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Fatores de risco que afetam as complicações da dissecação da veia safena na revascularização cirúrgica do miocárdio

The risk factors affecting the complications of saphenous vein graft harvesting in aortocoronary bypass surgery

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Resumo

Objetivo: **O problema da cicatrização de feridas é comumente observado após procedimentos de revascularização do miocárdio. Nosso objetivo é determinar a prevalência e os indicadores de complicação na dissecação da veia safena após procedimentos de revascularização coronária.**

Métodos: **Após revisão e aprovação pelo comitê de ética da instituição, uma revisão retrospectiva de 4029 procedimentos de revascularização foi realizada com enxerto da veia safena durante um período de seis anos. Treze fatores de risco para aqueles que desenvolveram complicações extensas nas feridas da perna foram analisados e comparados com toda a coorte de pacientes submetidos a procedimentos de revascularização semelhantes durante o mesmo período.**

Resultados: **Complicações nas feridas do membro inferior ocorreram em 68 pacientes (1,7%), 43 deles precisaram de intervenção cirúrgica adicional. Foram realizados 17 desbridamentos de feridas, nove transplantes de pele, uma angioplastia, 11 fasciotomias, três procedimentos vasculares e duas transferências livre de tecidos. Das treze variáveis analisadas pela análise multivariada, sexo feminino, IMC, uso de enxerto de veia torácica interna, doença vascular periférica, o uso de balão intra-aórtico no pós-operatório e hiperlipidemia pré-existente foram identificados como indicadores independentes significativos de complicações extensas nas feridas a perna (p<0,05).**

Conclusões: **As causas das complicações extensas nas feridas da perna após dissecação da veia safena para procedimentos de revascularização miocárdica são multifatoriais. Para minimizar essas complicações, recomendamos avaliações vasculares antes da dissecação da veia safena, atenção com a técnica cirúrgica apropriada e dissecação cuidadosa no local da incisão.**

Descritores: **Revascularização miocárdica. Veia safena. Ponte de artéria coronária. Perna. Complicações pós-operatórias/etiologia.**

Abstract

Objective: **Problem of wound healing is commonly observed after coronary artery bypass graft procedures. Our aim is to determine the prevalence and the predictors of saphenous vein harvesting complication after coronary revascularization procedures.**

Methods: **After institutional ethical committee review and approval, a retrospective review was undertaken of 4029 bypass procedures with saphenous vein graft performed over a period of six years is conducted. Thirteen risk factors for those who developed major leg wound complications were analyzed and compared with the entire cohort of patients, undergoing similar bypass procedures during the same period.**

Results: **Lower extremity wound complications occurred**

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in 68 patients (1.7%), 43 of them required additional surgical interventions. There were 17 wound debridements, nine skin grafts, one angioplasty, 11 fasciotomies, three vascular procedures, and two free tissue transfers. Of 13 variables evaluated by multivariate analysis, female gender, BMI, use of internal thoracic artery graft, peripheral vascular disease, the use of postoperative intraaortic balloon pump and preexisting hyperlipidemia were identified as significant independent predictors of major leg wound complications ($p<0.05$).

Conclusions: **The causes of major leg wound complications after saphenous vein harvest for coronary artery bypass graft procedures are multifactorial. To minimize these complications, we recommend vascular evaluations before saphenous vein harvest, attention to proper surgical technique, and careful harvest site section.**

Descriptors: **Myocardial Revascularization. Saphenous vein. Coronary artery bypass. Leg. Postoperative complications/etiology.**

INTRODUCTION

Coronary arteriosclerosis is most prevalent among males, diabetics, smokers, and those with obesity hyper lipidemia, and hypertension. It affects more than 13 million Americans today and has resulted in more than 573,000 coronary artery bypass graft (CABG) operations, performed in the United States, in 1995 [1]. Despite increased use of arterial grafts, the greater saphenous vein (GSV) still remains the most frequently employed conduit in coronary revascularization since its introduction in 1968. Although a considerable amount has been written concerning sternal wound infections after CABG, little information has appeared in the literature regarding lower extremity morbidity.

The reported incidence of leg wound complications after GSV harvest ranges from 1to 24% [2-5], with one series as high as 32.6% [6]. Commonly reported leg wound complications include dermatitis, cellulites, grater saphenous neuropathy, chronic non-healing wounds, and lymphocoele [6-9]. These complications rarely require surgical intervention and represent minor concerns in most CABG procedures. However, the major leg wound complications at the GSV harvest site can cause significant patient morbidity resulting in greater length of stay, increased hospital cost, and additional surgical procedures with associated deformities and limb loss.

The purpose of this study is to review result of treating 68 patients with major leg wound complications after CABG procedures over a seven-year period and to identify potential associated risk factors.

METHODS

Study design

After institutional ethical committee review and approval, a retrospective review was undertaken Between August 1997 and August 2003, 4029 CABG procedures using GSV with or without internal thoracic artery (ITA) grafts were performed at our institution.

Major leg wound complication was defined as a leg wound that had failed to respond to conservative treatment and required subsequent surgical intervention. Surgical intervention included debridement, thromboembolectomy, and fasciotomy, delayed wound closure with skin graft or local rotation flap, and free tissue transfer for limb salvage.

Demographic information, leg wound management protocol, and surgical procedures performed in all patients were obtained through retrospective chart review. Thirteen preoperative risk factors associated with leg wound complications among these patients were analyzed and compared with the entire cohort of patients undergoing CABG during the same interval. Risk factors examined in this study included age, body mass index (BMI), gender, diabetes mellitus, peripheral vascular disease (PVD), operation time, cardiopulmonary bypass time, aortic cross-clamp time, hyperlipidemia, hypertension, the use of ITA as bypass conduit, the number of GSV grafts and postoperative intraaortic balloon pumping (IABP) use. BMI was determined by patients body weight in kilograms (kg) divided by height in meters squared (m^2) [BMI=weight (kg)/ height (m^2). Statistical analysis consisted of a χ^2 contingency analysis or Fishers exact test for discrete variables and unpaired T test for continuous variables. A value of P less than 0.05 was considered significant. All variables were entered in multivariate stepwise regression analysis to identify significant independent predictors of major leg wound complications.

RESULTS

Lower extremity wound complications were identified in 68 patients (1.7%). There were 40 men and 28 women, with a mean age of 58.10±10.19 years (range: 31 to 72). Twenty five of who were treated successfully with non-operative management. The remaining 43 patients (63.2%) required one or more additional surgical procedures to treat their major leg wound complication. A comparison of patient characteristics based on whether they were leg wound identified or not is shown in Table 1.

The most frequent complication in our study was

dermatitis (28 patients) and the most common operations were debridement and fasciotomy. No amputation was required. These complications and surgical procedures are shown in Table 2.

Of 13 variables evaluated by univariate analysis, female gender, BMI, PVD, diabetes, use of internal thoracic artery graft, postoperative intraaortic balloon pump use and preexisting hyper lipidemia were identified as significant independent predictors of major leg wound complications (Table 3).

Statistically significant variables were entered into a multivariate stepwise regression analysis model which identified female gender, BMI, diabetes, use of internal thoracic artery graft, PVD, IABP use and preexisting hyperlipidemia were identified as significant independent predictors of major leg wound complications (Table 4).

Table 1. Patient demographics

Patients	Leg wound Present (N=68)	Absent (N=3961)	P value
Age (y)	58.10±10.19	57.26±9.31	NS
Female gender (%)	41.2	23.8	0.002
Operation time (h)	7.39±0.59	7.46±1	NS
AXC time (min)	97.47±28.86	94.48±36.24	NS
CPB time (min)	58.96±24.19	56.81±24.08	NS
BMI (Kg/m^2)	27.67±4.7	26.48±4.5	0.03

AXC = aortic cross clamp; BMI = body mass index; CBP = cardiopulmonary bypass; NS=non significant

Table 2. Postoperative complications and surgical procedures

Complications	Wound Leg Left Leg%	Right Leg%	Total%
Compartment	5.8	1.5	7.3
Dermatitis	17.5	23.6	41.1
Cellulitis	11.8	11.8	23.6
Ischemia	1.4	1.4	2.8
Necrosis	4.5	10.2	14.7
Thrombosis	5.8	1.5	7.3
Nonhealing w	1.5	1.5	3
Surgical Procedures			
Fasciotomy	13.9	11.6	25.5
Debridement	16.3	23.3	39.5
Debridement, Angioplasty	1	0	1
Thrombectomy	4.7	2.3	7
Skin graft	11.6	9.3	20.9
Free tissue transfer	0	4.7	4.7

DISCUSSION

The reported leg wound complications after myocardial revascularization range from 1%-44%. In 1981, DeLaria et al. [3] noted a 1% incidence of leg wound complications in a retrospective review of 2,545 coronary revascularizations using GSV grafts. Approximately 0.5% was identified as major leg wounds requiring surgical debridements and closures. They concluded that leg wound complications were more likely to occur in obese women. In 2007, a prospective study by Kayacioglu et al. [4] found the significantly increased risk for wound complications were also seen in female gender, diabetic and obese patients. Fowler et al. [6] found a major infection of the saphenous harvest site, occurred in 32.6% of a population of 11,636 patients, after CABG.

Table 3. Correlation of Risk Factors with Major Leg Wound Complications

Risk Factor	No Leg Wound (n=4029)	Leg Wound (n=68)	p
Age (y)	57.26±31	58.10±10.19	NS
CPB time (min)	94.48±36.24	97.47±28.86	NS
ACX time (min)	56.81±24.08	58.96±24.19	NS
Operation time (h)	7.46±1	7.39±0.059	NS
BMI (kg/m^2)	27.38±21.81	27.68±4.75	NS
Diabetes (%)	23.4(3959)926	48.5(68)33	<0.001
Female gender (%)	23.8(3961)943	41.2(68)28	<0.002
PVD (%)	17.9(3955)708	27.9(68)19	<0.029
Hypertension (%)	28.5(3956)1128	30.9(68)21	NS
Hyper lipidemia (%)	35.9(3957)1419	51.5(68)35	<0.029
IABP (%)	1(3960)40	4.4(68)3	<0.035
GSV graft	3.29±0.086	3.38±0.88	NS
ITA (%)	2.3(3959)91	2.9(68)2	<0.001

AXC = aortic cross clamp; BMI = body mass index; CBP = cardiopulmonary bypass; PVD=peripheral vascular disease; IABP=intraaortic balloon pump; ITA=internal thoracic artery; GSV=greater saphenous vein; NS=non significant

Table4 . Multivariate Analysis of Risk Factors

Risk Factor	Univariate p	Multivariate F	Multivariate p
Female gender	0.001	11.051	<0.001
Diabetes	0.0001	23.411	<0.0001
PVD	0.033	4.554	<0.032
Hyperlipidemia	0.029	3.538	<0.008
ITA	0.0001	7.491	<0.050
IABP	0.007	7.33	<0.001

PVD=peripheral vascular disease; IABP=intraaortic balloon pump; ITA=internal thoracic artery

Our incidence of leg wound complications 1.7% in 4029 CABG procedures with GSV harvesting were performed. Although obesity had been previously shown to be a risk factor for development of leg wound complications, we found also significant BMI difference between the patients with major leg wound complications (p=0.03) and the rest of the cohort. We concluded that leg wound complications were more likely to occur in women. Nevertheless, there is no clear explanation for it. One hypothesis is that female patients tend to have smaller peripheral arteries than males and overall have a higher morbidity and mortality after myocardial revascularization. Secondly, since the majority of female patients undergoing CABG procedures were postmenopausal, it is possible that decreased estrogen level may also impair leg wound healing in addition to its deleterious effect on cardiovascular disease. Estrogen receptors have been identified in various cells of human skin [10], and administration of estrogen has been shown to increase the release of platelet-derived growth factor alpha and to stimulate fibroblastic and myofibroblastic wound contraction [11]. However, information on the effect of hormone replacement on wound healing is still lacking.

Preexisting PVD is more common among patients undergoing CABG, and these patients lend to rely on collateral circulation to supply blood to their distal extremities. Kitamura et al. [12] reported a rare case of lower extremity ischemia after use of the left ITA for coronary revascularization. Their workup of the patient indicated that the left ITA was a major contributor to collateral blood flow to the left iliac artery. They recommended using only the GSV rather than the ITA in patients with "markedly enlarged" ITA and severe PVD to avoid limb ischemia. In our study, 93 patients had ITA grafts with their CABG procedures. Limb ischemia did not develop in any of these patients, but there was a significant correlation between the use of ITA and major leg wound complications (p=0.001).

However, a strong correlation was found between preexisting PVD and the development of major leg wound complications at the GSV harvest sites. Preexisting PVD was identified in 727 of 4,029 patients (18.1%). In contrast, 19 of the 68 patient (27.9%) with major leg wound complications had preexisting PVD (p=0.002). Among them, we could find only seven patients with documented lower extremity vascular evaluations before their operations (ABI ranged from 0.62 to 0.93). Clearly preoperative vascular evaluations are not indicated in all patients. However, if a patient demonstrates evidence of significant PVD on physical examination, a vascular workup of the lower extremity before harvesting GSV is advised. Scher et al. [13] recommended segmental Doppler pressure and pulse volume recordings for patients at risk for ischemic complications of distal leg incisions. GSV harvest should be avoided for Doppler ankle pressures less than 50 mm Hg. Furthermore, they recommended arteriography and vascular bypass for existing necrotic leg wounds with ankle pressure less than 50 mm Hg, as this may be incompatible with wound healing.

The reported lower extremity complications after IABP insertion ranged from 20% to 30%, with limb ischemia being the most common problem [14]. In our study, postoperative IABP was required in 43 patients, three of whom experienced major leg wound complications. Limb ischemia developed in two of these patients as a consequence of arterial thrombosis (Table 2). As expected, (two of three patients) had preexisting PVD, but none had vascular evaluations before their operations. Other reported risk factors for developing limb ischemia from IABP include female sex, diabetes mellitus, and smoking [14,15]. Previous research demonstrated that patient body surface area, method of balloon placement, age, preoperative homodynamic status, and preoperative ventricular function were not independent predictors of vascular complications from IABP [15].

Although it is difficult to predict which patient will require IABP during the postoperative period, most potential leg wound complications can be avoided with careful vascular examination before balloon insertion and contra lateral placement of the balloon pump in the leg where the vein grafts were not harvested. If limb ischemia does occur, removal of the IABP (as allowed by the patients condition) and/or local thrombectomy may be sufficient. If continued IABP support is indicated, contra lateral placement of IABP or a femorofemoral arterial bypass is recommended [16,17].

Predictably, significant correlation (p=0.0001) was found between diabetes mellitus and the development of major leg wound complications. Although in the study by Paletta et al. [18] multivariate analysis failed to identify diabetes mellitus as a significant independent risk factor, alterations in wound healing in diabetic patients contributed greatly to the development of leg wound complications. In patients with hyperglycemia, a higher concentration of glycosylated hemoglobin has an increased affinity for oxygen, thus contributing to low oxygen delivery at the capillary level [19,20]. This predisposes patients with diabetes mellitus to wound healing impairment at the GSV harvest site.

Other contributing factors include preexisting hyperlipidemia, atherosclerotic disease targeted at the lower extremity, increased blood viscosity due to stiffened red blood cells, and impaired immune system. Diabetes-related wound complication can be minimized with vigilant control of blood glucose level both preoperatively and postoperatively.

Minimally invasive techniques for GSV harvest have been described in the literature in attempts to reduce the incidence of leg wound complications [21,22].

Most recently, Allen et al. [22] demonstrated a

significantly lower complication rate with endoscopic vein harvesting technique compared with the traditional method. However, procurement of the GSV is still being performed with the traditional longitudinal incision. Adherence to basic surgical principles and proper vein harvest site selection still remain the essential factors in preventing leg wound complications, especially in patients with compromised lower extremity circulation. Minimal dissection, adequate homeostasis, careful approximation of subcutaneous tissue and skin, and prompt drainage of hematomas are key principles in reducing leg wound complications. The risk is further enhanced in the presence of diabetes mellitus and PVD.

CONCLUSION

The causes of major leg wound complications after GSV harvest for CABG procedures are multifactorial. Multivariate analysis suggests female gender, use of ITA, diabetes mellitus, postoperative use of IABP, preexisting PVD and hyperlipidemia as strong independent predictors of major leg wound complications. The complexity of management of these complications parallels their severity and ranges from simple debridement to free tissue transfer using micro vascular techniques. Potential serious complications can be avoided by (1) identifying patients at risk, (2) obtaining preoperative vascular evaluations and appropriate interventions, (3) selecting proper vein harvest sites and applying meticulous surgical techniques, (4) promptly recognizing and treating early complications, and (5) administrating aggressive therapy for established complications.

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