygın bir kabul görmüştür. Bu çalışmada merkezimizde KABG uygulanan hastalarda EVGH ile ilgili ilk deneyimlerimiz değerlendirildi.

Çalışma planı: Çalışmaya Aralık 2005 ve Haziran 2006 tarihleri arasında izole KABG uygulanan 32 hasta (6 kadın, 26 erkek; ort. yaş 62±10; dağılım 41-80) alındı. Endoskopik ven greft hazırlanması için dizin medial kısmına standart 2 cm'lik insizyon uygulandı. Ortalama takip süresi 5±3 aydı.

Bulgular: Aşırı kanamadan dolayı EVGH'den açık cerrahi yönteme geçilen iki hasta değerlendirmeye alınmadı. Diğer hastalarda safen venlerin endoskopik hazırlığı başarılıydı. Kullanılan bypass grefti sayısı 3.6±0.5 idi. Elde edilen ven yolu uzunluğu ortalama 45.0±12.6 cm idi; bu miktar ilk 10 hastada 38.3±5.7 cm iken, son 10 hastada 50.1±13 cm'ye yükseldi. Dikey insizyon uzunluğu ortalama 4.1±2.0 cm idi. Greft hazırlama süresi ortalama 43.5±9.5 dakika idi; bu süre zamanla azalarak 90 dakikadan 25 dakikaya düştü. Bacak derisi insizyonunu kapama süresi ortalama 6.6±2.9 dakika idi. İşlem sonrasında drenaj kateteri yalnızca iki hastada gerekti. Endoskopik ven greft hazırlanmasına bağlı komplikasyon olarak iki hastada ameliyat sonrası hematom (%6.7), bir hastada yüzeysel ekimoz (%3.3) görüldü. Hastanede kalma süresi ortalama 6.5±0.9 gün idi. Ameliyat sonrasında yara enfeksiyonu görülmedi. Hastaların hepsi erken hareket ve bacak insizyonlarının hızlı iyileşmesinden dolayı işlemden memnun kaldığını belirtti.

Sonuç: İlk deneyimlerimiz klasik açık yönteme göre EVGH yönteminin güvenli ve etkili olduğunu bir kez daha gösterdi. Hasta grubumuzun ifade ettiği yüksek derecedeki memnuniyet, KABG sırasında EVGH'nin rutin olarak kullanımını teşvik eder niteliktedir.

Anahtar sözcükler: Koroner arter bypass/yan etki; endoskopi; safen ven/transplantasyon; doku ve organ hazırlama.

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Despite extensive use of the arterial conduits to improve long-term patency, most patients undergoing coronary artery bypass grafting (CABG) still receive saphenous vein bypass grafts. Morbidity associated with conventional vein harvesting includes postoperative pain, leg edema, and leg-wound complications such as cellulitis, lymphangitis, purulent drainage, fat necrosis with wound breakdown, which are reported to have an incidence of 24% to 44%.[1,2] These complications may prolong hospital stay, increase the need for readmission, and the ongoing pain restricts ambulation and reduces the patient's quality of life.[2,3] Endoscopic vein harvesting (EVH) has been developed over the past decade,[4,5] aiming to reduce the morbidity and recovery time associated with the procedure.[5-7] It allows nearly complete harvest of the great saphenous vein, with excellent visualization, through minimal incisions.

The object of this study was to evaluate our initial experience with the EVH technique and its impact on patient satisfaction in patients who underwent elective CABG at King Faisal Heart Institute.

PATIENTS AND METHODS

Between December 2005 and June 2006, 32 patients (6 males, 26 females; mean age 62±10 years; range 41-80 years) underwent isolated CABG using the saphenous vein harvested with the endoscope (Vasoview 6, Guidant Corporation, Indianapolis, IN, USA). The study was approved by the Ethics Review Board of King Faisal Specialist Hospital & Research Center.

Patients undergoing any concurrent cardiac or vascular procedure were excluded from the study. Two patients in whom conversion to open technique was required due to bleeding were also excluded.

Surgical technique. Endoscopic harvesting was performed by the same surgeon in all the patients. The legs were circumferentially prepared. The greater saphenous vein was exposed by means of a 2-cm longitudinal incision along the medial surface of the knee. In cases in which a greater length of vein was needed (≥45 cm), the dissection was continued downward the ankle using the same incision. The vein was dissected free and surrounded by a vessel loop. Subcutaneous tunnels were created proximally and distally. A 7-mm extended length endoscopic dissecting device was then placed through the port and was introduced through the incision. A tunnel was created by blunt dissection along the length of the saphenous vein. After 5 to 10 cm of blunt dissection, the port balloon was inflated by 15-20 ml of air and simultaneous insufflation was performed through the insufflation port by using carbon dioxide at 3-4 l/minute to a pressure of 12 to 15 mmHg. The vein was circumferentially dissected and isolated from the surrounding tissue and the vein tributaries were identified. After the desired length of the saphenous vein was exposed, the endoscopic dissecting device was removed and a bipolar bisector device was introduced through the port for further dissection of the vein branches using a C-ring dissector and to cut them using bipolar scissors at an energy level of 20 to 25 W. After completion of dividing all the vein tributaries, a 1-cm incision was made in the groin to clamp the proximal part of the saphenous vein. The vein was transected and the end was ligated as per protocol. The vein was then pulled back toward the endoscopic port and was removed to the surgical table where the small branches were ligated using 4-0 silk. The resulting two incisions were closed by using 2-0 Vicryl running and 3-0 Vicryl subcuticular sutures. Drains were used if there was tendency to bleed. The leg was then wrapped in an elastic bandage for 48 hours. Drains were removed 48 hours postoperatively.

Outcome events and assessment. All patients received prophylactic perioperative and postoperative intravenous antibiotic therapy (Cefazolin, 1 gr every 8 hours). Wound care was given daily in the hospital, four weeks after discharge, and at every outpatient visit. Leg wound infection was defined as *(i)* evidence for purulent discharge with or without laboratory confirmation; *(ii)* presence of pain, swelling, redness, or heat plus the need to open the superficial incision; *(iii)* dehiscence or the need to open the wound when the patient had fever exceeding 38 °C, pain, or tenderness; or *(iv)* the presence of abscess on direct examination. Pain assessment was performed daily in the clinic and at every outpatient visit, and the patients were asked to rate the severity of pain at the wound harvest site on the basis of a scale from 0 to 10, where 0 represented severe pain and 10 represented no pain. The sensitivity of this method of assessment was previously reported.[8,9] Mobilization was assessed subjectively by the patient and objectively by the nurse. A scale of 0 (unable to walk) to 10 (excellent mobilization) was used. Measurements were made at postoperative days 2, 4, at discharge, and four weeks after discharge at outpatient visit. Patient satisfaction was also assessed including cosmesis of the leg incision using a scale from 0 (unsatisfied) to 10 (very satisfied). Hospital stay was defined as length of stay from surgery to discharge. The number of subsequent hospitalization due to leg wound complications was also recorded. The mean clinical follow-up was 5±3 months (range 3 to 16 months).

Histopathologic examination. A total of 10 specimens were collected and examined histologically to assess the quality of the harvested vein. The specimens were taken from the maximal traction point of the vein during EVH just at the base of branches and were immediately put in 10% buffered formalin vials. All the specimens were examined by the same pathologist who was blinded to

Table 1. Demographic data of the patients (n=30)

Patient characteristics	Mean±SD	n	%
Age (years)	62±10		
Female		6	20.0
Body surface area (m^2)	1.8±0.1		
Diabetes		17	56.7
Hypertension		12	40.0
Hypercholesterolemia		20	66.7
Smoking		11	36.7
Obesity		14	46.7
Renal failure		3	10.0

the entire study course. Histological structures evaluated were the endothelial layer, elastic lamina, medial smooth muscle, and connective tissue.

Statistical analysis. The results were expressed as mean±standard deviation. Statistical analyses were performed with Fisher's exact test. A p value of less than 0.001 was considered significant.

RESULTS

Thirty patients were evaluated after exclusion of two patients due to conversion to open technique. Patients were middle-aged and the majority were males. Demographic data of the patients are shown in Table 1 and surgical variables are shown in Table 2.

Vein harvest variables. All 30 veins were harvested successfully using the EVH technique, and all conduits were found to be usable for grafting by visual inspection. There were 7.8±3.3 branches required to be cut. Two patients required drainage insertion.

Our EVH procedure has evolved with experience. Initially, we eliminated a big groin incision to cut the vein proximally and limited its size to just 0.5 cm, allowing a small clamp to go through and grasp the vein outside the skin. The overall mean length of incisions was 4.1±2 cm (range 2 to 8 cm). The mean length of the harvested vein in the first 10 patients was 38.3±5.7 cm (range 30 to 50 cm), which increased to 50.1±13 cm (range 35 to 90 cm) in the last 10 patients by performing the harvesting incision just below the knee and continuing the harvesting distally toward the ankle. The time needed to close the skin was considerably low (Table 3). Harvesting time showed a strong learning curve (Fig. 1).

Table 3. Vein harvest variables

	Mean±SD	Range
Skin closure time (min)	6.6±2.9	4-15
Endoscopic vein harvesting time (min)	43.5±9.5	25-90
Length of all incisions (cm)	4.1±2.0	2-8
Length of the vein harvested (cm)	45.0±12.6	30-90

Table 2. Surgical variables

	Mean±SD	Range
Number of bypass grafts	3.6±0.5	3-5
Cross-clamp time (min)	71±16	34-98
Cardiopulmonary bypass time (min)	102±23	68-180

The EVH time decreased significantly by time with increased experience as shown in Table 4.

Outcome variables. No early or late deaths occurred in our study group. Postoperatively, one patient developed atrial fibrillation which was successfully converted to normal sinus rhythm with medical treatment. Complications related with EVH were postoperative hematoma in two patients (6.7%) and superficial ecchymosis in one patient (3.3%), but none of them required drainage. No wound infections occurred in the early postoperative period or during follow-up. Length of hospital stay was relatively short 6.5±0.9 days (range 5 to 8 days). No leg wound-related readmission occurred postoperatively, except for one diabetic patient who was admitted one week after discharge with wound infection at the radial artery harvesting site with perfect healing of the leg wound. At hospital discharge and at follow-up, all patients expressed their satisfaction regarding postoperative leg pain and cosmesis (Table 5). Subjective scores for mobilization were high in all the patients at the time of discharge and at follow-up (8.8±0.8 and 9.8±0.5, respectively).

Histological examination. A total of 10 saphenous vein segments were examined and compared with other 10 vein segments harvested by the traditional open technique. No histological differences were observed between the two groups.

DISCUSSION

Over several decades of coronary artery bypass surgery practice, morbidity related to saphenous vein harvest-

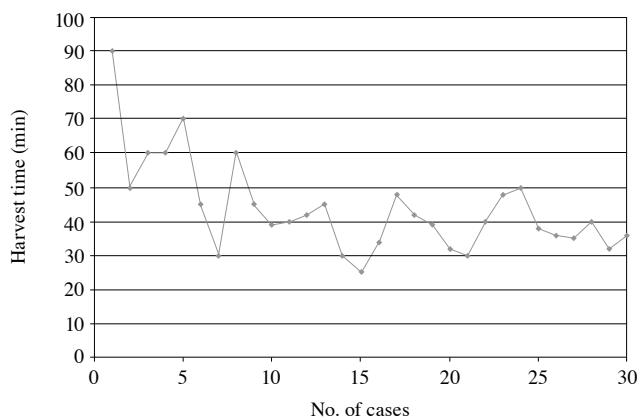

Fig. 1. Decrease in the time required to harvest the saphenous vein as our experience increased.

Table 4. Endoscopic vein harvesting (EVH) times in initial and final cases

	First 10 cases	Last 10 cases	*p*
EVH time (min)	54.9±17.0	38.5±6.3	<0.001
Closure time (min)	7.9±3.5	5.1±1.1	<0.001

Table 5. Levels of patient satisfaction

	Median	Mean±SD
Leg pain at discharge	10	8.9±2.0
Leg cosmesis at discharge	10	9.3±1.0
Leg pain at four weeks	10	9.1±2.4
Leg cosmesis at four weeks	10	9.9±0.4

ing by conventional methods has become an acceptable postoperative complication with rates ranging from as low as 1% to as high as 24%.[1-3,10,11] Postoperative leg wound morbidity prolongs hospital stay or necessitates readmission for intravenous antibiotics and debridement, both of which increase hospital cost. Most importantly, it affects the patient's quality of life by producing pain, discomfort, and difficulty in ambulation and frequently results in multiple outpatient visits. With the evolution of minimally invasive surgical techniques, less invasive methods of harvesting the saphenous vein have been developed with the goal of reducing postoperative wound morbidity.[5,12,13] The use of bridging technique has enhanced the potential for decreasing morbidity from leg-wound complications by maintaining superficial vascularity of the superficial tissue.[5,7,14-16] However, this technique poses some technical difficulties and is often associated with vein trauma by vein traction and dissection. Many studies have shown that endoscopic vein harvesting reduces postoperative pain, decreases length of hospital stay, and improves mobility.[5,13-15,17] In our series, postoperative leg pain was relatively low and it was comparable to other studies.[7,15,18] The low level of pain was so marked that patients visiting our outpatient clinic expressed surprise when asked about their leg pain. In addition, we found that their mobility immediately improved after surgery due to painless leg wound. In terms of patient satisfaction with cosmesis, the majority of patients (98%) were very satisfied with the procedure, since the incision was far smaller than that of the traditional open technique. Many randomized prospective studies showed that EVH reduced the rate of leg wound infections compared to the open technique.[7,12,18] In our study, no wound infection was observed at the discharge or at the follow-up period. No significant wound discharge occurred in our series. Only two patients developed hematoma after harvesting and both were operated on in the early period of the study. The use of a higher electrical voltage (25 to 30 V) to cut the branches and wrapping the leg immediately after the end of EVH were very useful measures to come over this complication. Our study, as well others, showed that fewer wound-related complications decreased both the length of hospital stay and the frequency of repeated admissions.[19,20] Apart from its advantages, EVH has some drawbacks such as increased harvesting time and potential trauma to the vein during harvesting. Our experience with the EVH procedure showed a learning curve. The harvest time for the first 10 cases averaged 54.9 minutes, whereas the last 10 cases averaged 38.5 minutes. Preparation of the vein was often completed when the first surgeon finished harvesting the mammary artery and started to cannulate the patient for cardiopulmonary bypass. In our study, conversion rate to open technique was 6.7% (n=2) and both instances were not related to the learning curve. Both cases had a very thin vein with minimal subcutaneous tissue and the shear force exerted by the endoscope resulted in damage to the vein and bleeding. Several studies reported no significant endothelial disruption with EVH.[5,16] In our study, we did not find any histological differences between vein segments harvested by EVH and by the traditional open technique. Similar findings were reported previously.[13,21]

In conclusion, our initial experience supports the previously shown safety and efficacy of the EVH technique compared to the traditional open technique. High-satisfaction expressed by the patients should encourage the routine use of EVH during CABG. Long-term patency rates of conduits harvested with EVH need to be followed.

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