Institutional report - Valves

Short- and mid-term results for aortic valve replacement in octogenarians

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Abstract

Population over 80 years who require surgery for degenerative aortic stenosis has largely increased in the past decades. We have compared short- and mid-term results for conventional aortic valve replacement (AVR) for calcific-degenerative aortic stenosis in older and younger than 80 years operated at our institution between April 2004 and December 2008. Predictors of mortality and major adverse cardio and cerebrovascular events (MACCEs) on the postoperative and follow-up period were determined through multivariable analysis. Four hundred and fifty-one patients were included in the study. Ninety-four than 80 years operated at our institution between April 2004 and December 2008. Predictors of mortality and major adverse cardio and cerebrovascular events (MACCEs) on the postoperative and follow-up period were determined through multivariable analysis. Four hundred and fifty-one patients were included in the study. Ninety-four

1. Introduction

The life expectancy increase has led to a spectacular rise of geriatric population in developed countries. The most common structural cardiac pathology within this population stratum is the degenerative-calcific aortic valve disease [1, 2]. Traditionally age and comorbidities associated with it are the reasons for which postoperative results for aortic valve replacement (AVR) in elderly patients were worse [3, 4]. In recent years, however, the scientific literature reporting lower morbimortality after AVR in elderly patients [5–7] has continued to increase. The aim of this study was to compare the short- and mid-term results of conventional AVR due to degenerative aortic stenosis in patients above and below 80 years of age and determine the risk factors for major adverse cardio and cerebrovascular events (MACCEs) after this surgery.

2. Material and methods

2.1. Patients

All consecutive patients suffering from severe degenerative aortic stenosis older than 60 years undergoing their first AVR (no other concomitant valve procedure associated) between April 2004 and October 2008 at our institution were included in this study. Patients under 60 years were excluded as degenerative calcification of the aortic valve is an infrequent cause of aortic stenosis in younger patients. Patients undergoing concomitant coronary surgery were also included because of the shared common risk factors [8]. Two groups were compared according to their age at the time of the intervention: under 80 years old, 80 years old and over 80 years old.

2.2. Surgical technique

AVR was performed with conventional cardiopulmonary bypass (CPB) and ascending aorta cross-clamping. We searched for ascending aorta and aortic arch calcification with epiarterial ultrasonography prior to selecting the site of cannulation. The selected size and brand of the prosthesis depended on the surgeons criteria. The prosthesis type (mechanical or biological) was chosen based on the patient’s preferences, life expectancy and comorbidities together with the doctor’s criteria.

2.3. Demographic, preoperative and surgical information

Retrospective information regarding the patient’s clinical profile prior to the operation was collected. An assessment
of the surgical risk based on the EuroSCORE scale [9] was
done. Surgical data were also collected: type and size of
prosthesis, duration of the surgery, CPB run time, associ-
cated coronary artery bypass grafting (CABG).

2.4. Events

We defined the postoperative period as the following:
30 days after the intervention or the postoperative in-
hospital stay. During this period of time, we evaluated:
1. Mortality. 2. Grouped MACCEs: including a) mortality;
b) acute cerebrovascular accidents (ACVAs); c) postopera-
tive acute myocardial infarction (AMI); d) postoperative
renal failure with the need of haemofiltration or hemo-
dialysis; e) definitive pacemaker implantation; and f) mediastinitis.

Patients were contacted by telephone call and underwent
routine check-ups at our centre on a periodic but not
uniform basis. During the follow-up, the following events
were registered: 1. Mortality for all causes. 2. Cardiac
mortality. 3. Grouped MACCEs, including: a) cardiac mort-
ality; b) ACVAs; c) readmission to hospital due to cardiac
cause; d) AMI; e) prosthetic replacement; f) thrombo-
embolic complications; g) prosthetic endocarditis; and h)
bleeding complications.

Patients who received a mechanical prosthesis received
long-term anticoagulation with acenocumarol. Patients who
received a bioprosthesis received long-term antiagregation,
except those who needed to be anticoagulated for some
other reason (atrial fibrillation, previous embolism, ...).

2.5. Statistical analysis

The distribution of preoperative and surgical variables in
both group ages was compared. Comparisons of categorical
variables were done with the χ²-test or Fisher’s exact-
test. The continuous variables inter-group differences
were analysed either with unpaired t-test or with the
Mann–Whitney U-test. Statistically significant differences
were considered when P<0.05. Statistics presented were
calculated only from valid data, ignoring missing data.

The predicting variables for the studied events were
determined through binary logistic regression. Results for
the multivariate testing were expressed in odds ratio (OR),
their confidence interval (CI) and P-value. Medium term
event-free survival was assessed using Kaplan–Meier esti-
mation with its corresponding 95% CI. A Mantel–Haenszel
‘log-rank’ test was applied to analyse survival differences.
By applying Cox’s proportional hazard model, the predictive
factors for outcomes during the follow-up period were also
analysed.

Statistical analysis was performed using SPSS® V. 15.0. For
Windows®.

3. Results

3.1. Sample description

Four hundred and fifty-one patients were included. Ninety-
four (20.8%) were ≥80 years old. The preoperative
characteristics are summarized in Table 1. The predictive
risk variables were rather homogeneous in both groups. A
higher prevalence of renal failure (P=0.014) and previous
myocardial infarction (P=0.013) in the octogenarian group
was observed. According to the EuroSCORE scale, the
surgical risk was higher in the eldest group [12.14% vs. 6.7%  
(P<0.001)].

Table 1 summarizes the most relevant operating details.
The proportion of patients with bioprosthesis was signifi-
cantly higher in the eldest group (95.7% vs. 64.7%,  
P<0.001). There were no significant differences in the
prosthetic size between both groups.

3.2. Postoperative results

The postoperative results are summarized in Table 2. No
significant differences were observed in MACCEs incidences
(P=0.719) or in hospital mortality (P=0.805). The adjusted
death rate was one for the under 80 years and 0.61 for the
octogenarians.

Table 3 shows the multivariate analysis results for hospital
mortality and postoperative MACCEs. Previous cardiac sur-
gery (OR=4.08, 95% CI 1.37–12.6), renal failure (OR=6.75,
95% CI 2.76–16.55), concomitant CABG (OR=2.57, 95% CI
1.07–6.16), female sex (OR=2.49, 95% CI 1.01–6.1) and
severe pulmonary hypertension (OR=3.68, 95% CI 1.19–
11.4) turned out to be independent predictors of hospital
mortality. Renal failure (OR=2.57, 95% CI 1.33–4.99) con-
comitant CABG (OR=2.49, 95% CI 1.41–4.4) and severe
pulmonary hypertension (OR=3.49, 95% CI 1.46–8.36) were
independent predictors for postoperative MACCEs. The age
≥80 years did not significantly increase the in-hospital
mortality (OR=0.85, 95% CI 0.3–2.42) nor the incidence of
grouped MACCESs (OR=0.9, 95% CI 0.46–1.96).

3.3. Follow-up

Mean follow-up was 30.1 months [standard deviation (S.D.)
14.1] for the group below 80 years and 27.1 (S.D.
14) for the octogenarians. Eleven patients (3.3%) were lost
in the younger group and 4 (4.6%) in the older. Table 4
shows each groups mean survival for each one of the
studied events. Differences were noticed in unadjusted
survival (P=0.002) and MACCEs free survival (0.038). MAC-
CEs free survival differences might be explained because a
greater incidence of hospital readmissions in the octoge-
narian group (20.5% vs. 11.2%, P=0.03). There were no
significant differences in cardiac mortality (P=0.055). Figs.
1, 2 and 3 represent the survival curves per age group for
each one of the events during the follow-up.

In Table 5, we show the results obtained for each one of
the events during the follow-up after applying Cox’s pro-
portional hazard model. High blood pressure (HBP) [Hazard
ratio (HR)=5.23; P=0.025], peripheral arterial disease
(PAD) (HR=5.06; P<0.001) and age over 80 years
(HR=2.44; P=0.001) were independent mortality predic-
tors. HBP (HR=8.24; P=0.040) and PAD (HR=3.55;  
P=0.014) were independent predictors of cardiac mortality.
PAD (HR=2.3; P=0.041) and diabetes mellitus
(HR=2.03; P=0.033) were independent predictors of MAC-
CEs during the follow-up. The only significant risk increase
from being an octogenarian is that of the incidence of all-cause mortality. Neither a higher cardiac mortality (P=0.080; HR=2.26; 95% CI 0.91–5.63) nor a greater incidence of grouped MACCEs (P=0.113; HR=1.77; 95% CI 0.87–3.57) were associated to the age of ≥80 years.

4. Discussion

Degenerative aortic stenosis is the most common structural cardiopathy in octogenarians and the predominant type of surgery in this group of age AVR [1, 2]. AVR is recommended due to the sombre prognosis for symptomatic severe aortic stenosis. The development of less aggressive techniques than open surgery (implantation via transcatheter) has restored the medical population’s interest in valvular replacement and forces us to review the real current state of conventional surgery in elderly patients.

Technical innovations together with the evolution of prosthesis designs in the last quarter century have allowed the reduction of complications inherent to conventional AVR in elderly patients. According to the North American Society of Thoracic Surgeons national database [5], mortality between 1996 and 2007 decreased by 24% and the incidence of cerebrovascular accidents decreased by 27%, whereas the patient population risk profile significantly worsened (particularly, population over 70 years of age increased by 10%).

Mortality published in current literature oscillates between 5% and 10% [5, 6, 10]. In this manuscript, we show the surgical risk (EuroSCORE) per patient group, the observed postoperative mortality and the adjusted mortality rates (real mortality/expected mortality). The decrease in mortality turned out to be particularly significant in the octogenarian group (7.4% (observed) against 12.14% (predicted)). This deviation has also been noticed by other authors [11] and could be explained as a maladjusted risk score to predict postoperative mortality in particular patient subgroups like those over 80 years of age.

The postoperative results in both groups were very similar as no significant differences either in mortality (P=0.805) or in grouped MACCEs (P=0.719) were detected. These results coincide with those obtained in other already published series [6]. With regards to surgical details, a prediction for heterologous biological implants on behalf of
Table 2
Postoperative results per group

<table>
<thead>
<tr>
<th></th>
<th>Age &lt;80 years, n = 357</th>
<th>Age ≥ 80 years, n = 94</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital mortality</td>
<td>24 (6.7%)</td>
<td>7 (7.4%)</td>
<td>0.805</td>
</tr>
<tr>
<td>Adjusted mortality (EuroSCORE)</td>
<td>1</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>Postoperative MACCEs</td>
<td>59 (16.5%)</td>
<td>17 (18.1%)</td>
<td>0.719</td>
</tr>
<tr>
<td>Mortality</td>
<td>24 (6.7%)</td>
<td>7 (7.4%)</td>
<td>0.805</td>
</tr>
<tr>
<td>ACVAs</td>
<td>14 (3.9%)</td>
<td>1 (1.1%)</td>
<td>0.327</td>
</tr>
<tr>
<td>R.F. (HF/HF)</td>
<td>11 (3.1%)</td>
<td>1 (1.1%)</td>
<td>0.474</td>
</tr>
<tr>
<td>Mediastinitis</td>
<td>10 (3%)</td>
<td>4 (5.2%)</td>
<td>0.503</td>
</tr>
<tr>
<td>Postoperative AMI</td>
<td>12 (3.4%)</td>
<td>3 (3.2%)</td>
<td>1</td>
</tr>
<tr>
<td>Permanent pacemaker</td>
<td>7 (2%)</td>
<td>5 (5.3%)</td>
<td>0.140</td>
</tr>
</tbody>
</table>

Results expressed in n (%) or median [interquartile range (IQR)]. P < 0.05 are considered significant.
MACCEs, major adverse cardio and cerebrovascular events; ACV A, acute cerebrovascular accident; R.F. HF, renal failure which required haemofiltration or haemodialysis; AMI, acute myocardial infarction.

Table 3
Independent predictors for hospital mortality and postoperative MACCEs

<table>
<thead>
<tr>
<th></th>
<th>Odds ratio</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous cardiac surgery</td>
<td>4.08</td>
<td>1.33–12.6</td>
<td>0.014</td>
</tr>
<tr>
<td>Female sex</td>
<td>2.49</td>
<td>1.01–6.1</td>
<td>0.047</td>
</tr>
<tr>
<td>Pulmonary arterial systolic pressure ≥ 60 mmHg</td>
<td>3.68</td>
<td>1.19–11.4</td>
<td>0.024</td>
</tr>
<tr>
<td>Renal failure</td>
<td>6.75</td>
<td>2.76–16.55</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Concomitant CABG</td>
<td>2.57</td>
<td>1.07–6.16</td>
<td>0.034</td>
</tr>
<tr>
<td>Postoperative MACCEs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulmonary arterial systolic pressure ≥ 60 mmHg</td>
<td>3.49</td>
<td>1.46–8.36</td>
<td>0.005</td>
</tr>
<tr>
<td>Renal failure</td>
<td>2.57</td>
<td>1.33–4.99</td>
<td>0.005</td>
</tr>
<tr>
<td>Concomitant CABG</td>
<td>1.98</td>
<td>1.41–4.40</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Stepwise backward binary logistic regression analysis with likelihood ratio tests. Only predicting variables are shown.
CABG, coronary artery bypass grafting; MACCEs, major adverse cardio and cerebrovascular events.

Table 4
Survival and overall incidence of events in the follow-up

<table>
<thead>
<tr>
<th></th>
<th>Age &lt;80 years, n = 322</th>
<th>Age ≥ 80 years, n = 83</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mortality</td>
<td>22 (6.8)</td>
<td>13 (15.7)</td>
<td>0.011</td>
</tr>
<tr>
<td>Cardiac mortality</td>
<td>14 (4.2)</td>
<td>7 (8%)</td>
<td>0.166</td>
</tr>
<tr>
<td>MACCEs</td>
<td>27 (8.1)</td>
<td>12 (13.8)</td>
<td>0.104</td>
</tr>
<tr>
<td>ACVAs</td>
<td>10 (3.1)</td>
<td>5 (6%)</td>
<td>0.203</td>
</tr>
<tr>
<td>Prosthesis replacement</td>
<td>3 (0.9)</td>
<td>3 (3.6)</td>
<td>0.104</td>
</tr>
<tr>
<td>Prosthesis endocarditis</td>
<td>5 (1.6)</td>
<td>4 (4.8)</td>
<td>0.091</td>
</tr>
<tr>
<td>Thromboembolic complications</td>
<td>1 (0.3)</td>
<td>2 (2.4)</td>
<td>0.108</td>
</tr>
<tr>
<td>Haemorrhagic complications</td>
<td>8 (2.5)</td>
<td>1 (1.2)</td>
<td>0.693</td>
</tr>
<tr>
<td>AMI</td>
<td>6 (1.9)</td>
<td>1 (1.2)</td>
<td>1</td>
</tr>
<tr>
<td>Hospital readmission</td>
<td>36 (11.2)</td>
<td>17 (20.5)</td>
<td>0.03</td>
</tr>
<tr>
<td>Survival</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mortality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac mortality</td>
<td>51.8 mm (50.6–53.3)</td>
<td>46 mm (42.5–50.4)</td>
<td>0.038</td>
</tr>
<tr>
<td>MACCEs</td>
<td>51.8 mm (50.1–53.3)</td>
<td>46 mm (42.5–50.4)</td>
<td>0.055</td>
</tr>
</tbody>
</table>

Results shown n (%) for overall incidence of each event. Time survival for each event expressed in mean survival (mm) (95% CI). χ²/Fisher’s test for overall incidences differences. Mantel–Cox test for survival differences. P < 0.05 are considered significant.
MACCEs, ACV A, prosthesis replacement, prosthesis endocarditis, thromboembolic and haemorrhagic complications, AMI and hospital readmission for any cardiac cause.
MACCEs, major adverse cardio and cerebrovascular events; ACV A, acute cerebrovascular accident; AMI, acute myocardial infarction.

mechanical prosthesis was noticed in both age groups (64.7% for under 80 years 95.7% for over 80 years) was observed.
When analysing the predictors of postoperative complications, age did not prove to be an independent risk for mortality or for other MACCEs (OR=0.85: 95% CI 0.3–2.42 and OR=0.9: 95% CI 0.46–1.96, respectively). The independent mortality predictors were previous cardiac surgery (OR=4.08, P=0.014), renal failure (OR=6.75, P<0.001), concomitant CABG (OR=2.57, P=0.034), female sex (OR=2.49, P=0.047) and severe pulmonary hypertension (OR=3.68, 95% CI 0.024). Independent predictors for MAC-
New Ideas

Institutional Report

Work in Progress Report

ESCVS Article

Negative Results

State-of-the-art

Best Evidence

Topic Brief

Communication

Case Report Follow-up

Paper

Editorial

Protocol

Proposal for Bail-out Procedure

Nomenclature

Historical Pages

Fig. 1. All cause mortality survival. Kaplan–Meier survival curves per age group. Horizontal axis: survival. Ordinate axis: follow-up time in months.

CEs were: severe pulmonary hypertension (OR=3.49, $P=0.005$), concomitant CABG (OR=1.98, $P=0.002$) and renal failure (OR=2.57, $P=0.005$). Previous cardiac surgery, pulmonary hypertension and renal failure are well-known postoperative adverse event predictors [9, 12, 13]. Negative influence of concomitant CABG in the outcomes

Fig. 2. Cardiac mortality survival. Kaplan–Meier survival curves per age group. Horizontal axis: survival. Ordinate axis: follow-up time in months.

of AVR has been widely reported in the literature [14] and also explains the results of this study.

A significant difference in the non-adjusted survival between the two age groups can be observed during the follow-up ($P=0.002$). This fact does not seem to be due to a higher cardiac mortality ($P=0.166$) and could probably be explained by demises caused from age related comorbidities. These facts corroborate those already published in other series [5, 11].

As expected, patient over 80 years had a worst survival than younger ones ($HR=2.44$, $P=0.025$). On the other hand, when analysing cardiac mortality, octogenarians did not seem to have worse outcomes than younger ($HR=2.26$, $P=0.080$). This fact could be explained to two factors: first, the sample size may have not been large enough to detect the differences; and second, the follow-up time has not been probably long enough.

Fig. 3. Survival free of MACCEs. Kaplan–Meier survival curves per age group. Horizontal axis: survival. Ordinate axis: follow-up time in months.

Table 5

Cox proportional hazard analysis. Independent predictors for events during follow-up

<table>
<thead>
<tr>
<th>Independent predictors of survival</th>
<th>HR</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High blood pressure</td>
<td>5.23</td>
<td>1.24–12.32</td>
<td>0.025</td>
</tr>
<tr>
<td>Peripheral arterial disease</td>
<td>5.06</td>
<td>2.15–11.93</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age ≥80</td>
<td>2.44</td>
<td>1.15–5.16</td>
<td>0.020</td>
</tr>
<tr>
<td>Cardiac mortality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peripheral arterial disease</td>
<td>3.55</td>
<td>1.29–9.78</td>
<td>0.014</td>
</tr>
<tr>
<td>High blood pressure</td>
<td>8.24</td>
<td>1.1–15.42</td>
<td>0.040</td>
</tr>
<tr>
<td>MACCEs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>2.03</td>
<td>1.63–3.91</td>
<td>0.033</td>
</tr>
<tr>
<td>Peripheral arterial disease</td>
<td>2.3</td>
<td>1.04–5.11</td>
<td>0.041</td>
</tr>
</tbody>
</table>

Cox proportional hazard analysis. Only significant variables in the model are shown. Data expressed in HR (hazard ratio), 95% CI and P-value.
Conventional AVR has improved its outcomes in octogenarians in the past two decades. Besides, it seems that predicted morbimortality in this group of patients may be overestimated by widespread used risk stratification scales, such as EuroSCORE. Many old patients are not referred for an AVR because poor outcomes are expected according to these scores. This and other reports might show us that these are not as bad as thought and, therefore, many of those patients could safely undergo a conventional AVR and improve their functional status and lifetime expectancy.

Results of new transapical and transfemoral aortic valvular implantation techniques have been very encouraging up to date [15]. However, according to the current status of conventional AVR shown in this and other reports, we have to be cautious when choosing a trans-catheter option in detriment of a conventional surgery. Comparative studies (conventional vs. transcatheter) are necessary to ascertain in what subgroups of patients less invasive techniques are safer and more cost effective than conventional AVR. Age alone should not be used to decide on one or another treatment. Instead, a precise individual risk profile including age and comorbidities would be a wiser manner to select patients for each technique.

References


