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The quality of life in patients with at least moderate ischemic mitral regurgitation qualified to cardiosurgery treatment

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Abstract: Background: To assess and compare mid-term outcomes and the quality of life (QoL) in patients with multivessel coronary artery disease (MVD) and moderate ischemic mitral regurgitation (IMR), treated with either coronary artery bypass grafting (CABG; group I) or CABG + mitral annuloplasty (CABG+MA; group II) in 12-months follow-up after surgery.
Methods: We prospectively analyzed 74 patients (50.7% female, 66 [67–72] years) with at least moderate IMR, 3–24 weeks after myocardial infarction (MI). The effective regurgitation orifice (ERO) was used for a quantitative IMR assessment. To evaluate QoL we used a Short Form-36 (SF-36) questionnaire.
Results: Patients in group II spent more time in the hospital, expired more infection complications and received more often in-hospital complications requiring use amines and intra-aortic balloon pump as compared to those in group I. Analysis of SF-36 showed that all patients treated surgically notable improved their QoL during 12 months of follow-up.
Conclusions: We observed a significant improvement in QoL among patients with MVD in 12 months follow-up after surgery irrespective of treatment type.

Keywords: coronary artery bypass graft, mitral annuloplasty, quality of life.

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Background

The World Health Organization defines health as a lack of disease or disability and a state of full physical, psychological and social capacity. According to the above definition the idea of human health in the holistic approach toward patients should be widened to the lack of disease, improvement of long-term prognosis as well as the quality of life (QoL). The aim of the study was to assess and compare the QoL in patients with multivessel coronary artery disease (MVD) and moderate ischemic mitral regurgitation (IMR), treated with either coronary artery bypass grafting (CABG, group I) or CABG and mitral annuloplasty (CABG+MA, group II) in 12-months follow-up after surgery.

Methods

Study population

This prospective observational cohort study conducted in academic hospital, included 74 patients aged >18, with a history of myocardial infarction (MI) and eligible for CABG [1]. All patients had moderate IMR (defined by the presence of the effective regurgitant orifice area (ERO) ≥10 and <20 mm^2) caused by restrictive systolic leaflet motion (Carpentier's type IIIb), with or without annular dilatation, which occurred after MI, with no evidence of primary leaflet, chordal, or papillary muscle pathology, excluding mechanical complications of MI. Patients were referred for CABG or CABG +MA based on clinical assessment, 2D echo at rest and during stress echocardiography [2]. The eligibility of patients for particular therapeutic methods was determined according to the echocardiographic criteria presented in Table 1.

Table 1. Eligibility criteria for an appropriate surgical treatment.

	CABG, group I	CABG+MA, group II
ERO ExE	<20 mm^2	≥20 mm^2
CH DBX	≤6 mm	6 mm <CH <10 mm
TA DBX	≤1.2 cm^2	1.2 cm^2 <TA <12.5 cm^2

ExE — exercise echocardiography, ERO — effective regurgitant orifice, CH — coaptation height, TA — tenting area

QoL was evaluated before and 12 months after surgery.

Each patient signed an informed consent form, and the study was approved by the institutional review board of the Medical University of Warsaw. The study had been conducted according to the principles stated in the Declaration of Helsinki.

Primary and secondary endpoints

Primary endpoint was assigned as difference in QoL during follow-up period of 12 months in each predefined group. Secondary endpoint was the evaluation of the parameters that specifically increased (or decreased) QoL.

The SF-36 questionnaire

The 36-Item Short Form Health Survey (SF-36) was used for the quantitative assessment of QoL [3]. The SF-36 questionnaire consists of 36 items. The subjects completed the questionnaire at baseline and after 12-months of follow-up. Completion of the questionnaire was each time verified and corrected if necessary, during the patient's visit. All calculations of QoL parameters, including mental component summary (MCS) and physical component summary (PCS), were carried out according to the established algorithms. All but one item are assigned to one of the eight health domains covering various aspects of physical and mental health: physical functioning (PF, 10 items), physical role functioning (RP, 4 items), emotional role functioning (RE, 3 items), vitality, (VT, 4 items), mental health (MH, 5 items), social role functioning (SF, 2 items), bodily pain (BP, 2 items) and general health perceptions (GH, 5 items). Health domain subscales consist of the sum scores of the assigned items. Out of the eight subscales, each representing one health domain, two summary measures can be constructed: the physical component summary (PCS) for self-perceived physical health that incorporates PF, RP, BP, GH dimensions and the mental component summary (MCS) for self-perceived mental health that incorporates RE, VT, SF, MH dimensions. In the absence of recognized standards of high and low values within SF-36 questionnaire, we dichotomized the PCS and MCS scores into deterioration and improvement in score during follow up period. Improvement in PCS and MCS scores was divided after assuming an elective cut off point based on the quartiles scores of the whole study group.

Echocardiography

Transthoracic echocardiograms (TTE) were performed within two days before surgery. All examinations were carried out using the iE33 system manufactured by Philips, a broadband transducer for TTE of 2.5 to 3.5 MHz frequencies.

IMR severity was considered moderate with ERO ≥10 mm^2 and <20 mm^2. Wall motion score index (WMSI) was calculated according to a 17-segment model [4]. The left ventricular volumes and ejection fraction (EF) were assessed by the biplane Simpson disk method [5]. The mitral valve deformation (MDI — mitral deformation indexes) was evaluated by measuring the tenting area (TA), i.e., the area enclosed between mitral leaflets and the line of annular plane and the coaptation height (CH), i.e., the distance between leaflet coaptation and mitral annular plane from the parasternal long-axis view at mid-systole [6].

Stress Echocardiography

Low dose dobutamine echocardiography (DBX) was used to distinguish akinetic viable segments from nonviable myocardial regions. The presence of a significant area of viable LV myocardium was the condition for patient inclusion for further analysis. Additionally, during DBX the dynamics of MDI (increase or decrease) and IMR changes were analyzed. The next step of qualification for the surgery included symptom-limited exercise echocardiography (ExE) to assess the dynamics of IMR changes.

Data collection

Baseline clinical characteristics (demographics, medical history and therapy) and echocardiography (resting and stress echocardiography) examination performed at baseline visit were retrieved from patient's medical records.

Statistical analysis

All continuous variables were tested for normality with the Shapiro-Wilk test. Continuous variables were assigned as non-parametric and expressed as median (interquartile range) or parametric and expressed as mean ± standard deviation (SD). Categorical variables were expressed as counts (n) with percentages (%). Fisher's exact test was used to compare categorical variables. Differences in continuous parameters were compared using Mann-Whitney U test (non-parametric) and t-test (parametric variables). Improvement in PCS was spited in increase of 0–30 and >30 and MCS was spited in increase of 0–20 and >20. To determine predictors of deterioration in PCS and MCS in all study group multivariate logistic regression analysis, using the stepwise forward procedure that included all variables that reached statistical significance ($p < 0.05$) in univariate analysis was performed. A two-sided p value of 0.05 was considered statistically significant. For database management and statistical analysis, we used SAS Institute Inc. 2015. SAS/IML® 14.1 User's Guide. Cary, NC: SAS Institute Inc.

Results

No statistically significant differences in baseline characteristics were observed between patients in both treatment groups. Patients in group II had a longer hospital stay after surgery, expired more infection complications and required using amines and intra-aortic balloon pump more often as compared to those in group I (Table 2).

Table 2. Baseline characteristics depending on procedure type performed.

Variable	Overall (n = 73)	Group I (n = 44)	Group II (n = 29)	p value
Demographics				
Age (years)	66 [67–72]	66 [58–72]	67 [57–73]	0.92
Females	37 (50.7%)	20 (45.5%)	17 (58.6%)	0.34
Coronary artery disease				
1-vessel	5 (6.8%)	1 (2.3%)	4 (13.8%)	0.08
2-vessel	19 (26.0%)	13 (29.6%)	6 (20.7%)	0.43
3-vessel	49 (67.1%)	30 (69.8%)	19 (67.9%)	1.00
CCS score	3 [2–3]	3 [2–3]	3 [2–3]	0.43
Family history	34 (46.6%)	22 (50.0%)	12 (41.4%)	0.48
Comorbidities				
Heart failure, NYHA class	2 [1–3]	2 [1–2]	2 [2–3]	0.10
Hypertension	44 (60.3%)	25 (56.8%)	19 (65.5%)	0.48
Atrial fibrillation	12 (16.4%)	7 (15.9%)	5 (17.2%)	1.00
Diabetes mellitus	24 (32.9%)	12 (27.3%)	12 (41.4%)	0.31
COPD	6 (8.2%)	3 (6.8%)	3 (10.3%)	0.68
Renal dysfunction	10 (13.7%)	5 (11.4%)	5 (17.2%)	0.51
Smoking (current/former)	54 (74.0%)	34 (77.3%)	20 (69.0%)	0.59
Hyperlipidaemia	43 (58.9%)	28 (63.6%)	15 (51.7%)	0.34
Hospitalization				
Time (days)	22 [16–32]	21 [16–26]	32 [22–46]	<0.01
Full revascularization	49 (67.1%)	28 (63.6%)	21 (72.4%)	0.46
Coronary bypass (number)				
0	3 (4.1%)	0 (0%)	3 (10.3%)	0.06
1	56 (76.7%)	35 (79.6%)	21 (72.4%)	0.65
2	10 (13.7%)	6 (13.6%)	4 (13.8%)	1.00
3	4 (5.5%)	3 (6.8%)	1 (3.5%)	1.00
In-hospital complications				
• Cardiogenic shock	4 (5.5%)	1 (2.3%)	3 (10.3%)	0.29
• Stroke/TIA	3 (4.1%)	0 (0%)	3 (10.3%)	0.06
• Infection	24 (32.9%)	10 (22.7%)	14 (48.3%)	0.04

Table 2. cont.

Variable	Overall (n = 73)	Group I (n = 44)	Group II (n = 29)	p value
• Renal failure	5 (6.8%)	2 (4.6%)	3 (10.3%)	0.38
• Pulmonary failure	3 (4.1%)	1 (2.3%)	2 (6.9%)	0.56
• Bleeding	2 (2.7%)	0 (0%)	2 (6.9%)	0.15
In-hospital treatment				
• Amines	37 (50.7%)	15 (34.1%)	22 (75.9%)	<0.01
• Antiarrhythmic dugs	21 (28.8%)	10 (22.7%)	11 (37.9%)	0.19
• IABP therapy	17 (23.3%)	6 (13.6%)	11 (37.9%)	0.02
• Beta-blockers	68 (93.2%)	42 (95.5%)	26 (89.7%)	0.38
• ACEI	59 (80.8%)	38 (86.4%)	21 (72.4%)	0.22
• Calcium channel blockers	9 (12.3%)	6 (13.6%)	3 (10.3%)	1.00
• Diuretics	61 (83.6%)	36 (81.8%)	25 (86.2%)	0.75
• Statins	65 (89.0%)	40 (90.9%)	25 (86.2%)	0.70

Number provided after the semicolon indicates the total number of patients available for that variable.
ACEI — angiotensin converting enzyme inhibitor; ARB — aldosterone receptor blockers; CABG — coronary artery bypass grafting; CCS — Canadian Cardiovascular Society; COPD — chronic obstructive pulmonary disease; IABP — Intra-Aortic Balloon Pump; MA — mitral annuloplasty; MRA — mineralocorticoid receptor antagonist; NYHA — New York Heart Association; TIA — transient ischemic attack

Irrespective of improvement or deterioration in PCS and/or MCS, patients did not statistically significant differed according to baseline characteristics, medications, hospitalization time and in-hospital complications and associated treatment (Table 3 and Table 4), except for older age among patients with deterioration in MCS as compared to those with improvement in MCS. After 1 year, comparing patients in both groups no differences were observed according to heart failure severity (based on NYHA scale), angina pectoris severity (based on CCS score) and quality of life (based on MCS and PCS summary) (Table 5A). Patients with improvement in PCS >30 has improved NYHA class by 1 more often than patients with increase in PCS increase of 0–30. Similar observation concerned MCS improvement (Table 5B and Table 5C).

Table 3. Baseline characteristics depending on changes in physical component summary (PCS) during follow up period.

Variable	Improvement in PCS			Deterioration in PCS (n = 8)	p value
	Overall (n = 65)	0–30 (n = 30)	>30 (n = 35)		
Demographics					
Age (years)	64 [57–72]	66 [58–72]	62 [57–73]	71 [68–72]	0.21
Females	33 (50.8%)	16 (53.3%)	17 (48.6%)	4 (50.0%)	1.00
Coronary artery disease					
1-vessel	5 (7.7%)	4 (13.3%)	1 (2.9%)	0 (0%)	1.00
2-vessel	18 (27.7%)	5 (16.7%)	13 (37.1%)	1 (12.5%)	0.67
3-vessel	42 (64.6%)	21 (70.0%)	21 (61.8%)	7 (87.5%)	0.42
CCS score	3 [2–3]	3 [2–4]	3 [2–3]	3 [2–3]	0.69
Family history	31 (47.7%)	14 (46.7%)	17 (48.6%)	3 (37.5%)	0.72
Comorbidities					
Heart failure, NYHA class	2 [1–3]	1 [1–2]	2 [2–3]	2 [2–3]	0.16
Hypertension	40 (61.5%)	19 (61.3%)	21 (60.0%)	4 (50.0%)	0.70
Atrial fibrillation	10 (15.4%)	7 (23.3%)	3 (8.6%)	2 (25.0%)	0.61
Diabetes mellitus	22 (33.8%)	8 (26.7%)	14 (40.0%)	2 (25.0%)	1.00
COPD	5 (7.7%)	2 (6.7%)	3 (8.6%)	1 (12.5%)	0.51
Renal dysfunction	10 (15.4%)	2 (6.7%)	8 (22.9%)	0 (0%)	0.59
Smoking (current/former)	47 (72.3%)	18 (60.0%)	29 (82.9%)	7 (87.5%)	0.67
Hyperlipidaemia	37 (56.9%)	15 (50.0%)	22 (62.9%)	6 (75.0%)	0.46
Hospitalization					
Time (days)	22 [16–35]	22 [17–32]	23 [16–38]	24 [18–30]	0.71
Full revascularization	45 (69.2%)	23 (73.3%)	22 (62.9%)	5 (62.5%)	1.00
Coronary bypass (number)					
0	3 (4.6%)	2 (6.7%)	1 (2.9%)	0 (0%)	1.00
1	49 (75.4%)	21 (67.7%)	28 (80.0%)	7 (87.5%)	1.00
2	10 (15.4%)	4 (13.3%)	6 (17.1%)	0 (0%)	0.59
3	3 (4.6%)	3 (10.0%)	0 (0%)	1 (12.5%)	1.00
In-hospital complications					
• Cardiogenic shock	4 (6.2%)	3 (10.0%)	1 (2.9%)	0 (0%)	1.00
• Stroke/TIA	3 (4.6%)	1 (3.3%)	2 (5.7%)	0 (0%)	1.00

Table 3. cont.

Variable	Improvement in PCS			Deterioration in PCS (n = 8)	p value
	Overall (n = 65)	0–30 (n = 30)	>30 (n = 35)		
• Infection	22 (33.8%)	10 (33.3%)	12 (34.3%)	2 (25.0%)	1.00
• Renal failure	4 (6.2%)	1 (3.3%)	3 (8.6%)	1 (12.5%)	0.45
• Pulmonary failure	3 (4.6%)	2 (6.7%)	1 (2.9%)	0 (0%)	1.00
• Bleeding	2 (3.1%)	0 (0%)	2 (5.7%)	0 (0%)	1.00
In-hospital treatment					
• Amines	33 (50.8%)	16 (53.3%)	17 (49.6%)	4 (50.0%)	1.00
• Antiarrhythmic dugs	19 (29.2%)	7 (23.3%)	12 (34.3%)	2 (25.0%)	1.00
• IABP therapy	16 (24.6%)	5 (16.7%)	11 (31.4%)	1 (12.5%)	0.67
• Beta-blockers	62 (95.4%)	29 (96.7%)	33 (94.3%)	6 (75.0%)	0.09
• ACEI	52 (80.0%)	24 (80.0%)	28 (80.0%)	7 (87.5%)	1.00
• Calcium channel blockers	9 (13.8%)	5 (16.7%)	4 (11.4%)	0 (0%)	0.58
• Diuretics	54 (83.1%)	24 (80.0%)	30 (85.7%)	7 (87.5%)	1.00

Number provided after the semicolon indicates the total number of patients available for that variable.
ACEI — angiotensin converting enzyme inhibitor; ARB — aldosterone receptor blockers; CCS — Canadian Cardiovascular Society; COPD — chronic obstructive pulmonary disease; IABP — Intra-Aortic Balloon Pump; MRA — mineralocorticoid receptor antagonist; NYHA — New York Heart Association; PCS — physical component summary; TIA — transient ischemic attack

Table 4. Baseline characteristics depending on changes in mental component summary (MCS) during follow up period.

Variable	Improvement in MCS			Deterioration in MCS (n = 12)	p value
	Overall (n = 61)	0–20 (n = 29)	>20 (n = 32)		
Demographics					
Age (years)	64 [55–73]	64 [55–71]	64 [56–74]	71 [68–72]	<0.01
Females	31 (50.8%)	14 (48.3%)	17 (53.1%)	6 (50.0%)	1.00
Coronary artery disease					
1-vessel	2 (3.3%)	0 (0%)	2 (6.3%)	3 (25.0%)	0.03
2-vessel	18 (29.5%)	7 (24.1%)	11 (34.4%)	1 (8.3%)	0.17
3-vessel	41 (68.3%)	22 (75.9%)	19 (61.3%)	8 (72.7%)	1.00

Table 4. cont.

CCS score	3 [2–3]	3 [2–3]	3 [2–3]	3 [2–3]	0.86
Family history	30 (49.2%)	15 (51.7%)	15 (46.9%)	4 (33.3%)	0.36
Comorbidities					
Heart failure, NYHA class	2 [1–3]	**1 [1–2]**	**2 [2–3]**	2 [2–3]	0.44
Hypertension	39 (63.9%)	16 (55.2%)	23 (71.9%)	6 (41.7%)	0.20
Atrial fibrillation	8 (13.1%)	4 (13.8%)	4 (12.5%)	4 (33.3%)	0.10
Diabetes mellitus	23 (37.7%)	8 (27.6%)	15 (46.9%)	1 (8.3%)	0.09
COPD	6 (9.8%)	3 (10.3%)	3 (9.4%)	0 (0%)	0.58
Renal dysfunction	9 (14.8%)	2 (6.9%)	7 (21.9%)	1 (8.3%)	1.00
Smoking (current/former)	45 (73.3%)	**17 (58.6%)**	**28 (87.5%)**	9 (75.0%)	1.00
Hyperlipidaemia	34 (55.7%)	13 (44.8%)	21 (65.6%)	9 (75.0%)	0.34
Hospitalization					
Time (days)	22 [16–32]	23 [17–36]	21 [15–31]	23 [20–33]	0.76
Full revascularization	41 (67.2%)	19 (65.5%)	22 (68.8%)	8 (66.7%)	1.00
Coronary bypass (number)					
0	2 (3.3%)	0 (0%)	2 (6.3%)	1 (8.3%)	0.27
1	45 (73.8%)	21 (72.4%)	24 (75.0%)	11 (91.7%)	1.00
2	10 (16.4%)	6 (20.7%)	4 (12.5%)	0 (0%)	1.00
3	4 (6.6%)	2 (6.9%)	2 (6.3%)	0 (0%)	1.00
In-hospital complications					
• Cardiogenic shock	4 (6.6%)	3 (10.3%)	1 (3.1%)	0 (0%)	1.00
• Stroke/TIA	3 (4.9%)	3 (10.3%)	0 (0%)	0 (0%)	1.00
• Infection	21 (34.4%)	9 (31.0%)	12 (37.5%)	3 (25.0%)	0.74
• Renal failure	3 (4.9%)	2 (6.9%)	1 (3.1%)	2 (16.7%)	0.19
• Pulmonary failure	3 (4.9%)	1 (3.5%)	2 (6.3%)	0 (0%)	1.00
• Bleeding	2 (3.3%)	1 (3.5%)	1 (3.1%)	0 (0%)	0.76
In-hospital treatment					
• Amines	32 (52.5%)	14 (48.3%)	18 (56.3%)	5 (41.7%)	0.54
• Antiarrhythmic dugs	18 (29.5%)	9 (31.0%)	9 (28.1%)	3 (25.0%)	1.00
• IABP therapy	14 (23.0%)	6 (20.7%)	8 (25.0%)	3 (25.0%)	1.00
• Beta-blockers	57 (93.4%)	27 (93.1%)	30 (93.8%)	11 (91.7%)	1.00
• ACEI	49 (80.3%)	22 (75.9%)	27 (84.4%)	10 (83.3%)	1.00

Table 4. cont.

Variable	Improvement in MCS			Deterioration in MCS (n = 12)	p value
	Overall (n = 61)	0–20 (n = 29)	>20 (n = 32)		
• Calcium channel blockers	8 (13.1%)	5 (17.2%)	3 (9.4%)	1 (8.3%)	1.00
• Diuretics	51 (83.6%)	25 (86.2%)	26 (81.3%)	10 (83.3%)	1.00

Number provided after the semicolon indicates the total number of patients available for that variable.
Bolded values indicated differences within group with improvement in MCS (0–20 vs. >20).
ACEI — angiotensin converting enzyme inhibitor; ARB — aldosterone receptor blockers; CCS — Canadian Cardiovascular Society; COPD — chronic obstructive pulmonary disease; IABP — Intra-Aortic Balloon Pump; MCS — in mental component summary; MRA — mineralocorticoid receptor antagonist; NYHA — New York Heart Association; TIA — transient ischemic attack

Table 5. Follow up visit.

A.

	Overall (n = 73)	Group I (n = 44)	Group II (n = 29)	p value
Weight gain	44 (60.3%)	25 (56.8%)	19 (65.5%)	0.48
All-cause hospitalizations	7 (9.6%)	3 (6.8%)	4 (13.8%)	0.43
NYHA scale				
• deterioration by 1 class	4 (5.5%)	3 (6.8%)	1 (3.5%)	1.00
• no improvement	30 (41.1%)	19 (43.2%)	11 (37.9%)	0.81
• improvement by 1 class	30 (41.1%)	19 (43.2%)	11 (37.9%)	0.81
• improvement by 2 classes	9 (12.3%)	4 (9.1%)	5 (17.2%)	0.47
• improvement by 3 classes	1 (1.4%)	0 (0%)	1 (3.5%)	0.40
CCS score				
• no improvement	12 (16.4%)	5 (11.4%)	7 (24.1%)	0.20
• improvement by 1 class	19 (26.0%)	14 (31.8%)	5 (17.2%)	0.19
• improvement by 2 classes	28 (38.4%)	15 (34.1%)	13 (44.8%)	0.46
• improvement by 3 classes	14 (19.2%)	10 (22.7%)	4 (13.8%)	0.38
Physical component summary				
• deterioration	8 (11.0%)	6 (13.6%)	2 (6.9%)	0.46
• improvement 0–30	30 (41.1%)	19 (43.2%)	11 (37.9%)	0.81
• improvement >30	35 (47.9%)	19 (43.2%)	16 (55.2%)	0.35

Table 5A. cont.

Mental component summary				
• deterioration	12 (16.4%)	7 (15.9%)	5 (17.2%)	1.00
• improvement 0–20	29 (39.7%)	19 (43.2%)	10 (34.5%)	0.48
• improvement >20	32 (43.8%)	18 (40.9%)	14 (48.3%)	0.63

CABG — coronary artery bypass grafting; CCS — Canadian Cardiovascular Society; MA — mitral annuloplasty; NYHA — New York Heart Association

B.

Variable	Improvement in PCS			Deterioration in PCS (n = 8)	p value
	Overall (n = 65)	0–30 (n = 30)	>30 (n = 35)		
Weight gain	42 (63.6%)	20 (64.5%)	22 (62.9%)	3 (37.5%)	0.25
All-cause hospitalizations	4 (6.2%)	0 (0%)	4 (11.4%)	3 (37.5%)	0.03
NYHA scale					
deterioration by 1 class	4 (6.2%)	4 (13.3%)	0 (0%)	0 (0%)	1.00
• no improvement	25 (39.4%)	16 (53.3%)	9 (25.7%)	5 (62.5%)	0.26
• improvement by 1 class	27 (42.4%)	8 (26.7%)	19 (54.3%)	3 (37.5%)	1.00
• improvement by 2 classes	9 (13.9%)	3 (10.0%)	6 (17.1%)	0 (0%)	0.58
• improvement by 3 classes	1 (1.5%)	0 (0%)	1 (2.9%)	0 (0%)	1.00
CCS score					
• no improvement	11 (18.2%)	5 (16.7%)	6 (17.1%)	1 (12.5%)	1.00
• improvement by 1 class	16 (24.6%)	7 (23.3%)	9 (25.7%)	3 (37.5%)	0.42
• improvement by 2 classes	25 (38.5%)	9 (30.0%)	16 (45.7%)	3 (37.5%)	1.00
• improvement by 3 classes	13 (20.0%)	9 (30.0%)	4 (11.4%)	1 (12.5%)	1.00

CCS — Canadian Cardiovascular Society; NYHA — New York Heart Association; PCS — physical component summary.
Bolded data means statistically significant difference (p <0.05) between PCS improvement 0–30 vs. >30.

C.

Variable	Improvement in MCS			Deterioration in MCS (n = 12)	p value
	Overall (n = 61)	0–20 (n = 29)	>20 (n = 32)		
Weight gain	36 (59.0%)	17 (58.6%)	19 (59.4%)	8 (66.7%)	0.75
All-cause hospitalizations	5 (8.2%)	2 (6.9%)	3 (9.4%)	2 (16.7%)	0.32
NYHA scale					
deterioration by 1 class	3 (4.9%)	2 (6.9%)	1 (3.1%)	1 (8.3%)	0.52
• no improvement	24 (39.3%)	**19 (65.5%)**	**5 (15.6%)**	6 (50.0%)	0.53
• improvement by 1 class	27 (44.3%)	**7 (24.1%)**	**20 (62.5%)**	3 (25.0%)	0.34
• improvement by 2 classes	7 (11.5%)	2 (6.9%)	5 (15.6%)	2 (16.7%)	0.64
• improvement by 3 classes	1 (1.6%)	0 (0%)	1 (3.1%)	0 (0%)	1.00
CCS score					
• no improvement	10 (16.4%)	5 (17.2%)	5 (15.6%)	2 (16.7%)	1.00
• improvement by 1 class	16 (26.2%)	7 (24.1%)	9 (28.1%)	3 (25.0%)	1.00
• improvement by 2 classes	23 (37.7%)	11 (37.9%)	12 (37.5%)	5 (41.7%)	1.00
• improvement by 3 classes	12 (19.7%)	6 (20.7%)	6 (18.8%)	2 (16.7%)	1.00

CCS — Canadian Cardiovascular Society; MCS — mental component summary; NYHA — New York Heart Association. Bolded data means statistically significant difference ($p < 0.05$) between MCS improvement 0–20 vs. >20.

In patients with both improvement in MCS and PCS, simultaneously improvement in left ventricle diastolic and systolic dimensions, WMSI, ERO and mitral regurgitation volume was observed (Table 6A and Table 6B).

Table 6. Echocardiography examination at baseline and follow up visit regarding physical component summary status (A), mental component summary status (B).

A.

Variable	Improvement in PCS (n = 65)	
	Baseline visit	FU visit
Rest echocardiography parameters		
LVDD (mm)	**55 [49–59]**	**50 [47–58]**
LVSD (mm)	**40 [35–48]**	**36 [31–46]**
LAD (mm)	43 [35–48]	42 [39–46]

Table 6A cont.

EDV (ml)	114 [89–148]	107 [78–146]
ESV (ml)	62 [42–96]	54 [36–90]
EF (%)	44 ± 9.9	47 ± 11
WMSI	**1.5 [1.4–1.8]**	**1.3 [1.1–1.6]**
RV (mm)	25 [23–27]	26 [24–28]
TAPSE (mm)	15 ± 4.3	15 ± 4.0
TPVG (mmHg)	26 ± 10	24 ± 9.6
ERO (mm2)	**16 [14–18]**	**7 [5–10]**
MR volume (ml)	**30 ± 16**	**15 ± 8.4**

B.

Variable	Improvement in MCS (n = 61)	
	Baseline visit	FU visit
Rest echocardiography parameters		
LVDD (mm)	**55 [50–59]**	**51 [47–57]**
LVSD (mm)	**40 [35–48]**	**36 [31–46]**
LAD (mm)	44 [40–45]	43 [40–46]
EDV (ml)	121 [89–151]	111 [76–151]
ESV (ml)	63 [46–96]	56 [36–91]
EF (%)	44 ± 9.9	47 ± 10
WMSI	**1.5 [1.4–1.8]**	**1.3 [1.1–1.6]**
RV (mm)	25 [23–27]	26 [24–28]
TAPSE (mm)	15 ± 4.5	15 ± 4.2
TPVG (mmHg)	25 ± 10	24 ± 10
ERO (mm2)	**17 [14–18]**	**7 [5–10]**
MR volume (ml)	**28 ± 15**	**15 ± 8.6**

CABG — coronary artery bypass grafting; EDV — end-diastolic volume; EF — ejection fraction; ERO — effective regurgitant orifice; ESV — end-systolic volume; FU — follow up; LAD — left atrial dimension; LVDD — left ventricle diastolic dimension; LVSD — left ventricle systolic dimension; MCS — mental component summary; MA — mitral annuloplasty; MR — mitral regurgitation; PCS — physical component status; RV — right ventricle; TAPSE — tricuspid annular plane systolic excursion; TPVG — trans-valvular pressure gradient; WMSI - wall motion score index

In multivariate analysis only two variables — older age and diabetes mellitus were independent predictors of deterioration in MCS (Table 7).

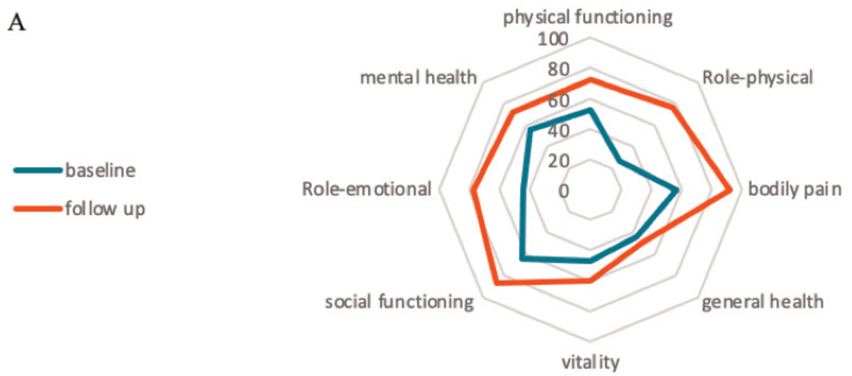
Table 7. Multivariate analysis for deterioration in MCS.

Variable	Multivariate analysis	
	HR (95%CI)	p value
Age (every 10 years)	1.217 (1.040–1.424)	**0.01**
Diabetes mellitus	0.035 (0.002–0.502)	**0.01**

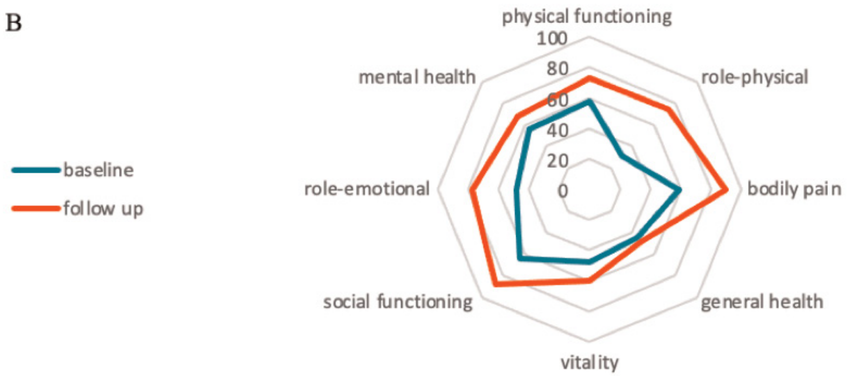
In all study group improvement in each item of SF-36 questionnaire was found (Fig. 1) with the highest improvement in physical role functioning. After 12 months in patients treated with CABG significant differences were found in all SF-36 items expect general health. In patients treated with CABG+MA only mental health improvement wasn't statistically significant.

Discussion

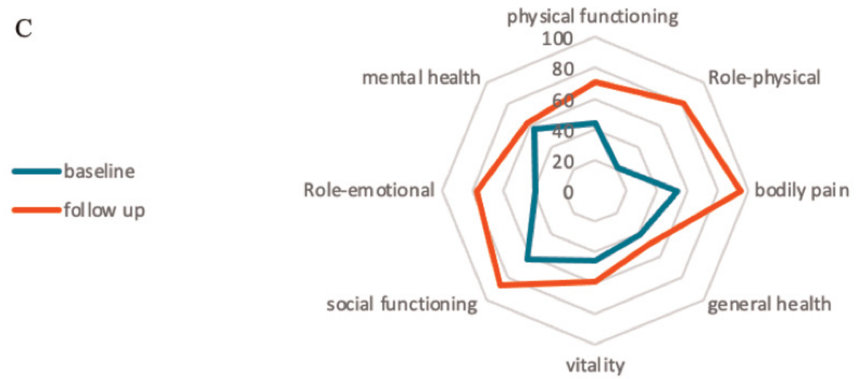
In the development of IMR, mitral tenting in combination with regional left ventricular myocardial scarring is believed to play an important role [7]. Although MA alone can reduce the degree of IMR, it is believed to have little functional benefits on left ventricular recovery [8–10]. Although consensus exists on the lack of need for a surgical repair to treat mild IMR, it remains controversial how moderate IMR should be managed. Different groups have argued for and against the necessity and the benefits of a concomitant MA during CABG in moderate IMR patients. In the recent Randomized Ischemic Mitral Evaluation (RIME) Trial, the supplementation of MA to CABG produced some clinical benefits. However, there were no differences in the 30-day and 1-year mortality between the two groups [11]. In study by Kim *et al.*, early post-operative death, low cardiac output syndrome requiring mechanical circulatory support and new-onset dialysis were also greater in the CABG with MA group than the CABG alone group after adjustment [9]. Therefore, the clinical outcomes only provided evidence against the use of a concomitant MA, as it offered no additional benefits and increased the likelihood of short-term complications. Other studies presented with the opposite view, suggesting clinical benefits in a concomitant MA during CABG [11, 12]. However, the discrepancies in the selection criteria for the study population may have had some influence on the differences in the results and conclusions between our study and other previous trials. Furthermore, the term 'IMR' has often been very loosely defined [13] referring to conditions arising either from an



Significant difference (p <0.05) in all items expect general "health."



Significant difference (p <0.05) in all items expect general "health."



Significant difference (p <0.05) in all items expect general "health."

Fig. 1. Quality of life at baseline and follow-up visit in all study group (A), patients in group I (B), in group II (C).

infarction or a reversible ischaemia [14]. The two causes of what is termed as 'IMR' by many studies would lead to very different clinical outcomes. This may be another reason for the conflicting results and conclusions from previous studies. We strongly believe that well-being means not only absence of disease. According to WHO the measurement of health and the effects of health care must include not only an indication of changes in the frequency and severity of diseases but also an estimation of well-being and this can be assessed by measuring the improvement in the QoL related to health care. Therefore, the aim of our study was to compare QoL during follow-up period of 12 months in each predefined group. We chose SF-36 questionnaire that allows to evaluate both physical and mental health [3]. The utility of this tool has been proved in multiple studies in many countries [15]. Moreover, it is a validated questionnaire widely used with cardiac surgery patients [16–19]. In our group patients with MVD and moderate IMR, improvement in PCS >30 and MCS >20 was correlated with improvement of NYHA class by 1 class. Smith and colleagues reported findings from the Cardiothoracic Surgical Trials Network study on IMR and observed that in the 301 patients with moderate IMR randomized to undergo CABG alone versus CABG and mitral valve repair, the addition of a mitral repair to CABG had similar to CABG group positive effect on QoL in 12-month follow-up. There was no significant difference between treatment groups with respect to any measure of QoL or functional status among surviving patients at 12 months [20]. In our study the change in the SF-36 scores also showed substantial and comparable improvement in the two groups during the first 12 months. Al-Ruzzeh *et al.* assessed the determinants of poor mid-term health related QoL at one year after isolated CABG. They found that preoperative gastrointestinal problems, preoperative congestive heart failure, and type D personality trait were independent predictors of the poor physical component of QoL. Peripheral vascular disease, infective complications, and type D personality trait were independent predictors of the poor mental component of QoL [18]. In our study multivariate analysis showed that only older age and diabetes mellitus were independent predictors deteriorations in MCS in analyzed group. Those results about age-related worsening in MCS score differ from other trials involving patients after CABG. Baig *et al.* performed systematically review the published literature relating to health related QoL outcomes for elderly patients who have undergone CABG. They conclude that performing CABG in the elderly may be associated with significant improvements in QoL [21]. In review of randomized controlled trials Jokkinen *et al.* demonstrated that CABG improves QoL of elderly patients suffering from severe coronary artery disease. The most important factor contributing with the improved postoperative QoL in CABG group was the relief of angina pectoris due to revascularization, and its definitive impact on overall health status both in physical and mental health domains [22].

Impact of diabetes mellitus on QoL after CABG has been reported previously and they are consistent with our results. Data taken from that trials identified several factors such as female sex, diabetes, peripheral vascular disease, >2 days intensive care unit stay, chronic obstructive pulmonary disease, any postoperative infection and the need for PCI in the first year to be independent predictors of low QoL after CABG [23, 24]. Such findings are likely to be translatable since many of these patients will have significant coexisting comorbidities, including diabetes, which may impact their post-operative functional status.

In summary: the improvement in each item of SF-36 questionnaire with the highest increase in physical role functioning in all study group allow us to believe that both CABG and CABG with mitral annuloplasty improves not only clinical parameters but also QoL of patients.

Limitations

The main limitation of the study is the small study sample size (≤100 patients), decreasing the ability to detect factors influencing QoL outcomes. There is currently no established optimal duration for QoL assessment and no studies report long-term (i.e., 5-year) outcomes. This is important to note as the evaluation of QoL within the first few months after surgery may not produce accurate results. Slower rehabilitation in some patients (i.e., older patients) may adversely affect QoL outcomes. Moreover, early beneficial effects on QoL seen during 12-month period of follow-up cannot be representative of long-term QoL improvements. Further research is, therefore, required to determine true QoL outcomes in longer period after surgery.

Conclusions

We observed a significant and similar improvement in QoL among patients with MVD with IMR in 12-months follow-up after surgery irrespective of treatment type (CABG or CABG+MA).

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Conflict of interest

The authors have declared that no conflicts of interest exist.

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