Progression of mitral regurgitation following ischemic mitral valve repair

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Key words: *recurrent mitral regurgitation; ischemic mitral valve repair.*

Summary. *Objective. Durability of mitral valve repair for ischemic mitral regurgitation remains questionable. The aim of our study was to reveal predictors of recurrent mitral regurgitation following ischemic mitral valve repair.*

Material and methods. The study population consisted of 136 patients with ischemic heart disease and ischemic mitral regurgitation. Mitral valve repair was performed at the Kaunas University of Medicine Hospital in 2000–2004. Preoperative echocardiographic examinations were performed two days before surgery, early postoperative examinations 5–10 days after mitral valve repair, late postoperative examinations at 1.89±0.15 years after operation.

Results. Mitral regurgitation increased from 0.78±0.77 at early period to 1.46±0.81 at late postoperative period (P<0.001). At late follow-up mitral regurgitation increased in 13 (9.5%) patients in comparison with preoperative mitral regurgitation and in 69 (50.7%) patients in comparison with early postoperative mitral regurgitation. Left ventricular end-diastolic diameter decreased significantly from 56.44±6.29 mm at early period to 54.44±5.98 mm at late period (P<0.004). Left ventricular ejection fraction increased from 35±10% at early period to 38±10% at late period (P<0.047). Left atrial diameter decreased from 46.12±6.35 mm at early period to 43.95±6.94 mm at late period (P<0.034).

Multivariate analysis revealed predictors of late postoperative mitral regurgitation: preoperative left ventricular end-systolic diameter index (P=0.037), left ventricular wall motion score index (P=0.042), mitral regurgitation (P=0.013), and systolic pulmonary artery pressure (P=0.04).

Conclusions. It is possible to predict the progression of mitral regurgitation following ischemic mitral valve repair. Late postoperative mitral regurgitation depends on these preoperative echocardiographic variables: left ventricular end-systolic diameter index, left ventricular wall motion score index, mitral regurgitation, and systolic pulmonary artery pressure.

Introduction

The basic mechanism of ischemic mitral regurgitation (MR) is leaflet tethering by the outward displacement of papillary muscles due to left ventricular (LV) remodeling (1–7). This condition is associated with a high morbidity and mortality when treated conservatively (8, 9). Alternatively, surgical correction of ischemic MR (in combination with coronary artery bypass grafting) may be preferred. However, ischemic mitral valve repair (MVR) is associated with a relatively high perioperative morbidity and mortality (10). Moreover, durability of MVR for ischemic MR remains questionable. Therefore, it is important to determine parameters which may have impact on progression of mitral regurgitation following MVR.

Methods

The study population consisted of 136 patients with ischemic heart disease and ischemic MR. MVR was performed at the Kaunas University of Medicine Hospital between 2000 and 2004. The baseline characteristics are presented in Table 1.

The definition of MR mechanism was performed according to Carpentier's functional classification: 84 (61.8%) patients had type I (annular dilation), 23 (16.9%) – type III (posterior leaflet restriction in systole), others – type I combined with type III.

All patients underwent conventional multivessel CABG using mild hypothermic-normothermic cardiopulmonary bypass and antegrade cold crystalloid cardioplegia. The repair consisted of an annuloplasty

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Table 1. **Preoperative patients characteristics**

Parameter	Value
Age, y	66.6±8.7
Gender, m/f	104/32
Previous MI	89 (65.4%)
Acute MI	47 (34.6%)
CA	2.7±0.5
MR grade	2.7±0.45
LVEF, %	34.7±9.2
NYHA II	7 (5.1%)
NYHA III	85 (62.6%)
NYHA IV	6 (4.4%)
Killip class II	25 (18.4%)
Killip class III	7 (5.1%)
Killip class IV	6 (4.4%)
MR mechnism:	
Type I	84 (61.8%)
Type III	23 (16.9%)
Type I+III	24 (17.6%)

CA – number of involved coronary arteries; LVEF – left ventricular ejection fraction; MI – myocardial infarction; MR – mitral regurgitation; NYHA – New York Heart Association functional class; type I – annular dilation; type III – posterior leaflet restriction in systole.

using double semi-purse-string suture.

Preoperative echocardiographic examinations were performed two days before surgery; early postoperative – 5–10 days after MVR; late postoperative – 1.89±0.15 years after operation.

Statistical analysis was performed using SPSS 12.0 programme. Multivariatle ANOVA was used to determine the relationships between preoperative clinical or echocardiographic variables and postoperative MR. Results were expressed as mean±SD. For comparison of variables before and after operation Student t test was used. $P<0.05$ was considered statistically significant.

Results

MR increased from 0.78±0.77 at early period to 1.46±0.81 at late postoperative period ($P<0.001$). At late follow-up MR increased in 13 (9.5%) patients in comparison with preoperative MR and in 69 (50.7%) patients in comparison with early postoperative MR.

LV end-diastolic diameter decreased significantly from 56.44±6.29 mm at early period to 54.44±5.98 mm at late period ($P<0.004$).

LV ejection fraction increased from 35±10% at early period to 38±10% at late period ($P<0.047$).

Left atrial diameter decreased from 46.12±6.35 mm at early period to 43.95±6.94 mm at late period ($P<0.034$).

Late postoperative MR depends on these preoperative echocardiographic variables: LV end-systolic diameter index (LVSDi) ($P=0.037$), LV wall motion score index ($P=0.042$), preoperative MR ($P=0.013$), systolic pulmonary artery pressure (SPAP) ($P=0.04$) (Table 2). There was no correlation between progression of MR and patient's age, NYHA functional class, number of involved coronary arteries, mechanism of MR, operative techniques ($P>0.05$).

If preoperative LVSDi is ≥25 mm/m², the possibility of recurrent MR >I° is greater by 48.2% than in the case of preoperative LVSDi<25 mm/m² ($\alpha=0.05$; $\beta=0.1$). If preoperative SPAP is >40 mmHg, the possibility of recurrent MR >I°, is twice greater than in the case of preoperative SPAP≤40 mmHg ($P=0.003$). If preoperative LV wall motion score index is <2, the possibility of late postoperative MR <II° is twice greater than in the case of score index ≥2 ($P=0.042$). The strong correlation was revealed between MR grade at early postoperative and late postoperative period: higher MR grade is at early postoperative period, the higher grade will be at the late postoperative period ($P<0.001$).

Discussion

The number of patients presenting with heart failure and severely dilated LV is increasing exponentially (11), majority having coronary artery disease as un-

Table 2. **Predictors of postoperative MR**

Predictor	*P* value
Preoperative LV end-systolic diameter index	<0.0001
Preoperative index of segmental contraction	0.042
Preoperative MR	0.013
Preoperative systolic pulmonary artery pressure	0.04

MR – mitral regurgitation; LV – left ventricular.

derlying cause (12). While treating ischemic MR, it is important to have a deep understanding of the changes in the mitral valve apparatus that has impact on ischemic mitral valve regurgitation. Previously, it was believed that ischemic MR occurs due to papillary muscle dysfunction (13). However, it was revealed that ischemic MR might be attributed to several factors such as mitral valve annulus, LV shape, papillary muscles, and *chordae tendineae* (14).

Conservative management of severe MR is associated with a poor prognosis, with a 1-year survival of 30% to 40% (15). CABG with mitral valve surgery is associated with an improved survival as compared with medical therapy (9). Still, surgical interventions in patients with ischemic cardiomyopathy are associated with a relatively high mortality, and CABG procedures alone do not reduce the severity of MR (8).

Patients with mitral regurgitation ≥2 before surgery are recommended to undergo mitral valve repair (16, 17). It was shown that the long-term prognosis was poor in the cases in which the grade of mitral regurgitation remained ≥2 after operation (14, 18).

Previous reports have shown that NYHA functional class was a good predictor of postoperative survival (16, 19) and heart failure (19, 20). However, the evaluation is subjective, and many patients are only mildly symptomatic because they limit their own activity unconsciously (21). Early study has revealed that age and less marked preoperative posterior tethering are predictive of recurrent MR (22). Higher mitral annular diameter, higher tethering area, and higher preoperative MR severity have been also identified as independent predictors of recurrent MR (23). Our study did not show any correlation between NYHA functional class and MR progression.

No correlation was found between recurrent MR and MR mechanism. Our study revealed that preoperative LVSDi, LV wall motion score index, MR, and SPAP are predictors of recurrent MR. This finding may suggest that extensive LV dilatation and severe LV dysfunction increased LV wall motion score and SPAP may be an irreversible process and surgery should preferably be performed before extensive LV dilatation and severe LV dysfunction occurred (10, 24).

Conclusions

Our study revealed predictive value of preoperative parameters for progression of mitral regurgitation following ischemic mitral valve repair. Preoperative predictors of late postoperative mitral regurgitation are following: left ventricular end-systolic diameter index, left ventricular wall motion score index, mitral regurgitation, and systolic pulmonary artery pressure.

Ikioperacinių žymenų prognostinė vertė išeminio mitralinio vožtuvo nesandarumo progresavimui po mitralinio vožtuvo plastikos

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Raktažodžiai: mitralinio vožtuvo nesandarumas, išeminio mitralinio vožtuvo plastika.

Santrauka. *Tikslas.* Mitralinio vožtuvo plastikos rezultatų ilgalaikiškumas, gydant išeminį mitralinį nesandarumą, tebėra neaiškus. Mūsų tyrimo tikslas buvo nustatyti grįžtamojo mitralinio nesandarumo prognostinius žymenis po išeminio mitralinio vožtuvo plastikos.

Medžiaga ir metodai. Išanalizuoti 136 pacientų, sergančių išemine širdies liga su išeminiu mitraliniu nesandarumu, kuriems 2000–2004 m. Kauno medicinos universiteto klinikose atlikta mitralinio vožtuvo plastika, duomenys. Ikioperacinis echokardiografinis tyrimas atliktas dvi dienos prieš operaciją, ankstyvasis pooperacinis – 5–10 dienų po mitralinio vožtuvo plastikos, vėlyvasis – 1,89±0,15 metų po operacijos.

Rezultatai. Mitralinis nesandarumas padidėjo nuo 0,78±0,77 ankstyvuoju laikotarpiu iki 1,46±0,81 vėlyvuoju ($p<0,001$). Vėlyvuoju pooperaciniu laikotarpiu, palyginus su ikioperaciniu, mitralinis nesandarumas padidėjo 13 (9,5 proc.) pacientų, palyginus su ankstyvuoju pooperaciniu – 69 (50,7 proc.) pacientams. Kairiojo skilvelio galinis diastolinis dydis sumažėjo nuo 56,44±6,29 mm ankstyvuoju laikotarpiu iki 54,44±5,98 mm vėlyvuoju ($p<0,004$). Kairiojo skilvelio išstūmimo frakcija padidėjo nuo 35±10 proc. ankstyvuoju laikotarpiu iki 38±10 proc. vėlyvuoju. Kairiojo prieširdžio diametras sumažėjo nuo 46,12±6,35 mm ankstyvuoju laikotarpiu iki 43,95±6,94 mm vėlyvuoju.

Faktorinės analizės metodu nustatėme, jog vėlyvąjį mitralinį nesandarumą galima prognozuoti remiantis šiais rodmenimis: kairiojo skilvelio galinio sistolinio dydžio indeksu ($p=0,037$), kairiojo skilvelio segmentinės

kontrakcijos indeksu (p=0,042), mitralinio nesandarumo laipsniu (p=0,013), sistoliniu plaučių arterijos spaudimu (p=0,04).

Išvados. Mitralinio vožtuvo nesandarumą po mitralinio vožtuvo plastikos galima prognozuoti remiantis šiais ikioperaciniais tyrimų rodmenimis: kairiojo skilvelio galinio sistolinio dydžio indeksu, kairiojo skilvelio segmentinės kontrakcijos indeksu, mitralinio vožtuvo nesandarumo laipsniu, plaučių arterijos sistoliniu spaudimu.

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