Aortic valve replacement in elderly patients with aortic stenosis

E Straumann, W Kiowski, I Langer, E Grädel, P Stulz, D Burckhardt, M Pfisterer, F Burkart

Abstract

Objective—To assess the risk of aortic valve replacement and long-term follow-up in elderly patients with dominant aortic stenosis.

Design—Retrospective analysis of patients who had aortic valve replacement over a 10 year period and were routinely seen in an outpatient clinic.

Setting—University hospital.

Patients—93 patients aged ≥ 60 and 47 patients ≥ 70 years with symptomatic aortic stenosis undergoing aortic valve replacement.

Main outcome measures—Early and late mortality in different age groups. Influence of preoperative signs and symptoms on overall outcome.

Results—The proportion of patients older than 70 years increased from 11% in 1978 to 54% in 1986. Perioperative mortality was 3.6% and mortality after 2 and 5 years was 9% and 13% respectively. Survival was similar (85% and 83%, respectively) in patients aged 60–69 years (group 1, n = 93, mean age 64.5 ± 2.7) and patients aged ≥ 70 years (group 2, n = 47, mean age 72.6 ± 2.5). Additional coronary artery disease and coronary bypass grafting did not significantly affect survival. The cardiothoracic ratio was inversely related to survival (Cox regression, p < 0.05). Preoperative symptoms (syncope, angina pectoris, and dyspnoea) were similar in both patient groups. After a mean (SD) follow up of 51 (33) months 96% of surviving patients were in NYHA functional class I or II with no difference between the two age groups. Similarly, the cardiothoracic ratio and Sokolow index decreased to near normal values in both age groups.

Conclusion—The risk of aortic valve replacement in patients with dominant aortic stenosis is low and not significantly influenced by age. Therefore replacement may be performed without increased risk in elderly patients and with a good long-term outcome.

Patients and methods

PATIENTS

A total of 140 patients aged ≥ 60 years (range 60–81 years, 96 men and 44 women) with dominant, symptomatic aortic stenosis underwent aortic valve replacement in our hospital between 1977 and 1986. All had angina pectoris or dyspnoea or both and 73% were in NYHA functional class III or IV. There was a history of syncope in 42% and concomitant aortic regurgitation in 87%. Operation was elective in 134 and urgent in six patients. All patients were operated on by the same surgical team using standard cardiopulmonary bypass and cold blood potassium cardioplegia in 108 patients for myocardial protection or coronary perfusion at the beginning of the study period in 32 patients. We used an interrupted suture technique. Mechanical prostheses were implanted in 119 (St Jude-Medical in 59, Björk-Shiley in 40, Omnicarbon in 13, Duromedics in six, and Starr-Edwards in one) and bioprostheses were used in 21 patients (Ionescu-Shiley in 17, and Carpentier-Edwards in four).

Bioprostheses were used only when long-term anticoagulation with warfarin was contraindicated or patients were not expected to outlive the tissue prostheses.

PREOPERATIVE INVESTIGATIONS

Left heart catheterisation was performed preoperatively in all patients for direct measurement of aortic pressure gradient (pull-back method) and assessment of concomitant coronary artery disease, aortic regurgitation, and left ventricular ejection fraction.

Coronary artery disease was defined as narrowing by 75% or more of the lumen of at least one vessel. Aortic regurgitation was graded angiographically: as grade I (just visible contrast regurgitation), grade II (contrast regurgitation to the apex, but fully washed out

Division of Cardiology
E Straumann
W Kiowski
I Langer
D Burckhardt
M Pfisterer
F Burkart

Department of Cardi thoracic Surgery, University Hospital of Basle, Basle, Switzerland
E Grädel
P Stulz

Correspondence to:
Dr Wolfgang Kiowski
Division of Cardiology,
Department of Internal Medicine, University Hospital, Rämistrasse 100, CH-8091, Zurich, Switzerland.

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after each ejection), grade III (contrast accumulation), and grade IV (free aortic regurgitation).

FOLLOW UP
After discharge patients were routinely seen in our outpatient clinic 3 and 12 months after operation and usually every year thereafter. We reviewed their records for symptoms (syncope, angina pectoris, dyspnoea), clinical findings, cardiothoracic ratio on chest x rays and 12 lead surface ECG preoperatively, at discharge, 3 months postoperatively, and at the last available follow up (at a mean of 51 (33) months after operation).

The following perioperative complications were assessed: newly developed atrial fibrillation present at discharge, bradycardia requiring pacemaker implantation, ventricular arrhythmias (ventricular tachycardia and ventricular fibrillation), bleeding requiring reoperation, myocardial infarction, stroke, haemodynamically significant pericardial effusion, pneumonia, wound infections, and sternal wound revision.

Survival was assessed as time from operation to last follow up examination. For patients not reporting for the last scheduled visit, the time of death was ascertained by asking the patient’s private physician or relatives.

At the last follow up examination patients were also asked to judge their improvement in physical limitation after operation as excellent/good, satisfactory, or unsatisfactory.

STATISTICAL ANALYSIS
Values are given as mean (SD). Student’s t test, Chi square test, and repeated measures analysis of variance (ANOVA) were used as appropriate. Survival rates were calculated according to the method of Kaplan-Meier. The influence of age, preoperative NYHA functional class, ejection fraction, calculated aortic valve area, left ventricular pressures, presence of coronary artery disease and concomitant bypass grafting on survival was estimated using the Cox proportional hazard model. All calculations were performed using the Systat statistical package. p Values of < 0-05 were regarded as statistically significant.

Results
The mean age of the study population was 67-2 (4-6) years. Ninety three patients were aged 60-69 (mean 64-5 (2-6)) years (group 1) and 47 patients were 70-81 (mean 72-6 (2-5)) years (group 2). The proportion of patients ≥ 70 years increased from 11% in 1978 to 54% in 1986.

Preoperative findings and symptoms
Table 1 summarises the preoperative characteristics of the patients. There were no significant differences in sex distribution; incidence of syncope, severe angina pectoris, and dyspnoea; and heart rate between the age groups.

Preoperative haemodynamic findings (table 2) were also similar in both groups except for left ventricular end diastolic pressure which was slightly but significantly higher in group 1 patients (p < 0-05). The peak-to-peak pressure gradient over the aortic valve was similar in both age groups (table 2).

The ejection fraction measured by left ventriculography during left heart catheterisation (mean 54%, range 18-82%) and by radio-nuclide angiography (mean 52%, range 15-82%) was similar in both age groups and was < 40% in 28% of group 1 and 24% of group 2.

Concomitant aortic regurgitation was present in 87%. The frequency and severity of concomitant aortic regurgitation were similar in both groups: grade I, II, and III regurgitation was seen in 22%, 25%, and 40% of group 1 patients and in 21%, 32%, and 32% of group 2 patients respectively. Grade IV regurgitation was not seen. The cardiothoracic ratio was similar in patients with grade III (0-53 (0-67)) or lesser degrees of aortic regurgitation (0-52 (0-51) NS).

Coronary artery disease was present in 33% of group 1 patients (8% had three vessel disease), and in 40% of group 2 patients (13% had three vessel disease, NS). Revascularisation procedures were performed in 25 of 30 group 1 and in 12 of 19 group 2 patients (p = 0-11, χ²).

In-hospital perioperative complications
The length of hospital stay was similar in both groups (20-6 (5-8) days in group 1 and 22-5 (16-4) days in group 2). In total, there were
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because in recent years more elderly patients had operations (4-6 (2-9) years in group 1 and 3-5 (2-3) years in group 2 (p = 0.03)).

There were two (1-4%) operative deaths, both in group 1, and hospital mortality (all deaths within 30 days including operative deaths) was 3-6% (n = 5), with no significant difference between group 1 (n = 4, 4-3%) and group 2 (n = 1, 1-9%).

During long-term follow up 16 patients died. There was a total of 21 deaths, with cardiac deaths in seven patients (33%). Four patients (19%) died of major bleeding (two intracerebral haemorrhages (one early, one late), one trauma, and one from aortic rupture); three patients (14%) died of cancer; two (10%) died from pneumonia (one early, one late) and in five patients (24%) the mode of death was not known.

Thus the probability of survival 1, 5, and 8 years after operation was 92-6% (125 patients at risk), 84-1% (n = 55), and 75-5% (n = 20) respectively for all patients. Figure 1 shows that the probability of survival was not significantly different in the older and the younger patient groups.

Of all factors evaluated only the preoperative cardiothoracic ratio was an independent predictor for survival in the Cox regression analysis (p = 0.04). Age, preoperative NYHA classification of angina pectoris and dyspnoea, ejection fraction, calculated aortic valve area, preoperative systolic and end diastolic left ventricular pressure, coronary heart disease, and bypass grafting were not significant determinants.

Figure 2 shows the changes in functional NYHA class, cardiothoracic ratio, and Sokolow index. At discharge NYHA limitations caused by angina pectoris or dyspnoea

Table 3  In-hospital complications in 140 patients undergoing aortic valve replacement

<table>
<thead>
<tr>
<th>Complications</th>
<th>Events (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New atrial fibrillation</td>
<td>12</td>
</tr>
<tr>
<td>Ventricular arrhythmias (VT/VF)</td>
<td>6 (1)</td>
</tr>
<tr>
<td>Bleeding requiring reoperation</td>
<td>5</td>
</tr>
<tr>
<td>Stroke</td>
<td>3 (1)</td>
</tr>
<tr>
<td>Reoperation because of aortic valve</td>
<td>3</td>
</tr>
<tr>
<td>Perioperative infarction</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Sternal wound revision/ wound infection</td>
<td>3</td>
</tr>
<tr>
<td>Aortic rupture</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Persistent III degree AV block</td>
<td>1</td>
</tr>
<tr>
<td>Severe right heart failure</td>
<td>1</td>
</tr>
<tr>
<td>Pericardial effusion</td>
<td>1</td>
</tr>
<tr>
<td>requiring pericardiocentesis</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39 (5)</td>
</tr>
</tbody>
</table>

Numbers in parentheses and deaths attributable to the respective complication. AV, atrioventricular; VF, ventricular fibrillation; VT, ventricular tachycardia.

39 perioperative complications (table 3). Complications were as common in the younger patients (n = 26, 28%) as in the older patients (n = 13, 28%).

FOLLOW UP

Six patients were lost to follow up. Follow up was somewhat shorter in group 2 patients
had already decreased similarly in both age
groups and there were no significant differences
after 3 months and at the last follow up
examination (repeated measures ANOVA).
Similarly the cardiothoracic ratio decreased in
both age groups after discharge to normal or
near normal values and then remained unchanged until the last examination. The
Sokolow index decreased progressively up to
the last examination in both groups, but
remained slightly higher in the older patient
group at the last examination (fig 2).

At last follow up examination 91% of sur-
viving patients reported an excellent or good
improvement in physical capacity, 8% judged it as satisfactory, and only one patient (group
2) judged it to be unsatisfactory (corresponding
values for groups 1 and 2: 90-6%, 9-4%,
0% 6 93%, 5-7%, 2-3%, NS). 

Discussion
In the early days of aortic valve replacement,
overall in-hospital mortality was 7-12%,12
and in patients over 60 years of age it was as
high as 20%.6-11 Depending on the age at opera-
tion, preoperative condition, and time of fol-
low-up long-term mortality ranged from 4-6%
to 10-4% per year.13,16-20 Since then surgical
outcome has improved substantially as the
result of advances in anaesthesia, myocardial
protection, and postoperative care.24-27

Our data in an elderly population with
dominant aortic stenosis accord with these
trends towards improved survival and show a
low perioperative (3-6%) and long-term mor-
tality (4-3%) at 5 years. Post hospital death (2%
included) after aortic valve replacement, ir-
respective of age. The low perioperative mortal-
ity may be due in part to the low incidence of
urgent operations, because the risk is higher
with urgent surgery.28-30 In terms of the severity
of preoperative symptoms (NYHA class III
and IV impairment in 73%) the overall out-
come in our patients was particularly good,
and compares well with recent reports in
which patients were clearly younger.31,32

Aortic valve replacement has also been
reported in patients considerably older than
ours.30-32 The early mortality (5-7%32 and
30%35) suggested, not unexpectedly, that the
risk in octogenarians was substantially higher
than in our study group of patients aged
between 70 and 80 years. However, late sur-
vival has also been reported to be excellent in
such patients31,32 and in one instance was
found to be even better than that of an age
and sex matched control group.33

Our data show also that quality of life and
functional capacity improved substantially in
all patients. Thus at the last follow up exami-
nation 91% of surviving patients reported
good or excellent improvement in their physi-
cal capacity and 96% were in NYHA func-
tional class I or II compared with NYHA III
or IV in 73% before operation. The cardio-
thoracic ratio decreased to normal or near
normal values within 3 months in both
groups, whereas left ventricular hypertrophy
seemed to regress progressively up to the last
examination. This continuing reduction of left
ventricular hypertrophy accords with a study
in which angiographically assessed left ven-
tricular muscle mass fell continuously during a
follow up of up to 70 months after aortic
valve replacement.33,34

Because there are no alternatives to valve
replacement our results and those of others
are particularly encouraging. The benefits of
balloon dilatation of the aortic valve were
short-lived: in a recent report restenosis
occurred in over 50% of patients within one
to two years. Furthermore, the best long-term
results were obtained in patients who would
have been expected to have excellent long-
term results after aortic valve replacement.35

Predictors of Mortality and Long-term Survival

We found that the cardiothoracic ratio was
the only independent predictor of survival in a
Cox regression model that evaluated nine
clinical and haemodynamic variables. Similar
observations have been reported before,36-38
but unlike others,24,25,32 we did not iden-
tify additional preoperative factors such as
preoperative ejection fraction, coronary artery
disease, NYHA classification, or presence of atrial
fibrillation.38 On theoretical grounds significant
concomitant aortic regurgitation might lead to
a greater increase in cardiothoracic ratio that
might explain the impact of cardiothoracic ratio
in our study. However, the cardiotho-
racic ratio in our patients with grade III regur-
gitation was no different from that in patients
with lesser degrees of regurgitation. The dis-
crepancies between our findings and those of
others may also be explained in part by the
fact that many of the variables shown to be
significant by univariate analysis may not be
by the multivariate analysis that we used.

Moreover, patients with either dominant aortic
stenosis or dominant aortic regurgitation were
sometimes assessed jointly39 despite the fact,
that the two lesions differ in many aspects.
Furthermore, we measured preoperative eje-
tion fraction only in 75 of our 140 patients.
However, we report on open chest cardiac
surgery in octogenarians the ejection fraction
was predictive of early mortality but not of
late mortality.31 We, like others,36-41 found that
concomitant coronary artery disease or coro-
nary artery bypass grafting did not signific-
antly affect survival. In contrast, others
found that late mortality was higher in
patients with aortic stenosis who had con-
comitant coronary artery disease than in those
who had stenosis alone42,43 and the Veterans
Administration valve study identified the
presence of three vessel disease as the most
powerful independent predictor of hospital
mortality after aortic valve replacement.36

Similarly, operative risk was higher in com-
bined aortic and coronary artery disease44 and
in patients undergoing additional coronary
artery bypass grafting.37,38,45,46 This discrep-
ancy cannot readily be explained but it may
arise because only 9% of our patients had
three vessel disease. Furthermore, coronary
artery bypass grafting was less likely to be
performed in those of our patients who were older than 70. This approach is supported by a recent review that questioned the evidence that coronary artery bypass grafting at the time of aortic valve replacement does indeed improve survival.49

Aortic stenosis is increasingly a disease of the elderly. Aortic valve replacement is the only successful treatment and it has become a safe procedure even in elderly patients with advanced functional impairment. Long-term survival and quality of life after aortic valve replacement in patients with dominant aortic stenosis are excellent, and advanced age alone should not be regarded a contraindication for aortic valve replacement in otherwise healthy patients.

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