Original Research

Aortic Valve Replacement in Octogenarians: Outcome and Predictors of Complications

Jens Litmathe, Peter Feindt, Muhamed Kurt, Emmeran Gams, Udo Boeken

Department of Thoracic and Cardiovascular Surgery, Heinrich-Heine-University Hospital, Düsseldorf, Germany

Key words: **Aortic valve replacement, octogenarians, complications, predictors.**

Introduction: We aimed to evaluate the outcome in octogenarians after aortic valve replacement (AVR) and to determine the perioperative parameters that were predictive of a complicated postoperative course.

Methods: The study population included 304 patients (65% male) aged 82.7 ± 3.5 years who underwent AVR alone (63%), in combination with coronary artery bypass grafting (28%) or with other procedures (9%), between 1998 and 1/2008. Most patients suffered from combined valve disease.

Results: Mechanical valves were implanted in 50% of the patients. The in-hospital mortality was 5.8%. The stay in the intensive care unit was 2.3 ± 0.5 days and in hospital 15.3 ± 2.6 days. After multivariate analysis we were able to identify some predictors for in-hospital mortality, such as preoperative cardiogenic shock ($p<0.02$), ejection fraction <0.3 ($p<0.03$), diameter of prosthesis <21 mm ($p<0.05$), and redo surgery. The most important predictors for postoperative complications after AVR were preoperative renal failure, additional surgical procedures (i.e. coronary artery bypass, mitral valve) and prolonged aortic cross-clamping (all $p<0.05$).

Conclusions: The outcome after AVR in octogenarians is satisfactory; the operative risk is acceptable and might even be reduced with an individual approach to perioperative management in high-risk patients.

Manuscript received: October 29, 2010;
Accepted: January 15, 2011.

Address:
Jens Litmathe

Department of Thoracic and Cardiovascular Surgery
Moorenstrasse 5
D-40225 Düsseldorf
Germany
e-mail: jens-litmathe@t-online.de

As a result of demographic changes in average life expectancy, the age of patients undergoing cardiac surgery continues to increase. Though the description "elderly patient" just 30 years ago was defined as 65 years old and more, this has currently increased to over 80 years.[1] For the general population of developed industrialised countries, Germany may serve as an excellent example: octogenarians constituted 1.9% of the German population in 1970, whereas by 1998 their number rose to 3.5%. During the last decade, more than 96,000 patients altogether underwent surgery using cardiopulmonary bypass annually. Of these, more than 3% were older than 80 years. This number can be expected to rise further within the coming years.[2]

With this ageing of the population the amount of degenerative valve diseases, especially aortic valve calcifications, has also increased. The greater use and sensitivity of two- as well as three-dimensional echocardiography has made the diagnosis of severe aortic valve stenosis become common, especially in older patients.

Aortic valve replacement is still the procedure of choice in those patients and previous studies have shown that even the elderly population should not be denied this therapy.[3-7] Furthermore, complex multi-valve disease is not infrequent nowadays. Only a few studies have focused on specific risk factors in this context.[8-10] Thus, we performed a retrospective analysis that represents our institution's experience in this field and evaluated possible risk factors for adverse events that are connected with a poor outcome.

Methods

The entire population consisted of 304 patients (65% men, mean age 82.7 ± 3.4 years). Of these, 63% underwent aortic valve replacement alone, 28% in combination with coronary artery bypass grafting, or with other procedures (9%) between 1998 and 1/2008. The patients mostly suffered from combined aortic valve disease. Concerning the aortic stenosis, we found a mean preoperative valve area of 0.7 ± 0.3 cm^2 and a mean gradient of 88 ± 22 mmHg in the entire cohort. Mechanical valves were implanted in 50% of the patients (defined as group 1, n=152); the other 50% of the patients received a biological valve (defined as group 2, n=152). The decision was made either with regard to the underlying concomitant diseases, such as atrial fibrillation, or by the patients' special request, or as judged by the attending surgeon.

All elective and emergency procedures as well as redo operations were included. A retrospective investigation, accompanied by the evaluation of predictors for readmission to the intensive care unit (ICU), was performed.

All operations were performed using a standard approach, with a median sternotomy, the application of extracorporeal circulation (ECC) and cold crystalloid cardioplegia according to the technique of Bretschneider.

Statistical analysis

Multivariate analysis (stepwise forward analysis) was used to identify factors that were predictors of major adverse events, such as death or severe complications (i.e. renal failure, low cardiac output syndrome, pulmonary infection, sepsis, stroke). The multivariate analysis was limited to variables that were known prior to operation. A subsequent analysis was made with preoperative and intraoperative variables to determine additional factors associated with a major complication. Ninety-five percent confidence intervals were calculated for each risk interval. Descriptive statistics are presented as mean values ± standard error of the mean. Student's t-test was used to calculate the significance level. A p-value <0.05 was considered to be statistically significant.

Results

Comparison of groups

We could not find any significant difference between the two groups either pre- or postoperatively. Prior to surgery, chronic obstructive pulmonary disease was present in 11.4% in group 1 and 9.9% in group 2, diabetes mellitus in 25.5% in group 1 and 27.6% in group 2 (including both insulin-dependent and not). Advanced stages of heart failure (at least New York Heart Association [NYHA] class III) were slightly more common in group 1 (15.5% vs. 15.1%), as were complaints related to unstable angina for those patients who suffered additionally from coronary artery disease and/or severe left ventricular hypertrophy (13.5% in group 1 vs. 12.1% in group 2). The proportion of urgent or emergent operations was 59.2% in group 1 and 58.1% in group 2. The duration of ECC was 117 ± 31 min in group 1 and 126 ± 37 min in group 2, and the incidence of postoperative bleeding that could be treated conservatively was 19.5% in group 1 and 17.1% in group 2.

There was a need for surgical re-exploration, either for bleeding or due to severely unstable haemodynamics, in 5.2% of the patients in group 1 and 5.7% in group 2. The main demographic data and the preoperative patients' characteristics are listed in Table 1.

The in-hospital mortality (during the period at the Heinrich-Heine-University) was 6% in group 1 and 6.2% in group 2. The stay in the ICU was 2.5 ± 0.5 days and in hospital 15.2 ± 2.3 days in group 1 and did not differ significantly from the values of group 2 (Table 2).

Multivariate analysis and predictors for poor outcome

From multivariate analysis we were able to identify various predictors of in-hospital mortality, such as preoperative cardiogenic shock, ejection fraction <0.3, diameter of prosthesis <21 mm and redo surgery (Table 3).

The most powerful predictors for more than one severe postoperative complication after aortic valve replacement were preoperative renal failure, additional surgical procedures and prolonged aortic cross-clamping (Table 4).

Discussion

Only fifteen years ago, cardiac operations in patients aged 80 years or older were relatively uncommon.[11] Since the last decade, however, there has been a marked increase in the number of operations performed in this age group. The underlying causes are reflected by the high incidence of cardiovascular dis-

Table 1. Preoperative characteristics in patients undergoing aortic valve replacement (AVR): groups 1 (mechanical valves) and 2 (biological valves).

	Group 1 (n=152)	Group 2 (n=152)	p
Age (y)	82.8 ± 3.4	82.6 ± 3.3	NS
Sex (% male)	66	64	NS
AVR alone/combined surgery (%)	62/38	64/36	NS
Morbid obesity (%)	17.4	18.2	NS
COPD (%)	11.4	9.9	NS
Diabetes mellitus (%)	25.5	27.6	NS
Arterial hypertension (%)	54.8	58.3	NS
Former neurologic problems (%)	8.4	6.7	NS
EF <40% (%)	18.2	17.5	NS
NYHA class IV (%)	15.5	15.1	NS
Renal failure (%)	6.6	5.9	NS
Unstable angina (%)	13.5	12.1	NS

COPD – chronic obstructive pulmonary disease; EF – ejection fraction; NYHA – New York Heart Association.

Table 2. Postoperative course in groups 1 and 2.

	Group 1 (n=152)	Group 2 (n=152)	p
Mechanical ventilation (h)	18.5 ± 4.5	17.5 ± 3.3	NS
Stay in ICU (days)	2.5 ± 0.5	2.5 ± 0.6	NS
Stay in hospital (days)	15.2 ±2.3	15.4 ± 2.7	NS
Patients with postop. complication(s) (%)	16	16.3	NS
Cardiovascular complication (LCOS)	12	12	NS
Renal failure	7.6	6.4	NS
Wound complication	3.4	3.6	NS
Pulmonary infection	4.4	5.0	NS
Sepsis	3.8	4.4	NS
Neurological complication	4.3	3.7	NS
Gastrointestinal complication	2.7	2.8	NS
In-hospital mortality (%)	6.0	6.2	NS

LCOS – Low cardiac output syndrome.

ease in advanced life[12] and the improved techniques of two- and three-dimensional echocardiography. It is not infrequent that elderly patients also suffer from concomitant disease, such as renal insufficiency, obstructive pulmonary disease or peripheral and central vascular disease.[13,14] The basic decision for surgical therapy under such circumstances has to take several aspects into account: possible differences between physiological and chronological age, the expected quality of life and the immediate perioperative risk are primarily important. Previous studies have already shown that these operations can be performed with an acceptable risk;[15,16] however; larger cohorts with a differential risk stratification are still the minority.

Bergus and colleagues presented an investigation of 306 patients undergoing isolated aortic valve replacement and found that advanced NYHA stages were a predictive risk factor for increased postoperative mortality.[17] In this study, however, the aspect of age in itself was not a negative predictor, which is in congruence with the findings of other authors.[7]

Further previous studies were able to identify emergent hospital admission or urgent operation as independent predictors for adverse postoperative events in an elderly population.[18] Although this could not be supported in our study, we prefer to perform surgery as early as possible once the decision has been made, in order to minimise the possible complications associated with advanced stages of left ventricular failure.

The most powerful predictors for immediate mortality in our current investigation involved a poor preoperative cardiac status: i.e. cardiogenic shock, redo surgery and severely reduced left ventricular function. This reflects the fact that most inotropic reserves are meagre in such a special patient group. Redo surgery can lead to prolonged operations, as well as to extended cardio-

Table 3. In-hospital mortality in all patients (n=304).

Pre- and intraoperative predictors	Odds ratio	95% CI	p
Preoperative renal failure	2.1	1.4 - 2.8	0.002
Female	1.8	1.5 - 2.8	0.001
NYHA class IV	1.8	1.1 - 3.1	0.002
Morbid obesity	1.4	1.0 - 1.7	0.001
Preoperative cardiogenic shock	2.8	1.9 - 3.3	0.001
Diabetes mellitus	1.2	0.8 - 1.3	0.08
Redo surgery	2.2	1.7 - 2.7	0.001
Former neurological problems	1.7	1.2 - 2.6	0.001
Preoperative EF <30%	2.8	1.9 - 3.2	0.001
Emergent status	1.5	1.1 - 2.3	0.001
Prosthesis <21 mm	2.6	1.6 - 3.1	0.002
Prolonged cross-clamping (>80 min)	1.8	1.7 - 2.6	0.002
Combined surgery	1.8	1.5 - 2.5	0.003

Abbreviations as in Table 1.

Table 4. Postoperative complications (≥1) in all patients (n=304).

Pre- and intraoperative predictors	Odds ratio	95% CI	p
Preoperative renal failure	2.8	1.7 - 3.4	0.001
Female	1.5	1.1 - 2.4	0.003
NYHA class IV	2.1	1.1 - 3.0	0.004
Morbid obesity	1.6	1.2 - 1.8	0.001
Preoperative cardiogenic shock	2.4	1.2 - 2.9	0.003
Diabetes mellitus	1.9	1.3 - 2.4	0.03
Redo surgery	1.5	1.1 - 1.9	0.04
Former neurological problems	1.9	1.4 - 2.5	0.002
Preoperative EF <30%	2.2	1.6 - 2.7	0.003
Emergent status	2.1	1.2 - 2.7	0.002
Prosthesis <21 mm	1.7	1.1 - 2.1	0.03
Prolonged cross-clamping (>80 min)	2.3	1.4 - 3.0	0.002
Combined surgery	2.5	1.6 - 3.2	0.001

Abbreviations as in Table 1.

pulmonary bypass and cross-clamp times with all their associated adverse effects. This is also reflected by the predictors we identified for major postoperative complications, such as materially prolonged cross-clamp time, combined surgery, and finally preoperatively known renal failure. The latter, in particular, frequently causes a prolonged stay in the ICU and the rate of complications may further increase accordingly.

The datum that a prosthesis diameter below 21 mm also influences the postoperative course again reflects, in our opinion, the intraoperative difficulties that are subsequently capable of provoking major adverse events. The influence of the prosthesis diameter on long-term survival is no less interesting; however, it was not the focus of this investigation but has been investigated in one of our earlier studies.[19] Furthermore, we can currently show that the choice of prosthesis type has no influence on the immediate perioperative outcome. In this regard, long-term results would also be essential.

Especially in light of catheter-supported techniques, which have become more widespread during the last years and which address mainly comparable patient characteristics, the findings of this study have special relevance: aortic valve operations, even in combination with further cardiac surgery, can be performed with an acceptable risk in elderly patients and thus continue to offer a serious alternative to interventional approaches. The operative schedule, however, has to be well planned and should be tailored to the individual patient in order to minimise the perioperative risk that underlies the evaluated predictors.

References

1. De Bono AH, English TA, Milstein BB. Heart valve replacement in the elderly. Br Med J. 1978; 30: 917-919.
2. Statistisches Bundesamt (Federal Statistical Office Germany) Wiesbaden 2004.
3. Levinson JR, Akins CW, Buckley MJ, et al. Octogenarians with aortic stenosis; outcome after valve replacement. Circulation. 1989; 80 (Suppl. I): I49-I56.
4. Akins CW, Hilgenberg AD, Vlahakes GJ, MacGillivray TE, Torchiana DF, Madsen JC. Results of bioprosthetic versus mechanical aortic valve replacement performed with concomitant coronary artery bypass grafting. Ann Thorac Surg. 2002; 74: 1098-1106.
5. Culliford AT, Galloway AC, Colvin SB. Aortic valve replacement for aortic stenosis in persons aged 80 years and over. Am J Cardiol. 1992: 67; 1256-1260.
6. Omer S, Chu D, Huh J, et al. Outcomes of aortic valve replacement performed by residents in octogenarians. J Surg Res. 2009; 156: 139-144.
7. Piper C, Hering D, Kleikamp G, Körfer R, Horstkotte D. Valve replacement in octogenarians: arguments for an earlier surgical intervention. J Heart Valve Dis. 2009; 18: 239-244.
8. Speziale G, Nasso G, Barattoni MC, et al. Short-term and long-term results of cardiac surgery in elderly and very elderly patients. J Thorac Cardiovasc Surg. 2011; 141: 725-731.
9. Di Eusanio M, Fortuna D, De Palma R, et al. Aortic valve replacement: Results and predictors of mortality from a contemporary series of 2256 patients. J Thorac Cardiovasc Surg. 2011; 141: 940-947.
10. Kolh P, Kerzmann A, Honore C, Cornte L, Limet R. Aortic valve surgery in octogenarians: Predictive factors for operative and long-term results. Eur J Cardiothorac Surg. 2007; 600-606: 2007
11. Akins CW, Daggett WM, Vlahakes GJ, Hilgenberg AD, Torchiana DF, Madsen JC Cardiac operations in patients 80 years old and older. Ann Thorac Surg. 1997; 64: 606-615.
12. Edmunds LH, Stephenson LW, Edie RN, Ratcliffe MB. Open-heart surgery in octogenarians. N Engl J Med. 1988; 319: 131-136.
13. Craver JM, Goldstein J, Jones EL, Knapp WA, Hatcher CR. Clinical, hemodynamic, and operative descriptors affecting outcome of aortic valve replacement in elderly versus young patients. Ann Surg. 1984; 199: 733-741.
14. The United Kingdom Heart Valve Registry Report 2000. A UK Heart Registry Publication. 2002.
15. Litmathe J, Boeken U, Feindt P, Gams E Concomitant CABG-procedures in elderly patients undergoing aortic valve replacement: An additional risk factor? Z Kardiol. 2003; 92: 447-452.
16. Litmathe J, Boeken U, Kurt M, Feindt P, Gams E. CABG-procedures in patients with advanced age: Early extubation and fast track management as an option? The Cardiology. 2008; 4: 7-10.
17. Bergus BO, Feng WC, Bert AA, Singh AK. Aortic valve replacement (AVR): influence of age on operative morbidity and mortality. Eur J Cardiothorac Surg. 1992; 6: 118-121.
18. Chocron S, Etievent JP, Viel JF, et al. Aortic valve replacement in the elderly: a comparative assay of potential risk factor modification. J Heart Valve Dis. 1995; 4: 268-273.
19. Boeken U, Litmathe J, Kurt M, Feindt P, Gams E. Hemodynamic performance and clinical consequences of aortic valve replacement with 21 mm size pericardial bioprosthesis. Thorac Cardiovasc Surg. 2005: 53; 281-284.