Original Research

Concomitant aortic regurgitation is a predictor of outcome after surgical aortic valve replacement in patients with severe aortic stenosis

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Abstract

Background: Concomitant aortic regurgitation (AR) might worsen the prognosis of severe aortic stenosis (AS). But the prognostic value of concomitant AR in patients operated for severe AS is not addressed.

Objective: The aim of this study was to assess the impact and association of presence and severity of concomitant AR in patients operated for severe AS on long-term left ventricular (LV) function, functional capacity, and mortality.

Materials and Methods: Study group consisted of 200 patients operated due to severe AS retrospectively. The patients were divided into AS group (100 patients with AS without AR or with mild AR) and AS+AR group (100 patients with AS and moderate, severe or very severe AR). Follow-up included a clinical examination and echocardiography 5–30 months after AVR.

Result: Patients in AS group had improved symptoms than AS+AR group. The patients with postoperative follow-up in AS group had lower LV volume indices than patients in AS+AR which was statistically significant(AS group; LVEDVi - 67±9.1, LVESVi - 22±7.2 compare to AS+AR group; LVEDVi - 84±21.3, LVESVi - 34±11, *p*-value< 0.05). Postoperative mean LVEF was 61±11 and 58±12 in AS and AS+AR group, respectively.

Conclusion: Our study indicates that the preoperative presence and severity of concomitant AR has an impact on the outcome after aortic valve replacement for the patients having severe aortic stenosis symptoms on the basis of symptoms,LV remodeling, systolic and diastolic function.

KEY WORDS: Aortic Stenosis (AS), Aortic Regurgitation(AR), Aortic Valve Replacement (AVR)

Introduction

Aortic valve disease is an ongoing research focus due to its high prevalence and common difficulties in decision-making for surgical intervention.In day to day clinical practice, a significant number of the patients with aortic stenosis (AS) have concomitant aortic regurgitation (AR) of different severity. Aortic valve replacement (AVR) is recommended as a standard surgical procedure for most patients with symptomatic aortic valve disease.[1] Currently, AVR accounts for 13% of all adult cardiac surgery[2] and remains the most common procedure among all cardiac valve operations in the United States.[3] After surgery, patients with severe aortic valve disease show dramatic improvement in their cardiovascular symptoms and survival.[4,5] Factors that may influence outcome following AVR include age, preoperative NYHA class, left ventricular (LV) hypertrophy and ejection fraction (EF), heart rhythm disturbances, preoperative pressure gradient over aortic valve, and the presence of coronary artery disease.[6,7] But the impact of concomitant AR in patients operated for

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severe AS is not addressed. Some earlier studies identified the preoperative presence of significant AR as arisk factor for the development of postoperative LV dysfunction.[8]

Therefore, the aim of the present study was to retrospectively examine the prognosis of presence and severity of concomitant AR in patients operated for severe A Son the basis of symptoms, left ventricular (LV) function, and mortality.

Materials and Methods

We analyzed a retrospective cohort of 200 patients in whom surgical AVR was performed for severe AS between February 2014 and February 2016 at Lokmanya Tilak Municipal Medical College Hospital, Mumbai. All procedures performed in our study involving the above-mentioned patients were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declarations and its later amendments or comparable ethical standards.

The patients were included if valve replacement was performed exclusively with an aortic valve prosthesis (biologic or mechanical). The following exclusion criteria were applied: (a) valve replacement due to predominant AR or significant AR and associated AS with mean gradient over aortic valve ≤ 40 mmHg or coronary heart disease with mild concomitant aortic valve damage; (b) valve replacement in the context of type A aortic dissection with valve involvement or other disorders of the ascending aorta, along with those cases in which aortic annulus enlargement was also performed; (c) repair or replacement of another heart valve; and (d) mitral or tricuspid valve disease occurring as a result of rheumatic heart disease, endocarditis, or valve prolapse of any etiology.

A total of 200 patients met inclusion or exclusion criteria and were included in the study. Patients were divided into2 groups on the basis of preoperative 2-d echocardiography: AS group - patients with isolated symptomatic AS and significant AS with trace or mild (1+) AR; and AS+AR group - patients with significant AS and moderate (2+) AR, severe (3+) or very severe (4+) AR.

All surgeries were performed using a standard general anesthesia protocol, median sternotomy approach, employing cardiopulmonary bypass with mild systemic hypothermia (30–34°C).

Demographic, epidemiologic, clinical,pre and postoperative echocardiographic variables were analyzed.

Echocardiography

All patients who had undergone MVR carry adetailed preoperative transthoracic echocardiogram with a 2–4 MHz multi-frequential transducer. Echocardiography was repeated at the follow-up. Mean follow-up period was average 16 months (5–30 months) after surgery. Patient position, echocardiographic imaging planes, and measures were performed as recommended by the American Society of Echocardiography. Left ventricle volumes were adjusted to body surface area and expressed as indexes. LV systolic dysfunction was defined as LVEF < 45%. The left ventricular ejection fraction (LVEF) was obtained using the biplane Simpson method.

Statistical analysis

Continuous variables are presented as mean values ± standard deviation, and categorical variables as absolute numbers and percentages. The normal distribution of continuous variables was analyzed using the Kolmogorov–Smirnov test. The association between categorical variables was assessed using either Pearson's chi-square or Fisher's exact test. To compare preoperative and postoperative variables of all the groups, the paired student's t-test or the Wilcoxon test, were used. The significance level of all tests was set at 5%.

Results

Preoperative and operative characteristics

A total of 200 patients were studied, 100 in the AS group and 100 in the AS+AR group. The overall mean age of the patients was 55.96±14.1 years (range 40–70 years). The average age group range in AS group is higher than AS+AR group. Patients in AS+AR group had a significantly higher mean left ventricular end-diastolic volume index (EDVi), mean left ventricular end-systolic volume index (ESVi). There were no significant differences between the groups with respect to other preoperative variables as shown in Table 1.

Operative characteristics

Among all 200 patient of aortic valve replacement, 172 patients (86%) underwent mechanical, and 28 patients (14%) underwent biological aortic valve replacement. The overall prosthesis size was 22.51±1.8. In AS+AR group, prosthesis size of the aortic valve was slightly higher than AS group. The overall mortality rate was 6%. There was no significant difference between the 2 groups with respect to mortality.

Follow-up data

Among 200 patients, 188 came for follow up. Mean follow-up period was 16 months (5 –30 months) after surgery. NYHA class was improved in both groups. In AS group, there was more improvement than AS+AR group, but there was no statistically significant difference. It can be appreciated that the patients in AS group had lower LV volume indices than patients in AS+AR which was statistically significant. Mean LVEF was improved in both the group (Table 3).

Discussion

The main finding of our study is that in patients with severe AS, the coexistence of significant associated AR impacts symptoms, LV remodeling, systolic, and diastolic function. Preoperative characteristics of both groups in our study were similar except for the age (AS group older) and LV volume indices (higher in AS+AR group). With respect to intraoperative

Table 1: Preoperative demographic, clinical, echocardiographic data

	Overall	AS	AS + AR	*p* value
Total number of patients	200	100	100	
Male (n,%)	146 (73)	74(74)	72 (72)	0.750
Female (n,%)	54 (27)	26(27)	28 (28)	
Age (years)	55.96±14.1	58.85±11.2	52.48±13.05	0.657
Diabetes (%)	18 (9)	10(10)	8 (8)	0.621
Hypertension (%)	66 (33)	38(38)	28(28)	0.132
NYHA Class mean ± S.D.	2.35±0.4	2.30±0.38	2.4±0.5	0.710
Atrial fibrillation	9(4.5)	6(6)	3(3)	0.306
LV EDVi (ml/m^2) mean ± S.D.	80.6±19.3	70.2±12.1	90.6±26.3	0.0001
LV ESVi (ml/m^2) mean ± S.D.	30.1±10.5	24.4±9.6	34.6±15.6	0.0007

Abbreviations: LV - left ventricle, EDVi -end-diastolic volume index, ESVi -end-systolic volume index, EF - ejection fraction, LVMi -left ventricular mass index,S.D. - standard deviation.

Table 2: Operative data

	Overall	AS	AS + AR	*p*-value
Prosthesis type Mechanical (n%) Biological (n%)	 172(86) 28(14)	 88(88) 12(12)	 84(84) 16(16)	0.414
Prosthesis size in mm	22.51±1.8	21.86±1.7	23.11±1.8	0.912
Operative mortality (n, %)	12(6)	5(5)	7(7)	0.551

Table 3: Follow-up data

	AS	AS + AR	*p*-value
NYHA class mean ± S.D.	1.96±0.31	2.06±0.38	0.686
LV EDVi (ml/m2) mean ± S.D.	67±9.1	84±21.3	0.01
LV ESVi (ml/m^2) mean ± S.D.	22±7.2	34.1±11	0.01
LVEF (% mean ±SD)	61±11	58±12	0.112

Abbreviations: LV - left ventricle, EDVi -end-diastolic volume index, ESVi -end-systolic volume index, EF - ejection fraction, LVMi -left ventricular mass index,S.D. - standard deviation.

results, the mortality was higher in AS+AR group, but it was not statistically significant (*p*-value>0.05). On follow-up, patients of both the groups improved symptomatically. The symptoms in term of NYHA class of the patients in the AS group (1.96±0.31) had better improvement than AS+AR group (2.06±0.38).Both the volume indices i.e. LVEDVi and LVESVi were decreased in both the groups compared to preoperative value. But the indices are significantly decreased in AS group compared to AS+AR group (*p*-value<0.05). The mean LVEF was improved in both the groups as compared to preoperative EF. But there was no significant difference in both the groups in postoperative follow-up.

Due to its increasing prevalence and major health burden, nowadays,AS is the most studied valvular heart disease. The current practice guidelines contain precise recommendations regarding the diagnosis and indications for surgeryin AS.[9] Conversely, there is a lack of data on mixed aortic valve disease and this is why there are currentlyno specific guideline recommendations in this particular setting. There were few articles reported regarding outcome after surgical aortic valve replacement in the patients having severe aortic stenosis with concomitant aortic regurgitation.[6,8] Preoperative characteristics of both groups in our study were similar except for the age (AS group older)and LV volume indices (higher in AS+AR group). The reason for the discrepancy in age is probably the fact that AS in older patients is the most common consequence of degenerative process with calcificationof the valve leaflets,[10] while in younger patients it ismostly due to congenital aortic valve diseases.[10] Additionally,coexisting AR is more frequent in younger patients,[10] which is similar to the findings of our study. Significantly higher preoperative LV volumes and pronounced LV hypertrophy in patients with AS and coexisting significant AR, in relation to patients with isolated AS, was also noted in earlier reports.[6,7] There is ongoing controversy with respect to the impact of perioperative AR on long-term outcome following AVR due to severe AS. There were studies regarding the controversy, but results were different due to different methodology. Our data suggest that there is no difference in perioperative mortality between the AS and AS+AR groups, which is similar to previously reported paper.[11] In the follow-up period, the symptoms with regards to NYHA were improved in both the groups. But the improvement was more in AS group. The process of LV remodeling after AVR, in the sense of reduction of volumes, is consistent with our findings. Despite the reduction of LVvolumes in AS+AR group, they were significantly higher than in AS group. This is in accordance with findings of other authors who followed patients with similar characteristics.[6,7] Although the evident difference in LV volume indices was noted between the groups, there was no difference in LVEF. In other words, in the patients with AS, if preoperative LV adaptation is appropriate,

similar long-term outcome according to LV systolic function was seen. Therefore, it can be postulated that in patients with AS and appropriate preoperative LV adaptation, capable of preserving LV systolic function, postoperative LV function will also be preserved regardless of the degree of coexisting AR.[8,12]

Study limitations

Our study has some limitations. First, it is a retrospective study. The follow-up period was only 16 months. The long-term outcome is not addressed.

Conclusion

Our study indicates that the preoperative presence and severity of concomitant AR has an impact on the outcome after aortic valve replacement for the patients having severe aortic stenosis symptoms on the basis of symptoms, LV remodeling, systolic and diastolic function. So, preoperative association and severity of concomitant AR should be properly addressed before surgery of aortic valve replacement for severe aortic stenosis and regular follow-up required for these patients.

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