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Prognostic impact and change of concomitant mitral regurgitation after surgical or transcatheter aortic valve replacement for aortic stenosis

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ABSTRACT

Background: Significant aortic stenosis (AS) is frequently associated with mitral regurgitation (MR) of varying degrees. We sought to assess the change in MR grade after the aortic valve procedure, to find predictors of MR improvement and finally to determine the prognostic impact of persistent MR.
Methods: We retrospectively analyzed a group of 101 AS patients who underwent aortic valve replacement (AVR) or transcatheter aortic valve implantation (TAVI) at our institution between January 2007 and March 2014 and who presented with MR grade 2 or higher on preoperative echocardiogram – 35 patients underwent an isolated AVR, 18 underwent TAVI, and the rest underwent a combined procedure, which included coronary artery bypass grafting. The mean follow-up was 28.5 ± 21 months.
Results: MR improved significantly after the procedures (2.4 ± 0.5 vs. 1.9 ± 0.9, $p < 0.001$) and a decline in the severity of MR was observed regardless of etiology (degenerative/post-rheumatic, functional/ischemic, combined) without significant changes between groups ($p = 0.667$). Downgrading of MR severity was associated with improvement in ejection fraction ($p = 0.021$) and reduction in the size of cardiac chambers, especially the left atrium (left atrial diameter, $p < 0.001$). None of the preoperatively evaluated factors (severity of AS, MR etiology, ejection fraction, cardiac chamber dimensions, coronary artery disease, and New York Heart Association functional class) was a significant predictor of MR improvement. Persistence of higher degrees of MR was associated with a more frequent need for cardiovascular hospitalization, while the survival rate 3 years after procedure was not affected ($p = 0.146$).
Conclusions: In the majority of AS patients, an aortic valve procedure leads to reduction in coexistent MR. A significant decrease in the severity of MR in our study was observed regardless of etiology and preoperative grade of MR. Persistence of higher degrees of MR was associated with increased patient morbidity.

Introduction

Significant aortic stenosis (AS) is frequently associated with mitral regurgitation (MR) of varying degrees. The prevalence of MR is reported in up to 75% of patients undergoing aortic valve replacement (AVR) [1]. Similarly, coexisting moderate to severe MR is frequent in patients undergoing transcatheter aortic valve implantation (TAVI) and the occurrence is reported in 22–48% of patients [2–4]. Severe MR usually requires surgical intervention at the time of AVR; however, in the setting of either moderate degree of MR or excessively high risk of double valve surgery, the mitral valve is often left untreated. A number of factors have to be taken into account when making a decision regarding the extent of surgery. The persistence of moderate to severe MR after an aortic valve procedure is associated with a worse outcome and higher morbidity [5–7]. Double valve surgery is burdened by higher operating and in-hospital mortality compared to isolated AVR [8,9]. Most studies have demonstrated a significant improvement in MR after isolated AVR or TAVI, although only the functional etiology of MR was examined in most of them [10–13]. However,

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not all patients experience a reduction in MR severity and the degree of reduction is not exactly known. For these reasons, we decided to retrospectively analyze group of AS patients that preoperatively presented with MR grade 2 or higher and underwent aortic valve surgery or intervention without mitral valve procedure. Our aims were to (1) assess the change in MR grade after aortic valve procedures, (2) to identify predictors of MR improvement, and (3) finally to determine the prognostic impact of persistent MR with respect to survival and morbidity.

Methods

We retrospectively reviewed 101 AS patients who underwent an aortic valve procedure between January 2007 and March 2014 in our Cardiocenter. All of these patients presented with MR grade 2 or higher on preoperative echocardiogram. In all cases, the indications for surgery or intervention as well as the extent of surgery were discussed during the heart team session. The decision not to intervene on the mitral valve was based either on the degree of MR or unacceptably high risk of double valve surgery. Thirty-five patients underwent isolated AVR, 18 underwent TAVI, and the rest underwent a combined procedure, which included surgical myocardial revascularization (Fig. 1). The mean follow-up was 28.5 ± 21 months and the median follow-up was 24 months. All patients underwent a standard preoperative examination including transthoracic echocardiography and selective coronarography. Most patients also had preoperative transesophageal echocardiography with a more accurate assessment of the etiology and severity of MR. The severity of MR was determined according to current guidelines integrating structural, Doppler, and quantitative parameters (regurgitation jet evaluation in color flow mapping, pulse wave, and continuous wave Doppler examination, width of vena contracta, and regurgitant orifice area measurement – PISA method). MR severity was graded as follows: 0 = none, 1 = mild, 2 = mild to moderate, 2.5 = moderate, 3 = moderate to severe, and 4 = severe. The etiology of MR was based on the presence of morphological changes of the mitral valve apparatus considered typical for degenerative or post-rheumatic disease. The determination of a functional or ischemic etiology of MR was based on the absence of structural changes. The combined etiology of MR was considered in the case of coexistence of functional and morphological changes. Linear dimensions of cardiac chambers (internal dimension of the left ventricle and anteroposterior dimension of the left atrium) were measured in the parasternal long-axis view using two-dimensional echocardiography. Left ventricle ejection fraction (EF) was assessed using the biplane method of disks (modified Simpson's rule) where feasible. In rare cases with a poorly visible endocardium, the EF was estimated. In patients with AVR, a bioprosthesis or mechanical prosthesis was inserted at the discretion of the surgeon and patient preference. The subgroup of patients, whose operative risk was too high, underwent TAVI with a CoreValve ReValving (Medtronic, Dublin, Ireland) system implantation. After surgery or intervention, all patient follow-ups were monitored by our institution's specialized ambulatory department. Post-procedure echocardiography examination was performed in 94% of patients (5 patients died before examination, 1 patient was a no-show) during the first year after procedure, not earlier than one month after the procedure (the median was 2 months). We also monitored all post-procedure hospitalizations at our institution. Mortality data were obtained from a database maintained by the Institute of Health Information and Statistics of the Czech Republic.

The research was carried out according to the principles of the Declaration of Helsinki. Patients gave informed consent and the ethics committee of University Hospital Kralovske Vinohrady in Prague (Czech Rep.) approved the study.

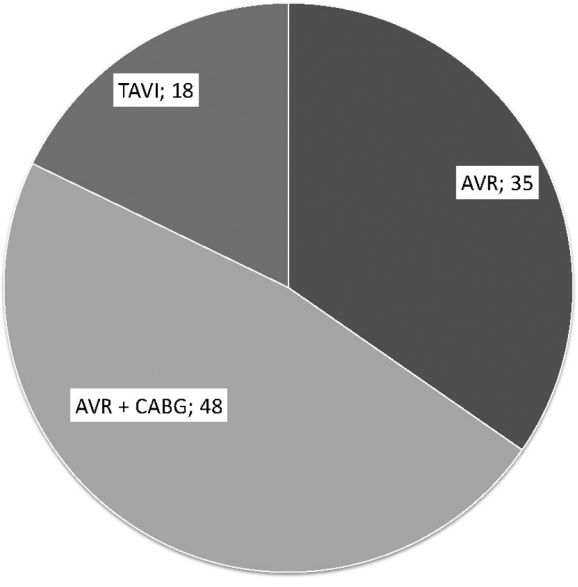

Fig. 1. Procedures. Thirty-five patients underwent isolated aortic valve replacement (AVR), 18 transcatheter aortic valve implantation (TAVI), and the rest (48) combined procedure – AVR + coronary artery bypass grafting (AVR + CABG).

Statistical analysis

Data are expressed as mean ± standard deviation for continuous variables and as a percentage for categorical variables. Continuous variables (EF, cardiac chamber dimensions) were compared using the paired *t*-test with a significance level (p-value) < 0.05. The change in MR grade was tested using Bowker and Wilcoxon paired tests. Relationships between changes in the degree of MR and changes in specific parameters (EF, cardiac chamber dimensions) as well as the influence of preoperative factors on changes in MR grade were tested using a robust variant of linear regression and multiple linear regression. The prognostic value of procedural-related MR changes was tested using logistic regression; survival rates were estimated, and graphed, using the Kaplan–Meier method. Survival rates were compared using the log-rank test.

Results

Baseline characteristics, including echocardiographic data, are summarized in Table 1. As shown, the predominance of patients in our cohort had mild to moderate (grade 2) MR pre-procedurally and the most frequent etiology was degenerative followed by combined etiology. The majority of patients with degenerative etiology of MR had various extent of annular calcification with leaflet thickening and only the minority (8 patients) had anterior or posterior leaflet prolapse. Table 2 summarizes the echocardiographic variables that were compared before and after procedures. This comparison was made only in those patients ($n = 95$) whose echocardiographic data were available both before and after procedure. As shown, EF, left ventricular end-diastolic diameter (LVEDD), and left atrial diameter (LAD) did not differ significantly, although there was a trend toward reduced size, particularly, in left atrial dimensions ($p = 0.052$ for indexed value).

Change in MR

Quantitative changes in MR are shown graphically in Fig. 2. The majority of patients (59%) experienced an improvement in MR post-procedure. MR remained unchanged in 24% of patients, worsened in 12% of patients, and 5% of patients died before their scheduled postoperative echocardiographic examination. Overall, there was a statistically significant reduction in the degree of MR