Age alone should not preclude surgery: Contemporary outcomes after aortic valve replacement in nonagenarians

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Objectives: Advanced age plays a major role in surgical risk algorithms; however, the outcomes data for the very elderly are lacking. We, therefore, evaluated the outcomes after surgical aortic valve replacement (SAVR) in nonagenarians (age, >90 years) at our institution during an 11-year period.

Methods: The demographics, procedural details, and in-hospital outcomes were retrospectively analyzed for 119 nonagenarians with symptomatic, severe aortic stenosis who had undergone SAVR or SAVR plus concomitant surgery from 2001 to 2012. The mean follow-up period was 915 ± 832 days.

Results: The average age was 91.7 ± 1.9 years (range, 90-98), and the mean Society of Thoracic Surgeons score was 8.9 ± 5.7. The mean aortic valve gradient was 45 ± 16 mm Hg, mean aortic valve area was 0.66 ± 0.2 cm^2, and mean ejection fraction was 49.8% ± 11.8%; 47% underwent isolated SAVR. The average length of stay was longer than expected; however, the rates of prolonged ventilation (16.8%), new atrial fibrillation (43.7%), stroke (0.8%), and renal failure (5.9%) were acceptable. Three patients (2.5%) required reoperation for bleeding. Overall, the 30-day and 1-year mortality was 7.6% and 21.0%, respectively. The multivariate predictors of mortality at 1 year included previous myocardial infarction (hazard ratio, 2.79; 95% confidence interval, 1.21-6.45; $P = .016$), obstructive lung disease (hazard ratio, 3.90; 95% confidence interval, 1.66-9.15; $P = .025$), and diabetes (hazard ratio, 2.77; 95% confidence interval, 1.08-7.07; $P = .033$). The observed in-hospital mortality was lower than expected (observed/expected, 0.85).

Conclusions: Excellent procedural and long-term outcomes can be achieved in nonagenarians, and age alone should not be a contraindication to SAVR in selected populations. Our sample cohort has validated the feasibility of a primary operative strategy in elderly patients with aortic stenosis and acceptable risk profiles. (J Thorac Cardiovasc Surg 2014;148:1360-9)

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The increasingly aging population, with its proportionally greater prevalence of aortic stenosis (AS), has made symptomatic, severe AS in the very elderly an important clinical question. The establishment of transcatheter aortic valve replacement (TAVR) has complicated the treatment algorithm for AS in the very elderly, in particular, in those >90 year old (nonagenarians). The Placement of AoRTic TraNscathetER Valve (PARTNER) trial has shown TAVR to be an effective treatment in nonoperative patients and an equivalent treatment to surgical aortic valve replacement (SAVR) in high-risk patients with AS, with supporting data extending to 3 years.[1] Thus, TAVR has been approved for commercial use in these populations.[2] Surgical risk algorithms play an important role in patient risk stratification, and advanced age has been a large component of traditional surgical risk scoring systems (predicted risk of mortality Society of Thoracic Surgeons [STS] score and the logistic EuroSCORE) when evaluating elderly patients. Advanced age has often been used as rationale for pursuing medical therapy or TAVR to avoid the burden of recovery associated with SAVR. However, anecdotal surgical reports and published data from octogenarians have suggested that SAVR in selected elderly populations is not only feasible, but can also provide excellent outcomes in selected patients,[2] with reported 30-day mortality rates as low as 2.3% to 2.8% in octogenarians.[3,4]

Conventional SAVR has long been considered the reference standard for the treatment of AS; however, outcomes data after SAVR from nonagenarians are lacking. The present study is the first, to the best of our knowledge, to define the surgical outcomes of patients aged ≥90 years

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Abbreviations and Acronyms

AS = aortic stenosis
AVR = aortic valve replacement
BMI = body mass index
CI = confidence interval
HR = hazard ratio
ICU = intensive care unit
MI = myocardial infarction
SAVR = surgical aortic valve replacement
STS = Society of Thoracic Surgeons
TAVR = transcatheter aortic valve replacement

in the current era. In addition to describing the mortality and morbidity of SAVR in this population, we have evaluated the effect of additional surgical procedures on the outcomes and described the predictors of all-cause mortality. This information is critical for the future development of treatment algorithms for AS in the very elderly, which can include medical therapy, TAVR, and SAVR.

METHODS

Patient Population

From January 2001 to November 2012, 119 consecutive patients aged ≥90 years had undergone SAVR with or without concomitant cardiac surgical procedures at our institution. The demographic and clinical outcome data were retrospectively collected from a medical records review. The present study met all the guidelines of the institutional review board of Columbia University.

Demographics and Risk Factors

The demographic and preoperative variables collected included age, gender, race, body mass index (BMI), and comorbid medical conditions, including low body weight (BMI < 20 kg/m^2), obesity (BMI > 25 kg/m^2), diabetes, hypertension, chronic obstructive pulmonary disease, renal failure, smoking history, severe aortic wall calcification, peripheral arterial disease, cerebrovascular disease, atrial fibrillation, and previous myocardial infarction (MI), percutaneous transluminal coronary angioplasty, or cardiac surgery (see the Appendix E1 for the full details of the definitions). The preoperative clinical status, including the Canadian Cardiovascular Society angina classification, New York Heart Association symptom class, and requirement for intra-aortic balloon pump, was also collected. Finally, the echocardiographic variables, including the preoperative left ventricular ejection fraction, and valvular pathologic features and severity, were also recorded in the database.

All surgeries were performed using a standard, median sternotomy approach, with cardiopulmonary bypass and mild systemic hypothermia (30°-34°C). Myocardial protection was achieved with either cold blood (1 L antegrade followed by repeated doses every 20 minutes; from 2001 to 2010) or del Nido solution (1 L antegrade single dose; from 2011 to 2012) cardioplegia.[5]

The selection of valve prosthesis type was at the discretion of the operating surgeon, with a strong preference for biologic valves in this age group, regardless of the preoperative presence of chronic atrial fibrillation or other clinical variables. All patients underwent coronary angiography and echocardiography before surgery. Coronary artery bypass grafting, additional valvular procedures, or other cardiac surgical procedures were performed for any recognized indications.

The operative details that were collected included the priority of surgery (elective, urgent, emergency), concomitant surgery performed, type and size of the valve prosthesis, cardiopulmonary bypass time, and global ischemic time. Postoperative in-hospital complications included the need for intra-aortic balloon pump or mechanical circulatory support, inotrope dependence on intensive care unit (ICU) admission, ventricular or atrial arrhythmia, need for a permanent pacemaker, respiratory failure, renal failure, sepsis or endocarditis, sternal wound infection, gastrointestinal bleeding, stroke, MI, and reoperation for bleeding as defined by the Valve Academic Research Consortium definitions.[6]

The primary outcomes included the length of ICU stay, the total length of hospital stay, in-hospital mortality, discharge status, and 1- and 5-year survival status. A follow-up rate of 100% for survival status was achieved using the Social Security Death Index. The discharge placement locations included home, physical rehabilitation facilities, and skilled nursing homes.

Statistical Analysis

Continuous variables are presented as the mean ± standard deviations, and categorical data are presented as counts and percentages. All patients were included in the final analysis. Survival curves were constructed for time-to-event variables using Kaplan-Meier estimates. Survival comparisons among the groups of patients were performed using the Mantel-Haenszel log-rank test. Univariate and multivariate Cox proportional hazard regression models were used to assess the hazard ratios (HRs) and 95% confidence intervals (CIs), comparing isolated AVR and AVR plus concomitant surgery. Landmark analyses were used according to a prespecified landmark point at 1 year (365 days), and we estimated the HRs separately for events ≤1 year and from 1 to 5 years. Stratified analyses were performed according to these periods, and chi-square tests were performed to assess for an interaction between treatment effect and time. To identify the predictive factors for mortality at 30 days, 1 year, and 5 years, univariate Cox proportional hazard regression analysis was performed using clinically relevant baseline covariables (BMI < 20 kg/m^2, history of MI, concomitant surgery, Canadian Cardiovascular Society angina class, chronic obstructive pulmonary disease, diabetes, renal insufficiency according to the estimated glomerular filtration rate, left ventricular ejection fraction < 30%, and mitral regurgitation grade ≥ 2). Significant associations, defined as univariate associations with $P < .2$, were entered into a multivariate Cox proportional hazard regression model. The association of risk predictors was assessed using Wald statistics. All P values were 2 sided. The data were analyzed using STATA 1212 (StataCorp LP, College Station, Tex).

RESULTS

Baseline Characteristics

The baseline clinical characteristics are summarized in Table 1. The SAVR volume increased each year throughout the study period (Figure 1, *A*). The mean patient age was 91.7 ± 1.9 years (range, 90-98), 43.7% were women, 93.3% were white, and the mean BMI was 25.0 ± 3.9 kg/m^2. Using the BMI, 17 patients were underweight (<20 kg/m^2), and 41.2% of the patients were classified as overweight (BMI > 25 kg/m^2). One patient had undergone previous cardiac surgery, 82.4% had a history of hypertension, 11.8% had diabetes mellitus, and 38.6% had a history of tobacco use. Also, 15 patients (12.6%) had chronic atrial fibrillation, 21 (17.6%) had a history of stroke, and 9 (7.6%) had a