Prospective comparative study of single-layer versus double-layer closure of leg wounds after long saphenous vein harvest in coronary artery bypass graft operations

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ABSTRACT

Introduction: Wound infection is one of the major complication post CABG that leads to prolonged length of stay and cost post surgery. Coronary artery bypass grafting is one of the most commonly performed operations in the world. The long saphenous vein harvested by traditional techniques is still widely used and caries a risk of wound infection.

Objective: The purpose of this study is to ascertain if a single-layer closure result in better wound healing and functional outcome as compared with the traditional two-layer closure after harvest of saphenous vein.

Methods: Sixty-seven consecutive patients undergoing CABG were prospectively randomized to have their leg wound closed by either a single-layer technique with a suction drain or double layers without suction drain. All wounds were assessed for the presence of serous discharge, inflammation, edema, purulent exudates, infection of the deep tissues, and pain postoperatively and two weeks after discharge.

Results: There were trends towards increased rates of wound related outcomes in patients in double layer group when compared with single layer group. Out of 77 patients in our study, 52 patients underwent single layer closure (males, n = 37; females, n= 15) and 25 patients underwent double layer closure (males, n = 21; females, n = 04). There was significant statistical difference between the treatment groups with single layer group having lower average scores (4.038) compared to double layer group (9.467), P- value 0.001. Patients whose legs were closed with the single layer technique had less post operative edema (23.07% vs 53.30) and pain (44.2 vs 73.33) compared with the double layer group.

Conclusions: Single-layer leg wound closure over a suction drain has shown a better wound outcome compared to traditional double-layer closure. A possible mechanism of better wound healing in the former technique might be through decreased tissue handling and a reduction in leg edema.

KEY WORDS single layer closure; double layer closure; saphenous vein

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Background

Literature has shown that 2% to 24% of coronary artery bypass grafting (CABG) procedures are complicated by surgical site infections (SSI) at the sternal or conduit harvest site incisions (1-4). One large series involving 3,525 patients undergoing coronary artery bypass grafting over a 10-year period reported an average complication rate of 4.2% (5). Even though there is an increase in the use of arterial grafts but still the long saphenous vein remains the most frequently used conduit for coronary revascularization. . Usual traditional technique for harvesting the saphenous vein involves a long continuous open skin incision, with harvest of the entire length often necessary for multiple grafts. Different techniques had been developed to avoid leg wound infection like traditional double layer closure, single layer closure ,use of clips, endovein harvesting to name few, but very little attention has been paid to leg wound in coronary artery bypass grafting surgery and in particular to best method of skin closure. Everyone is concerned mainly about deep chest infections and mediastinitis because of their potential for serious morbidity and mortality, but in reality graft harvest site infections may actually be more common after CABG (6-8), which not only result in increased morbidity for patients, but also increase the length of hospital stay and hospital costs.

The purpose of this study was to compare two methods of leg wound closure; single-layer closure over a suction drain and the

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traditional double-layer closure without suction drain.

Patients and methods

After getting approval from the ethics committee Seventy- seven patients were included in the study in whom saphenous vein was used as a conduit for coronary artery bypass grafting or CABG with valve replacement at the Sultan Qaboos University Hospital, Department of Surgery, Cardiothoracic surgery division between March 2009 to May 2010. Total of Eighty-nine legs that had the long saphenous vein harvested were analyzed in this prospective randomized trial comparing two different methods of leg wound skin closure.

Patient demographics, pre and postoperative data and outcomes, were obtained through chart review, in hospital assessments and follow- up visits.

Patients were preoperatively randomized into two treatment groups: single-layer or double layers. A single surgeon performed all conduit vein harvests and closure of wounds. Beginning three cm above the ankle anterior to medial malleolus the skin was incised down to the level of the saphenous vein and the incision extended proximally, special attention paid to avoid flaps. Multiple incisions with intervening skin bridges were not used. Leg incisions were closed before reversal of anticoagulation by protamine. Single-layer closure was achieved by closing the skin with subcuticular 3-0 monocryl over a suction drain after achieving satisfactory haemostasis using ligature clips and minimal use of cautery (9). Depending on the length of the incision one to two drains were placed in the leg and thigh to drain the subcutaneous space. Double-layer closure involved closing the subcutaneous fat layer additionally with 2-0 Vicryl.

All wounds were covered with a surgical dressing and the leg was wrapped with an elastic crepe bandage for 48 hours. Suction drains were removed after 48 hours and antithrombotic stockings were worn on both legs and total drainage noted. As per our unit protocol for patients undergoing uncomplicated coronary artery bypass grafting, receive intravenous cephalosporin (Cefuroxime 750 mg at eight-hour intervals) for the first 72 hours.

All leg wounds were assessed after 48 hrs, fifth, day of discharge, and two weeks after discharge. The wounds were assessed for inflammation, extent of edema, discharge, infection and pain. Presence of pus and wound dehiscence indicates serious clinical wound infection, but lesser degrees of wound infection as well as impaired healing are also clinically important and they lead to the morbidity associated with coronary artery bypass grafting. All assessments were performed by the same surgeon.

To have an objectivity and uniformity in the assessment of leg wound healing we used a wound score (Table 7) which included the presence of serous discharge, inflammation (oedema), purulent exudate, and separation of the deep tissues, isolation of bacteria, and use of additional treatment (10).

Statistical analysis

All statistical analysis was performed using SPSS 16 statistical package. Continuous data were analyzed using student's t test. Statistical significance was determined as p value 0.05 or less.

Results

Out of 77 patients in our study, 58 were male (single layer closure, n=37; double layer closure, n=21 and 19 were female (single-layer closure, n=15; multiple-layer closure, n=04).

Table 1 shows demographics of the patients in both groups. The groups had almost similar demographics, although double layer group had less number of females and diabetics, but that was not statistically significant.

Wound score

One of the main outcome variables of our study was the total wound score shown in table 2. In twenty- five patients (single layer, n=20; multiple layer, n=5) had veins harvested from both their legs. In these patients the average of the wound scores from both legs was used in the analysis. There was a significant statistical difference (P<0.001) between the groups, the patients in single layer group having lower average scores compared to double layer group (4.038 vs 9.467).

Wound healing disturbances were serous discharge, inflammation, edema, infection, pain, and wound dehiscence. We categorized wound healing disturbances as satisfactory healing, disturbance of healing, minor wound infection, moderate wound infection and severe wound infection according to wound scale as shown in table 3.

Diabetic patients are known to have impaired wound healing, hence the wound score is expected to be higher in this subgroup of patients. In our study, 37 patients were diabetic (32 in single layer and 5 in double layer group; noninsulin dependent diabetes; n=31; insulin dependent diabetes; n=6). Diabetic patients who had their leg wound closed in single layer had better wound healing compared to double layer group and had comparatively lower scores. Average wound score of diabetics in single layer was 3.69 while in double layer it was 13.2 which is statistically significant.

On analyzing the wound characteristics it was found that single layer closure had less wound problems compared to double layer closure as evident from table 4. Almost half of the patient in double layer group had serous discharge, inflammation, edema, whereas only one-fourth of the pt had these problems in single layer group.

Average in hospital stay was almost similar in both the groups

but one patient in double layer group stayed for 32 days because of leg wound infection.

Wound length incision, table 5, was analyzed with respect to wound scores in both groups and it was found that there was no difference in wound characteristics with respect to incision lengths.

Patient's were also analyzed for pain in the incision site using Mosby pain rating scale as shown in table 6, it was found that more than half of the pt were pain-free in single layer group whereas only one-fourth of the pt were pain-free in double layer group which is statistically significant.

Discussion

Leg wound complications after CABG are an underrated source of patient morbidity. In present era which is approaching almost negligible mortality after successful CABG surgery , it is often disheartening to both the surgeon and especially to the patient when a wound complication develops or when the wound outcome is suboptimal which leads to prolonged hospital stay and they may spend some more weeks despite having otherwise successful coronary artery surgery. Even though there is increasing towards the use of arterial conduits for revascularization, but still most patients undergoing coronary artery bypass grafting have single or multiple lengths of long saphenous vein harvested for grafting by the open technique. It is therefore important that proper surgical technique and methods to improve wound healing are explored and used. Although a good surgical technique is the most important factor in wound outcome, and but still the method of skin closure seems to be an important factor within this.

The goal of the closure method is to allow appropriate healing by proper apposition of wound edges, to avoid complications such as infection, to result in a cosmetically acceptable scar, to be comfortable to the patient, to be easily performed (11).

Chugtai et al in their study compared clips versus suture technique and they reported that closure with subcuticular technique achieves better outcomes than the use of skin clips (12).

Angelini et al in their prospective randomized trial in CABG patients examined three methods of leg wound skin closure in 113 patients: continuous vertical mattress using 2-0 nylon; continuous subcuticular closure using 2-0 dexon and metal clips. They found that wound discharge, inflammation and infection were significantly less with subcuticular closure. Thus, they recommended standard use of subcuticular techniques for skin closure after saphenous vein harvesting (13). There study correlates well with our study which also shows that single layer subcuticular closure showing better wound outcome than double layer closure.

The continuous subcuticular suture was first described by Halstead in 1890 (13).

Delaria and coworkers have shown that the leg wound complication s resulted in a mean of 12 additional days in the hospital and increased hospital costs by $9900 (1). In our study hospital average stay was almost same for both the groups but one patient overstayed due to wound infection in double layer group.

To have the good wound healing it is important to maximize blood flow with respect to skin, and the method of closure is important in this view. Zografos et al studied the cutaneous wound blood flow by infrared laser Doppler flowmetery using various suturing techniques for abdominal wounds. They found that there was significantly greater blood flow at the wound edges and at uninjured skin in patients where subcuticular closure was used compared to where other closure techniques were used. They attributed this to massive closure techniques decreasing blood supply leading to ischaemia and to suboptimal conditions for healing resulting in greater infection rates (14).

Zafar et al in a recent study compared the two methods of closure; single layer versus multiple layer , and they concluded that single layer wound closure is superior to traditional multiple layer closure (15) which again support our finding of better wound outcomes with single layer closure technique.

Diabetes is a well-known risk factor for wound infection after cardiac surgery. Diabetic patients have a higher incidence of peripheral vascular disease and impaired neutrophil function. The combination of macrovascular and microvascular disease with impaired cellular defense mechanisms predisposes diabetic patients to impaired wound healing (16). In our study diabetic patients who had their leg wound closed with a single layer had lower wound scores compared with diabetics in the multiple-layer group (3.69 vs 13.2).

Patients who had their wounds closed in a single layer over a suction drain had less postoperative edema in the donor leg compared with the conventional method of leg wound closure. This can be attributed to decreased dead space due to evacuation of the hematoma and minimal tissue handling when using the single-layer closure technique. We have also hypothesized that in double layer technique we may close small lymphatic channels which may lead to increased postoperative edema in this group. We use minimal electrocautery for hemostasis, which leads to less injury to vascular capillaries which limit tissue injury and decreases subcutaneous debris which may be nidus for infection.

Studies have shown lower wound complication rates with endoscopic vein harvest techniques (17,18) but, these techniques have financial implications, a learning curve, and longer harvest times (19).

Recent study published in NEJM in July 2009 by John H Alexander, MD, of Duke University Medical Center, and colleagues reported, compared with open surgery to harvest grafts, endoscopic procedures had higher 12- to 18-month

Table 1. Demographics of patients

	Single layer (%)	Double layer (%)	P value
Number	52	25	
Age (years)	57.80+/-9.73	54.46+/-9.72	0.246
Males	37 (71.2)	21 (86.7)	0.452
Females	15 (28.8)	04 (13.3)	0.156
Diabetics	32 (61.53)	05 (41.60)	0.199
Hypercholesterolemia	33 (63.46)	08 (66.66)	0.875
Peripheral vascular disease	2 (03.84)	0	0.126
Preoperative steroids	02 (03.84)	01 (08.33)	0.514
Smoker	14 (31.10)	06 (54.50)	0.146
COPD	08 (15.38)	01 (08.33)	0.683
Renal failure	04 (7.6)	04 (33.33)	0.012
Cross clamp time (min)	43.40	52.2	0.420
Bypass time (min)	79.7	86.6	0.712
Length of stay (days)	10.67	11	0.856

Table 2. Descriptive statistics for total wound score

Treatment	n	Minimum	Maximum	Mean	SD
Single layer	52	0	16	4.038	8.93
Double layer	25	0	32	9.467	5.32

Table 3. Category of infection

Category	Single layer No. (%)	Double layer No. (%)	Wound scale
Satisfactory healing	43 (82.69)	13 (53.33)	0-10
Disturbance of healing	9 (17.31)	8 (33.33)	11-20
Minor wound infection	0	2 (6.66)	21-30
Moderate wound infection	0	2 (6.66)	31-40
Severe wound infection	0	0	>40

Table 4. Wound characteristics

	Single layer	Double layer
Serous discharge	15(28.8)	07(46.6)
Inflammation	12(23.07)	07(46.6)
Edema	12(23.07)	08(53.3)
Infection	00(00)	01(3.33)
Pain	23(44.2)	11(73.33)
In hospital stay	10.67	11.00

Table 5. Descriptive statistics for length of leg incision (cm)

Treatment	n	Median	Minimum	Maximum	Mean	SD
Single layer	52	52	24	78	52.6	15.5
Double layer	25	54	20	82	58.5	16.1

Table 6. Pain score

	Single layer (%)	Double layer (%)
None	29 (55.77)	07 (26.60)
Mild	20 (38.46)	10 (40)
Moderate	03 (5.77)	08 (33.33)
Severe	00 (00)	00 (00)

Table 7. Wound score

	Proportion of wound affected (%)					
Wound characteristic	0	<20	20-39	40-59	60-79	>80
Serous exudates	0	1	2	3	4	5
Inflammation	0	1	2	3	4	5
Infection	0	2	4	6	8	10
Separation of deep tissue	0	2	4	6	8	10
Criteria						Points
Additional treatment						
Antibiotics						10
Drainage of pus under local anaesthesia						5
Debridement of wound (general anaesthesia)						10
Serous discharge						daily 0-5
Inflammation						daily 0-5
Infection						daily 0-10
Separation of deep tissue						daily 0-10
Isolation of bacteria						10
Stay as inpatient prolonged over 14 days						5
Total score						Category of infection
0-10						Satisfactory healing
11-20						Disturbance of healing
21-30						Minor wound infection
31-40						Moderate wound infection
>40						Severe wound infection

vein-graft failure (46.7% vs 38.0%, P<0.001) (20), and was associated with significantly higher mortality, MI, and repeat revascularization rates at three years.

Conclusions

A subcuticular single layer closure over suction drain has shown an overall improved wound outcome and less pain compared to double layer suture technique. This can be attributed to combination of less tissue handling, decreased lymphatic obstruction leading to decreased postoperative edema.

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