MITRAL VALVE REPAIR AND REPLACEMENT: RESULTS OF MULTI-CENTRE STUDY

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ABSTRACT

The etiology of mitral valve disease has changed in the last 20 years, and new techniques for the diagnosis and repair of mitral valves have been advanced. A retrospective regional study was conducted to identify changes in patient and disease characteristics and in population-based rates for mitral valve repair and replacement.

METHODS: Data from 1648 patients were collected from 5 clinical centers between January 1, 2000, and December 31,2007.

RESULTS: Total mitral valve procedures increased 2.4 times, from 8.7 to 20.6 cases/100,000/year (p_{trend} =0.004). Primary procedures increased form 6.7 to 16.9 cases/100,000/year (p_{trend} =0.014). Primary mitral valve repair procedures increased 3.7 times, from 2.4 to 8.9 cases/100,000/year (p_{trend} =0.012), whereas mitral valve replacement increased only 1.9 times, from 4.3 to 8.0 cases/100,000/year (p_{trend} =0.016). Repeat mitral valve operations did not change significantly (p_{trend} =0.810). During this period, there was a significant increase of the percentage of octogenarians (p_{trend} =0.016) and of patients with ejection fractions <40% (p_{trend} =0.012). There was a decrease in the percentage of patients with mitral stenosis (p_{trend} =0.024).

CONCLUSION: The new techniques for diagnosis and repair of mitral valvular disease, regional data demonstrate substantial increased rates of mitral repair and replacement and expanded indications of older age and poorer left ventricular function.

Key words: Mitral valve repair, Mitral regurgitation, Mitral valve replacement

INTRODUCTION

Since Carpentier introduced improved techniques for mitral valve repair in 1971,[1] the etiology and treatment of mitral valve disease have changed.[2] As the incidence of rheumatic mitral stenosis and regurgitation has decreased, mitral regurgitation primarily caused by degenerative disease of the mitral apparatus and caused by left ventricular dysfunction associated with coronary artery disease has become the predominant hemodynamic lesion of the mitral valve. The increasing use of intra-operative echocardiography, the improvement in cardiac surgical care, and the evolution of reparative techniques have changed the approach to the surgical treatment of mitral valve disease. At the same time, economic imperative have raised concerns about the appropriateness, effectiveness, and cost of cardiac surgical procedures.[3,4,5] For mitral valve surgery, little is known about related changes in population-based procedure rates for mitral repair and replacement in this time frame. This study was conducted to assess changes in population-related patient and disease characteristics.

MATERIALS AND METHODS

From January 2000 through December 2007, 1648 patients >30 years of age underwent mitral valve repair or replacement at 1 of 5 clinical centers in Hitchcock Medical Center, Lebanon, Eastern Medical Center, Damascus, Allied Health Care, Bangor, Regional registry, Mashhad and Maine Hospital, Istanbul. As such, the combined cardiac surgical cases of these centers represent a valid estimate of the regional population experience. A primary mitral valve procedure was defined as the first operation on the mitral valve, regardless of whether a previous coronary bypass graft procedure or other valve procedure had been performed or not. Repeat mitral procedures involved at least 1 previous mitral valve operation. Mitral valve repair was defined as any procedure, including the use of a prosthetic ring, performed on the mitral valve to restore normal valve function without implanting a prosthetic valve. Other data included in this study are age, sex, New York Heart Association functional class, coronary artery disease, preoperative atrial fibrillation, ejection fraction, concomitant coronary artery bypass grafting, priority at operation, mitral stenosis, and mitral insufficiency. Annual population-based

rates for mitral valve operations were calculated with the combined number of mitral valve procedures for each year from the 5 clinical centers and the yearly estimated population figures. Population-based rates were expressed as cases per 100,000 residents per year. Other data were presented as a mean (age) or a proportion. These data were analyzed with the STATA nptrend test for trends across ordered group.[6] A *P* value <.05 was considered to be significant.

RESULTS

Mitral valve operations in patients >30 years of age during the time frame 2000 to 2007 are presented in Table-1. The total number of mitral valve procedures increased 2.4 times, from 8.7 to 20.6 cases/100,000/year (p_{trend}=0.004). Primary procedures increased from 6.7 to 16.9 cases/100,000/year (p_{trend}=0.014). For primary procedures, mitral valve repair increased 3.7 times, from 2.4 to 8.9 cases/100,000/year (p_{trend}=0.012), whereas mitral valve replacement increased 1.9 times, from 4.3 to 8.0 cases/100,000/year (p_{trend}=0.016). The rate of repeat mitral valve operations did not change significantly (p_{trend}=0.810).

At the same time, as shown in Figure 2, *B*, The proportion of patients with ejection fractions <40% more than tripled, from 7.1% to 23.4% (p_{trend}=0.012). There was small but not significant decrease in the proportion of women, from 50.5% to 41.1% (p_{trend}=0.064), although the rates for procedures in both women and man increased during the time frame of the study.

The proportion of patients with mitral stenosis decreased significantly, from 26.2% to 12.4% (p_{trend}=0.024), although the population-based rate increased from 2.28/100,000 to 2.55/100,000 cases in the same time frame.

The proportion of patients with mitral regurgitation remained high without much change (82.4%-88.3%, p_{trend}=0.333). Although the proportion of patients with a preoperative diagnosis of coronary disease did not change significantly (p_{trend}=0.180), there was a significant increase in the proportion of patients undergoing a concomitant coronary bypass grafting procedure, from 43.0% to 49.8% (p_{trend}=0.044). The proportion of cases with preoperative atrial fibrillation, New York Heart Association functional class IV, or emergency priority at operation showed no significant trend during the same time frame.

DISCUSSION

This study evaluated changes in mitral valve procedure rates and patient and disease characteristics during the 8-year period between January 2000 and December 2007. During this time frame, mitral valve procedures significantly increased 2.4 times, from 8.7 to 20.6 cases/100,000/year. Primary mitral valve procedure rates increased 2-fold, with no change in the rate of repeat mitral procedures. This overall rate increase was caused by 2 factors: the increasing use of repair for the surgical treatment of mitral valve disease and expanded indications for mitral procedures in general. Although both repair and replacement procedures increased significantly in this series, repair rates more than tripled (from 2.4-8.9 cases/100,000), with the proportion of repair versus replacement increasing from 23% to >50%. An important factor in the shift toward repair for the surgical treatment of mitral valve disease may be a change in etiology of mitral valve disease, with less rheumatic and more degenerative and coronary artery disease-related mitral valve problems.(7,8,9,10,11) With the drop from 26.2% to 12.4% in the proportion of mitral stenosis cases, the surgical treatment of mitral valve disease has become synonymous with relief

Table-1
Yearly break - up

	2000	2001	2002	2003	2004	2005	2006	2007	*P* trend
Population	1,637,885	1,647,171	1,656,458	1,665,744	1,675,030	1,684,317	1,693,603	1,702,889	
Primary opertions	6.7	6.8	7.2	6.7	5.4	9.3	12.3	11.5	.014
Repair	2.4	2.3	2.2	2.3	2.3	4.5	5.1	5.4	.012
Replecement	4.3	4.5	5.0	4.4	3.1	4.9	7.1	6.1	.016
Repeat operations	2.0	2.7	4.5	4.3	4.2	5.4	2.4	3.8	.810
Total operations	8.7	9.4	11.8	11.0	9.6	14.7	14.7	15.3	.004

Table-2
Break up of various patient sub-groups and disease characteristics

	2000 (n=107)	2001 (n=109)	2002 (n=118)	2003 (n=111)	2004 (n=90)	2005 (n=158)	2006 (n=211)	2007 (n=199)	*P* trend
Age (mean y)	64.7	65.8	65.7	66.0	64.4	65.7	66.0	67.4	.030
Age>80(% yes)	0.0	5.5	5.1	6.3	3.3	4.4	9.0	9.0	.016
Sex (% female)	50.5	66.7	66.9	51.4	43.3	49.4	42.7	50.3	.064
CAD (% yes)	48.1	57.4	52.5	52.3	53.3	60.1	55.0	59.6	.180
Afib preop (% yes)	38.9	39.8	39.3	29.7	37.8	31.2	35.7	34.8	.082
EF (%<40)	7.1	15.1	9.7	18.0	19.7	23.3	16.7	21.9	.012
NYHA (% 4 or 5)	39.4	42.5	21.3	24.5	28.9	21.8	32.8	26.6	.148
Mitral stensis (%yes)	26.2	22.0	25.0	31.3	19.8	25.6	22.0	21.5	.024
Mitral regurg (%yes)	82.4	90.7	91.2	95.5	95.6	99.4	88.0	82.3	.333
Emergency (% yes)	5.6	2.4	11.9	6.3	8.9	6.3	4.3	8.0	.352
CABG (% yes)	43.0	38.5	43.2	45.9	50.0	55.1	51.4	53.8	.044

of mitral regurgitation (the regional population-based rates for mitral stenosis have, however, increased insignificantly, from 2.3 cases to 2.3 cases 2.6 cases/100,000/year; (p_{trend}=0.280). The preferred method of accomplishing this is the repair or reconstruction of the valve, which preserves the all-important chordal apparatus with consequent improved left ventricular function.[12,13] These data from our own region reflect this important trend, favoring repair over replacement for the treatment in mitral regurgitation. Indeed, current diagnostic and surgical techniques applied with skill in mitral valve disease should permit a realistic target of 50% for repair versus replacement.[14,15]

The indications for mitral valve surgery in our region have expanded to include older and sicker patients. Although the number of patients in all age groups increased, he significant trend many more older, higher risk patients to the surgical roles. In addition, patients with poorer left ventricular function, defined by an ejection fracation <40%, formed an increasingly higher proportion (7.1%-23.4%) of cases during the period of this study also, contributing importantly to the overall increase in mitral procedure rates. Other studies have reported similar changes in patterns and trends in heart valve surgery.[14,17] During this period, our experience has also shown an increase (43.0%-49.8%) in the cases undergoing concomitant coronary bypass grafting, although the proportion of cases with a preoperative diagnosis of coronary disease has remained constant. None of the other patient or disease characteristics we studied changed significantly. In-hospital, risk-adjusted morality rates for these cases have been previously reported.[6]

The strength of this study is its analysis of 1684 surgical mitral valve procedures performed in a 10-year period for a 1.7-million person subset, >30 years of age, from a regional population of 3.1 million people. It documents a marked increase in papulation-based rates and expanded indications for these procedures in an increasingly cost-conscious era of improved diagnostic and surgical techniques. At the same time, we have data to support increased population-based rates for mitral regurgitation or an increase in its severity to account for the increased procedure rates. What does seem clear is the expand use since 1990 of preoperative transesophageal echocardiography for not only valvular cases, but also coronary bypass graft operations.[18] As a consequence, the discovery of associated regurgitant mitral disease has fostered the addition of a mitral valve procedure to a coronary bypass graft operation.

In addition, we did not collect specific preoperative clinical and intraoperative echocardiographic and mitral valve pathologic data. These additional data could provide measures for assessing the causes and severity of mitral regurgitation and resultant preoperative functional impairment for each pa-

tient.[11,19] This information could in turn serve as a guide to the appropriateness of the particular operative intervention and its long-term outcomes.

The results of our study are relevant for both resource planning and future outcomes research. The shirt from mitral replacement to repair in patients with severe mitral regurgitation of degenerative and ischemic etiology may be desirable for improved immediate and long-term risk. Coronary artery bypass graft surgery alone in patients with significant acute ischemic mitral regurgitation may occasionally improve left ventricular function and lessen the ischemic regurgitation. More commonly, however, surgery is required to correct acute severe ischemic mitral regurgitation.[12] For moderate mitral regurgitation related to ischemic heart disease, there is continuing controversy about the necessity for valve repair or replacement and the effectiveness of different techniques. It is therefore reasonable that the increased numbers of mitral valve repair procedures may not necessarily represent an improvement in care. The additional hazard of such an intervention may not outweigh its benefits.[20,21,22]

Further work in this area should include the collection and analysis of standardized intraoperative pathologic and echocardiographic data to improve the assessment of the appropriateness the surgical intervention and the long-term, procedure-specific outcomes when a mitral valve procedure is performed.

CONCLUSION

Regional data demonstrate substantially increased rates of mitral repair and replacement in the 8-year period of this study. A more than 3-fold increase in repair procedures has made a major contribution to this trend. The data also point to expanded indications for mitral valve surgery because of changes in disease and patient characteristics, with higher proportion of older patients, poorer left ventricular function, and less rheumatic mitral valve disease.

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