



ORIGINAL ARTICLE

Aortic valve replacement surgery improves the quality of life of octogenarians with severe aortic stenosis[☆]



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KEYWORDS

Aortic stenosis;
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Abstract

Introduction: Aortic stenosis (AS) is the most common valvular disease in the elderly, affecting around 8.1% by the age of 85, with a negative impact on quality of life.

Objective: To determine the impact of surgical aortic valve replacement (AVR) on octogenarian quality of life in octogenarians.

Methods: In a single-center retrospective study of octogenarians undergoing isolated SAVR for symptomatic AS between 2011 and 2015, quality of life was assessed using the Medical Outcomes Study Short Form (SF-36) at baseline and at three, six and 12 months after surgery. Scores for the eight domains and two components of the SF-36 were compared at baseline and in the postoperative period by one-way analysis of variance.

Results: Over a five-year period, 163 octogenarians underwent SAVR, of whom 3.1% died in the hospital. Deceased patients and those who did not complete the SF-36 were excluded.

A total of 81 patients were included, mean age 83 ± 2 years, 63% female, 60.5% in NYHA class II or higher and 19.7% with left ventricular systolic dysfunction. The mean logistic EuroSCORE was 10.7 ± 5.1 %. In the hospital, 1.2% suffered stroke, 1.2% received a permanent implantable pacemaker and 23.5% presented atrial fibrillation. In the assessment of quality of life, improvement was seen in all SF-36 domains ($p < 0.002$) and in the physical component ($p < 0.001$) at three, six and 12 months compared to baseline. The mental component also showed improvement, which was significant at six months ($p = 0.011$).

Conclusion: SAVR improved the physical and mental health status of octogenarians with severe AS. This improvement was evident at three months and consistent at six and 12 months.

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PALAVRAS-CHAVE

Estenose aórtica;
 Cirurgia valvular
 aórtica;
 Octogenário;
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 SF-36

A cirurgia de substituição valvular aórtica melhora a qualidade de vida dos octogenários com estenose aórtica severa

Resumo

Introdução: A estenose aórtica (EA) é a doença valvular mais prevalente dos idosos e afeta 8.1% dos doentes com 85 anos, condicionando a qualidade de vida.

Objetivo: Determinar o impacto da cirurgia de substituição valvular aórtica (SVA) na qualidade de vida dos octogenários.

Métodos: Estudo unicêntrico e retrospectivo com octogenários submetidos a cirurgia de SVA por EA grave isolada entre 2011 e 2015. A qualidade de vida foi avaliada pelo questionário *Short Form* (SF)-36 no pré-operatório (PREOP), aos 3, 6 e 12 meses após cirurgia. As oito dimensões e as duas componentes do SF-36 foram comparadas no PREOP e no pós-operatório com a comparação múltipla *anova one-way*.

Resultados: No período de cinco anos, 163 octogenários foram submetidos a cirurgia de SVA, 3,1% faleceram no internamento. Excluíram-se doentes falecidos e sem SF-36 preenchido. Foram incluídos 81 doentes com 83±2 anos, 63% mulheres, 60,5% em classe NYHA>2 e 19,7% com disfunção sistólica ventricular esquerda. O EuroSCORE logístico foi de 10,7±5,1%. No internamento, 1,2% tiveram acidente vascular cerebral, 1,2% implantaram *pacemaker* permanente e 23,5% apresentaram fibrilhação auricular. Na avaliação da qualidade de vida e na comparação com o PREOP: todas as dimensões do SF-36 ($p<0,002$) e a componente física ($p<0,001$) apresentaram melhoria aos 3, 6 e 12 meses. A componente mental apresentou melhoria, sendo esta significativa aos seis meses ($p=0,011$).

Conclusão: A cirurgia de SVA melhorou o estado de saúde físico e mental dos octogenários com EA, sendo essa melhoria evidente aos três meses e consistente aos 6 e 12 meses.

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Introduction

In recent decades, mean life expectancy has increased, leading to an increase in the number of elderly people with valvular disease.¹ Aortic stenosis (AS) is the most common valvular disease in this patient group, affecting 8.1% by age 85.² This is therefore an important patient group, but in a significant portion (30-40%)^{3,4} surgical aortic valve replacement (SAVR) is still denied, leading to a dismal prognosis, with one-year mortality ranging between 30% and 50%.^{5,6} SAVR is thus the recommended treatment for symptomatic severe AS.⁷⁻⁹

Although octogenarians have more comorbidities and therefore higher surgical risk than younger patients, the evidence demonstrates that in some of these patients, the surgical risk may be acceptable to perform SAVR, with mortality reported to be between 1.9% and 9%.¹⁰⁻¹⁸

On the other hand, it should be pointed out that the main purpose of surgery in this age group is to improve quality of life rather than survival, given that the increase in longevity is marginal.^{19,20} Quality of life can be assessed using questionnaires such as the Medical Outcomes Study Questionnaire Short Form 36 (SF-36), a validated, credible and widely-used general health survey.^{18,21-24} However, there have been few studies on the impact of SAVR on octogenarians' quality of life.^{18,25-27}

Objective

To determine the impact of SAVR for severe AS on the quality of life of octogenarians.

Methods**Patient selection**

This retrospective descriptive correlational study was performed in the cardiothoracic surgery department of Hospital Santa Marta, Lisbon.

Between January 2011 and December 2015, 163 consecutive patients aged 80 years or over with isolated severe AS underwent SAVR. Severe AS was defined in accordance with the European Society of Cardiology (ESC) guidelines on valvular disease.⁷

The criteria for acceptance of patients for surgery were technical feasibility and absence of cognitive dysfunction and frailty. The mean logistic EuroSCORE of the sample was 10.7%.

Quality of life was assessed using the SF-36 questionnaire, version 2²¹ at four time points: at baseline and at three, six and 12 months after surgery.

Patients who did not complete the SF-36 questionnaire at all of the above time points (n=58), and those who died

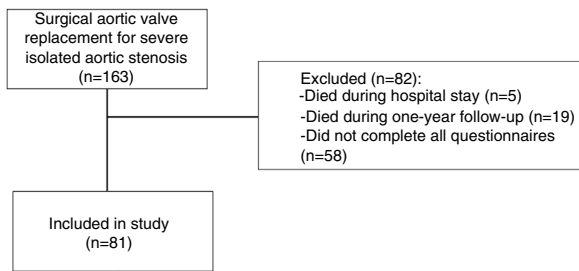


Figure 1 Flowchart of patient selection process.

during hospital stay (n=5) or during follow-up (n=19), were excluded. After application of the exclusion criteria, 81 patients who underwent SAVR for isolated severe AS were included (Figure 1).

Definition of variables

Data were collected on demographics (age and gender), relevant history (heart failure, chronic obstructive pulmonary disease, chronic kidney disease [CKD]) and cardiovascular risk factors (hypertension, diabetes, dyslipidemia, obesity and smoking). Preoperative clinical data were assessed, including New York Heart Association (NYHA) functional class²⁸ and Canadian Cardiovascular Society (CCS) angina class.²⁹ Preoperative left ventricular ejection fraction (LVEF) was assessed by transthoracic echocardiography and the logistic EuroSCORE was calculated.³⁰

Creatinine clearance was estimated using the Cockcroft-Gault formula.³¹ CKD was defined as creatinine clearance <60 ml/min/1.73 m² and obesity as body mass index \geq 30 kg/m².

In-hospital mortality was defined as death occurring during hospitalization for surgery.

SF-36 Health Survey

The SF-36 Health Survey is a widely used questionnaire developed under the aegis of the Medical Outcomes Study.²¹ The Portuguese version has been validated by Ferreira et al. for the Portuguese population.³²

The questionnaire contains 36 health-related multiple-choice questions grouped into eight domains (physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional and mental health). The eight domains are scored from 0 (worst health state) to 100 (best health state) and are summarized in two scales that measure the physical and mental components.²¹

Statistical analysis

A descriptive analysis was carried out to characterize the population profile. Continuous variables are presented as mean and standard deviation and categorical variables are presented as percentage. In the quality of life assessment, the eight domains and two components of the SF-36 did not follow a normal distribution and so a non-parametric test was used. The domains and components were compared at four time points (preoperatively and at three, six and 12

Table 1 Demographic characteristics of the study population (n=81).

<i>Demographic data</i>	
Age, years	83 \pm 2
Female, n (%)	51 (63)
<i>Cardiovascular risk factors, n (%)</i>	
Hypertension	72 (88.9)
Dyslipidemia	60 (74.1)
Obesity	21 (25.9)
Diabetes	20 (24.7)
Smoking (current or past)	8 (9.8)
<i>Personal history, n (%)</i>	
Heart failure	46 (56.8)
<i>CKD</i>	
Stage 1/2	41 (50.6)
Stage 3	33 (40.7)
Stage 4	6 (7.4)
Stage 5	1 (1.2)
COPD	6 (7.4)
<i>Preoperative clinical data</i>	
NYHA functional class, n (%)	32 (39.5)
II	47 (58.0)
III	2 (2.5)
IV	17 (21.0)
CCS class, n (%)	48 (59.3)
0	14 (17.3)
1	2 (2.5)
2	10.7 \pm 5.1
3	
Logistic EuroSCORE (%)	
<i>LVEF, n (%)</i>	
\geq 50%	65 (80.2)
30-49%	15 (18.5)
<30%	1 (1.2)

CCS: Canadian Cardiovascular Society angina classification; CKD: chronic kidney disease; COPD: chronic obstructive pulmonary disease; LVEF: left ventricular ejection fraction; NYHA: New York Heart Association.

Data presented as mean \pm standard deviation or n (%).

months postoperatively) using one-way analysis of variance for multiple comparisons. The level of significance was set at a p value of <0.05. The statistical analysis was performed using IBM SPSS Statistics version 20.0.

Results

Demographic characteristics

The demographic characteristics of the study population are presented in Table 1.

Table 2 In-hospital complications in the study population (n=81).

<i>Neurological complications, n (%)</i>	
Stroke	1 (1.2)
Delirium, mental confusion or TIA	9 (11.1)
<i>Cardiological complications, n (%)</i>	
AF	19 (23.5)
Temporary pacemaker	6 (7.4)
Permanent pacemaker	1 (1.2)
MI	0 (0)
<i>Respiratory complications, n (%)</i>	
Atelectasis, pleural effusion or pneumothorax	5 (6.2)
Pneumonia	0 (0)
<i>Renal complications, n (%)</i>	
Postoperative hemodialysis	1 (1.2)
Hospital stay (days)	9±3

AF: atrial fibrillation; MI: acute myocardial infarction; TIA: transient ischemic attack.

Data presented as mean ± standard deviation or n (%).

The mean age of the 81 patients was 83±2 years and 63% were female. Regarding cardiovascular risk factors, 89% of the patients were hypertensive, 74% had dyslipidemia and 25% were diabetic. CKD stage 3 or higher was found in 49% of the patients. In the preoperative functional assessment, 61% of the patients were in NYHA class >2 and 20% in CCS class ≥2, while 20% had LVEF <50%. Mean logistic EuroSCORE was 10.7±5.1%.

Operative variables

All patients underwent conventional sternotomy. The mean time of extracorporeal circulation was 92 min. Antegrade/retrograde cardioplegia was used in most cases (74 patients), followed by retrograde (six patients) and antegrade (one).

A biological valve was implanted in 80 patients. The median annulus diameter was 21 mm.

In-hospital complications

Mean hospital stay was 9±3 days.

With regard to neurological complications, 1.2% of the patients suffered stroke and 11.1% presented delirium, mental confusion or transient ischemic attack. In terms of cardiological complications, 23.5% of the patients presented atrial fibrillation and 1.2% had a permanent pacemaker implanted.

In-hospital complications in the study population are presented in [Table 2](#).

Complications in follow-up

During one-year follow-up, two patients (2.5%) suffered stroke, one (1.2%) had acute respiratory distress syndrome and two (2.5%) were hospitalized for unknown causes.

Assessment of quality of life using the SF-36 questionnaire

The results for the eight domains of the SF-36 questionnaire are presented in [Table 3](#). All the domains showed statistically significant improvement ($p < 0.02$) at three, six and 12 months compared with the preoperative period. Comparison between the three, six and 12-month postoperative periods showed no statistically significant differences.

The results for the physical and mental components of the SF-36 questionnaire are shown in [Table 4](#). The mental component presented a statistically significant improvement at six months compared with the preoperative period ($p = 0.011$). At three ($p = 0.34$) and 12 ($p = 0.076$) months there was improvement, although this was not statistically significant.

The physical component showed statistically significant improvements ($p < 0.001$) at three, six and 12 months compared with the preoperative period. However, no statistically significant differences were found when the three-, six- and 12-month postoperative periods were compared with each other.

Discussion

This study aimed to assess the impact of SAVR during the first postoperative year on the quality of life of octogenarians with isolated severe AS. Surgical mortality and morbidity rates were also analyzed.

In this single-center series, SAVR improved quality of life in both physical and mental terms compared with the preoperative period, and morbidity and mortality rates were acceptable.

In-hospital mortality was 3.1%, comparable to other published series, which report rates between 1.9% and 9%.^{11–18}

The mortality associated with SAVR in this age group has fallen in recent decades, from 7.5% in 1982–1999 to 5.8% in 2000–2006.^{33,34} These results are due to improvements in surgical techniques, anesthesia, cardiopulmonary bypass, postoperative care and organ protection.^{12,35,36}

As regards clinical complications, in our study 1.2% of patients suffered stroke, 1.2% had a permanent pacemaker implanted and 23.5% presented atrial fibrillation during hospitalization. The rates presented are similar to those in other series of octogenarians with severe AS, demonstrating that SAVR is feasible in this patient group.^{12,14,15}

In our study, we used the SF-36 health survey²¹ to assess the quality of life at four time points: in the preoperative stage and at three, six and 12 months after surgery. A comparison with the preoperative period is essential in order to assess changes in quality of life. By contrast, some series assessed quality of life only in the postoperative period, which consequently affected their analysis and interpretation.^{23,24,37} To our knowledge, there are two studies in the literature that assessed quality of life with the

Table 3 Comparison of the score for the eight domains of the SF-36 at baseline compared with 3, 6 and 12 months after surgery.

	Baseline	3 months	p	6 months	p	12 months	p
Physical functioning	33.3	59.6	<0.001	59.7	<0.001	62	<0.001
Role physical	31.7	60.6	<0.001	60.1	<0.001	61.7	<0.001
Pain	56.2	81.2	<0.001	80.8	<0.001	80.7	<0.001
General health	47.6	58	<0.001	54.2	0.016	56	0.001
Vitality	35.3	57.6	<0.001	57.9	<0.001	60.4	<0.001
Social functioning	67.4	80	<0.001	82.6	<0.001	82.4	<0.001
Role emotional	59.2	76.6	<0.001	74	<0.001	73.9	0.002
Mental health	56.5	64.6	0.001	66.1	<0.001	63.4	0.003

Table 4 Comparison of scores for the physical and mental components of the SF-36 at baseline compared with 3, 6 and 12 months after surgery.

	Baseline	3 months	p	6 months	p	12 months	p
Physical component	52.5	55.3	<0.001	55.0	<0.001	55.3	<0.001
Mental component	56.1	56.7	0.342	56.9	0.011	56.7	0.076

SF-36 in the pre- and postoperative periods in octogenarians with severe AS.^{18,26} The reason we performed this assessment at three time points in the postoperative stage was to understand changes in quality of life over the first year. Given that in the first weeks after the intervention patients are in a worse clinical state due to the trauma of surgery, we decided that the first postoperative assessment would be at three months.

With regard to analysis of the eight SF-36 domains, our study revealed a statistically significant improvement in all domains ($p < 0.02$) at the three postoperative time points compared to the preoperative period. It should be pointed out that the improvement in quality of life occurred early on, at three months. For example, between baseline and three months, there were increases of 28 points in the role physical domain ($p < 0.001$), 26 points in the physical functioning domain ($p < 0.001$), 20 points in the pain domain ($p < 0.001$) and 17 points in the role emotional domain ($p < 0.001$). Considering the morbidity associated with cardiothoracic surgery, one would expect this positive effect to have taken longer than three months to reach statistical significance, but this was not the case.

In a study of 20 octogenarians, Lam et al. found that improvement was observed at six months postoperatively in five of the eight SF-36 domains: bodily pain, general health, vitality, social functioning and mental health.²⁶ Limitations of Lam et al.'s study included the small number of patients, analysis at only one postoperative time point, and failure to consider the components of the SF-36 individually.²⁶

With regard to analysis of the SF-36 components, in our series the physical component presented significant improvement at all postoperative time points compared with baseline ($p < 0.001$). These findings show that in spite of the patients' advanced age (mean 83 ± 2 years), surgery improved their physical capacity, and this was evident early on, at three months postoperatively. In 163 octogenarians who underwent SAVR for severe AS (isolated surgery in 88) assessed using the SF-36 at baseline, one month and 12 months, Klomp et al. identified improvement in the physical component at 12 months ($p < 0.001$).¹⁸

As for assessment of the mental component, our study revealed improvement in the physical component at the three postoperative time points compared with baseline, which was significant at six months ($p = 0.011$). In Klomp et al.'s series the mental component worsened at 30 days ($p = 0.002$) and improved at 12 months compared with the preoperative period, although without statistical significance ($p = 0.1$).¹⁸

Other studies have also demonstrated postoperative improvement in the quality of life of octogenarians undergoing SAVR, through the use of other health questionnaires such as the SF-12,³⁸ Kansas City Cardiomyopathy

Questionnaire³⁹ and the Karnofsky Performance Score.^{25,27} Reynolds et al.²⁵ used the SF-12 questionnaire in 300 patients undergoing SAVR and observed statistically significant improvement in the mental and physical components at six and 12 months ($p < 0.05$) compared with the preoperative period.

Our study assessed the quality of life of octogenarians with isolated severe AS who underwent SAVR. Assessment preoperatively and at three time points in the first year of follow-up (three, six and 12 months) of the eight domains and two components of the SF-36 enabled a detailed analysis of the patients' quality of life.

In patients whose age is already that of mean life expectancy and for whom increased longevity is thus not the main purpose of SAVR, quality of life is crucial and should therefore be systematically assessed. Given this priority, prospective studies are required with larger study populations to evaluate the impact of surgical intervention on quality of life.

Although our study does not compare therapeutic alternatives for this patient group, the ESC guidelines recommend that in patients with severe AS and intermediate or high surgical risk (Society of Thoracic Surgeons score or EuroSCORE II $\geq 4\%$ or logistic EuroSCORE $\geq 10\%$), the choice between SAVR and transcatheter aortic valve implantation (TAVI) should be made by the heart team, with preference for TAVI in elderly patients by transfemoral access.⁴⁰ It is important to point out that the complications associated with TAVI should not be underestimated, as shown by rates of pacemaker implantation (8.5%⁴¹-25.9%),⁴² paravalvular leak (5.3%),⁴² stroke (3.8%)⁴³ and atrial fibrillation (8.6%⁴³-12.9%).⁴² In our study, patients presented lower rates of stroke (1.2%) and of pacemaker implantation (1.2%) and a higher rate of atrial fibrillation (23.5%).

According to the ESC guidelines, many of our patients would be indicated for TAVI, but given our results, with a low rate of complications and improvement in quality of life, surgery should be considered as the first option. The decision-making process should also take into account that SAVR is currently a less costly procedure than TAVI. However, the decision between the two strategies should be individualized and taken collectively by the heart team.

Limitations

This was a retrospective, observational, single-center study and as such is subject to inherent bias. Other limitations are the small population sample, selection of the patients by the surgical center, and exclusion of a significant proportion of patients who did not complete the SF-36 questionnaire at all four time points.

Conclusion

In octogenarians with severe AS, SAVR may be performed with acceptable mortality and morbidity rates.

In our study, SAVR improved octogenarians' quality of life in physical and mental terms. This was already evident at three months after surgery and consistent at six and 12 months compared with the preoperative period.

In this age group, surgery should be considered given the evidence of clinical improvement in these patients.

Conflicts of interest

The authors have no conflicts of interest to declare.

References

- Huber CH, Goeber V, Berdat P, et al. Benefits of cardiac surgery in octogenarians – a postoperative quality of life assessment. *Eur J Cardiothorac Surg.* 2007;31:1099–105.
- Lindroos M, Kupari M, Heikkilä J, et al. Prevalence of aortic valve abnormalities in the elderly: an echocardiographic study of a random population sample. *J Am Coll Cardiol.* 1993;21:1220.
- lung B, Cachier A, Baron G, et al. Decision-making in elderly patients with severe aortic stenosis: why are so many denied surgery? *Eur Heart J.* 2005;26:2714–20.
- Pierard S, Seldrum S, de Meester C, et al. Incidence, determinants and prognostic impact of operative refusal or denial in octogenarians with severe aortic stenosis. *Ann Thorac Surg.* 2011;91:1107–12.
- Ben-Dor I, Pichard AD, Gonzalez MA, et al. Correlates and causes of death in patients with severe symptomatic aortic stenosis who are not eligible to participate in a clinical trial of transcatheter aortic valve implantation. *Circulation.* 2010;122:S37–42.
- Leon MB, Smith CR, Mack M, et al. Transcatheter aortic-valve implantation for aortic stenosis in patients who cannot undergo surgery. *N Engl J Med.* 2010;363:1597–607.
- Vahanian A, Alfieri O, Andreotti F, et al. Guidelines on the management of valvular heart disease (version 2012): the Joint Task Force on the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS). *Eur J Cardiothorac Surg.* 2012;42:S1–44.
- Nishimura RA, Otto CM, Bonow RO, et al. 2014 AHA/ACC Guideline for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation.* 2014;129:2440–92.
- Nishimura RA, Otto CM, Bonow RO, et al. 2017 AHA/ACC Focused Update of the 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Am Coll Cardiol.* 2017;S0735–1097:36019–29.
- lung B1, Vahanian A. Epidemiology of valvular heart disease in the adult. *Nat Rev Cardiol.* 2011;8:162–72.
- Kolh P, Kerzmann A, Honore C, et al. Aortic valve surgery in octogenarians: predictive factors for operative and long-term results. *Eur J Cardiothorac Surg.* 2007;31:600–6.
- Dell'Amore A, Aquino TM, Pagliaro M, et al. Aortic valve replacement with and without combined coronary bypass grafts in very elderly patients: early and long-term results. *Eur J Cardiothorac Surg.* 2012;41:491–8.
- Chiappini B, Camurri N, Loforte A, et al. Outcome after aortic valve replacement in octogenarians. *Ann Thorac Surg.* 2004;78:85–9.
- Saxena A, Poh CL, Dinh DT, et al. Early and late outcomes after isolated aortic valve replacement in octogenarians: an Australasian Society of Cardiac and Thoracic Surgeons Cardiac Surgery Database Study. *Eur J Cardiothorac Surg.* 2012;41:63–8.
- Di Eusanio M, Fortuna D, Cristell D, et al. Contemporary outcomes of conventional aortic valve replacement in 638 octogenarians: insights from an Italian Regional Cardiac Surgery Registry (RERIC). *Eur J Cardiothorac Surg.* 2012;41:1247–52.
- Molstad P, Veel T, Rynning S. Long-term survival after aortic valve replacement in octogenarians and high-risk subgroups. *Eur J Cardiothorac Surg.* 2012;42:934–40.
- Calvo D, Lozano I, Llosa JC, et al. Aortic valve replacement in octogenarians with severe aortic stenosis. Experience in a series of consecutive patients at a single center. *Rev Esp Cardiol.* 2007;60:720–6.
- Klomp WW, Nierich AP, Peelen LM, et al. Survival and quality of life after surgical aortic valve replacement in octogenarians. *J Cardiothorac Surg.* 2016;11:38.
- Maillet JM, Somme D, Hennel E, et al. Frailty after aortic valve replacement (AVR) in octogenarians. *Arch Gerontol Geriatr.* 2009;48:391–6.
- Bonow RO, Carabello BA, Chatterjee K, et al. 2008 focused update incorporated into the ACC/AHA 2006 guidelines for the management of patients with valvular heart disease: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to revise the 1998 guidelines for the management of patients with valvular heart disease). Endorsed by the Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. *J Am Coll Cardiol.* 2008;52:e1–142.
- Ware JE Jr, Gandek B. Overview of the SF-36 Health Survey and the International Quality of Life Assessment (IQOLA) Project. *J Clin Epidemiol.* 1998;51:903–12.
- Kidher E, Harling L, Nihoyannopoulos P, et al. High aortic pulse wave velocity is associated with poor quality of life in surgical aortic valve stenosis patients. *Interact Cardiovasc Thorac Surg.* 2014;19:189–97.
- Vicchio M, Della Corte A, De Santo LS, et al. Tissue versus mechanical prostheses: quality of life in octogenarians. *Ann Thorac Surg.* 2008;85:1290–5.
- Sundt TM, Bailey MS, Moon MR, et al. Quality of life after aortic valve replacement at the age of >80 years. *Circulation.* 2000;102 19 Suppl. 3. III70–4.
- Reynolds MR, Magnuson EA, Wang K, et al. Health-related quality of life after transcatheter or surgical aortic valve replacement in high-risk patients with severe aortic stenosis: results from the PARTNER (Placement of AoRTicTraNscathetER Valve) Trial (Cohort A). *J Am Coll Cardiol.* 2012;60:548–58.
- Lam BK, Hendry PJ. Patients over 80 years: quality of life after aortic valve replacement. *Age Ageing.* 2004;33:307–9.
- Khan JH, McElhinney DB, Hall TS, et al. Cardiac valve surgery in octogenarians: improving quality of life and functional status. *Arch Surg.* 1998;133:887–93.
- The Criteria Committee of the New York Heart Association. Nomenclature and criteria for diagnosis of diseases of the heart and great vessels. 6th ed. Boston, MA: Little, Brown & Co.; 1994.
- Campeau L. The Canadian Cardiovascular Society grading of angina pectoris revisited 30 years later. *Can J Cardiol.* 2002;18:371–9.
- Nashef SA, Roques F, Michel P, et al. European System for Cardiac Operative Risk Evaluation (EuroSCORE). *Eur J Cardiothorac Surg.* 1999;16:9–13.

31. Cockcroft DW, Gault MH. Prediction of creatinine clearance from serum creatinine. *Nephron*. 1976;16:31–41.
32. Ferreira P, Lara F, Luís P. Physical and mental summary measures of health state for the Portuguese population. *Rev Port Saúde Pública*. 2012;30:163–71.
33. Pulignano G, Gulizia M, Baldasseroni S, et al. ANMCO/SIC/SICIGISE/SICCH Executive Summary of Consensus Document on Risk Stratification in elderly patients with aortic stenosis before surgery or transcatheter aortic valve replacement. *Eur Heart J Suppl*. 2017;19 Suppl. D:D354–69.
34. Vasques F, Messori A, Lucenteforte E, et al. Immediate and late outcome of patients aged 80 years and older undergoing isolated aortic valve replacement: a systematic review and metaanalysis of 48 studies. *Am Heart J*. 2012;163:477–85.
35. Brown JM, O'Brien SM, Wu C, et al. Isolated aortic valve replacement in North America comprising 108,687 patients in 10 years: changes in risks, valve types, and outcomes in the Society of Thoracic Surgeons National Database. *J Thorac Cardiovasc Surg*. 2009;137:82–90.
36. Melby SJ, Zierer A, Kaiser SP, et al. Aortic valve replacement in octogenarians: risk factors for early and late mortality. *Ann Thorac Surg*. 2007;83:1651–7.
37. Sjogren J, Thulin LI. Quality of life in the very elderly after cardiac surgery: a comparison of SF-36 between long-term survivors and an age-matched population. *Gerontology*. 2004;50:407–10.
38. Ware J, Kosinski M, Keller SD. A 12-item short-form health survey: construction of scales and preliminary tests of reliability and validity. *Med Care*. 1996;34:220–33.
39. Green CP, Porter CB, Bresnahan DR, et al. Development and evaluation of the Kansas City Cardiomyopathy Questionnaire: a new health status measure for heart failure. *J Am Coll Cardiol*. 2000;35:1245–55.
40. Baumgartner H, Falk V, Bax J, et al. 2017 ESC/EACTS Guidelines for the management of valvular heart disease. The Task Force for the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS). *Eur Heart J*. 2017;38:2739–91.
41. Leon MB, Smith CR, Mack MJ, et al. Transcatheter or surgical aortic-valve replacement in intermediate-risk patients. *N Engl J Med*. 2016;374:1609–20.
42. Reardon MJ, Van Mieghem NM, Popma JJ, et al. Surgical or transcatheter aortic-valve replacement in intermediate-risk patients. *N Engl J Med*. 2017;376:1321–31.
43. Smith CR, Leon MB, Mack MJ, et al. Transcatheter versus surgical aortic-valve replacement in high-risk patients. *N Engl J Med*. 2011;364:2187–98.