Aortic Valve Replacement in Octogenarians: Is Biologic Valve the Unique Solution?

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Background. This study analyzed morbidity, mortality, and quality of life after aortic valve replacement with mechanical and biologic prostheses in octogenarian patients.

Methods. A retrospective analysis was performed in 345 consecutive patients, mean age of 82 ± 2 years (range, 80 to 92), who had aortic valve replacement from May 1991 to April 2005. A bioprosthesis (group I) was used in 200 patients (58%), and 145 (42%) received a mechanical prosthesis (group II). Associated cardiac procedures were done in 211 patients (61%), of which 71% were coronary artery bypass grafting. Patients had symptomatic aortic stenosis (84.3%) or associated aortic insufficiency; 88% were in New York Heart Association (NYHA) class III or IV. The mean preoperative aortic valve gradient was 62 ± 16 mm Hg (range, 25 to 122 mm Hg). The mean left ventricular ejection fraction was good (0.52 ± 0.12); 30 patients (8.7%) had an ejection fraction of less than 0.30.

Results. The in-hospital mortality rate was 7.5% (26 patients); 17 (8.5%) in group I and 9 (6.2%) in group II (p = 0.536) Significant predictors of operative mortality were preoperative renal insufficiency (blood creatinine > 2.00 mg/mL) and need for urgent operation. Mean follow-up, complete at 100%, was 40 ± 33 months (range, 1 to 176 months). Long-term follow-up, using Kaplan-Meier analysis, showed an overall survival of 61% at 5 years and 21% at 10 years; survival by type of prosthesis was significantly higher with mechanical prostheses (log-rank p = 0.03). Freedom from cerebrovascular events (thromboembolic/hemorrhagic) at 5 and 10 years was 89% and 62% in the mechanical group and 92% and 77% in the biologic group (p = 0.76). Postoperative NYHA functional class was I or II in 96% of patients. Quality-of-life scores were excellent considering the age of the patients. No differences were found between the two groups.

Conclusions. Surgical treatment for symptomatic aortic stenosis in octogenarians has an acceptable operative risk with excellent long-term results and good quality of life. In this cohort, survival rate is slightly but significantly higher with mechanical prostheses.


The long-term performance of biologic and mechanical prostheses for aortic valve replacement (AVR) has been extensively evaluated [1–3]. The age of patients who undergo AVR varies considerably in the reported series, and although surgical treatment for severe symptomatic aortic stenosis in the elderly is widely accepted as an elective treatment [4–6], there is still some reluctance to offer AVR [7–12]. In addition, in very old patients, differences in valve-related morbidity and mortality for biologic and mechanical aortic prostheses are not well known. Anticoagulation is fraught with caution because it may be associated with complications, particularly in the elderly [10–12].

Our institution, Policlinico San Donato, has seen a constant and progressive increase in octogenarian patients referred for cardiac operations. The aim of this study was to assess mortality, morbidity, and quality of life in octogenarians operated on for AVR and to compare results using biologic or mechanical prosthesis.

Patients and Methods

Between 1991 and 2005, 345 consecutive octogenarians (mean age, 82; range 80 to 92 years), affected by symptomatic aortic valve stenosis, underwent AVR at our institution. Aortic valve insufficiency was associated in 53 patients (15.3%), and 150 (43.5%) had concomitant coronary artery disease. Renal insufficiency, defined as blood creatinine level exceeding 2.00 mg/dL, was present in 35 patients (10.1%); peripheral vascular disease, defined as documented concomitant supraaortic vessels disease or limb vessels disease or abdominal aortic disease, or a combination, was detected in 62 patients (18%). Severe cardiac insufficiency, defined as an ejection fraction (EF) of less than 0.30, was present in 31 patients (8.7%). The mean aortic valve gradient was 62 ± 16 mm Hg. Preoperatively, 88% of patients were in New York Heart Association (NYHA) class III or IV. Dyspnea on effort and angina were predominant symptoms. Preoperative data
were obtained by a retrospective review of clinical records.

In 200 patients (57.9%), AVR was done with a bioprosthesis (group I), and 145 patients (42.1%) received a mechanical prosthesis (group II). Table 1 summarizes baseline demographic and clinical characteristics by group. During the 14-year period of this study, both stented and stentless bioprosthesis were used; mechanical prosthesis were bileaflets in all patients.

All the procedures were performed with extracorporeal circulation and moderate hypothermia (30°C to 32°C) with intermittent crystalloid antegrade cardioplegia. The mean sizes of the prosthesis were 23 ± 1.6 mm for stentless, and 20 ± 2.0 mm for mechanical (p = 0.0001). Associated cardiac procedures were done in 211 patients (61%), and 26 (7.5%) had more than one associated procedure (Table 2).

Table 2. Associated Procedures by Group

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Group I (n = 200)*</th>
<th>Group II (n = 145)b</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CABG</td>
<td>78 (39)</td>
<td>72 (49)</td>
<td>0.04</td>
</tr>
<tr>
<td>Mitral valve replacement</td>
<td>6 (3)</td>
<td>11 (7.6)</td>
<td>0.07</td>
</tr>
<tr>
<td>Mitral valve repair</td>
<td>16 (8)</td>
<td>6 (4)</td>
<td>0.147</td>
</tr>
<tr>
<td>Tricuspid valve repair</td>
<td>7 (3.5)</td>
<td>7 (4.8)</td>
<td>0.537</td>
</tr>
<tr>
<td>Reduction ascending aortoplasty</td>
<td>4 (2)</td>
<td>2 (1.4)</td>
<td>0.663</td>
</tr>
<tr>
<td>Atrial septal closure</td>
<td>1 (0.5)</td>
<td>1 (0.6)</td>
<td>0.818</td>
</tr>
</tbody>
</table>

* Group I had a biologic prosthesis.  b Group II had a mechanical prosthesis.

Follow-up data were obtained by telephone contact with patients, family members, or referring physician. During the interview, the Medical Outcomes Study Short-Form 36 (SF-36) Health Survey questionnaire for health-related quality-of-life assessment was administered. The regional death registry was also used to ensure completeness of mortality data. Our local ethical committee approved this retrospective study, and individual patient consent was waived.

The baseline characteristics of groups I and II were assessed by t tests for continuous variables and χ² for categoric variables. Morbidity and mortality were calculated by Kaplan-Meyer actuarial methods and compared with the log-rank statistic. A value of p < 0.05 was considered statistically significant for all variables. Values are presented as mean ± standard deviation. Analysis was done with SPSS software (SPSS Inc, Chicago, IL).

Table 3. Operative Complications by Prosthesis Type

<table>
<thead>
<tr>
<th>Complication</th>
<th>Group I (n = 200)*</th>
<th>Group II (n = 145)b</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleeding</td>
<td>4 (2)</td>
<td>3 (1.5)</td>
<td>0.964</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>48 (24)</td>
<td>28 (19)</td>
<td>0.299</td>
</tr>
<tr>
<td>Low cardiac output</td>
<td>10 (5)</td>
<td>7 (4.8)</td>
<td>0.941</td>
</tr>
<tr>
<td>Renal failure</td>
<td>8 (4)</td>
<td>3 (2)</td>
<td>0.313</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>11 (5.5)</td>
<td>4 (2.7)</td>
<td>0.217</td>
</tr>
</tbody>
</table>

* Group I had a biologic prosthesis.  b Group II had a mechanical prosthesis.

The percentage of patients who had concomitant coronary artery bypass grafting (CABG) was higher in the mechanical group (p = 0.04; Table 2). The mean number of grafts was 2.3 ± 1.2 in the mechanical group and 1.8 ± 0.9 in the biologic group (p = 0.002). Three patients in the mechanical group had previous cardiac interventions, including 2 previous biologic valves and one previous CABG.

All the mechanical group patients received warfarin after surgery, and 26 (17.9%) received anticoagulation preoperatively for atrial fibrillation. In the biologic valve group, 41 patients (20.5%) were receiving anticoagulation before the operation, and an additional 12 patients (6%) were considered postoperatively.

Table 4. Causes of Hospital Death by Groups

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Group I (n = 200)*</th>
<th>Group II (n = 145)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis</td>
<td>2 (1)</td>
<td>2 (1.4)</td>
<td>0.745</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
<td>7 (3.5)</td>
<td>3 (2.1)</td>
<td>0.434</td>
</tr>
<tr>
<td>Cerebrovascular accident</td>
<td>2 (1)</td>
<td>1 (0.6)</td>
<td>0.759</td>
</tr>
<tr>
<td>Others</td>
<td>6 (3.0)</td>
<td>3 (2.0)</td>
<td>0.592</td>
</tr>
<tr>
<td>Total</td>
<td>17 (8.5)</td>
<td>9 (6.1)</td>
<td>0.425</td>
</tr>
</tbody>
</table>

* Group I had a biologic prosthesis.  b Group II had a mechanical prosthesis.
started anticoagulation treatment during follow-up for de novo atrial fibrillation, cerebrovascular disease, or other causes. Policlinico San Donato is a national referral hospital for cardiovascular surgery; therefore, during follow-up patients were monitored by several different anticoagulation centers across the country where the patients live.

**Hospital Mortality and Morbidity**

The in-hospital mortality rate, defined as mortality within 30 days postoperatively, was 7.5% (26 patients), consisting of 17 patients (8.5%) in group I and 9 (6.2%) in group II ($p = 0.536$).

Major complications that occurred in the operative period were surgical revision for bleeding in 7 patients (2%) and low cardiac output in 17 (4.9%). An intraaortic balloon pump was used in 6 patients (1.7%) and pulmonary complications with prolonged (>72 hours) mechanical ventilation occurred in 15 patients (4.5%). Worsening of renal function occurred in 11 (3.2%), but hemofiltration was not required (Table 3).

At univariate analysis we found that the preoperative variables associated with hospital mortality were renal insufficiency ($p = 0.001$), EF ($p = 0.02$), EF less than 0.30 ($p = 0.05$), urgent operation, defined as clinical instability, pulmonary edema, and complex ventricular arrhythmias ($p = 0.001$). At multivariate logistic regression analysis, preoperative renal insufficiency and urgency resulted significant predictors of in-hospital mortality (Exp [B] 7.775 [95% confidence limit (CL), 2.6 to 23.2] and 11.3 [95% CL, 2.1 to 59.1], respectively ($p < 0.001$). Operative mortality in clinically stable patients with an EF exceeding 0.30 and no renal insufficiency was 2.7% and decreased to 1.6% in case of absent associated procedures. Causes of operative death are reported in Table 4. Unstable patients also presented with a significantly higher incidence of postoperative renal and respiratory failure ($p < 0.005$) and a lower preoperative EF.

**Follow-Up**

Mean follow-up was 40 ± 33 months (range, 1 to 176 months); follow-up was completed in 100%. The NYHA functional class improved from 3.3 ± 0.7 to 1.2 ± 0.5 ($p = 0.001$) in the biologic group, and from 3.2 ± 0.6 to 1.2 ± 0.5 in the mechanical valve group ($p < 0.001$). At follow-up, 78% of patients were in NYHA class I, 18% in class II, and 4% in class III. Of the 319 survivors, late death occurred in 104 (32.6%). Stroke was the cause of death in 20 patients (11 mechanical, 9 biologic; $p = 0.221$). Kaplan-Meyer analysis shows a global survival rate of 61% at 5 years, 21% at 10 years, and 16% at 14 years (Fig 1). Long-term survival was fairly significantly better in the mechanical group (Fig 2). A trend favoring mechanical valves was also observed for cardiac related deaths (Fig 3). No
differences resulted according to associated CABG (Fig 4). Sex-related survival was higher in women ($p = 0.006$).

During follow-up, 29 major cerebrovascular events (CVE) were observed; 22 patients had a thromboembolic event, 14 in the mechanical group and 8 in the biologic group ($\chi^2, 0.03$). Seven patients had a hemorrhagic event, 2 in the biologic group and 5 in the mechanical group. There were 20 CVE related deaths, 9 patients in the biologic group and 11 in the mechanical group ($p = 0.241$). Freedom from CVE was 89% and 62% at 5 and 10 years in the mechanical and 92% and 77% in the biologic group ($p = 0.76$). Fig 5 reports SF-36 score according to valve type, reflecting a good health-related quality of life. No differences were observed between patients with biologic and mechanical prostheses.

Comment
Cardiac surgery in the elderly is increasing and will increase even further in the coming decades as health care in general improves and the number of elderly patients requiring aortic valve replacement increases. Studies have evaluated the surgical results in elderly patients, although the term elderly is often used to describe different populations. For example, Tseng and colleagues [4] defined as elderly a population older than 70 years, whereas Florath and colleagues [5] defined elderly as being older than 65 years. However, age in itself is considered a risk factor for mortality-morbidity by scoring methods.

Safety surveys by age group have been performed over the years, and many reports document the safety of cardiac interventions even in octogenarians, excluding urgent or emergency clinical status [7, 9–14]. In such conditions, the presence of comorbidities is associated with poor outcome [15, 16]. Further reported predictors of in-hospital mortality were NYHA functional class III and IV, concomitant aortic valve insufficiency, small body surface, and an EF of less than 0.40 [14–16]. In our analysis, an EF of less than 0.30 was associated with a higher mortality rate, and urgent operation and preoperative renal insufficiency were independent predictors of in-hospital death.

Avoidance of major traumatic operations and prolonged hospital stay are important in the recovery of patients with biologic and mechanical prostheses.
these patients and to reduce the hospital costs; thus, minimally invasive surgery and, more recently, percutaneous AVR are advocated. However, no patient in our study was treated with percutaneous AVR. This technique, although promising, has been adopted in few centers, and results need to be validated [10].

Biologic valves are considered the optimal choice in patients aged older than 70 years, as indicated in the 1998 American Heart Association/American College of Cardiology guidelines [17], and the age has more recently been even lowered to 60 or 65 years [18]. However, it has been reported that the type of valve devices implanted in patients older than 65 was a bioprosthesis only in 50% of cases [10]. The choice of mechanical prostheses in elderly patients is often due to different factors, including chronic atrial fibrillation, the use of anticoagulation for other diseases, less need of reoperation, and preference of the cardiologist or surgeon [17–20]. Our surgical preference for mechanical valves was mostly related to technical reasons such as small and calcific aortic annulus or aortic root, or both, especially in case of a stentless biologic valve implant. As a consequence, the mean size of the prosthesis was 23 ± 1.8 mm in the biologic, 22 ± 1.6 mm in the stentless, and 20 ± 2.0 mm in the mechanical group (p < 0.0001).

The use of mechanical or biologic valves was not motivated by patient clinical preoperative status because the patients were comparable and there were no significant differences between the two groups. Rather, patients in the mechanical group had a higher incidence of NYHA class III and they had more frequent associated cardiac procedures (Tables 1 and 2).

In octogenarian patients with aortic valve procedures, early- and long-term results have significantly improved due to technical optimization, better myocardial protection, and postoperative management. Nowadays, the hospital mortality rate is between 2% and 10% [1–9, 13–15]. The in-hospital mortality rate in our series was 7.5%, and overall survival was good, with survival at 1, 3, 5, and 10 years of 82%, 74%, 61%, and 21%, respectively (Fig 1).

It is still debated if CABG associated with AVR increases operative death [8, 21]. In our cohort, CABG was associated with AVR if coronary lesions were present on preoperative coronary angiography, regardless of ischemic symptoms and signs, and was not associated with higher in-hospital and late death (Fig 4). Coronary lesions are frequently detected in very old patients, but when ischemic signs are absent, CAbG associated with AVR may not increase operative risk and may even be beneficial in order to protect from intraoperative and late adverse ischemic cardiac events [8].

We observed less CVEs in patients with a bioprosthetic aortic valve, in agreement with other studies [8, 20, 21]. Overall, the incidence of major CVE was low (9%) in both mechanical and biologic valves, similar to 10.4% in an age-matched population in the same era [22]. We also noted that despite a higher incidence of CVE, our octogenarian patients with mechanical valves had a higher survival rate (p = 0.03; Fig 2) and a trend for reduced cardiac-related death (Fig 3). For these reasons, the choice to implant a mechanical aortic valve could be reasonable and justified in some instances.

Previous experiences focusing on health-related quality of life after cardiac operations in octogenarians reported a good quality of life, with SF-36 scores that were similar to scores in the general population of patients aged older than 65 years [23]. In our cohort, the SF-36 scores confirmed a good or excellent functional status and quality of life, with an equal or better score for those that had a mechanical aortic prosthesis (Fig 5).

The NYHA class also improved significantly in our population, but we think that NYHA classification, based on symptoms of dyspnea on exercise, is not applicable to octogenarians, whose physical activity is necessarily limited. Almost one-fifth of survivors had their 90-year birthday during follow-up, and 82% of them had mechanical valves.

The major limitation of the present study is that it is retrospective and not randomized. However, the two groups are comparable because we could not identify any factor being significantly different with respect to the risk profile. The lowest value of p was 0.191 for transaortic gradient, which does not allow us to draw any further analysis and to proceed with the next steps of a propensity score. In fact, the propensity score is useful if the...
“baseline” groups are not homogeneous to make them comparable.

A second important limitation is that it is difficult to know the exact cause of death by telephone interview with the family members, especially in such an old population. Because of our study issue, we focused on stroke as the cause of death, and other causes, especially noncardiac ones, might have not been appropriately assessed, even at the regional death registry.

In conclusion, this study shows that the survival rate and health-related quality of life are excellent in octogenarians who undergo AVR for aortic stenosis with biologic or mechanical valves. The modest but significant advantage of mechanical valves starting from the first years of follow-up can be related to warfarin therapy and not to structural deterioration of the bioprosthesis. Because our findings are somewhat different from those of other series that do not show survival benefit with one type of valve over another, we do hope that our study will stimulate others to either confirm or refute our conclusions. Our study indicates that in this population, in whom the true “philosophic” objective is to favor “good years with good life,” satisfactory results can at least be obtained with either type of valve prosthesis.

References


INVITED COMMENTARY

de Vincentiis and colleagues [1] present a report on a retrospective series of 345 patients greater than 80 years of age who underwent aortic valve replacement. The operative mortality is low (7.5%) considering that more than half of these patients underwent concomitant other cardiac procedures and the postoperative quality of life...