Mortality and complications after aortic bifurcated bypass procedures for chronic aortoiliac occlusive disease

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Objective: **Open surgery has given way to endovascular grafting in patients with aortoiliac occlusive disease. The growing use of endovascular grafts means that fewer patients with aortoiliac occlusive disease have open surgery. The declining open surgery caseload challenges the surgeon's operative skills, particularly because open surgery is increasingly used in those patients who are unsuitable for endovascular repair and hence technically more demanding. We assessed the early outcome after aortic bifurcated bypass procedures during two decades of growing endovascular activity and identified preoperative risk factors.**

Methods: **Data on patients with chronic limb ischemia were prospectively collected during a 20-year period (1993 to 2012). The data were obtained from the Danish Vascular Registry, assessed, and merged with data from The Danish Civil Registration System.**

Results: **We identified 3623 aortobifemoral and 144 aortobiiliac bypass procedures. The annual caseload fell from 323 to 106 during the study period, but the 30-day mortality at 3.6% (95% confidence interval [CI], 3.0-4.1) and the 30-day major complication rate remained constant at 20% (95% CI, 18-21). Gangrene (odds ratio [OR], 3.3; 95% CI, 1.7-6.5; $P = .005$) was the most significant risk factor for 30-day mortality, followed by renal insufficiency (OR, 2.5; 95% CI, 1.1-5.8; $P = .035$) and cardiac disease (OR, 2.1; 95% CI, 1.4-3.1; $P < .001$). Multiorgan failure, mesenteric ischemia, need for dialysis, and cardiac complications were the most lethal complications, with mortality rates of 94%, 44%, 38%, and 34%, respectively.**

Conclusions: **Aortic bifurcated bypass is a high-risk procedure. Although open surgery has increasingly given way to endovascular repair, 30-day outcomes have remained stable during the past decade. Thus, it is still acceptable to consider an aortic bifurcated bypass whenever endovascular management is not feasible. (J Vasc Surg 2015;62:75-82.)**

The management of aortoiliac occlusive disease has undergone substantial changes since the introduction of percutaneous transluminal techniques. The endovascular technique has improved much over time, and today, focal and complex atherosclerotic lesions are increasingly treated endovascularly.[1] This shift makes it difficult for the surgeon to keep up sufficient surgical skills because the open surgery caseload is reduced. Hypothetically, the surgeon is further challenged by the fact that with the growing sophistication of percutaneous transluminal techniques, the procedures that are left for open surgery are becoming ever more surgically demanding.

Extant literature on 30-day mortality and complication rates in open aortic bypass surgery stems from the time before endovascular repair became an alternative, and estimated risk rates vary considerably.

No recent randomized trials have been published on aortic bifurcated bypass procedures. A large-scale register survey, taking advantage of the unique and complete Danish civil registration system, The Danish Register of Causes of Death, offers a robust estimation of the early risk after aortic bifurcated bypass procedures during the past 20 years.

The objective of this study was to assess the mortality and the complication rate after aortic bifurcated bypass procedures for aortic occlusive disease during a period with growing endovascular activity and to identify preoperative risk factors in a national cohort registered prospectively over 20 years.

METHODS

The Danish Vascular Registry. Since 1993, all vascular procedures performed in Denmark have been registered in the Danish Vascular Registry (www.karbase.dk). The registry contains data on demographics, indications for surgery, comorbidity, surgical procedures, in-hospital

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Table I. Criteria for complications[4]

Complications	*Definition*
Medical complications	
Cardiac	Myocardial infarction, heart failure, or arrhythmia necessitating medical treatment
Pulmonary	Pneumonia or respiratory distress syndrome necessitating medical treatment or mechanical ventilation for >2 days
Renal failure	Increase in serum creatinine of >150 μmol/L
Dialysis	Transient or permanent need for dialysis
Intensive care	Stay in intensive care unit for >3 days
Stroke/TIA	CT-confirmed incidence of stroke or clinically suspected TIA
Deep venous thrombosis	Verified by ultrasound imaging
Pulmonary embolism	Radiographically confirmed
Compartment syndrome	Fasciotomy performed
Multiorgan failure	Diagnosis reported by the intensivist
Surgical complications	
Bleeding	Requiring reoperation
Rupture of the abdominal fascia	Requiring reoperation
Bowel obstruction	Confirmed by laparotomy
Mesenteric ischemia	Confirmed by laparotomy
Embolism	Peripheral embolization confirmed by reduction in ABI
Graft failure	Total or partial occlusion of the graft
Graft infection	Necessitating medical treatment
Wound complications	Infection, hematoma, lymphocele requiring surgical revision

ABI, Ankle-brachial index; *CT,* computed tomography; *TIA,* transient ischemic attack.

complications, discharge, and 30-day outcome. Other variant procedures, such as aorta-uniiliac-unifemoral or iliobifemoral, could be excluded from the data retrieval. Data are reported prospectively, continuously, and online to a central server.[2] The clinical data of the Registry have previously been proven to be very accurate.[3] Every Danish citizen has a unique civil registration number that is used to link data from the Danish Vascular Registry to data from The Danish Register of Causes of Death, which gives the precise dates of death.

The Danish National Board of Health and the Danish Data Protection Agency approved the Danish Vascular Registry and the data linkage performed in the present study. According to Danish law, a patient's consent to data capture from an officially approved registry, such as the Danish Vascular Registry, is not required where such data are used for statistical purposes.

Patients. Data on all patients who had an aortobifemoral (ABF) or an aortobiiliac (ABI) bypass for limb ischemia in Denmark from 1993 to 2012 were extracted from The Danish Vascular Registry. To be able to draw safe conclusions on patients planned for open aortic bifurcated bypass procedures due to chronic limb ischemia, we excluded procedures featuring a high-risk profile, defined as acute aortic or iliac thrombosis, a procedure initiated in the night shift, adjunctive mesenteric or renal procedures, and patients with previous aortoiliac open surgery. Patients with previous aortoiliac endovascular procedures were not excluded.

End points. The primary end point was 30-day mortality and complications after aortic bifurcated bypass procedures during the study period. Preoperative and intraoperative risk factors potentially influencing the early outcome were analyzed as secondary end points. Mortality after a major complication was assessed for each individual complication and for each institution.

Definitions. Mortality was defined as death ≤30 days of surgery. Major complications were defined as predischarge medical or surgical incidents necessitating treatment, extending hospitalization, or being fatal and which were registered in the Vascular Registry as having occurred ≤30 days of the primary aortic bifurcated bypass procedures. Nonfatal wound complications necessitating treatment or prolonged hospitalization were defined as minor complications. Whether the complication led to extended hospitalization was determined by the surgeon discharging the patient. Complications not necessitating intervention were not registered. The complication criteria are detailed in Table I.[4]

Statistics. Primary end points were expressed as mean with 95% confidence intervals (CIs). For all potential explanatory preoperative and intraoperative risk factors listed in Table II suspected of being associated with an adverse 30-day outcome (except blood loss and procedure time), a multivariable model was fitted that contained all variables that were significant in the univariate logistic regression analysis at the 20% to 25% level. We then assessed whether removal of the covariate produced an important change, defined as a 20% change in the coefficients of the variables remaining in the model. If so, it was regarded as an important confounder and therefore added to the model again. We continued to do so until no variables could be deleted from the model. All previously excluded variables from the initial multivariable model were added to the model to confirm that they were neither statistically significant nor important confounders.[5] A P value of $<.05$ after multivariate regression analysis was considered to indicate statistical significance.