Aortic root surgery in the United States: A report from the Society of Thoracic Surgeons database

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Objective: The purpose of the present study was to evaluate the early clinical outcomes of aortic root surgery in the United States.

Methods: The Society of Thoracic Surgeons database was queried to identify all patients who had undergone aortic root replacement from 2004 to early 2010 (n = 13,743). The median age was 58 years (range, 18-96); 3961 were women (29%) and 12,059 were white (88%). The different procedures included placement of a mechanical valve conduit (n = 4718, 34%), stented pericardial (n = 879, 6.4%) or porcine (n = 478, 3.5%) bioprosthesis, stentless root (n = 4309, 31%), homograft (n = 498, 3.6%), and valve sparing root replacement (n = 1918, 14%).

Results: The median number of aortic root surgeries per site was 2, and only 5% of sites performed >16 aortic root surgeries annually. An increased trend to use biostented (porcine or pericardial) valves during the study period (7% in 2004 vs 14% in 2009). The operative (raw) mortality was greater among the patients with aortic stenosis (6.2%) who had undergone aortic root replacement, independent of age. Mortality was greater in patients who had undergone concomitant valve or coronary artery bypass grafting or valve surgery (21%). The lowest operative mortality was observed in patients who had undergone aortic valve sparing procedures (1.9%).

Conclusions: Most cardiac centers performed aortic root surgery in small volumes. The unadjusted operative mortality was greater for patients >80 years old and those with aortic stenosis, regardless of age. Valve sparing root surgery was associated with the lowest mortality. A trend was seen toward an increased use of stented tissue valves from 2004 to 2009. (J Thorac Cardiovasc Surg 2015;149:116-22)

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Supplemental material is available online.

Aortic root replacement has historically associated with considerable morbidity and mortality.[1,2] Recent technical advances in thoracic aortic surgery and improvements in cerebral and myocardial protection has improved outcomes[3]; however, significant morbidity and mortality has remained.[4] The contemporary outcomes of aortic root surgery in the United States are uncertain. The purpose of the present study was to better evaluate the early clinical outcomes and institutional characteristics of aortic root surgery in the United States.

METHODS

Patients

The patient population analyzed in the present study was obtained from the Society of Thoracic Surgeons (STS) Adult Cardiac Surgery Database (ACSD).[5] The study included all patients aged ≥18 years who had undergone aortic root replacement from January 1, 2004 to early 2010 (n = 13,743). The data were collected using versions v2.52 (years 2004-2007) and v2.61 (years 2008-2010) of the STS database (available at: http://www.sts.org/quality-research-patient-safety/national-database/database-managers/adult-cardiac-surgery-database/d).

The exclusion criteria were active or treated endocarditis, type A aortic dissections, and an aortic aneurysm with locations other than the ascending aorta only or ascending aorta and aortic arch. When comparing the valve types used for aortic root reconstruction, only mechanical, stented (porcine or pericardial), stentless, and homograft valves were included; patients with autograft, ring, or band annuloplasty or who had missing or mismatched valve types were excluded. Patients with an unreported age were also excluded when comparing the operative outcomes by age. Previous reoperation was defined as any previous open heart procedure, such as previous coronary artery bypass grafting (CABG) and valve or other cardiac, great vessel, or congenital surgery. Univariate analysis was used to compare the surgical outcomes in the presence of preoperative conditions and concomitant procedures. When comparing the outcomes in the presence of aortic stenosis, increased age, concomitant CABG, concomitant valve, concomitant CABG and valve procedure, and

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Abbreviations and Acronyms
ACSD = Adult Cardiac Surgery Database
CABG = coronary artery bypass grafting
LOS = length of stay
STS = Society of Thoracic Surgeons

concomitant aortic aneurysm repair, any missing data in the area of interest were imputed as negative.

RESULTS

Patient and Operative Characteristics

The present study included 13,746 patients who had undergone aortic root surgery from 2004 to 2010 (Table 1). The patient ages in the study population ranged from 18 to 96 years (median, 58 years); 3961 were women (29%) and 12,059 were white (87%). A total of 1918 patients had undergone a valve sparing root procedure (15%) and 11,825 patients had undergone root reconstruction with a valve conduit. The prevalence of the various procedures was as follows: mechanical valve conduit, 37%; stented pericardial, 7% or porcine bioprosthesis, 4%; stentless root, 33%; and homograft, 4%. A total of 2724 patients had previously undergone cardiac surgery (21%). Concomitant procedures included CABG (n = 3811, 30%) and mitral and/or tricuspid valve surgery (n = 1201, 9%).

Morbidity and Mortality

The overall operative raw mortality of all patients undergoing aortic root surgery was 4.2%. The outcomes of patients with aortic stenosis, increased age, previous medial sternotomy, the use of select concomitant procedures, and various aortic root procedures are listed in Table 2. Operative mortality increased with patient age from 2.4% in patients <60 years old to 15% in patients >80 years old (Table 2). Aortic valve sparing root repair had the lowest incidence of operative mortality and in-hospital stroke. Concomitant procedures were associated with greater operative mortality, a longer length of stay (LOS), and increases in surgical complications, such as stroke, reoperation for bleeding, acute renal failure, and acute renal failure requiring dialysis (see Appendix Tables E2-E4). Operative mortality was greater among patients with aortic stenosis (6.2%) than in those without (3.5%) who had undergone aortic root replacement (Table 3). The incidence of acute renal failure, renal failure requiring dialysis, and LOS were increased in patients with aortic stenosis.

Operative mortality, LOS > 14 days, and total intensive care unit stay worsened significantly with increased patient age (Table 4). The operative mortality of patients ≥80 years was 15% and the rate of LOS > 14 days was 23% compared with 2.3% and 6.1%, respectively, in patients <60 years. The proportion of female patients increased from 23% to 51% in patients <60 years old and those >80 years, respectively. In-hospital reoperations for any reason were more frequent in patients of increasing age.

Redo Sternotomy and Concomitant Procedures

Operative mortality and LOS > 14 days was greater in patients with previous sternotomy (8.9% and 15%) compared with those without (3.5% and 8.6%; Appendix Table E1). Concomitant procedures increased the operative mortality, rates of reoperation for bleeding, acute renal failure, and LOS > 14 days (Appendix Tables E2 and E3). The operative mortality of concomitant CABG, valve (mitral or tricuspid), and CABG and valve was 9.5%, 13%, and 21%, respectively (Table 3). The rate of acute renal failure and LOS > 14 days was 9.5% and 16% with concomitant CABG, 13% and 22% with concomitant valve surgery, and 17% and 30% for concomitant CABG and valve surgery, respectively.

Prosthesis Preference

Aortic valve sparing aortic root procedures resulted in an operative mortality of 1.9% (Table 1), which was less than that for mechanical valve conduit (3.8%), stented tissue valve conduit (5.6%), stentless root (5.8%), and homograft (7.6%) procedures (Table 5). The incidence of stroke was greatest in the homograft (4.0%) than in the mechanical valve conduit (2.0%), stented tissue valve (3.1%), stentless root (2.2%), and aortic valve sparing (2.3%) procedures. The rates of acute renal failure, reoperation for bleeding, hemodialysis, and LOS > 14 days were similar among the aortic root procedures. Mechanical (44%) and biostentless (40%) valves were the most frequently used, and biostented pericardial (8.1%), biostented porcine (4.4%), and homograft (4.4%) valves were less common.

Trends in Aortic Root Surgery

The percentage of patients undergoing aortic root surgery with mechanical, biostented, stentless, and homograft valves or valve sparing procedures were compared between 2004 and 2009 (Appendix Table E5). The mechanical and biostented valves were the most frequently used prosthesis from 2004 to 2009, with stentless and homograft valves less common after 2006. The usage of biostented valves has nearly doubled in 5 years. The proportion of valve sparing aortic root procedures has remained approximately 15%.

DISCUSSION

The present study included a large contemporary cohort evaluating aortic root replacement surgery trends in the United States reported to date with 13,746 patients included from 2004 to 2010. A recently published study by Williams and colleagues[4] analyzed patients reported in the STS

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