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Factors Affecting Lower Limb Amputation following Arterial Bypass Surgery

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Abstract

Study background: To identify important risk factors for subsequent amputation within one year after surgery in patients with acute lower limb ischemia undergoing distal arterial bypass.

Methods: A chart review of patients undergoing distal vascular bypass for lower limb ischemia within the 5-year period between 2006 and 2011 was done. All patients were followed for at least one year. The outcome of interest was the need for amputation of the treated limb within one year after bypass surgery. Potential risk factors associated with the need to perform amputations were abstracted from the medical charts. Logistic regression and chi-square tests were used to identify significant associations between risk factors and amputation.

Results: Of 128 patients reviewed, only 18 (14%) had amputations within one year. Although there was a trend for increased risk of amputation for patients with a history of smoking, DM, renal dysfunction, presenting with rest pain, lower ABI, multilevel disease, circumferential thickening of the stenosis, and lower risk for patients taking postoperative antiplatelets (but not anticoagulants), the only significant risk factor at the 5% level were poorly controlled diabetes mellitus after operation and cerebrovascular disease.

Conclusion: A few well-known risk factors were associated with increased risk of early amputation after arterial bypass surgery.

Keywords: Chronic arterial occlusion; Lower limb ischemia; Cerebrovascular disease; Diabetes mellitus

Introduction

Limb salvage is the primary goal in management of peripheral arterial occlusive disease (PAOD), especially in patient with critical limb ischemia [1-3]. Tentative conclusions might be drawn by examination of the outcome of surgery for PAOD as measured by the rate of amputation [4]. Evaluation of therapeutic effectiveness of interventional procedures used to treat peripheral arterial occlusive disease (PAOD) requires use of several outcome measures that assess factors that affect patients directly (e.g., survival, amputation-free survival, quality of life, and pain relief), and clinical measures (e.g., laboratory test measurement) [5-7].

To evaluate the long-term outcome of revascularization procedures for PAOD at the population level, survival and major amputation-free survival rates should be used, because they provide more clinically accepted estimates compared with the correlation between utilization rates for revascularization and amputation procedures, which have been used to describe outcome in previously published reports in the literature [8].

Several population-based studies have decreased rate of amputation in association with increased use of revascularization procedures [1,2,4,5,8]. On the other hand some studies showed no changes in lower extremities amputation rates [9-11]. The assumption in these studies is that if revascularization procedures avert the need for amputation in some patients, then a negative correlation should exist between rates of amputation and revascularization procedures.

Risk of amputation following revascularization procedures was positively associated with type of procedure, black race, uninsurance/Medicaid, and diabetes status [12]. Risk of death was also higher following bypass surgery while this might reflect underlying severity of disease. Patient education, screening, and optimal care of lower extremities should be emphasized to peripheral vascular disease (PVD) patients at an early stage of the disease process [12].

For several risk factors, diabetes-related amputation rates exhibit high regional variation, even after age, sex, and race adjustment [13]. Only patients receiving dialysis, and not patients with milder degrees of renal insufficiency, appear to be at higher risk for limb loss after revascularization, compared with patient with normal renal function [14].

Materials and Methods

Study design

A retrospective hospital based cohort study utilizing administrative database in Ramathibodi hospital was conducted from 1 January 2006-31 December 2011.

Data source

The study was conducted at the Ramathibodi hospital. Case record for bypass surgery from Ramathibodi hospital discharge was analysed. The database record contains information on patient demographics, underlying diseases of patients (diabetes mellitus, hypertension, coronary artery diseases, congestive heart failure, cerebrovascular accident, renal insufficiency), diagnosis and procedures. The diagnosis codes were based on International Classification of Diseases (ICD) 10th division while operations were based on ICD-9 CM.

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Identification of cases

A procedure code for lower extremities arterial bypass surgery code 39.29, the code 39.25 were considered for aorto-ilio-femoral bypass.

Characteristics of patients such as presence of diabetes mellitus, hypertension, coronary artery diseases, congestive heart failure, cerebrovascular accident, renal insufficiency were abstracted from medical records. History of smoking was recorded.

Patients were followed from date of surgery until the occurrence of the outcome of interest (major amputation within 1 year) or until last follow up, whichever comes first. Major amputation was defined as through-ankle amputation, below knee amputation, or above knee amputation.

Statistical analysis

Logistic regression and chi-square tests were used to identify significant associations between risk factors and amputation. All *P* values reported were two-tailed and were considered significant at 0.05, statistical analysis were perform with SPSS.

Results

This study was undertaken to determine the outcome of revascularization procedures of PAOD on a hospital basis by reviewed data in Ramathibodi hospital between 2006 and 2011. The overall amputation rate in one year was 18 patients in 128 patients (14 %) after revasucularization procedure. Mean of ABI in affected limb in amputation group and non-amputation group were 0.46 and 0.53 respectively. Mean of ABI in contralateral side in amputation group and no- amputation group were 0.82 and 0.86 respectively. Patient baseline characteristics are summarized in table 1.

For many parameters in these 128 patients reviewed in Ramathibodi Hospital in between 1994-2004, there was a trend for increase risk of amputation for patients with history of smoking, diabetes mellitus, renal dysfunction, presenting with rest pain, lower ABI, multilevel disease, circumferential thickening of the stenosis, and lower risk for patients taking postoperative antiplatelets (but not in anticoagulant group), the only significant factors were poorly controlled diabetes mellitus and cerebrovascular diseases. There was no correlation between risk of amputation in one year and coronary artery diseases, congestive heart failure (during hospital period).

	No Amputation	Amputation	P value
Number of patients	110	18	
Mean age (y) (+) SD	61.1(14.7)	63.0 (15.8)	0.759
Sex (%F/M)	61/64	3/18	0.053
Smoker	64/110	13/18	0.265
Diabetes mellitus	57/110	8/18	0.774
Hypertension	55/110	10/18	0.662
Coronary artery disease	16/110	2/18	0.699
Congestive heart failure	3/110	1/18	0.533
Cerebrovascular disease	7/110	4/18	0.037
Renal insufficiency	13/110	3/18	0.566
Most severe symptom (claudication)	26/110	3/18	0.626
Most severe symptom (rest pain)	11/110	3/18	
Most severe symptom (tissue loss)	73/110	12/8	
Number of disease (unilevel)	3/110	1/18	0.756
Number of disease (multilevel)	107/110	17/18	
Mean ABI/ contralateral ABI	0.53/0.86	0.46/0.82	0.417,0.532
Poorly controlled DM	14/71	3/12	0.046

Table 1: Patient baseline characteristics.

For surgical procedures, there was no significance in comparing by type of inflow, outflow and types of graft in both groups.

Discussion

Although there was a trend for increased risk of amputation for patients with a history of smoking, DM, renal dysfunction, presenting with rest pain, lower ABI, multilevel disease, circumferential thickening of the stenosis, and lower risk for patients taking postoperative antiplatelets (but not anticoagulants), the only significant risk factor at the 5% level were poorly controlled diabetes mellitus after operation and cerebrovascular disease.

Dormandy et al. [15] showed a 5-year survival rate of 70% in patients with intermittent claudication while other studies reported a 5-year survival rate of 38 to 48% for patients with critical leg ischemia treated surgically [16]. Al-Omran et al. [8] showed 5-year cumulative survival rate of 61.5% and major amputation-free survival rate of 83.4%, compared with 69% and 92.2% in patients who underwent angioplasty. Male sex, older age, diabetes, and heart disease were associated with increased risk for death after revascularization procedure [8]. Increased risk of major amputation after revascularization procedures was associated with male sex, older age, and diabetes where as hypertension was linked to decreased risk. However, because of absence of clinical indications (intermittent claudicating or ischemia) for intervention in the databases, comparison between survival rates for these procedure reports is not possible [17,18].

Ages [19-21], male sex [20-22], coronary artery disease [19,21,23], diabetes [5,18], and hypertension [23-26] have all been reported as predictors for increased mortality in patients with PAOD. The most significant factor in our study was poorly controlled diabetes mellitus when compared to other factors such as patients with history of smoking, diabetes mellitus, renal dysfunction, presenting with rest pain, lower ABI, multilevel disease, circumferential thickening of the stenosis. The risk was lower in patients who were taking postoperative antiplatelets (but not in anticoagulant group).

PAOD in diabetic patient (DM) progress more rapidly and more severely than non-diabetic patient [27]. DM compromises endothelial function by several mechanisms i.e., hyperglycemia, excess circulation of free fatty acid, increased oxidative stress, decreased nitric oxide synthesis and prostacyclin [27]. DM also augments the unstable atheroma formation due to secretion of cytokine by diabetic endothelial cell that inhibits collagen production of smooth muscle cell [28]. Fibrinolytic activity is impaired in DM which favors a tendency to coagulate and persistent thrombin formation [29]. All these pathophysiological mechanisms are important reasons that explain the significance of poorly controlled DM in lower limb amputation after bypass surgery.

Limitation of this retrospective study was that we couldn't control many parameters because of small volume of patients, making many well known risk factors not significant for amputation. However this study provides more clinically accepted estimates of outcome of revascularization procedures at the population level, which may be of great interest to patients undergoing revascularization to treat PAOD. Physicians could use survival and amputation-free survival rate and factors that influence them to explain to patient the long term outcome of revascularization procedures.

In future we will extend this study to increase the number of patients enrolled that impact on factors affecting the outcome of revascularization procedures and searching for other factors influencing amputation free survival rate or significant parameters that may predict outcome of revascularization procedures.

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