Clinical outcomes of aortic root replacement after previous aortic root replacement

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Objective: The study objective was to examine the short- and long-term outcomes of reoperative aortic root replacement after a previous aortic root replacement.

Methods: From September 1985 to February 2011, 84 consecutive patients underwent reoperative aortic root replacement. The patients' mean age was 46 ± 15 years (range, 19-80 years), and 86% were men. The main indication for reoperation was failed biological or bioprosthetic aortic valve and prosthetic valve endocarditis. Cox proportional hazard regression modeling was performed to identify risk factors that adversely affected overall survival.

Results: The operative mortality was 6% (5 patients). Perioperative morbidity included myocardial infarction in 2 patients, low cardiac output syndrome in 7 patients, sepsis in 3 patients, pulmonary complications in 7 patients, renal failure in 3 patients, reoperation for bleeding or tamponade in 5 patients, superficial sternal wound infections in 3 patients, permanent transvenous pacemaker in 8 patients, and stroke in 1 patient. Kaplan–Meier estimates for survival at 5, 10, and 12 years were 82.5% ± 4.7%, 72.5% ± 6.4%, and 65.0% ± 7.6%, respectively; the freedom from reoperation was 100%, 92.3% ± 5.2%, 92.3% ± 5.2%, respectively; and valve-related mortality was 93.1% ± 3.4%, 90.8% ± 4.0%, and 86.2% ± 5.8%, respectively. During the follow-up, valve-related deaths occurred in 7 patients. Age by increments of 5 years (hazard ratio, 1.205; 95% confidence interval, 1.036-1.401) and prosthetic valve endocarditis (hazard ratio, 2.662; 95% confidence interval, 1.054-6.724) were independent risk factors for mortality.

Conclusions: Aortic root replacement after a previous aortic root replacement is associated with a relatively low operative mortality and perioperative morbidity, but long-term survival is suboptimal. Increasing age and prosthetic valve endocarditis adversely affect survival. (J Thorac Cardiovasc Surg 2013;146:611-5)

ACD

In 1968, Bentall and De Bono[1] described an operation using a tubular graft and a prosthetic valve for combined replacement of the ascending aorta and aortic valve with reimplantation of the coronary arteries. Forty years later and after several technical modifications, this operation has become an essential part of the surgical armamentarium to treat patients with aortic root disease.[2-5] Sioris and colleagues,[6] from Toronto General Hospital, reported an operative mortality for the modified Bentall procedure of 4% in patients who underwent operation between 1990 and 2001, and many other series have reported similar operative mortality.[6-10] However, despite extensive evidence of safety of the modified Bentall procedure as a first cardiac surgical intervention, there is limited information regarding the clinical outcomes of this operation after a previous aortic valve surgery, and in particular after a previous aortic root replacement (ARR). In 2007, Szeto and colleagues[11] reported a 30-day mortality of 11.5% in 156 patients who underwent a reoperative ARR after a previous aortic valve replacement. Raanani and colleagues,[12] from Toronto General Hospital, reported an operative mortality of 3% in a small consecutive series of 31 patients who had undergone a previous Bentall procedure.

The objective of this study was to examine the short- and long-term outcomes of ARR as a reoperative surgery after a previous ARR.

PATIENTS AND METHODS

From September 1985 to February 2011, 84 patients underwent ARR as a reoperative procedure after ARR. The interval between the first ARR and the redo ARR was 11.5 ± 7.3 years. The patients' clinical profile, the type of valve used in the previous ARR, and the indications for reoperations are summarized in Table 1. Most patients had undergone only 1 previous ARR, but 3 patients had undergone 2 previous ARRs, and 2 patients had undergone 3 previous ARRs in this series.

Operations were performed following standard techniques for ARR whenever possible. Certain modifications were needed for more complex aortic root pathology, particularly cases of aortic root abscess with extensive destruction of the aortoventricular junction and surrounding structures.[12-16] Table 2 summarizes the operative data.

Twenty-two patients underwent ARR by suturing a tubular Dacron graft to the left ventricular outflow tract (LVOT), reimplanting the coronary arteries to this conduit, and implanting a bioprosthetic or mechanical aortic valve inside the Dacron graft.[14] The rationale for this technique was to

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Abbreviations and Acronyms
ARR = aortic root replacement
LVOT = left ventricular outflow tract

be able to tailor the Dacron graft to any defect in the LVOT and to allow for reimplantation of the coronary arteries without having to interpose a graft between the main conduit and the coronary arteries. However, an interposition graft of Dacron or saphenous vein between a main coronary artery and the neoaortic root was used in 19 patients (in the right coronary artery in 3, in the left main artery in 6, and in both main arteries in 10). Most of these grafts were less than 2 cm in length.

The research ethics board of Toronto General Hospital approved this study, and patient consent was waived considering the observational study design.

The primary end point of this study was survival after surgery. Operative mortality was defined as any death in hospital or during the first 30 postoperative days. Perioperative complications were analyzed, such as myocardial infarction, low cardiac output syndrome, stroke, renal failure, wound infection, sepsis, pulmonary complications, atrial fibrillation, use of intra-aortic balloon pump, need for inotropes, duration of assisted ventilation, and length of stay in intensive care unit and hospital. Secondary end points were freedom from reoperation on the aortic valve for any cause and freedom from valve-related death.

The following preoperative variables were examined for the potential effect on outcomes: age, sex, body surface area, New York Heart Association functional class, congestive heart failure, angina, urgent or emergency surgery, previous coronary artery bypass, preoperative shock, severe chronic obstructive pulmonary disease (forced expiratory volume < 1.0 L/s), left ventricular ejection fraction, diabetes mellitus, hypertension, hyperlipidemia, peripheral vascular disease, active endocarditis, remote or active endocarditis, previous stroke or transient ischemic attack, atrial fibrillation, preoperative renal failure, Marfan syndrome, cardiopulmonary bypass and aortic clamping times, and technical aspects of the surgery, such as type of valve explanted, technique of coronary artery reimplantation, and combined operative procedures.

All data were prospectively collected and validated by a full-time research team. Follow-up data were obtained from electronic patient records and updated by telephone interviews. The median follow-up was 5.5 years, and the mean follow-up was 5.0 years (0-20.9 years). The follow-up was 100% complete.

Statistical Analysis

Categoric variables are reported as number and percentages. Continuous variables are expressed as mean ± standard deviation or median and interquartile range when appropriate. All statistical analyses were performed with SAS 9.1 software (SAS Institute, Inc, Cary, NC). Statistical analysis was performed using the chi-square test or Fisher exact test for categoric variables and *t* tests or Wilcoxon rank-sum test for continuous variables depending on the distribution. No multiple imputation or adjustments for multiplicity were considered. Cox proportional hazard regression modeling was performed to identify predictors of survival.[17] Kaplan–Meier curves were constructed using STATA SE 11.2 (StataCorp LP, College Station, Tex). Kaplan–Meier curves were plotted up to 150 months of follow-up to maintain a meaningful minimum of 10% of the population at risk.

RESULTS

Perioperative Mortality and Morbidity

The operative mortality was 6% (5 patients). The causes of death were ruptured thoracoabdominal aortic aneurysm in 1 patient, technical problems related with bleeding during surgery for an extensive aortic root abscess in 1 patient, multiorgan failure in 1 patient, unexplained cardiac arrest in 1 patient, and sudden death in 1 patient. Perioperative morbidity is presented in Table 3.

Patients' Survival

There were 5 operative and 15 late deaths. The causes of late death were endocarditis in 4 patients, congestive heart failure in 2 patients, cancer in 2 patients, hemophilia in 1 patient, coagulopathy in 1 patient, anticoagulation-related hemorrhage in 1 patient, motor vehicle accident in 1 patient, myocardial infarction in 1 patient, sudden death in 1 patient, and death after back surgery in 1 patient. Patients' survivals at 5, 10, and 12 years were 82.5% ± 4.7%, 72.5% ± 6.4%, and 65.0% ± 7.6%, respectively (Figure 1).

Freedom From Reoperation on the Aortic Valve for Any Reason

During the follow-up, 4 patients underwent reoperation. The causes for reoperation were prosthetic valve endocarditis in 2 patients, tissue valve failure in 1 patient, and subaortic stenosis with mitral stenosis in 1 patient. All 4 patients survived reoperation. Freedom from reoperation on the aortic valve for any reason at 5, 10, and 12 years was 100%, 92.3% ± 5.2%, and 92.3% ± 5.2%, respectively (Figure 2). Reoperations were performed at 99, 102, 155, and 251 months.

Freedom From Structural Valve Deterioration

Structural valve deterioration developed in 1 patient at 155 months of follow-up. Freedom from reoperation on the aortic biological/bioprosthetic valve (n = 30) for any reason up to 12 years was 100%.

Freedom From Valve-Related Mortality

Seven patients died of valve-related causes: prosthetic valve endocarditis in 4 patients, sudden death in 1 patient, coagulopathy in 1 patient, and anticoagulant-related hemorrhage in 1 patient. The valve-related mortality event was at 4, 21, 33, 54, 71, 122, and 152 months of follow-up. Freedom from valve related mortality at 5, 10, and 12 years was 93.1% ± 3.4%, 90.8% ± 4.0%, and 86.2% ± 5.8%, respectively.

Cox Proportional Hazard Regression Analyses for Death From Any Cause

The only 2 variables predictive of death from any cause were age by increments of 5 years (hazard ratio, 1.20; 95% confidence interval, 1.03-1.40) and prosthetic valve endocarditis (hazard ratio, 2.66; 95% confidence interval, 1.05-6.72).

DISCUSSION

Given the technical challenges of performing an ARR in a patient who already underwent one, we decided to