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STUDY OF FACTORS AFFECTING PROGNOSIS IN MITRAL & AORTIC VALVE SURGERY AT A TERTIARY CARE CENTRE IN CENTRAL INDIA

Medical Science

Dr Satish R. Das — Associate Professor, Department of Cardiovascular & Thoracic Surgery, Super Speciality Hospital, Government Medical College, Nagpur

Dr Yogesh N. Zanwar — Assistant Professor, Department of Anaesthesia, Super Speciality Hospital, Government Medical College, Nagpur

ABSTRACT

Background- The influence of preoperative clinical, hemodynamic, and surgical procedures on long-term prognosis after combined aortic and mitral valve surgery is not well studied.

Methods and Results- One hundred seventy patients who underwent surgery for chronic combined aortic and mitral valvular disease between 2004 and 2014 were followed up for an average of 5.3 years. The perioperative mortality rate was 4%, and 5- and 10-year survival rates were 61% and 33%. Main predictors of late survival were age at surgery, preoperative left ventricular ejection fraction, cardiac index, tricuspid surgery, pulmonary vascular resistance, NYHA class and additional aortocoronary bypass graft surgery. In multivariate stepwise Cox analysis, ejection fraction, age at surgery and tricuspid surgery were independent predictors of late survival.

Conclusions- In combined aortic and mitral valve disease, preoperative myocardial function is the main predictor of long-term survival.

KEYWORDS

surgery, valves, prognosis

INTRODUCTION:

Combined aortic and mitral valve surgery was, in the past, associated with a high operative mortality and unsatisfactory late results.[1–3] Despite significant improvement in surgical techniques with marked decrease in operative mortality rates and a considerable increase in late postoperative survival rates, some reluctance remained to subject a patient with combined aortic and mitral disease to surgery.[4,5] A paucity of experience due to the limited number of cases, a lack of good prospective clinical and hemodynamic studies in patients who have not undergone surgery and great differences in clinical presentation and hemodynamics between regurgitant and stenotic lesions complicate the decision-making process for surgery in patients with combined aortic and mitral disease.[1,6,7]

The purpose of this study is to assess preoperative clinical, hemodynamic, and surgical predictors for long-term survival after combined aortic and mitral valve surgery.

METHODS:

Type of Study- Observational study

Study Setting- Department of Cardiovascular & Thoracic Surgery, tertiary care government hospital in central India

Study Period- 2004 to 2014

Sample Size- All 170 patients who underwent combined aortic and mitral valve surgery at Super- Specialty Hospital, Nagpur during the study period.

All except 2 patients underwent right and left heart catheterization, and all except 2 had left ventricular (LV) angiography. All patients >40 years old and those with angina pectoris underwent coronary angiography. For the calculation of LV volume and ejection fraction (EF), only high quality angiograms were considered. Hence, preoperative EF and volume were reported in only 159 of 170 patients (94%). NYHA class was determined according to symptoms and functional impairment at the time of preoperative evaluation and operation regardless of previous symptoms and history.

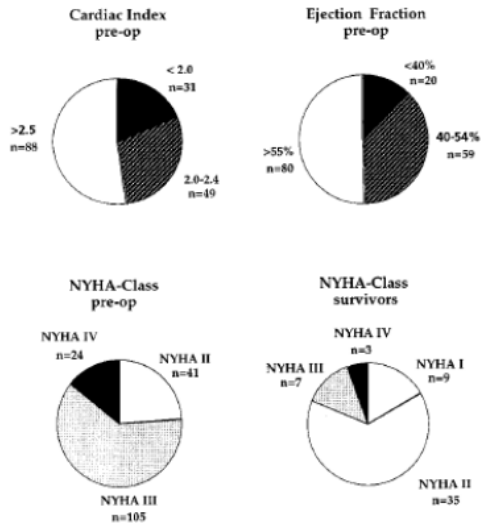
Patients

Sixty percent (102) patients were male. Age of patients at the time of surgery ranged from 21-79 years (mean- 50.5 years). Cause of valvular disease was rheumatic in 41% of patients, and 18% had history of bacterial endocarditis; in other patients, the origin of valvular disease wasn't specified and was assumed to be degenerative. None were operated while they had acute endocarditis, and in majority of patients, endocarditis antedated surgery by several years. Previous surgery of heart and great vessels had been performed in 35 patients (21%).

Clinical and Hemodynamic Data

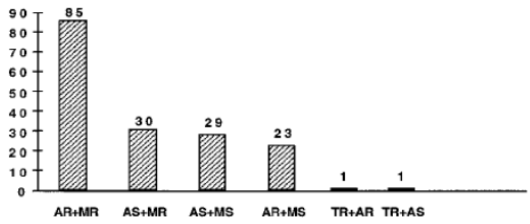
Preoperative NYHA class was 2.9, whereas 24% of patients were in class II, 62% were in class III, and 14% were in class IV (Figure 1).

Figure 1: Preoperative distribution of cardiac index, LVEF and NYHA classes



Heart failure was present in 45% of patients. The mean duration of cardiac symptoms was 5.2 years; in 51% of patients, symptoms were present for <4 years, and in 12% of patients, symptoms were present for >12 years. According to type and hemodynamic severity of valvular disease, patients were divided into different groups **(Figure 2).** The combination of aortic regurgitation and mitral regurgitation was the most common disease (50%).

Figure 2: Preoperative classification of predominant diseases in study patients



(AR- Aortic Regurgitation, AS- Aortic Stenosis, MR- Mitral Regurgitation, MS- Mitral Stenosis, TR- Tricuspid Stenosis)

Follow-Up

After surgery, all patients were seen at least once in our outpatient clinic, generally 6 months after surgery. Additional information was obtained through the use of standardized questionnaires. Causes of death and cardiac complications were classified according to guidelines[8] and were obtained from medical reports & death certificates. The mean follow-up was 5.3 years (901 patient-years); in surviving patients, it was 7.3 years, with the longest follow-up being 11.2 years. During the follow-up, 14 patients (8% of the entire group) were lost 11 months to 7.8 years after the operation (mean follow-up, 3.6 years).

Statistical Analysis

Statistical evaluations were performed with SPSS (version 18). Survival was calculated according to the Kaplan-Meier method. Univariate & Cox hazard regression analysis were performed.

Surgical Procedures

All 170 patients had combined aortic and mitral valve surgery. In 41 patients (24%), additional surgical procedures were performed: reconstruction of the tricuspid valve due to significant regurgitation [n=29 (17%)], aortocoronary bypass graft surgery [n=7 (4%)], and surgery of the ascending aorta [n=7 (4%)]. Replacement (n=280) and repair (n=60) of the aortic and mitral valves were both performed. Mechanical prostheses were used in most patients; bioprostheses were used more often in the aortic (32%) than in the mitral (18%) position.

RESULTS

Survival

Ninety-four patients died and 14 were lost to follow-up; the early mortality rate (<1 month) was 4%, and 5- and 10-year survival rates were 61% and 33%, respectively. The mortality rate remained stable during the entire follow-up period (5%/patient-year). Most patients (72%) died of cardiac causes; heart failure (30%) and sudden, unexpected death (15%) were the most frequent causes of cardiac death. Non-cardiac death occurred in 12 patients, with malignancies (n=5) and infections (n=4) being the most common causes. In 14 patients, the cause of death remained unknown; these cases were regarded as probably cardiac related. In calculations, they were grouped together with cardiac death. The average NYHA class of long-term survivors was 2.1; 17% were in class I, 65% were in class II, 13% were in class III, and 6% were in class IV.

Reoperations

During the follow-up, 46 cardiac reoperations were performed in 37 patients, with an early mortality rate of 7%. Prosthesis replacement was performed in the aortic and mitral (n=12), aortic (n=9), mitral (n=10), and tricuspid (n=2) positions. In 4 patients, refixation of mitral prosthesis had to be performed; 4 heart transplantations became necessary 4-7 years after initial valve replacement due to intractable heart failure. Valvular reoperations were combined with surgery of the ascending aorta (n=5), aortocoronary bypass graft surgery (n=2), and tricuspid reconstruction (n=2). Bioprosthesis degeneration was the reason for reoperation in two thirds of the cases. Elective heart transplantation was performed in 3 patients at 4, 5, and 7 years after valve replacement, without early and late deaths; the only emergency transplantation performed due to early postoperative intractable myocardial failure after reoperation of aortic and mitral prosthesis and aortocoronary bypass graft surgery was not successful. Mean duration of function for bioprostheses was 5.1+0.2 years in aortic and 4.1+0.2 years in mitral position. Reoperation-free survival rates were 57% after 5 years and only 21% after 10 years.

Cardiac Complications

During the follow-up, 45 major complications other than reoperation (death included) were encountered; the most common were stroke (n=16), endocarditis (n=11), embolism (other than cerebral) (n=7), myocardial infarction (n=6), and bleeding during anticoagulation (n=5). Due to diagnostic difficulties, we have not differentiated between embolic and hemorrhagic stroke as causes. The incidence of all thromboembolic survival and bleeding complications (stroke, embolism, and bleeding) was 1.6%/patient-year, whereas the incidence of lethal complications was 0.3%/patient-year. The incidence of bacterial endocarditis was 0.6%/patient-year, and that of lethal outcome was 0.1%/patient-year.

Survival

The impact of different parameters on long-term survival after combined aortic and mitral surgery is presented in **Table 1.**

Table 1: Parameters influencing survival

Parameter	P	
	Cardiac Survival	Operation-free Survival
Age at surgery	0.0002	0.02
Sex	0.65	0.54
Rheumatic fever	0.39	0.76
Endocarditis	0.44	0.06
Previous operation	0.64	0.21
Heart failure history	0.56	0.47
Duration of symptoms	0.85	0.91
NYHA functional class	0.04	0.47
Sinus rhythm	0.25	0.59
Right atrial pressure	0.12	0.30
Pulmonary arterial pressure	0.13	0.61
Left atrial pressure	0.16	0.66
LV end-diastolic pressure	0.86	0.89
Pulmonary vascular resistance	0.03	0.56
Cardiac Index	0.007	0.39
LV ejection fraction	0.002	0.10
LV end-systolic volume	0.12	0.05
Mechanical vs biologic aortic prosthesis	0.27	0.02
Mechanical vs biologic mitral prosthesis	0.85	0.04
Mitral repair vs replacement	0.08	0.14
Tricuspid repair	0.03	0.08
Ascending aortic surgery	0.72	0.63
Aortocoronary bypass	0.04	0.18

Age, duration of symptoms, pressure, and volume parameters were calculated as continuous variables; all other data were analyzed as dichotomous variables. Higher age at surgery, higher preoperative NYHA class, higher pulmonary artery resistance, lower cardiac index, lower LVEF, additional tricuspid surgery, and aortocoronary bypass graft surgery were significantly (P<0.05) related to poorer late survival rates. When preoperative NYHA classes are analyzed separately, only NYHA class II was clearly related to better long-term outcome, with the differences in survival rates for NYHA classes III and IV being minimal during the entire follow-up period. Only a cohort of patients with the lowest EF (<40%) had clearly decreased survival rates. The survival rates for patients with moderately decreased EF (40% to 54%) and normal EF (>54%) were very similar. Neither cause of the valvular disease, duration of symptoms, nor previous heart failure was a predictor of late outcome. A certain trend for better late outcome was noted with lower preoperative right and left atrial and pulmonary artery pressures; only pulmonary vascular resistance was a significant survival predictor in univariate analysis.

The type of prosthesis (mechanical versus bioprosthesis) had no major impact on long-term outcome; a strong tendency for better long-term survival, falling short of statistical significance (P<0.08), was seen for 55 patients with mitral valve repair. Additional tricuspid regurgitation requiring surgery decreased the late survival rate. Despite bypass surgery, the outcome of patients with coronary artery disease was poor. In multivariate stepwise regression analysis of the foregoing parameters, only age {P=0.0011, exponential coefficient [Exp (Coef)]1.034}, LVEF [P=0.0008, Exp(Coef) 2.10], and additional tricuspid surgery [P=0.007, Exp(Coef) 0.966] arose as independent predictors of the late outcome.

In univariate analysis for reoperation-free survival, age, LV end-systolic volume, and use of bioprosthesis in the aortic and mitral position were major predictors of reoperation. In multivariate analysis, higher age, higher end-systolic volume, use of a bioprosthesis in the aortic position, and tricuspid surgery were independent predictors of higher risk of reoperation in long-term follow-up.

DISCUSSION:

The optimal timing of surgical treatment for combined aortic and mitral surgery is not well defined.[9] The decreased operative mortality rates and improved late survival rates during the past decade require reassessment of indication for surgery in patients with combined valvular disease.[3,4,10] This study summarizes the experience with combined aortic and mitral surgery, with an emphasis on preoperative

clinical and hemodynamic data and the choice of surgical procedures as predictors of long-term survival.

Surgical Results

Our observations demonstrate that combined valvular surgery can be performed with a low operative mortality rate of <5% and good results (5-year survival rate, 61%), whereas three fourths of long-term survivors had a fair quality of life (NYHA classes I and II). Similar results in comparable patient cohorts have been reported.[2–4,10,11] Nevertheless, the early operative mortality rate is higher and the late survival rate is lower than those after isolated aortic or mitral valve replacement.[1,9,12] Heart failure and sudden, unexpected death are the major late causes of death.[3,4,10] Heart failure can occur slowly and insidiously, many years after valve replacement, and heart transpl antation might become necessary when myocardial failure is refractory to medical therapy. Thus, current late postoperative survival rates do not exactly correspond to "survival of the heart." In particular, patients with preoperative severe chronic volume overload and reduced myocardial function might require heart transplantation late after valve replacement.

Significant tricuspid regurgitation requiring surgical repair worsened the prognosis.[3] The prognostic importance of preoperatively increased pulmonary vascular resistance points to the importance of chronic pressure load on the right ventricle for postoperative outcome. Thus, it is not only genuine tricuspid valve disease but also the chronic overload of the right ventricle with dilation and myocardial failure that burdens the late postoperative outcome. Tricuspid repair should be performed when hemodynamic significant regurgitation is present, because such disease does not disappear after correction of the left-side valvular disease.[13,14] In our relatively young patient group, the incidence of coronary rtery disease was very low, but the long-term prognosis of these patients was less favorable despite aortocoronary bypass graft surgery.

Influence of Surgery

During the study period, older mechanical prostheses and a higher number of bioprostheses were used. Two late deaths were due to acute dysfunction of mechanical prostheses in the mitral position, which is a well-recognized problem of convex-concave modification of this prosthesis.[15] The durability of bioprostheses, especially in the mitral position, is limited, and two thirds of repeat operations in our patients were due to prosthesis degeneration.[16] The type of prosthesis remained without major importance for long-term survival due to the low mortality rates for reoperation, confirming the results of randomized studies of aortic or mitral valve replacement with mechanical prostheses or bioprostheses.[17] The reoperation for combined aorto-mitral replacement has a higher operative mortality rate than that for isolated valve reoperation, which calls for complete abandonment of the use of bioprostheses for combined aortic & mitral valve replacement.

Repair of mitral valve was performed in one third of our patients. In isolated mitral regurgitation, valve repair is superior to valve replacement in cases with suitable valvular pathology.[18,19] In our patients, we noted the trend for better long-term survival rates with mitral repair compared with replacement, but the difference did not reach the level of statistical significance.

Survival Predictors

Preoperative LVEF appeared to be the best single predictor of survival after combined aorto-mitral valve surgery. Information on preoper ative myocardial function in combined valvular disease is rare.10 Significantly decreased late outcome was demonstrated only for patients with severely reduced EF (<40%). On reflection of the experience with valve replacement in isolated aortic or mitral regurgitation, the potential for recovery after successful double valve replacement is equally limited when preoperative systolic function is severely decreased.[9,20,21] The presence of severe tricuspid regurgitation requiring surgery is the second important predictor of late outcome. Preoperative clinical status is of only limited predictive value for postoperative outcome. Lower late survival rates for patients in preoperative NYHA class III or IV could be demonstrated on univariate analysis, but neither duration nor severity of previous symptoms had any major impact on late survival.

Retrospectively, the indication for combined aortic and mitral surgery in our patients appears to have been too conservative. Half of our patients had a reduced LVEF and cardiac index, three fourths of them were in NYHA class III or IV over a long period of time, and heart failure developed in the majority. In these patients, the potential for improvement of surgical outcome is indicated by earlier surgery, before severe decrease in myocardial function began.

Summary and Prospects for Future Development

With modern surgical perioperative treatment and durable prostheses that have excellent hemodynamic performance, late postoperative results in combined aortic and mitral valve disease depends crucially on preoperative LV function. Low operative mortality rates and good late results make valve replacement mandatory even in moderately symptomatic patients before LV function dysfunction ensues. Durable, modern mechanical substitutes such as bileaflet prostheses should be chosen for valve replacement, but when possible, mitral repair should be attempted. Close surveillance of patients after successful valvular surgery should be maintained, especially in patients with preoperatively decreased myocardial function. Consequent modern medical treatment of postoperative myocardial dysfunction should be provided.

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