Aortic Valve Replacement in Octogenarians: Analysis of Risk Factors for Early and Late Mortality

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Background and aim of the study: **Cardiac surgery can be performed on elderly patients in good physical and mental health, thus improving their mortality, morbidity, and quality of life. Nevertheless, for some elderly patients aortic valve replacement (AVR) is still denied because of the presence of preoperative characteristics, such as older age and left ventricular dysfunction. The study aim was to review early and long-term results in patients aged ≥80 years who underwent AVR for severe aortic stenosis, and to identify risk factors for in-hospital and late mortality.**

Methods: **A total of 165 patients (mean age 82 ± 2.1 years) underwent AVR for severe aortic stenosis, with or without concomitant coronary revascularization, at the authors' institution. The mean aortic valve area was 0.61 ± 0.2 cm^2. Preoperatively, 20 patients (12%) had a left ventricular ejection fraction <35%. The mean EuroSCORE was 9.45 ± 1.52.**

Results: **Seven patients (4%) experienced low cardiac output syndrome, and acute renal failure occurred in 24. No perioperative myocardial infarction, stroke or sternal wound infection was detected. In total, 23 patients (14%) required prolonged ventilatory support. The in-hospital mortality was 3%. After a mean follow up of 43 ± 35.6 months there were 18 late deaths: the cardiac-related mortality was 7%. The mean NYHA class was improved from 2.86 ± 0.67 to 1.44 ± 0.57 (p <0.0001).**

Conclusion: **Conventional AVR remains the standard of care, and can be performed with satisfactory in-hospital mortality, long-term life expectancy and quality of life in high-risk elderly patients. Although the transcatheter aortic valve technique seems to be a promising option, its long-term value must be established in prospective, randomized trials.**

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Aortic stenosis is the most common cardiac valvular disease among the elderly population, with a prevalence that increases with age (1). It is well established that aortic valve replacement (AVR) is the treatment of choice for severe symptomatic patients (2), although the decision to operate on the elderly patient may raise problems related to an increase in operative mortality and morbidity (3,4).

It has been shown in several studies that cardiac surgery can be performed on elderly patients in good physical and mental health, thereby improving their mortality, morbidity, and quality of life (5,6). Nevertheless, AVR is still denied to some elderly patients because of the presence of preoperative characteristics, such as older age associated with comorbidities that include left ventricular dysfunction (7). Associated coronary artery bypass grafting has also been reported as a risk factor for increased mortality (8).

Alternative attempts at relieving aortic stenosis in non-surgical patients initially involved balloon aortic valvuloplasty (9). Although this approach resulted in a modest hemodynamic improvement, there was a high incidence of restenosis and an unsatisfactory long-term survival rate (10). As a consequence, interest shifted towards transcatheter AVR, for which an initial experimental evaluation was performed and early clinical results published (11). Although this new approach showed promise for the treatment of selected high-risk patients, the current indications are not yet standardized and remain a matter of debate.

The study aim was to review the early and long-term

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results in elderly patients who underwent AVR for severe aortic stenosis, and to identify the risk factors for in-hospital and late mortality.

Clinical material and methods

Patients

From a total of 199 octogenarians affected by aortic valve pathology, 165 consecutive patients underwent AVR to treat severe aortic stenosis, with or without concomitant coronary artery revascularization, at the Heart Surgery Department of the University of Parma, between July 1997 and April 2008. This retrospective study complied with the Declaration of Helsinki, and was approved by the review board of the authors' institution. Each patient provided their informed consent to participate in the study.

Any patient affected by concomitant mitral or tricuspid valve disease, or who had undergone previous surgery for AVR was excluded from the study. An additional eight patients who underwent minimally invasive aortic valve implantation, using the Edwards SapienTM (Edwards Lifesciences Inc., Irvine, CA, USA) prosthesis at the authors' institution were also excluded, in consideration of absolute contraindications to conventional AVR.

The preoperative NYHA functional class was assessed for each patient of the study group. The severity of aortic valve stenosis was defined according to revised ACC/AHA 2006 guidelines (12). All patients underwent a preoperative coronary angiography. The European System for Cardiac Operative Risk Evaluation (EuroSCORE), which is based on demographic, preoperative and operative variables, was calculated for each patient and used as a predictor of perioperative mortality (13).

Study population

Among the 165 patients (85 females, 80 males), the median age was 82 years (range: 80 to 90 years). The majority of patients (76%) had a history of hypertension, 12% had diabetes mellitus, and 18% had peripheral vascular disease. Chronic obstructive pulmonary disease (COPD) and preoperative renal failure were less common. A previous acute myocardial infarction (MI) was reported by 9% of patients. The main demographic and preoperative clinical characteristics are listed in Table I. The majority of patients presented with severe symptoms of dyspnea. Preoperatively, the mean NYHA class was 2.9 ± 0.67, with 80% (n = 132) designated as class III or IV. Twenty patients (12%) had a left ventricular ejection fraction (LVEF) less than 35%, while transthoracic echocardiography revealed a mean aortic valve area of 0.61 ± 0.2 cm^2. The mean EuroSCORE was 9.45 ± 1.52 (range: 7 to 15), with 69 patients (42%) having an additive EuroSCORE ≥10. Details of the preoperative hemodynamic characteristics of all patients are listed in Table I.

Table I: Baseline demographic and cardiovascular characteristics (n = 165).

Characteristic	Value
Age (years)*	82 (80-90)
Gender ratio (M:F)	85:80 (52:48)
Hypertension (n)	125 (76)
Diabetes (n)	19 (12)
COPD (n)	16 (10)
Peripheral arteriopathy (n)	29 (18)
Previous stroke (n)	1 (1)
Previous AMI (n)	15 (9)
Heart failure (n)	12 (7)
Previous CABG (n)	1 (1)
Previous PTCA (n)	4 (2)
NYHA class (n)	
I	8 (5)
II	25 (15)
III	113 (69)
IV	19 (12)
LVEF (%)*	55 (20-80)
LVEF ≤35% (n)	20 (12)
AVA (cm^2)+	0.61 ± 0.2
Left main stem disease (n)	3 (2)
Three-vessel disease (n)	18 (11)
Two-vessel disease (n)	18 (11)
One-vessel disease (n)	38 (23)
Elective surgery (n)	131 (79)
Urgent surgery (n)	28 (17)
Emergency surgery (n)	6 (4)
Additive EuroSCORE (range)*	9.45 ± 1.52 (7-15)
Mean logistic EuroSCORE (%)+	13.6 ± 7.12

*Values are median (range) for continuous variables.
+Values are mean ± SD for continuous variables.
Values in parentheses are percentages.
AMI: Acute myocardial infarction; AVA: Aortic valve area; COPD: Chronic obstructive pulmonary disease; LVEF: Left ventricular ejection fraction.

Perioperative management

All procedures were conducted under cardiopulmonary bypass (CPB) and at a systemic temperature of 34°C. Warm intermittent blood cardioplegia or cold crystalloid cardioplegia were used at the discretion of the operating surgeon. Coronary artery bypass grafting (CABG) was performed whenever coronary angiography showed a stenosis >70% on the major epicardial vessels. The selection of valve prosthesis type was made by the operating surgeon, taking into account the patient's age, anatomic features of the aortic annulus, preoperative presence of atrial fibrillation (AF), and any preference. Postoperatively, all patients

were prescribed aspirin, except those who received warfarin therapy because of refractory postoperative AF or mechanical prosthesis implantation.

Definition of the complications

The postoperative complications were determined as follows. A diagnosis of postoperative low cardiac output syndrome (LCOS) was made if a patient required either intra-aortic balloon counterpulsation and/or dopamine support >5 μg/kg/min for more than 24 h in the intensive care unit (ICU) in order to obtain a systolic blood pressure >90 mmHg and a cardiac index >2.0 l/min/m^2, despite an adequate preload. Perioperative MI was defined as the appearance of a new Q-wave or an elevation of the myocardial fraction of creatine kinase levels and troponin I, in association with persistent ST segment changes. Postoperative renal failure was defined as a serum creatinine level ≥2 mg/dl. Stroke was considered to be any neurologic deficit that persisted longer than 24 h, confirmed by clinical findings or computed tomography scanning, whereas transient ischemic cerebral attack was defined a sudden, focal neurologic deficit lasting for less than 24 h. Respiratory failure was defined as a requirement for mechanical ventilatory support for more than two days in the ICU. In-hospital mortality was considered to be any death occurring within 30 days after surgery.

Follow up

Follow up data were obtained via telephone interviews and clinic visits, and was 100% complete. All survivors were questioned to obtain information with regards to their health status and quality of life, presence or absence of angina pectoris, dyspnea, and postoperative NYHA functional class.

Statistical analysis

Descriptive statistics were used to describe the patient characteristics. Continuous data were reported as mean ± SD, or median and range when appropriate; categorical data were reported as absolute or relative frequencies. In total, 25 variables were selected for the univariate and multivariate analysis, including gender, smoking habit, arterial hypertension, hyperlipidemia, COPD, diabetes mellitus, peripheral vascular disease, cerebrovascular disease, previous MI, previous cardiac surgery, previous percutaneous transluminal coronary angiography (PTCA), heart failure history, Canadian Cardiovascular Society (CCS) grade of angina, NYHA functional class, LVEF, left main stem disease, three-vessel disease, CPB and aortic cross-clamp times, urgency/elective surgery, EuroSCORE ≥10, postoperative LCOS, the use of intra-aortic balloon counterpulsation, perioperative MI, respiratory failure, acute renal failure (ARF), bleeding requiring re-exploration, and stroke.

Table II: Operative details.

Variable	Value
Prosthesis type	
Biological	161 (98)
Mechanical	4 (2)
Median prosthesis size (mm)*	23 (18-29)
Actual size (mm)	
19/21	82 (50)
23	56 (34)
≥24	27 (16)
Associated CABG (n)	66 (40)
Coronary anastomoses/patient*	1.7 (0-3)
LIMA graft (n)	21 (13)
CPB time (min)+	104.82 ± 27.51
Aortic cross-clamp time (min)+	78.04 ± 22.06

*Values are median (range) for continuous variables.
+Values are mean ± SD for continuous variables.
Values in parentheses are percentages.
CABG: Coronary artery bypass grafting;
CPB: Cardiopulmonary bypass; LIMA: Left internal mammary artery.

To estimate the importance of an individual preoperative variable with respect to in-hospital mortality, the relative risk was derived for each variable considered. The determination of relative risk was based on the equation: relative risk = presence of the individual variable (%)/absence of the individual variable (%). A relative risk of 1.0 represents no additional risk for perioperative death in these patients. As a second step, the Cox proportional hazard regression model was used to evaluate sudden death risk as a function of significant preoperative factors, identified using a backward elimination based on the Akaike Information Criteria (AIC). The Kaplan-Meier estimator was used to describe patients' survival over time, and the Mantel-Haenszel log-rank test to determine influential factors. Continuous factors were converted into a 0-1 variable: the threshold defining critical values was 10 for EuroSCORE and 35% for LVEF. For operative factors, the prosthesis size, cross-clamp time and CPB time were obtained by considering 23 mm, 90 min, and 120 min, respectively, as the critical values. One-tailed and two-tailed 95% confidence intervals were evaluated for each test. A p-value <0.05 was considered to be statistically significant. All data analyses were performed using R 2.6.2 software.

Results

Operative characteristics and postoperative course

The large majority of the implanted valves were biological prostheses (98%), and 50% of the valves

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Table III: Relative risk for perioperative death.

Variable	Variable present			Variable absent			Relative risk
	Patients (n)	Deaths (n)	Mortality (%)	Patients (n)	Deaths (n)	Mortality (%)	
Previous PTCA	4	1	25	161	4	2.5	10
EuroSCORE ≥10	40	3	7.5	125	2	1.6	4.7
Female gender	85	4	4.7	80	1	1.2	3.9
NYHA class III/IV	132	5	3.8	33	0	0	3.8
Heart failure history	12	1	8.3	153	4	2.6	3.2
Extracardiac arteriopathy	29	2	6.9	136	3	2.2	3.1
LVEF ≤35%	20	1	5	145	4	2.8	1.8
Smoking history	25	1	4	140	4	2.9	1.4
Urgent/emergent surgery	34	1	2.9	131	4	3	1
Dyslipidemia	47	1	2.1	118	4	3.4	0.6
Previous AMI	15	1	1.4	150	4	2.8	0.5
Hypertension	125	3	2.4	40	2	5	0.5
Previous stroke	1	0	0	164	5	3.1	0
COPD	16	0	0	149	5	3.3	0
Diabetes mellitus	19	0	0	146	5	3.4	0
Chronic renal failure	2	0	0	163	5	3.1	0
Left main stem disease	3	0	0	162	5	3.1	0
Three-vessel disease	18	0	0	147	5	3.4	0
CCS grade III/IV	19	0	0	146	5	3.4	0
Previous CABG	1	0	0	164	5	3	0

AMI: Acute myocardial infarction; AVA: Aortic valve area; CABG: Coronary artery bypass grafting; CCS: Canadian Cardiovascular Society; COPD: Chronic obstructive pulmonary disease; LVEF: Left ventricular ejection fraction; PTCA: Percutaneous transluminal coronary angiography.

implanted had a diameter ≤21 mm. A biological stentless valve was used in 19 patients, and a mechanical prosthesis in only four, because of preoperative chronic AF requiring oral anticoagulation, or because there was intraoperative evidence of a narrowed valvular annulus. Of 74 patients affected by concomitant coronary artery disease, 66 underwent CABG. In eight patients no surgical coronary revascularization was performed due to the atherosclerotic disease being localized in a single, small coronary vessel (a diagonal branch in five patients, and a posterior descending coronary artery in three). Details of the operative procedures employed are listed in Table II.

In-hospital morbidity and mortality

During the postoperative period, seven patients (4%) experienced LCOS following cardiotomy, two of whom (1%) required intra-aortic balloon counterpulsation. No perioperative acute MI was detected. Most patients (84%) required blood transfusions, but surgical revision for postoperative bleeding was required in six cases. Acute renal failure occurred in 24 patients, two of whom required transient dialysis treatment. No strokes or sternal wound infections were detected. Two patients (1%) had transient ischemic cerebral attacks, though without any sequelae. In total, 45 patients (27%) had postoperative AF; 20 of these required oral anticoagulation treatment because of the prolonged duration of the arrhythmia, which was unresponsive to anti-arrhythmic drugs. Twenty-three patients (14%) required prolonged ventilatory support due to difficulties in respiratory weaning, while seven required permanent pacemaker implantation due to postoperative advanced atrioventricular block (n = 5) or very slow ventricular response to AF (n = 2). The mean ICU stay was 2.9 ± 2.2 days (median 2 days; range: 1 to 21 days).

The overall in-hospital (30-day) mortality was 3% (five patients). The causes of death were multiorgan failure secondary to LCOS in two patients, sudden death due to ventricular arrhythmias in two, and cerebrovascular accident in one patient. The relative risks for perioperative death are detailed in Table III. The statistical analysis confirmed that previous PTCA, EuroSCORE ≥10, female gender, NYHA class III/IV, heart failure history, extracardiac arteriopathy, LVEF ≤35%, and a history of smoking were associated with a high relative risk for perioperative death.

The preoperative variables were then analyzed in a multivariate Cox proportional hazard regression model, used to evaluate in-hospital death risk. All preoperative variables that did not satisfy the proportion-

*Table IV: Differences in postoperative morbidity between the first and second halves of the study period.**

Variable	Period 1997-2002	Period 2003-2008	p-value
LCOS	5/54 (9)	2/111 (2)	0.07
IABP	1/54 (2)	1/111 (1)	0.64
Respiratory failure	16/54 (30)	7/111 (6)	0.0009
Postoperative ARF	9/54 (17)	15/111 (14)	0.6

*Data represent number of events/number of patients treated.
Values in parentheses are percentages.
ARF: Acute renal failure; IABP: Intra-aortic balloon pump; LCOS: Low cardiac output syndrome.

Table V: Results of Mantel-Haenszel Log-rank tests of preoperative, operative and postoperative factors.

Variable	Observations (n)	χ^2	p-value
Extracardiac arteriopathy	29	9.3	0.00227
EuroSCORE ≥10	67	7.6	0.00592
LVEF ≤35%	20	4.3	0.03830
LCOS	7	8	0.00458
Postoperative ARF	8	8.6	0.00345

ARF: Acute renal failure; LCOS: Low cardiac output syndrome; LVEF: Left ventricular ejection fraction.

al hypothesis performed with univariate analysis were removed from the model. The initial model was simplified through a backward elimination based on Akaike Information Criteria (AIC = 212.31). An analysis of the significant model (AIC = 205.11) showed that the risk of sudden death was decreased as the LVEF increased (exp. coeff. 0.962, p = 0.014); moreover, the risk was reduced if patients were male (exp. coeff. 0.494, p = 0.11). In contrast, the risk of sudden death was increased in patients suffering from extracardiac arteriopathy (exp. coeff. 3.796, p = 0.003).

An investigation was also conducted into the differences in postoperative morbidity according to time, by comparing adverse events that occurred during the first and second halves of the study period. A significant reduction was found in the incidence of respiratory failure requiring prolonged mechanical ventilation, and there was a tendency towards a lower incidence of postoperative LCOS during the later period. There was no significant difference between the first and second halves of the study period with regards to the rate of acute renal failure (Table IV).

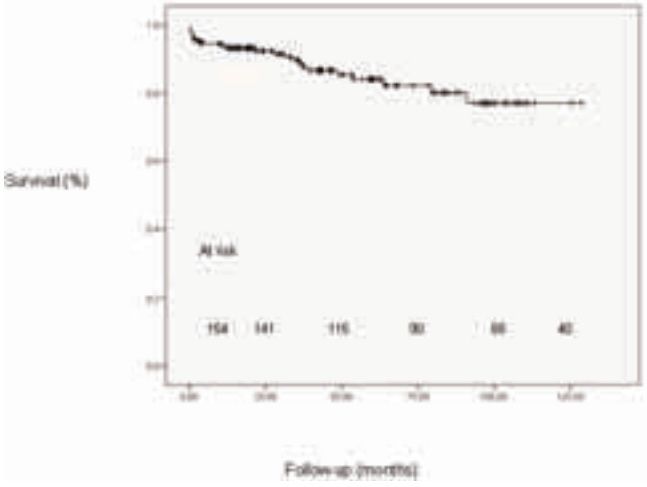

Figure 1: Actuarial overall survival.

Follow up events

At a mean follow up of 4.0 ± 2.76 years (median 3.5 years; range: 0.01 to 10.7 years) there were 18 late deaths (11%), of which 11 (7%) were cardiac-related. Five patients died from refractory heart failure, five died suddenly, and one patient died from MI. Two patients had a fatal stroke, two died from the consequences of chronic renal failure, one patient had a complex intestinal obstruction, one died from cancer, and the last patient died from unknown causes. The mean NYHA class was improved in survivors, from 2.9 ± 0.67 to 1.4 ± 0.57 (p <0.0001). None of the patients experienced thromboembolism, prosthetic valve endocarditis, or reoperations.

The overall actuarial survival was 93% at one year, 89% at three years, and 83% at five years (Fig. 1), whereas actuarial survival in the subpopulation of patients with an additive EuroSCORE ≥10 (mean logistic EuroSCORE 19.3 ± 7.2%) was 85% at one year, 78% at three years, and 70% at five years. Log-rank tests showed that extracardiac arteriopathy (p = 0.002), additive EuroSCORE (p = 0.005), LVEF (p = 0.03), LCOS (p = 0.004) and ARF (p = 0.003) were each significant predictors of late mortality (Table V).

Discussion

The natural history of patients affected by severe aortic stenosis is very poor. Typically, 90% of patients with angina and syncope die within three years of the onset of symptoms, and within two years after the onset of heart failure (14). Nevertheless, it has been reported that AVR is performed in few patients with severe aortic stenosis, because physicians tend to be reluctant to recommend surgery, when considering the patients' advanced age and associated comorbidities (7).

If treated conservatively, patients with severe aortic stenosis have a poor prognosis, with survival rates at

one, five, and 10 years of 62%, 32%, and 18%, respectively (15). Moreover, the prognosis is worse in the presence of advanced age, left ventricular dysfunction, heart failure, and renal failure. Balloon valvuloplasty in high-risk patients results in a modest hemodynamic improvement, with a reported high incidence of restenosis and an unsatisfactory long-term survival rate (9,10). Recently, transcatheter aortic valve replacement techniques have emerged as an exciting alternative treatment in high-risk patients affected by severe aortic stenosis, although no randomized studies comparing the results of these new approaches with those of modern conventional surgery have yet been reported.

Open-heart surgery can be performed safely on elderly patients in good physical and mental health, and will improve their mortality, morbidity, and quality of life (5,6). Indeed, recent studies have shown mortality rates of 5.7-10% after AVR in octogenarians (5,6,16-18). Continued refinements in surgical technique, cardiac anesthesia, myocardial protection and postoperative respiratory fast-track weaning may be determinants leading to the improved outcome for elderly patients. The in-hospital mortality of the present study was 3%, confirming that AVR can be performed with an acceptable risk in patients aged over 80 years.

The prediction of outcome in these high-risk patients, based on preoperative risk factors, is an important issue. Several studies have reported that age, heart failure with advanced NYHA class, urgent procedure, previous PTCA and associated CABG are independent predictive factors of mortality in high-risk patients who underwent AVR (6,16). These results suggest that an early intervention may be warranted in this high-risk population, in order to avoid the worsening of heart function and the onset of symptoms of heart failure. In the present study, the calculated relative risks for perioperative death in patients with a EuroSCORE ≥10, NYHA class IV at the time of surgery, a history of heart failure, or LVEF ≤35% are, respectively, 4.7, 3.8, 3.2, and 1.8, thus confirming that an earlier detection of any initial impairment of hemodynamic compensation might lead to a potentially better outcome.

A multivariate analysis was used to evaluate the 30-day risk of death for patients after surgery. Both, extracardiac arteriopathy and a depressed LVEF proved to be significant risk factors for early mortality. In the present authors' experience, the risk of death also proved to be lower if the patients were male. Severe concomitant coronary artery disease was not associated with an increased relative risk for in-hospital death in octogenarians, a finding confirmed recently by others (17). Improvements in both surgical and perioperative care, based on a wider use of arterial conduits for CABG, intraoperative myocardial protection with antegrade and/or retrograde normothermic blood cardioplegia, and postoperative respiratory fast-track weaning, suggest that an aggressive and complete coronary revascularization should be performed whenever possible, even though this adds time to the surgical procedure. These technical refinements led to an improved outcome in the present patients, as shown by a significant reduction in the incidence of respiratory failure and a tendency towards a lower incidence of postoperative LCOS during the second half of the study period.

In the present study, estimates of survival at one, three, and five years were 93%, 89%, and 83%, respectively. These values compared well with those reported recently by others, and confirmed a good long-term survival despite advanced age and comorbidities (5,6,16-18). A log-rank test showed that extracardiac arteriopathy, additive EuroSCORE, low LVEF, postoperative LCOS and ARF were risk factors predictive of late mortality. The results obtained in the present patients demonstrated not only an extended life expectancy, but also a significant improvement in NYHA class. Finally, when the patients' perception of their quality of life was evaluated, 90% of the survivors were satisfied with their choice.

For AVR, bioprostheses are the safest choice in octogenarians, because they rarely require anticoagulation therapy, with its consequent high incidence of bleeding-related and thrombotic complications. Moreover, the structural deterioration of tissue valves is limited in the elderly population. In the majority of the present patients, no thromboembolic events were reporting following the implantation of tissue valves, thus confirming the results of a previous study with regards to the safe prophylaxis of aspirin after biological AVR (19).

The development of transcatheter AVR may offer a promising treatment option for patients with severe aortic stenosis who are deemed inoperable owing to associated comorbidities that increase their preoperative logistic EuroSCORE. Reported studies based on early experiences with this technique have shown that percutaneous aortic valve implantation is a procedure involving relatively high mortality and morbidity. Typically, the 30-day mortality rates range from 8% to 20%, while the six-month mortality ranges from 10% to 37% (20-24). However, most reports to date have been observational in nature, from selected and unrandomized series, and no data are yet available for the long-term outcome of this new and promising technique. Clearly, refinements in both equipment and technique, in the improved selection criteria for candidates, and of acquired knowledge have all led to reductions in mortality and morbidity after transcatheter AVR, with

an implant success rate of 100% having been achieved in a recent series (23).

Patient selection remains a critical point for the evaluation of these new techniques. The most important consideration is that the logistic EuroSCORE alone is not an accurate standard to select candidates for percutaneous procedures, because it has been shown to overestimate the surgical mortality of these high-risk patients (25). The EuroSCORE does not take into account several clinical conditions that are determinants of early and long-term outcome, such as heart failure, diabetes, mitral regurgitation and renal failure, and technical contraindications to conventional surgery such as the presence of porcelain aorta. Consequently, it remains impossible to compare modern traditional surgery with transcatheter valve techniques on the basis of the logistic EuroSCORE alone, because these high-risk patients may be subject to a significant selection bias that would affect the comparative analysis of the results for each technique. In fact, high-risk patients enrolled in transcatheter valve implantation studies are affected by more comorbidities than are patients undergoing standard surgery. In the present study, when the Cox proportional hazard regression model was performed on the preoperative variables that are determinants of the perioperative risk, it failed to demonstrate any significant impact of the variable additive EuroSCORE on 30-day mortality. Although the log-rank tests showed the additive EuroSCORE to be a significant predictor of late mortality, it is believed that this issue alone does not constitute sufficiently strong evidence to contraindicate surgery in this subgroup of very elderly patients, in whom the primary end point is a satisfactory quality of life at the mid-term follow up.

A complete clinical evaluation of all individual preoperative morbidities is mandatory in order to contraindicate traditional aortic valve surgery. In the present analysis, the subset of octogenarians for whom traditional aortic valve surgery would probably be questionable is characterized by the presence of extracardiac arteriopathy and a depressed LVEF. As these patients represent a subgroup at higher risk for in-hospital mortality, a careful evaluation is warranted in order to indicate standard surgery for them. However, it is remarkable to note that extracardiac and peripheral arteriopathy also constitute major potential contraindications to femoral transcatheter valve implantation.

Which of the elderly patients would be ideal candidates for standard AVR is not easy to determine. An elderly person with some background illness and a good expected quality and length of life would most likely benefit well from such surgery. However, discrepancies between the patient's chronological age and biological age must be dealt with, and the risk-benefit analysis tailored to each patient. Nonetheless, the results of the present study have provided convincing evidence that advanced age alone should not be a deterrent for standard AVR, if it has been determined that these benefits do indeed outweigh the potential risk.

Although the initial results of transcatheter aortic valve implantation are encouraging, it is believed that, in the absence of an accurate predictive model for surgical mortality, these new techniques should be reserved only for patients affected by an absolute contraindication to conventional surgery. Hopefully, however, supportive evidence will be provided in the near future, by the ongoing Placement of AoRTic TraNscathetER Valve-Investigational Device Exemption (PARTNER-IDE) Trial.

Study limitations

The primary limitation was that the study involved only a single center, and was both retrospective and observational in nature. The limited number of events during the in-hospital period did not allow an extensive statistical risk analysis for early mortality, and therefore any conclusions drawn are limited in their application. Notably, the study was limited by the potential selection bias of patients deriving from specific referral patterns to the institution, and the personal selection criteria of the cardiologists and surgeons. Likewise, no information was available concerning the number of elderly patients with severe aortic stenosis who were considered to be at very high risk by their primary care physician to undergo heart surgery during the same time period.

In conclusion, the results of the present study confirm the weight of evidence that conventional AVR, whether isolated or associated with coronary artery disease, can be performed with acceptable in-hospital mortality and satisfactory long-term life expectancy and quality of life in high-risk elderly patients. Whilst transcatheter aortic valve techniques show great promise, and represent an exciting option, their further long-term evaluation must be established by conducting prospective, randomized trials.

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