Valve Surgery in Octogenarians: A Safe Option with Good Medium-Term Results

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Background and aim of the study: **The number of octogenarians is increasing in industrialized societies, and many patients aged over 80 years have heart valve disease which is amenable to surgical treatment. The perioperative outcomes and long-term results in very elderly patients undergoing valve surgery were evaluated.**

Methods: **A retrospective analysis was conducted of 2,791 patients with long-term follow up, who underwent valve surgery between 1990 and 2002. Of these patients, 132 (68 males, 64 females) were aged over 80 years (mean age 82 ± 2 years; range: 80-94 years).**

Results: **Ninety-five patients (71.9%) underwent aortic valve replacement, 36 (27.3%) mitral surgery, and one patient had double-valve surgery. Sixty-five patients (49.2%) required concomitant coronary artery bypass grafting. There were 11 (8.3%) redo procedures. Patients aged over 80 years were significantly more symptomatic preoperatively than their younger counterparts (NYHA class III-IV 90.9% versus 69.0%, p <0.001), with more congestive cardiac failure, hypertension, peripheral vascular disease, obstructive pulmonary disease, and renal failure (all p <0.05). Perioperative mortality did not, however, differ significantly between groups (<80 years versus ≥80 years, 2.9% versus 4.6%, p = 0.10). There was also no difference in the composite end point of in-hospital death, renal failure, stroke, low output state, myocardial infarction, or sternal wound infection (<80 years versus ≥80 years, 10.5% versus 11.4%, p = 0.8). The mean follow up period was 66 ± 44 months (<80 years) versus 61 ± 37 (≥80 years). Late mortality was higher in the elderly group (10-year survival 37.9% versus 68.2%, p <0.001) and preoperative atrial fibrillation (RR 2.75; CI: 1.44-5.23), coronary artery disease (RR 1.98; CI 1.12-3.52) and congestive cardiac failure (RR 2.13; CI: 1.10-4.11) were independent predictors of late mortality. The groups did not differ with respect to long-term valve-related events, with the exception of fewer reoperations among elderly patients.**

Conclusion: **Valve surgery in selected octogenarians is associated with low morbidity and mortality. The outlook after surgery is very good, and surgery should not be denied to this group on the basis of age alone.**

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The number of octogenarians is increasing in line with the increase in life expectancy in industrialized countries (1). Indeed, in the United States the number is expected to quadruple over the next 50 years (2). Older people have an increased incidence of cardiovascular disease (3), and one of the most important developments in cardiac surgery over the past decade has been the marked increase in numbers of elderly patients being referred for surgery. Several reports have documented satisfactory outcomes after cardiac surgery in the ninth decade of life (4-6), particularly in relation to coronary artery bypass grafting (CABG). In spite of these favorable reports, timely cardiac surgery is still sometimes denied to patients solely on the basis of their age. Many elderly patients have cardiac valvular lesions which can be corrected surgically, and if timely surgery is denied to them they may then require urgent, high-risk surgery at a later date. In addition, the natural history of unoperated severe valvular disease is often dismal, particularly when associated with significant symptoms.

Previous reports have shown that the risks of surgery for valvular heart disease are higher in older patients (7,8). A balance must be struck between the

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increased operative risks, the reduced life expectancy, and the ability of surgery to improve the quality of life of survivors. Decision making can therefore be challenging in this group of patients. The study aim was to evaluate perioperative outcomes and long-term results in very elderly patients undergoing valve surgery.

Clinical material and methods

Study population

Approval for the study was obtained from the hospital research ethics board. A standard set of perioperative data was collected prospectively for all patients undergoing cardiac surgery at Toronto General Hospital between 1990 and 2002. This information was entered into a database that has been described previously (9). Long-term follow up data were available from 132 patients aged ≥80 years who underwent valve surgery during the study period, and this was compared to 2,659 valvular patients aged <80 years operated on over the same time period.

The present authors do not use an explicit patient selection algorithm for octogenarian patients, and the decision to operate is made on an individual patient level. In general, however, surgery will not be performed on octogenarians with multiple comorbidities, particularly renal failure (serum creatinine level >200 mg/dl) and peripheral vascular disease.

Operative technique

Standard anesthesia, surgical and perfusion techniques were employed. Cardiopulmonary bypass (CPB) was instituted using ascending aortic cannulation and two-stage venous cannulation of the right atrium for isolated aortic valve replacement (AVR), and bicaval cannulation for operations involving the mitral or tricuspid valve. Under mild systemic hypothermia (34°C), cardiac arrest was induced and maintained using intermittent hyperkalemic cold blood cardioplegia. When CABG was required, proximal anastomoses were constructed before removal of the aortic cross-clamp.

Follow up

All patients were followed up prospectively at periodic intervals. Recent follow up was conducted either by mailed questionnaire or by telephone interview. When patients could not be contacted via these methods, follow up data were obtained from the patient's family physician. Follow up was 100% complete for the entire patient population (n = 2,791).

Statistical analysis

Data were expressed as mean ± SD. Ordinal and nominal data were compared using the χ^2 test, or Fisher's exact test when appropriate. Continuous variables were compared with the unpaired Student's *t*-test, or the Kruskal-Wallis test when appropriate. Long-term outcomes were evaluated by Cox regression analysis. Variables with a univariate p-value <0.25, or of known biological significance, were examined. A stepwise procedure (backward Wald elimination test) was employed and a p-value <0.05 used to enter and eliminate variables.

Results

Univariate comparisons of baseline preoperative patient characteristics are listed in Table I. When compared with patients aged <80 years, those aged over 80 were significantly more symptomatic preoperatively and had more congestive cardiac failure, hypertension, peripheral vascular disease, obstructive pulmonary disease, and renal failure. Likewise, a greater proportion of elderly (>80 years) patients than younger patients were female.

Aortic valve replacement was performed more frequently in the over- 80s age group (Table II). Significantly more patients aged over 80 required concomitant CABG, and bioprostheses were implanted more frequently in older patients (Table II).

Overall morbidity and mortality was low in both groups (Table III), and perioperative mortality did not differ significantly between the two groups. Similarly, there were no differences in the incidence of perioperative myocardial infarction, stroke, low output syndrome, renal failure, or in the duration of intensive care unit (ICU) stay, nor in the composite end point of in-hospital death, renal failure, stroke, low output state, myocardial infarction or sternal wound infection.

The mean follow up period was similar for the two groups (5.7 versus 5.6 years in the under-80s and over-80s, respectively); details of long-term outcomes are listed in Table IV. There were only six perioperative deaths in patients aged over 80 years; hence, multivariable analysis was not deemed appropriate to evaluate predictors of operative mortality in this group. Seventy-eight patients died during the follow up period. Multivariable regression analysis of long-term outcomes showed that preoperative atrial fibrillation (risk ratio (RR) 2.75; CI: 1.44-5.23, p = 0.002), coronary artery disease (RR 1.98; CI 1.12-3.52, p = 0.02) and congestive cardiac failure (RR 2.13; CI: 1.10-4.11, p = 0.02) were independent predictors of late mortality in patients aged over 80 years. Neither age nor valve position were independent predictors of late death in the elderly group.

Table I: Preoperative patient characteristics.

Parameter	Age <80 years (n = 2,659)	Age >80 years (n = 132)	p-value
Age (years)*	62.3 ± 12.1	81.8 ± 2.2	<0.001
BSA (m^2)*	1.85 ± 0.22	1.70 ± 0.19	<0.001
Gender			0.003
Male	1706 (64.2)	68 (51.5)	
Female	953 (35.8)	64 (48.5)	
Diabetes	310 (11.7)	17 (12.9)	0.7
Hypertension	934 (35.2)	59 (44.7)	0.03
ECG rhythm			0.2
NSR	2030 (76.4)	103 (78.0)	
AF	557 (21.0)	20 (15.2)	
CHB	69 (2.6)	9 (6.8)	
LVEF (%)			0.17
>60	1088 (41.1)	49 (37.4)	
40-60	1155 (43.6)	54 (40.5)	
20-40	364 (13.8)	25 (19.1)	
<20	41 (1.5)	4 (3.0)	
NYHA class			<0.001
I	169 (6.4)	1 (0.8)	
II	654 (24.6)	11 (8.3)	
III	1186 (44.6)	71 (53.8)	
IV	649 (24.4)	49 (37.1)	
Stroke/TIA	287 (10.8)	18 (13.6)	0.3
PVD	166 (6.3)	14 (10.6)	0.04
CHF	1522 (57.3)	90 (68.2)	0.01
MI	75 (2.8)	7 (5.3)	0.19
Redo surgery	369 (13.9)	11 (8.3)	0.07
Renal failure	45 (1.7)	7 (5.3)	0.003
COPD	188 (7.1)	17 (12.9)	0.01

*Values are mean ± SD.
Values in parentheses are percentages.
AF: Atrial fibrillation or flutter; BSA: Body surface area; CHB: Complete heart block; CHF: Congestive heart failure; COPD: Chronic obstructive pulmonary disease; ECG: Electrocardiogram; LVEF: Left ventricular ejection fraction; MI: Myocardial infarction; NSR: Normal sinus rhythm; PVD: Peripheral vascular disease; TIA: Transient ischemic attack.

Table II: Operative data.

Parameter	Age <80 years (n = 2,659)	Age >80 years (n = 132)	p-value
CPB time (min)*	104 ± 40	108 ± 39	0.2
Cross-clamp (min)*	79 ± 31	75 ± 30	0.9
Valve position			<0.001
Aortic	1223 (46.0)	95 (71.9)	
Mitral	1211 (45.5)	36 (27.3)	
Double	225 (8.5)	1 (0.8)	
Prosthesis			<0.001
Mechanical	639 (24.0)	1 (0.8)	
Bioprosthesis	1353 (50.9)	118 (89.4)	
Concomitant CABG	910 (34.2)	65 (49.2)	0.01

*Values are mean ± SD.
Values in parentheses are percentages.
CABG: Coronary artery bypass grafting; CPB: Cardiopulmonary bypass.

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Table III: Postoperative outcome data.

Parameter	Age <80 years (n = 2,659)	Age >80 years (n = 132)	p-value
ICU stay (days)*	2.2 ± 15.0	1.9 ± 5.8	0.7
Operative mortality	78 (2.9)	6 (4.6)	0.10
Perioperative MI	23 (0.9)	2 (1.5)	0.2
LOS	184 (6.9)	11 (8.3)	0.8
Stroke	56 (2.1)	4 (3.0)	0.16
Sternal infection	17 (0.6)	0 (0.0)	0.4
Pacemaker	178 (6.7)	8 (6.1)	0.8
Renal failure	40 (1.5)	1 (0.8)	0.9
IABP	71 (2.7)	3 (2.3)	0.4
Composite+	280 (10.5)	15 (11.4)	0.8

*Values are mean ± SD.
+Composite: end point of in-hospital death, renal failure, stroke, low output state, myocardial infarction, or sternal wound infection.
Values in parentheses are percentages.
IABP: Intra-aortic balloon pump; ICU: Intensive care unit; LOS: Low output syndrome with requirement for inotropes or mechanical devices for >30 min to maintain blood pressure >90 mmHg with a cardiac index <2.2 l/min/m^2; MI: Myocardial infarction.

Discussion

During the past decade the number of octogenarians undergoing cardiac surgery for the relief of symptoms, and on prognostic grounds, has increased (3-8). Several studies have demonstrated favorable outcomes following cardiac surgery in elderly patients, both in terms of low operative mortality and with respect to postoperative improvements in NYHA functional status and quality of life. For example, Sundt et al. (10) reported that quality of life assessed by questionnaire after AVR in patients aged over 80 years was similar to that predicted for the elderly general population. Nonetheless, it is the present authors' opinion that patients aged over 80 years continue to be denied the potential benefits of cardiac surgery solely because they are considered to be too high-risk for such major surgery. In the case of patients with cardiac valvular pathology, the decision not to offer surgery is especially important because the natural history of unoperated severe valvular disease is often dismal, particularly when it is associated with significant symptoms (11).

It has been shown previously that the risks of surgery for valvular heart disease are higher in older patients (7,8), and decision making can be challenging in this group. This situation is not helped by the paucity of data from randomized controlled trials (12,13). A prospective study designed to examine this subject would, however, require multicenter collaboration if results were to be made available within a reasonable time frame. In addition, the lack of reliable percutaneous techniques (14) or alternative medical therapies for severe cardiac valvular disease would raise difficult ethical questions for any proposed randomized studies. Such randomized trials are, therefore, not likely to be conducted in the foreseeable future.

The present results do, however, show that excellent outcomes can be achieved when valve surgery is performed in selected patients aged over 80 years. Elderly patients have reduced cardiopulmonary, hepatic and

Table IV: Outcome data (% freedom from clinical events).

Outcome	Age <80 years			Age >80 years			p-value
	1 year	5 years	10 years	1 year	5 years	10 years	
Death	94.7±0.4	84.7±0.7	68.2±1.5	92.4±2.3	76.6±3.9	37.9±7.3	<0.001
VRMM	93.6±0.6	81.9±1.5	70.8±1.8	98.3±1.7	79.5±6.4	63.6±15.1	0.7
Reoperation	98.4±0.2	97.4±0.3	92.1±1.0	100±0.0	100±0.0	100±0.0	0.03
TE	97.0±0.4	90.8±0.8	84.8±1.4	98.3±1.7	79.3±6.5	79.3±6.5	0.13

Values are mean ± SD.
TE: Thromboembolic events; VRMM: Valve-related morbidity or mortality.

renal physiological reserves and, as noted, also have a higher prevalence of comorbid conditions. In the present study, no differences were observed in perioperative morbidity and mortality between patients aged over 80 years and their younger counterparts, though there was a trend toward higher mortality. Especially gratifying was the observation that, contrary to popular anecdote - and despite older patients having greater preoperative comorbidity - the duration of ICU stay for elderly patients did not differ significantly from that of the younger age group. This observation is particularly important in an era of increasing pressure to contain healthcare costs (5).

Aortic stenosis is the most frequently encountered heart valve lesion in the elderly (15), and AVR was the most common procedure performed in the over-80s in the present study. The relatively small number of elderly patients in the present study would suggest that they were carefully preselected by the surgeons and their referring physicians. However, the frequency with which concomitant CABG was required, and the presence of comorbidities, were significantly higher in the elderly group. In addition, a greater proportion of elderly patients (aged >80 years) than younger patients were female, reflecting the higher life expectancy of women over men in the general population (6). These points suggest that, whilst the elderly patients in the present study were certainly carefully selected, as a group they were representative of patients typically seen in routine cardiac surgical practice.

It was found that while preoperative atrial fibrillation, coronary artery disease and congestive cardiac failure were independent predictors of late mortality in patients aged over 80 years, neither age nor valve position were independent predictors of late death in this group. Previous studies have reported a number of different factors which predicted late mortality in elderly patients undergoing valvular surgery. Collart et al. (8) reported that age over 85 years, diabetes and renal dysfunction were independent predictors of late death after valvular surgery in octogenarians. Mistiaen et al. (16), in contrast, suggested that urgent surgery, myocardial infarction, carcinoma and digoxin use were the relevant predictors after AVR in patients aged over 80, while Sundt et al. (10) found that stroke, obstructive pulmonary disease, aortic stenosis and renal dysfunction predicted late death after AVR in elderly patients. The variation in these retrospective reports may be explained by the relatively small numbers of patients recruited into the studies, and by differences in selection criteria applied by different surgeons when deciding on which octogenarians were to be offered surgery.

Bioprosthetic valves are recommended for heart valve replacement in the elderly primarily because they allow patients to avoid the need for long-term anticoagulation, with its attendant risks. In addition, bioprostheses have a slower rate of structural valve deterioration in older patients (17). It is, however, difficult to draw conclusions regarding the impact of valve types on long-term outcomes because very few patients aged over 80 years have received mechanical valves. Nonetheless, the risk of reoperation was found to be reduced in older patients despite the greater use of bioprostheses. Whether this difference was due to the low rate of structural valve dysfunction in elderly patients, or to the prohibitively high risk of redo surgery in this group, cannot be determined from the present analysis. However, no significant difference in the incidence of valve-related events was observed during follow up (Table IV), which suggests that the implanted valves performed as well in patients aged over 80 years as in they did in the younger group.

In conclusion, the present study evaluated the outcomes of valvular operations patients aged ≥80 years at the time of surgery. The results suggested that, in selected patients, old age alone need not be a contraindication to successful surgery. A 10-year survival approaching 40% in a group of patients with a mean age of 82 years, as was observed, compared very favorably with the life expectancy of patients without cardiac valvular disease in the ninth decade of life (1). Provided that the potential exists for surgery to improve quality of life, and if the complex nature of the proposed surgery is accepted, patients aged over 80 years can be offered heart valve surgery with acceptable perioperative and long-term results.

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Meeting discussion

DR. GUY FRADET (Vancouver, BC, Canada): Over the years, have you evolved a common protocol to approach those patients referred to you in terms of investigations conducted?

DR. ANDREW CHUKWUEMEKA (Toronto, Ontario, Canada): No, and this is the crux of the issue. Clearly these patients are selected, but there is a paucity of common protocols across the units or even within units, and this introduces selection bias at all stages - whether it's referral by the cardiologist or the surgeon agreeing to take on the case. Perhaps we should be aiming for standardized protocols.

DR. NEAL KON (Winston-Salem, North Carolina, USA): You said that preoperative atrial fibrillation was a significant risk factor for postoperative survival. Can you comment on anticoagulation in those patients, and would you recommend a radiofrequency maze operation or such-like in elderly patients, or is that too much surgery?

DR. CHUKWUEMEKA: To answer your second point first, that has not been done, so I can't predict what the results might be. Clearly, if you are going to select a good candidate, there is no reason why they should be treated differently to their younger counterparts. The inference is that preoperative atrial fibrillation is in some ways a marker of more advanced disease preoperatively, and hence the inference on long-term outcomes.

DR. KENTON ZEHR (Rochester, Minnesota, USA): I find that these studies are becoming increasingly interesting from the viewpoint that we are now looking at percutaneous aortic valve replacement in patients. Cardiologists will tell you that there are very many patients who are denied surgery and who will be candidates for percutaneous aortic valve replacement. But did you examine the selection bias? Recently, we examined a series of aortic valve replacements in the over-80s at the Mayo Clinic. We have now performed over 1,000 in over 30 years - back in the 1970s the mortality was 14%, but in the past 10 years or so it has been 3%. The overall mortality is about 6% for the whole series, and this includes coronaries. We are finding similar risk factors, such as renal failure, congestive heart failure and low ejection fraction, but our selection bias has not really changed since the 1970s. We have simply improved our methods so that mortality has been reduced from 14% to about 6%. I truly believe that very few patients are denied surgery for aortic stenosis - can you comment on that? In your series, do you believe that this represents the bulk of patients presented to you for aortic valve replacement, or is there a significant selection bias here?

DR. CHUKWUEMEKA: I do think that is the case before referral, yes, but there is another driving factor, and that is patient choice. The decision may not simply be that of the surgeon or cardiologist. I don't know how many people never make it to the surgeon's office, but I do think that at various stages it is the patient who decides, and that will change the driving force.

DR. ZEHR: When we see your mortality rates it's difficult to imagine that there is a large octogenarian patient population that will be unacceptable for surgery.