Healthcare-associated Infections After Lower Extremity Revascularization

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WHAT THIS PAPER ADDS

Infrainguinal open vascular procedures are particularly prone to surgical site infection. However, owing to the steady advancement of endovascular treatments, the contemporary incidence of associated infections is largely unknown. This study presents recent data on infectious complications and related risk factors after lower extremity open and endovascular revascularization on a national basis, thereby providing a means of assessing the choice of treatment and likely outcomes for different patient categories.

Objective: This population-based study aims to elucidate the incidence of healthcare-associated infections (HCAI) and related risk factors in non-emergent, open and endovascular lower extremity vascular procedures.
Method: This was a retrospective analysis of prospectively collected data from the Swedish National Vascular Surgery registry (Swedvasc), National Patient registry, and Cause of Death registry. A nationwide survey of all postoperative infections among patients who have undergone non-emergent open and endovascular surgery for lower extremity arterial disease between January 2005 to December 2010 ($n = 10,547$) has been performed. Data were retrieved from the National Vascular Surgery registry and cross-matched with the National Patient and Cause of Death registries. The primary purpose of the study was to identify the rate of 30-day postoperative infections and the associated risk factors for the different classes of lower extremity ischemia and operative procedures.
Results: The study cohort included patients with claudication 27.0% ($n = 2,827$) and critical limb ischemia (CLI), consisting of rest pain 17.0% ($n = 1,835$) and ulceration/gangrene 56.0% ($n = 5,885$) undergoing endovascular intervention ($n = 6,262$; 59.0%), thromboendarterectomy ($n = 1,061$; 10.0%), or bypass surgery ($n = 3,224$; 31.0%). The total incidence of postoperative infection (<30-days) was 9.7% ($n = 1,019$), including skin and soft tissue infection ($n = 735$; 6.9%), urinary tract infection ($n = 168$; 1.6%), pneumonia ($n = 114$; 1.1%), and sepsis ($n = 91$; 0.9%). In claudicants, the risk of infection was increased eightfold for bypass surgery compared with endovascular intervention (odds ratio 8.4, 95% confidence interval 5.0—14). Risk factors associated with infection were degree of lower extremity ischemia, diabetes, renal insufficiency, and heart and lung disease ($p < .05$).
Conclusion: The postoperative rate of HCAI is associated with cardiovascular risk factors, operative method, and degree of lower extremity ischemia. This may be of assistance when deciding on the type of operative procedure for these patients.

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INTRODUCTION

Postoperative infections in vascular surgery are relatively common complications with potentially grave consequences.[1,2] Infectious complications range from surgical site infections (SSI), which can vary from superficial dermal infections (Szylagyi Grade I) to deep infections involving arterial implants (Szylagyi Grade III), and can directly affect the outcome of the operation and possibly result in limb loss, urinary tract infections (UTI), pneumonia, or sepsis, causing considerable morbidity and prolonged hospital length of stay.[1] Infrainguinal open procedures are particularly prone to SSI owing to the use of groin incisions[2] and an over-representation of diabetics in the patient population.[3,4] The steady advance of percutaneous endovascular treatments has, by and large, eliminated the risk of SSI in this patient category. However, owing to the ambulatory nature of these treatments and varying follow-up regimens the incidence of associated infections is largely unknown.

The aim of this study was to evaluate the rate of healthcare-associated infections (HCAI) and related risk factors in patients treated for lower extremity arterial disease on a national basis, thereby providing a means of

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assessing the choice of treatment and likely outcomes for different patient categories.

METHOD

Study population

All patients who underwent non-emergent primary infrainguinal surgery, open or endovascular, for lower extremity arterial disease between January 2005 and December 2010 were included in the study. Patients with secondary procedures, re-operations, or combined endovascular and open surgery were excluded ($n = 2,763$). Only the first surgery/intervention in the time span for each patient was included in the analysis.

The study was approved by the local ethics committee.

Data source

The Swedish National Registry for Vascular Surgery (Swedvasc), the Swedish National Patient Register (NPR), and the Cause of Death Register were used as data sources to collect information about patients who underwent either open or endovascular lower extremity revascularization during the study period. Using the subjects' Civic Registration Numbers (CRN), which are registered at every contact with the health authorities, facilitated the cross-matching of data between different databases. Since 1994, when the Swedvasc registry was established on a national basis, it has been continuously updated and improved to include all vascular procedures. Owing to the increasing number of endovascular interventions the registry underwent a major revision in May 2008 and became known as Swedvasc 2.0. Thirty-four hospitals ranging from smaller county hospitals to university hospitals covering all major population centres have contributed to the database. The external validity of Swedvasc has been shown to be >90.0%.[5] All contact with healthcare providers, whether hospitals or community care providers, are registered in the NPR. According to a recent report, the rate of missing main diagnosis codes was 0.9% for hospital admissions and 10.0% for primary care contacts.[6] All deaths, including their causes, are registered in the national Cause of Death Register.

Study data

Data regarding demographics, presenting symptoms, comorbidities, type of procedure, and follow-up visits at 30 days and 1 year were collected from Swedvasc. These data were subsequently cross-matched with the NPR database and the Cause of Death Registry to identify all postoperative cases of infection within 30 days of the index operation. Data regarding the 1-year amputation rate and 30-day mortality were also obtained by cross-matching the three databases.

Postoperative infections were classified according to the International Classification of Diseases (ICD-10-SE) diagnostic codes for skin and soft tissue infection, including wound infection/abscess and graft infection (L031, L032, L033, L038, L039, L08, L97, T814, T827), UTI (N10, N11, N12, N30, N39), pneumonia (J12–J18), and sepsis (A40, A41). Lower extremity amputation was defined as major amputation—above ankle (NGQ19; NFQ19).

The comorbidities included diabetes mellitus (all types), hypertension, renal insufficiency (s-creatinine >150 μmol/L), cerebrovascular disease (history of stroke, transient ischemic attack, or major neurological deficit), heart disease (history of myocardial infarction, angina pectoris, heart failure, or previous coronary intervention), lung disease (chronic obstructive pulmonary disease), and smoking (history of smoking within 5 years of index procedure). The only discrepancy between Swedvasc 1.0 and 2.0 concerning the definitions of the above risk factors was the omission of atrial fibrillation from heart disease in Swedvasc 2.0.

The patients were divided into three diagnostic categories based on the presenting lower extremity symptoms: claudication, critical limb ischemia (CLI) (rest pain without wound/gangrene), and ulceration/gangrene.

The operative methods were comprised of both open surgical procedures and endovascular interventions. The open surgical methods included groin thromboendarterectomy (TEA), including the common femoral, profunda, and proximal superficial arteries and bypass surgery (vein or synthetic grafts). The endovascular interventions included a range of procedures from percutaneous transluminal angioplasty to subintimal angioplasty and placement of stents/stent-grafts. The guidelines for the administration of prophylactic antibiotics in open procedures ranges nationwide from one to three doses of cloxacillin (2 g intravenously [i.v.]) and in case of penicillin allergy, clindamycin (600 mg i.v. three times). As there are no national or regional guidelines pertaining to the administration of prophylactic antibiotics for endovascular procedures, the use of such prophylaxis remains discretionary. Hybrid cases (open and endovascular) were excluded.

Statistical analysis

The database was prepared using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA). R version 2.14.2 (R Foundation for Statistical Computing, Vienna, Austria), and package mice version 2.12 [2] was used for statistical analyses and generation of statistical output.

The primary purpose of the study was to identify the rate of 30-day postoperative infections and the associated risk factors for the different classes of lower extremity ischemia and operative procedures. The secondary purpose of the study was to identify any associations between postoperative infections and 30-day mortality and amputation within 1 year.

Data are presented as the number and proportion of patients for each independent variable both as a total and the proportion with an infection within 30 days.

The impact of the selected variables on all types of infections within 30 days were analyzed using logistic regression models adjusted for Swedvasc registry version (Swedvasc 1.0 or 2.0), both with only the variables and registry version as factors (univariate model), and with all the selected variables and registry version (multivariate