Current Surgical Treatment of Calcified Aortic Stenosis

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Currently, aortic stenosis is the main indication for cardiac surgery in western countries. With the aim of describing the clinical and surgical characteristics and the short-term outcome of current surgical treatment, we carried out a retrospective study of 238 patients (mean age 71 years, 43% female) who underwent surgery during 2002–2003. Of these, 73% had a EuroSCORE >6. Surgical procedures included isolated aortic valve replacement in 61%, ascending aorta surgery in 14%, coronary artery by-pass grafting in 21%, and mitral surgery in 4%. The in-hospital mortality rate in the 30 days after surgery was 7.1%. Multivariate analysis, adjusted for age, sex, and left ventricular ejection fraction, showed that only concomitant coronary artery by-pass grafting was significantly associated with in-hospital mortality (odds ratio=4; *P*=.019). Factors associated with mortality at 18 months were: previous neurological disease (hazard ratio [HR]=3.25; *P*=.017), prosthesis diameter <21 mm (HR=2.86; *P*=.018), and coronary artery by-pass grafting (HR=2.35; *P*=.05).

Key words: *Aortic valve stenosis. Surgery. Mortality.*

Tratamiento quirúrgico actual de la estenosis aórtica calcificada

La estenosis aórtica es actualmente la indicación más común de cirugía cardiaca en nuestro medio. Para describir el perfil clinicoquirúrgico y los resultados a corto plazo de su tratamiento quirúrgico actual, estudiamos retrospectivamente a 238 pacientes intervenidos durante 2002-2003 (media de edad, 71 años; el 43% eran mujeres). El 73% tenía EuroSCORE > 6. Se realizó: sustitución valvular aórtica aislada al 61% de los pacientes; intervención sobre aorta ascendente al 14%; derivación coronaria al 21% y cirugía mitral al 4%. La mortalidad hospitalaria (antes de 30 días tras la cirugía) fue del 7,1%. En el análisis multivariable ajustado a edad, sexo y fracción de eyección, sólo la derivación coronaria se asoció a una mayor mortalidad hospitalaria (*odds ratio* = 4; p = 0,019). Los factores asociados a la mortalidad a los 18 meses fueron: enfermedad neurológica previa (*hazard ratio* [HR] = 3,25; p = 0,017), diámetro protésico < 21 mm (HR = 2,86; p = 0,018) y derivación coronaria (HR = 2,35; p = 0,05).

Palabras clave: *Estenosis valvular aórtica. Cirugía. Mortalidad.*

INTRODUCTION

Calcified aortic stenosis (CAS) is a prevalent condition that will become increasingly more common in upcoming years along with ageing of the Spanish population. Two percent of the population over age 65 have frank CAS,[1] and the condition is now the most common reason for cardiac surgery in adults.[2] A number of articles have been published on specific aspects of surgery for CAS.[3-5] Nevertheless, studies systematically reviewing surgical treatment for the disease itself are less common[6-8] and include patients who likely had different clinical profiles than those we now encounter.

The purpose of this study is to describe the clinical and surgical characteristics and the short-term outcome of surgery for CAS in a current series.

METHODS

We conducted a retrospective study with 238 consecutive patients who underwent surgery between January 1, 2002 and December 31, 2003 for severe CAS (aortic valve area <1 cm^2 and/or mean valve

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TABLE 1. **Clinical and Surgical Characteristics of 238 Patients Who Underwent Surgery for Severe Aortic Stenosis**

Age, mean (SD), y	71 (8)
Age ≥76 years	83 (35)
Women	102 (43)
Body mass index, mean (SD)	28.1 (4.1)
Diabetes	61 (26)
Hypertension	143 (60)
Peripheral artery disease	20 (8)
Previous stroke	21 (9)
Chronic obstructive pulmonary disease	33 (14)
Creatinine ≥1.5 mg/dL	19 (8)
Creatinine clearance,mean (SD), mL/min/1.73 m^2	71 (21)
Functional class III–IV	122 (52)
Previous hospitalizations for heart failure	57 (24)
Acute coronary syndrome	18 (8)
Coronary disease ≥50%	75 (32)
Sinus rhythm	196 (82)
Left ventricular ejection fraction, mean (SD), %	54 (15)
Left ventricular ejection fraction <39%	36 (15)
Indexed aortic valve area, mean (SD), cm^2/m^2	0.36 (0.07)
Mean gradient, mean (SD), mm Hg	59 (17)
Previous cardiac surgery	4 (1.6)
EuroSCORE, mean (SD)	6.8 (2.5)
EuroSCORE ≥6	173 (73)
Urgent surgery	8 (3.4)
Metal stent	76 (32)
Stentless	15 (6.3)
Supraannular prosthesis	18 (7.5)
Prosthetic diameter, mean (SD), mm	22.6 (2)
Graft >21 mm	100 (42)
Extracorporeal circulation time, mean (SD), min	115 (50)
Clamping time, mean (SD), min	81 (35)
Postoperative intra-aortic balloon counterpulsation	18 (8)
Surgery performed	
Isolated valve replacement	145 (60.9)
Associated cardiac surgery	93 (39.1)
Mitral valve surgery (valve repair, replacement)	10 (4.2)
Elective coronary artery bypass graft	50 (21)
Thoracic aorta surgery (aortic repair, tube-graft, Bentall)	40 (16.8)

Data are expressed as mean (standard deviation) or number of patients (%).

gradient on Doppler study >50 mm Hg), excluding patients with rheumatic heart disease, aortic prosthesis, and severe aortic regurgitation.

The demographic, clinical, echocardiographic, and surgical data were obtained from the medical histories (Table 1). In-hospital mortality included any deaths that occurred within the first 30 days after surgery or before hospital discharge. The EuroSCORE[9] was calculated and the expected mortality was estimated.[10] Mean follow-up was 18 (range, 0.07-44) months, completed in 236 (99%) patients.

The variables are summarized as mean (standard deviation) or percentage. The *P* value less than .05 was considered significant. The Mann-Whitney *U* test and the χ^2 test, as applicable, were used to compare the groups. Variables associated with mortality during hospitalization and during follow-up were determined by multiple logistic regression and Cox regression, respectively, adjusted for age, sex, and ejection fraction. The variables were introduced into the models using a stepwise approach; variables (Table 1) with *P*<.1 were included in the univariate analysis and variables with *P*<.05 were retained in the model.

RESULTS

Among the total, 73% of patients were at high surgical risk (EuroSCORE >6). Surgery in addition to aortic valve replacement was scheduled in 39.1%: coronary artery bypass graft, 43 (18%) patients; thoracic aorta surgery, 33 (13.9%; Bentall–de Bono operation, 13; tube-graft, 5; aortic repair, 15); mitral surgery, 10 (4.2%); and thoracic aorta surgery plus coronary bypass surgery, 7 (2.9%). In 7 patients, unscheduled surgery was performed (aortocoronary bypass, 3 patients; mitral surgery, 2; aortic repair, 2). Procedures to expand the prosthetic area were used in 37 (15.5%) patients: stentless in 15, supraannular prosthesis in 18, and annulus enlargement in 4.

In-hospital mortality was 7.1% (95% confidence interval [CI], 4.2-11.1). Expected mortality was 9.1% (95% CI, 8.1%-10.1%; *P*=.008). The variables associated with mortality are summarized in Table 2. In the multivariate analysis, only elective aortocoronary bypass (*P*=.019) and the need for intra-aortic counterpulsation to wean the patient from extracorporeal circulation (*P*<.001) retained statistical significance.

A total of 23 patients died during follow-up. In the univariate analysis, the variables associated with mortality during follow-up were elective aortocoronary bypass (*P*=.091), history of neurological disease (*P*=.045), and prosthetic diameter <21 mm (*P*=.047). The 3 variables retained significance in the multivariate analysis (Table 3).

TABLE 2. **Predictive Variables of in-Hospital Mortality (Adjusted for Age, Sex, and Left Ventricular Ejection Fraction)**

	Univariate	Multivariate	
	P	*P*	OR (95% CI)
Mean gradient	.05	.47	0.98 (0.95-1.03)
Emergency	.10	.24	3.1 (0.5-21)
Coronary artery bypass graft	.03	.018	4 (1.3-12.8)
Clamping time	.05	.51	0.99 (0.95-1.03)
ECC time	.01	.27	1 (0.99-1.02)
IABC	<.001	<.001	16 (4.9-56)

CI indicates confidence interval; ECC, extracorporeal circulation; IABC, intra-aortic balloon counterpulsation; OR, odds ratio.

TABLE 3. **Multivariate Analysis of Mortality During Follow-Up of 219 Survivors of Aortic Stenosis Surgery (Adjusted for Age, Sex, and Left Ventricular Ejection Fraction)**

	P	HR (95% CI)
History of neurological disease	.017	3.25 (1.24-8.53)
Prosthetic diameter <21, mm	.018	2.86 (1.20-6.82)
Elective coronary artery bypass graft	.054	2.35 (0.98-5.60)
Age	.37	0.99 (0.96-1.08)
Sex	.35	0.62 (0.23-1.7)
Left ventricular ejection fraction	.52	0.99 (0.96-1.02)

CI indicates confidence interval; HR, hazard ratio.

DISCUSSION

Calcified aortic stenosis is currently the main indication for cardiac surgery in our setting. Similar to other recent surgical series,[7] our study showed that these patients present a complex clinical profile: 40% required other surgery in addition to aortic valve replacement and 75% were at high surgical risk (EuroSCORE >6).

In keeping with other reports,[11-13] the in-hospital mortality of our series is not negligible. The only preoperative variable associated with in-hospital mortality was the need for coronary revascularization. This is a common finding in all large series and registries[11-13] and is related to the complicated surgical technique and the more adverse clinical profile of patients with a coronary condition. The fact that coronary revascularization continues to be associated with prognosis among patients who survive the surgical procedure in other series[14] as well as our own confirms the importance of this clinical profile. Some authors have proposed a hybrid therapy in which coronary angioplasty is performed before valvular surgery.[15] This would be more justifiable in patients with other predictors of short postoperative survival.

One subgroup consists of patients who require surgery for dilation of the ascending aorta. In our series, the surgery-related mortality in these patients was similar to that seen in isolated valve replacement, probably because the latter included younger patients with bicuspid aortic valve and because the procedures were performed by only a few surgeons.

We consider an analysis of the short-term outcomes to be important because it provides additional information that may be extremely relevant for decision-making. Surgical decisions are usually made on the basis of in-hospital mortality data; we feel that our findings should also be included in the decision process, particularly in elderly patients who have few symptoms. In our study, the short-term prognosis was determined by a history of neurological disease or implantation of a small prosthesis. This last point is consistent with the findings of recent studies on prosthesis-patient mismatch[5] and justifies the efforts to obtain larger effective prosthetic areas and detect small valve annuli prior to surgery.

The main limitations of the study are its retrospective design, the relatively small sample size, and the fact that the series is from only one site. In addition, the use of prosthetic diameter is merely a surrogate for assessment of prosthetic area and potential prosthesis-patient mismatch.

We concluded that the patients in our setting who currently undergo surgery for severe CAS present high surgical risk. Cardiovascular surgery associated with aortic valve replacement is required by 40% of patients. Coronary revascularization is often needed (20%) and has a strong impact on the short-term outcomes. This should be assessed to establish the risk/benefit ratio of surgery, particularly in patients who are older or have few symptoms.

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