Contemporary outcomes of surgery for aortic root aneurysms: A propensity-matched comparison of valve-sparing and composite valve graft replacement

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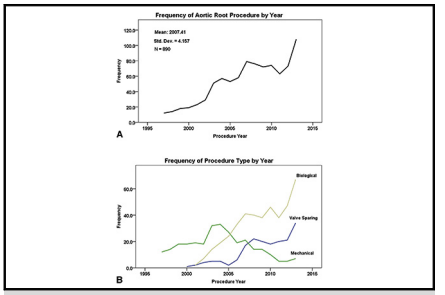
ABSTRACT

Objective: The study objective was to give an overview of the current state of the art of the surgical treatment of aortic root pathologies in a high-volume center.

Methods: From May 1997 to January 2014, aortic root replacement was performed in 890 consecutive patients; 289 received a mechanical composite valved graft, 421 received a biologic composite valved graft, and 180 received a valve-sparing reconstruction. Propensity matching analysis was used to neutralize the differences in baseline characteristics between patients assigned to the different procedures.

Results: Operative mortality was 0.2% (0% in the valve-sparing reconstruction group); the incidence of major postoperative complications was less than 0.5%. Predictors of adverse in-hospital outcome were age, nonelective operation, renal status, reoperation, New York Heart Association class, ejection fraction, and concomitant procedures. Five-year survival was 89.4%. Previous myocardial infarction, preoperative renal status, redo operation, and concomitant procedures were significantly associated with follow-up death. In the propensity-matched groups, the type of operation performed did not affect in-hospital and late outcome. Aortic reintervention rates at 5 years were 0% for the mechanical composite valved graft group, 2.4% for the biologic composite valved graft group, and 7.3% for the valve-sparing reconstruction series.

Conclusions: In the current era, aortic root replacement can be performed with low perioperative risk in high-volume aortic centers. The type of operation performed does not affect early or late survival. Although the mechanical composite valved graft remains the gold standard for durability, the biologic composite valved graft and valve-sparing reconstruction are excellent options for those who cannot take or want to avoid long-term anticoagulation. (J Thorac Cardiovasc Surg 2015;150:1120-9)



Temporal trends in aortic root surgery.

Central Message

Among 890 consecutive patients who underwent composite root replacement or a valve-sparing procedure, the type of operation performed did not affect early and late outcomes.

Perspective

This series shows how ARR can be performed in the current era with low operative risk and excellent long-term results, independently of the type of operation performed. The operation should be individualized to the characteristics and the need of the single patient.

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Supplemental material is available online.

Surgery of the aortic root has changed substantially over the last 3 decades. For many years, the classic Bentall operation was the only possible surgical solution for diseases involving the sinuses of Valsalva and the aortic valve.[1] Even in experienced hands, the perioperative mortality was not insignificant.[2-4] However, since the introduction of the exclusion technique,[5] the mortality and major morbidity of aortic root replacement (ARR) have seen a dramatic decline. In recent years, groups focused on aortic disease have reported elective operative mortality less than 5%, with a marked decline in the incidence of stroke, hemorrhage, and other major postoperative complications.[6]

Valve-sparing replacement (VSR) has introduced yet another modification to the surgical technique, allowing patients the opportunity for aortic root reconstruction while retaining their native aortic valve.[7] In addition,

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Abbreviations and Acronyms

ARR = aortic root replacement
bCVG = biologic composite valved graft
CTD = connective tissue disorder
MAE = major adverse event
mCVG = mechanical composite valved graft
NYHA = New York Heart Association
PSM = propensity score matching
STS = Society of Thoracic Surgeons
VSR = valve-sparing replacement

improved durability of biological aortic valve replacement also has allowed patients in need of complete root replacement the option of a composite valve graft without the need for anticoagulation.[8] These refinements in surgical technique, along with improvements in critical care, have dramatically improved the expectations for patients in need of ARR. A substantial decline in perioperative risk, together with a deeper understanding of the natural history and intrinsic mechanisms of aortic disease, has expanded the pool of patients in need of root surgery and exponentially increased the number of procedures performed over the last decade.[6]

To date, there has been limited comparison regarding which technique of ARR would be best for a variety of patient populations. Most of the data in these studies have been confounded by major selection bias or a limited number of patients for comparison. In an effort to better characterize the current state of ARR in a high-volume aortic center, we compared the results of 3 different contemporary surgical techniques: VSR, biologic composite valved graft (bCVG), and mechanical composite valved graft (mCVG) replacement. By using propensity score matching (PSM), we wanted to redefine expected outcomes for these complex procedures and identify factors that contribute negatively to both perioperative and long-term survival. Data generated from this analysis could be used to determine the most appropriate surgical option for a wide-ranging cohort of patients in need of ARR.

MATERIALS AND METHODS

Patient Population and End Points

This study was approved by the institutional review board. The need for individual patient consent was waived. A review of prospectively collected data from the Weill Cornell Medical College Department of Cardiothoracic Surgery aortic surgery database was conducted to identify all consecutive patients who underwent ARR from May 1997 to January 2014.

Overall, 1001 cases were identified; patients undergoing ARR for acute or chronic aortic dissection (n = 111) were excluded from the analysis. Patients with extensive aortic root destruction because of aortic root infection were also excluded. Of the 890 remaining patients, 289 received an mCVG, 421 received a bCVG, and 180 received VSR using the remodeling (9) (n = 22) or reimplantation (7) (n = 158) technique.

Primary end points were operative mortality and follow-up death from any cause. Secondary end points were the incidence of major postoperative complications (myocardial infarction, stroke, new-onset renal insufficiency requiring dialysis, need for tracheostomy, or deep sternal wound infection) and a composite of major adverse events (MAEs) postoperatively (in-hospital death and major postoperative complications).

Surgical Technique

Indications for the operations were related to the severity of the valvular dysfunction or the size of aortic dilatation on the basis of best practice or the American Heart Association/American College of Cardiology guidelines. The operative technique used has been described in detail.[9]

Briefly, all the operations were performed using median sternotomy, central aortic cannulation, hypothermic cardiopulmonary bypass, aortic crossclamping, and myocardial protection with cold antegrade blood cardioplegia; ε-aminocaproic acid (5 g load and then 1 mg/h during bypass) was routinely used as an antifibrinolytic agent. In cases of concomitant disease in the aortic arch, deep hypothermic circulatory arrest with retrograde cerebral perfusion was used.[10] ARR using an mCVG or a bCVG was performed using the modified Bentall technique.[5] For patients in need of a biological prosthesis, the stented valve was sewn inside a Dacron prosthesis (Maquet Corp, Fairfield, NJ) 3 to 5 mm larger than the valve using a continuous 3-0 polypropylene suture. For VSR, the first 22 patients were treated using the Yacoub remodeling technique,[11] whereas in the remaining 158 patients the classic David-I reimplantation method was used.[7]

Database, Follow-up, and Data Collection

The Weill Cornell Medical College Department of Cardiothoracic Surgery aortic surgery database is constantly updated and maintained by a team of clinical information analysts; data collection is validated regularly by means of external and internal control. Preoperative and perioperative variables are entered prospectively during in-hospital stay. Postoperatively, clinical and computed tomography evaluation is performed after 6 months and every year thereafter or in case of clinical symptoms suggestive of aortic disease, and data are entered at the time of the follow-up visit. In case of missing or unreliable data, direct interview with the patient, a relative, or the treating physician is performed.

Follow-up was 90% complete. Median follow-up time was 22.0 months (25th percentile, 5.0 months; 75th percentile, 52.5 months). Age- and sex-matched reference population survival estimates were obtained from the Centers for Disease Control and Prevention's National Vital Statistics Reports. Postoperative stroke was defined as the postoperative onset of a major neurologic deficit lasting more than 24 hours and accompanied by computed tomography evidence of ischemic or hemorrhagic brain lesion.

Statistical Analysis

Data were stored using Microsoft Access 2010 software (Microsoft Corp, Redmond, Wash) and analyzed using IBM SPSS Statistics version 22 (IBM, Armonk, NY), R version 3.2.0 (R Foundation for Statistical Computing), IBM SPSS Statistics–Essentials for R 22.0, cmprsk package, and MatchIt package.

Data from the study population were compared using the chi-square test for categoric variables and the Student *t* test for continuous variables. Multivariate and univariate analyses for in-hospital MAE and long-term survival were computed to assess for significant demographic and preoperative predictors of such events.

Because of the heterogeneity in patient characteristics among the mCVG, bCVG, and VSR groups, PSM was used to adjust for baseline differences and reduce confounding.[12,13] Three separate PSM models were built to compare the 3 surgical groups. The probability of being assigned to different surgical treatment was calculated from demographic and