VIEWPOINT

How should we manage symptomatic aortic stenosis in the patient who is 80 or older?

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Cardiologists can expect to see an increasing number of elderly and very elderly patients with symptomatic aortic stenosis. By the year 2000, 2 million people in England (4·2% of the population) will be aged 80 years or older.[1] Aortic stenosis is common in this age group: the best estimate of its prevalence is provided by a population-based study in Finland[2] which found severe stenosis (valve area <0·8 cm^2 by Doppler echocardiography) in 2·9% (95% confidence interval 1·4 to 5·1%) of randomly selected people aged 75–86, half of whom had symptoms and were regarded as candidates for valve replacement. Applied to England, and assuming survival from the onset of symptoms to be 4 years, these figures predict a potential need for >3500 aortic valve replacements per year in patients over 80.

In a cash-limited system of health care, the provision of cardiac surgery for elderly patients will reduce the funds available for the treatment of younger patients. Several methods, all with limitations,[3] have been proposed to deal with such competing claims. But any judgement on resource allocation must take into account the health gains conferred by the intervention. While there is no dispute about its value in younger patients with symptomatic aortic stenosis, is there good evidence that patients over 80 can benefit from valve replacement?

Is the prognosis of symptomatic aortic stenosis different in elderly patients?

The potential benefits of valve replacement must be set against the prognosis without operation.[4] Elderly patients fare worse than younger ones. A study of 50 patients of mean age 77 found that only 25% survived 3 years after diagnosis, compared with 77% of a matched control population.[5] This is likely to reflect the increasing prevalence of coronary disease and hypertension with age[6]: as well as their independent effects on survival, both contribute to left ventricular dysfunction,[7] which is probably the most important adverse prognostic factor in unoperated symptomatic aortic stenosis.[8–11] Age, however, is not related to the rate of progression of valve stenosis,[12 13] nor to the likelihood of subsequent cardiac events in the absence of symptoms.[14]

What are the risks of aortic valve replacement in the elderly?

EARLY MORTALITY

The estimated operative risk is a major consideration when deciding for or against any cardiac surgery. For adults undergoing aortic valve replacement, early mortality (within 30 days of operation) increases with age, although most studies[15–19] have found that age is less important than other factors such as functional class or the need for urgent operation (table 1). In these series, largely of middle aged patients, early mortality was 5·3–8·3%.

Studies of patients over 80[20–27] (all from the United States) are summarised in table 2.

Table 1 Preoperative factors identified by multivariate analysis that predict early mortality after aortic valve replacement

First author	*No of patients*	*Mean age (range)*	*Early (%) mortality*	*Preoperative factors*
Scott[15]	1479	59 (—)	7·0	FC, renal failure, AF, AR, age
Magovern[16]	259	58 (18–86)	6·9	Urgent operation, age
Sethi[17]	661	— (—)	8·3	3vCAD, LV systolic pressure, previous op, BSA, cardiac index
Christakis[18]	1098	— (—)	5·3	Urgent op, endocarditis requiring urgent op, CAD, previous op, age
Logeais[19]	2196	— (<75)	6·6	Age

FC, advanced functional class; AF, atrial fibrillation; AR, aortic regurgitation; op, operation; 3vCAD, three vessel coronary artery disease; LV, left ventricular; CAD, coronary artery disease. BSA, body surface area.

Table 2 Early mortality after aortic valve replacement in patients aged 80 years and older

First author	*Year of publication*	*Early mortality (deaths/patients (%))*	
		AVR	*AVR + CABG*
Rich[20]	1985	0/1 (0)	0/8 (0)
Tsai[21]	1986	0/10 (0)	3/12 (25)
Edmunds[22]	1988	10/33 (30)	4/17 (24)
Fiore[23]	1989	0/6 (0)	1/4 (25)
Levinson[24]	1989	1/31 (3)	5/31 (16)
Culliford[25]	1991	2/35 (6)	7/36 (19)
Freeman[26]	1991	5/45 (11)	9/42 (21)
Elayda[27]	1993	4/77 (5)	18/75 (24)
Total		22/238 (9·2)	47/225 (20·9)

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There is wide variation in the observed mortality, which is unrelated to the year of publication or the number of patients studied. Pooling the data gives an estimate of the early mortality of isolated aortic valve replacement (AVR) in this age group of 9·2% (95% confidence interval 5·6 to 12·9%) and of aortic valve replacement combined with coronary artery bypass grafting (AVR/CABG) of 20·9% (95% CI 15·6 to 26·2%). Two European studies (which did not separate patients having AVR or AVR/CABG) reported results broadly in line with these estimates, with overall early death rates of 14% (in 44 patients over 80)[28] and 12·4% (in 675 patients aged 75–92).[19]

Though data from these studies provide us with some guide when advising patients on their individual operative risk, several limitations should be noted. All were retrospective, and the results may have been published because they were considered to be better than average. The selection criteria for surgery were not explicit, and no study included information on patients in whom surgery was not performed: such patients must have existed as some underwent balloon dilatation of the aortic valve.

There is surprisingly little agreement between the studies on the relative importance of preoperative factors in predicting risk, although the two largest series[19 27] both identified impaired left ventricular function (as reflected in an ejection fraction < 45%[27] or clinical heart failure[19]) as the most powerful preoperative predictor of early mortality. Left ventricular dysfunction in severe aortic stenosis may have several causes including previous myocardial infarction, yet this was not found to be an independent predictor of early mortality in the three studies[19 24 25] in which it was assessed. It is possible that patients who had had large infarcts did not survive to undergo surgery, or were not referred.

A reliable method of estimating operative risk based on objective data available in all patients is clearly desirable. From an analysis of the outcome of 3500 consecutive cardiac operations, Parsonnet *et al* derived a simple method of predicting risk which was tested prospectively in 1332 operations.[29] This predicts the risk of isolated aortic valve replacement in patients over 80 to be at least 25%, and that of valve replacement combined with bypass grafting to be at least 27%. These high estimates largely reflect the 20% risk assigned to age over 80 (as compared with 7% for age 70–74 and 12% for age 75–79). The dominance of chronological age over other preoperative risk factors in this model is surprising, and further information on its accuracy in patients of this age is needed.

PERIOPERATIVE COMPLICATIONS

Perioperative complications have been reported in up to 83% of patients over 80 undergoing aortic valve replacement,[27] although many of these (such as arrhythmias) are transient and do not prejudice a good long-term result. A retrospective case-control study[28] in which patients over 80 were matched with patients aged 65–75 found no significant difference between the groups as regards overall complication rate (45% *v* 48%, older *v* younger), median time spent in intensive care (2 *v* 1 day), and median hospital stay (24 *v* 20 days).

Stroke is an especially feared complication of cardiac surgery. The incidence after aortic valve replacement in this age group has ranged from 1·4% (of 71 patients)[25] to 11·1% (of 171 patients).[27] It is unclear to what extent this wide range reflects differences in operative technique, characteristics of the patients, or chance.

Can elderly patients gain long-term benefit from surgery?

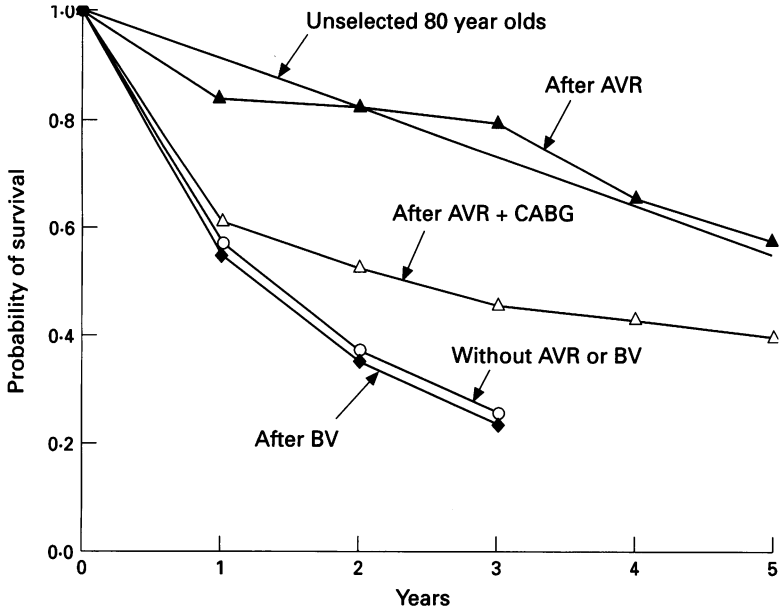
In terms of survival, the answer is yes. A comparison with the survival of the general population provides a useful (if flawed[30]) measure of this: elderly patients undergoing isolated aortic valve replacement (and therefore unlikely to have significant coronary disease) have a survival curve close to that of the general population (figure).[24 25 27] The survival benefit is less for patients who have AVR/CABG,[25 27] largely because of their higher early mortality. Preoperative factors are not predictive of medium and long term survival,[24 27] probably because of the high incidence of non-cardiac causes of death in patients of this age.

Clinicians often maintain that in this age group the quality of life is a more important consideration than its duration. Reported effort tolerance (as reflected in New York Heart Association (NYHA) class) is usually improved after valve replacement for aortic stenosis, and indeed this improvement is generally greater in elderly patients, because their preoperative state tends to be worse. In one series, 86% of patients over 80 were in NYHA classes III or IV before surgery, as compared with 36% of matched patients aged 65–75; elderly patients alive 6 months after surgery were all placed in classes I or II, and three quarters were socially independent.[28]

Should cardiac catheterisation be performed before a decision on aortic valve replacement?

We believe so, though we recognise the increased risk of catheterisation in this age group. A retrospective study of 242 patients over 80 (35% of whom had valve disease) reported a procedural mortality of 0·8% and non-fatal complications in 5%, rates four to five times greater than seen in younger patients.[31] A decision regarding the need for valve replacement can usually be based on clinical and echocardiographic data alone,[32 33] and in most patients, catheterisation may therefore be required only for coronary arteriography.

The rationale for coronary arteriography is the belief that bypass of significant coronary stenoses at the time of valve replacement reduces the early mortality, at least for patients



Comparison of actuarial survival of unselected 80 year olds (United States population; data cited in reference 24) and patients with symptomatic aortic stenosis. Solid and open triangles: patients aged 80 and over after isolated AVR (n = 77) or aortic valve replacement combined with coronary artery bypass grafting (n = 75) or another surgical procedure (n = 19) (AVR + CABG) (data from reference 27). Open circles: patients who did not undergo valve replacement or balloon dilatation of the aortic valve (n = 50, mean age 77) (data from reference 5). Filled diamonds: patients who underwent percutaneous balloon dilatation of the aortic valve (n = 674, mean age 78) (data from reference 11).

with multivessel disease, even if it does not neutralise the long-term adverse effects of coronary disease.[34 35] However, Logeais *et al* reported that bypass grafting (performed in 13%) did not influence early mortality in 625 patients aged 75–92.[19] They commented that coronary arteriography was routinely performed after 1990, and that their data, obtained retrospectively, cannot be used to support a policy of restricting arteriography to selected groups of elderly patients.

Which elderly patients should not undergo valve replacement?

An unacceptably high operative risk is commonly cited as a reason against cardiac surgery in patients over 80. This raises several difficult questions. Can an operative risk of perhaps 30% be regarded as unacceptably high, when the prognosis without surgery is so poor? Is it ethical to deny patients surgery on the basis of an estimate of operative risk predicted by a model that may be methodologically flawed or not prospectively validated in this age group?[36 37]

Beyond a general agreement that dementia and advanced or untreatable cancer make cardiac surgery inappropriate, it is uncertain to what extent the presence of other illness should influence the decision about surgery. Non-cardiac disease was present in a third of 675 patients aged 75–92 having aortic valve replacement, but was not found to be a determinant of early mortality.[19] The Parsonnet method of predicting operative risk[29] assigns an increased risk to patients with diabetes (+ 3%), morbid obesity (+ 3%), and chronic renal failure requiring dialysis (+ 10%). Other important illnesses, such as chronic airways disease, are excluded, largely because of the lack of suitable methods of measuring their severity.

Decision analysis may be a useful tool when clinicians are faced with difficult problems,[38] as it makes explicit the trade-offs between risks and benefits. Applied to an 87 year old woman with severe aortic stenosis, coronary disease, and impaired left ventricular function,[39] decision analysis came down strongly in favour of valve replacement, but revealed that much of the benefit of surgery is on prolongation of survival: the short and long term morbidity associated with surgery tends to offset the improvement in quality of life.

Is percutaneous balloon dilatation of the aortic valve a useful alternative to aortic valve replacement?

Regrettably not. Although it can increase valve area and improve symptoms in the short term, the medium and long term results have been poor[10 11]; indeed, there is little evidence that balloon dilatation alters the natural course of the disease (figure). Event free survival after balloon dilatation is determined by left ventricular function and functional state before the procedure[10 11]; patients with good left ventricular function and mild symptoms have the best outcome, but would of course be at relatively low risk for valve replacement too. Data from a United States registry showed that 134 (20%) of 674 patients subsequently underwent aortic valve surgery with a survival of 88% at 1 month and 71% at 2 years.[11] Balloon dilatation of the valve may possibly be of benefit to patients with cardiogenic shock[40 41] from aortic stenosis, if followed by valve replacement.

Conclusion

Aortic valve replacement is technically possible at any age.[42] Whether it is the right course in patients over 80 with symptomatic aortic stenosis depends on many factors, perhaps the most important of which is the patient's own view of the desirability of prolonging life. For patients who have normal coronary arteries and preserved left ventricular function, and no other medical problems of importance, valve replacement confers a substantial health gain; for others—perhaps most[19]—without these favourable characteristics, the risks are greater and the benefits less. The challenge is to develop valid measures of these risks and benefits so that the decision on surgery can be guided by science rather than prejudice.

1 Office of Population Censuses and Surveys. *Subnational population projections for England* Series pp3, no 9 (in press).
2 Lindroos M, Kupari M, Heikkila J, Tilvis R. Prevalence of aortic valve abnormalities in the elderly: an echocardiographic study of a random population sample. *J Am Coll Cardiol* 1993;**21**:1220–5.
3 Hope T, Sprigings D, Crisp R. "Not clinically indicated": patients' interests or resource allocation? *BMJ* 1993; **306**:379–81.
4 Braunwald E. On the natural history of severe aortic stenosis. *J Am Coll Cardiol* 1990;**15**:1018–20.
5 O'Keefe JH Jr, Vlietstra RE, Bailey KR, Holmes DR Jr.

Natural history of candidates for balloon aortic valvuloplasty. *Mayo Clin Proc* 1987;**62**:986–91.
6 Wei JY. Age and the cardiovascular system. *N Engl J Med* 1992;**327**:1735–9.
7 Vekshtein VI, Alexander RW, Yeung AC, *et al.* Coronary atherosclerosis is associated with left ventricular dysfunction and dilatation in aortic stenosis. *Circulation* 1990; **82**:2068–74.
8 Hammermeister KE, Cantor AB, Burchfiel CM, Sethi GK, Hong DM. Clinical, haemodynamic and angiographic predictors of survival in unoperated patients with aortic stenosis. *Eur Heart J* 1988;**9** (suppl E):65–9.
9 Kennedy KD, Nishimura RA, Holmes DR Jr. Bailey KR. Natural history of moderate aortic stenosis. *J Am Coll Cardiol* 1991;**17**:313–9.
10 Kuntz RE, Tosteson ANA, Berman AD, *et al.* Predictors of event-free survival after balloon aortic valvuloplasty. *N Engl J Med* 1991;**325**:17–23.
11 Otto CM, Mickel MC, Kennedy JW, *et al.* Three-year outcome after balloon aortic valvuloplasty: insights into prognosis of valvular aortic stenosis. *Circulation* 1994; **89**:642–50.
12 Otto CM, Pearlman AS, Gardner CL. Hemodynamic progression of aortic stenosis in adults assessed by doppler echocardiography. *J Am Coll Cardiol* 1989;**13**:545–50.
13 Roger VL, Tajik AJ, Bailey KR, Oh JK, Taylor CL, Seward JB. Progression of aortic stenosis in adults: new appraisal using doppler echocardiography. *Am Heart J* 1990; **119**:331–8.
14 Pellikka PA, Nishimura RA, Bailey KR, Tajik AJ. The natural history of adults with asymptomatic, hemodynamically significant aortic stenosis. *J Am Coll Cardiol* 1990; **15**:1012–7.
15 Scott WC, Miller DC, Haverich A, *et al.* Determinants of operative mortality for patients undergoing aortic valve replacement: discriminant analysis of 1,479 operations. *J Thorac Cardiovasc Surg* 1985;**89**:400–13.
16 Magovern JA, Pennock JL, Campbell DB, Pae WE, Bartholomew M, Pierce WS, *et al.* Aortic valve replacement and combined aortic valve replacement and coronary artery bypass grafting: predicting high risk groups. *J Am Coll Cardiol* 1987;**9**:38–53.
17 Sethi GK, Miller DC, Souchek J, *et al.* Clinical, hemodynamic, and angiographic predictors of operative mortality in patients undergoing single valve replacement. *J Thorac Cardiovasc Surg* 1987;**93**:884–97.
18 Christakis GT, Weisel RD, David TE, Salerno TA, Ivanov J. Predictors of operative survival after valve replacement. *Circulation* 1988;**78** (suppl I): 25–34.
19 Logeais Y, Langanay T, Leguerrier A, *et al.* Surgery for aortic stenosis in elderly patients: a study of surgical risk and predictive factors. *Circulation* 1994;**90**:2891–8.
20 Rich MW, Sandza JG, Kleiger RE, Connors JP. Cardiac operations in patients over 80 years of age. *J Thorac Cardiovasc Surg* 1985;**90**:56–60.
21 Tsai TP, Matloff JM, Gray RJ, *et al.* Cardiac surgery in the octogenarian. *J Thorac Cardiovasc Surg* 1986;**91**:924–8.
22 Edmunds LH Jr, Stephenson LW, Edie RN, Ratcliffe MB. Open-heart surgery in octogenarians. *N Engl J Med* 1988;**319**:131–6.
23 Fiore AC, Naunheim KS, Barner HB, *et al.* Valve replacement in the octogenarian. *Ann Thorac Surg* 1989;**48**:104–8.
24 Levinson JR, Akins CW, Buckley MJ, Newell JB, Palacios IF, Block PC, *et al.* Octogenarians with aortic stenosis: outcome after aortic valve replacement. *Circulation* 1989;**80** (suppl I):49–56.
25 Culliford AT, Galloway AC, Colvin SB, *et al.* Aortic valve replacement for aortic stenosis in persons aged 80 years and over. *Am J Cardiol* 1991;**67**:1256–60.
26 Freeman WK, Schaff HV, O'Brien PC, Orszulak TA, Naessens JM, Tajik AJ. Cardiac surgery in the octogenarian: perioperative outcome and clinical follow-up. *J Am Coll Cardiol* 1991;**18**:29–35.
27 Elayda MAA, Hall RJ, Reul RM, Alonzo DM, Gillette N, Reul GJ Jr, *et al.* Aortic valve replacement in patients 80 years and older: operative risks and long-term results. *Circulation* 1993;**88** (part 2):11–6.
28 Olsson M, Granstrom L, Lindblom D, Rosenqvist M, Ryden L. Aortic valve replacement in octogenarians with aortic stenosis: a case-control study. *J Am Coll Cardiol* 1992;**20**:1512–6.
29 Parsonnet V, Dean D, Bernstein AD. A method of uniform stratification of risk for evaluating the results of surgery in acquired adult heart disease. *Circulation* 1989;**79** (suppl I):3–12.
30 Rahimtoola SH. Valvular heart disease: a perspective. *J Am Coll Cardiol* 1983;**1**:199–215.
31 Clark VL, Khaja F. Risk of cardiac catheterization in patients aged > 80 years without previous cardiac surgery. *Am J Cardiol* 1994;**74**:1076–7.
32 Slater J, Gindea AJ, Freedberg RS, *et al.* Comparison of cardiac catheterization and doppler echocardiography in the decision to operate in aortic and mitral valve disease. *J Am Coll Cardiol* 1991;**17**:1026–36.
33 Galan A, Zoghbi WA, Quinones MA. Determination of severity of valvular aortic stenosis by doppler echocardiography and relation of findings to clinical outcome and agreement with hemodynamic measurements determined at cardiac catheterization. *Am J Cardiol* 1991;**67**:1007–12.
34 Jones M, Schofield PM, Brooks NH, *et al.* Aortic valve replacement with combined myocardial revascularisation. *Br Heart J* 1989;**62**:9–15.
35 Lund O, Nielsen TT, Pilegaard HK, Magnussen K, Knudsen MA. The influence of coronary artery disease and bypass grafting on early and late survival after valve replacement for aortic stenosis. *J Thorac Cardiovasc Surg* 1990;**100**:327–37.
36 Wasson JH, Sox HC, Neff RK, Goldman L. Clinical prediction rules: applications and methodological standards. *N Engl J Med* 1985;**313**:793–9.
37 Seymour DG, Green M, Vaz FG, Coles EC. Risk prediction in medicine and surgery: ethical and practical considerations. *J Roy Coll Phys Lond* 1990;**24**:173–7.
38 Pauker SG, Kassirer JP. Decision analysis. *N Engl J Med* 1987;**316**:250–8.
39 Wong JB, Salem DN, Pauker SG. You're never too old. *N Engl J Med* 1993;**328**:971–5.
40 Cribier A, Remadi F, Koning R, Rath P, Stix G, Letac B. Emergency balloon valvuloplasty as initial treatment of patients with aortic stenosis and cardiogenic shock. *N Engl J Med* 1992;**326**:646.
41 Moreno PR, Jang I-K, Newell JB, Block PC, Palacios IF. The role of percutaneous aortic balloon valvuloplasty in patients with cardiogenic shock and critical aortic stenosis. *J Am Coll Cardiol* 1994;**23**:1071–5.
42 Tsai TP, Denton TA, Chaux A, Matloff JM, Kass RM, Blanche C, *et al.* Results of coronary artery bypass grafting and/or aortic or mitral valve operation in patients ⩾ 90 years of age. *Am J Cardiol* 1994;**74**:960–2.