Low-dose dobutamine stress echocardiography cannot predict mitral regurgitation reversibility after coronary artery bypass grafting

Farideh Roshanali, MD,[a] Saeed Shoar, MD,[a,b,c] Nasrin Shoar, MD,[d] Mohammad Naderan, MD,[c] Farshid Alaeddini, MD, PhD,[a] and Mohammad Hossein Mandegar, MD[b]

Background: The ideal management of ischemic mitral regurgitation (MR) remains a clinical dilemma because of the suboptimal available therapeutic options. Recently, new concepts have emerged, pointing to the benefits of a patient selection approach when debating the management of moderate ischemic MR. We investigated the predictability of low-dose dobutamine stress echocardiography (DSE) in selecting candidates for CABG with moderate MR for valve repair.

Methods: From November 2002 to May 2010, 110 candidates for first-time CABG, who were admitted to the cardiac surgery department in Day General Hospital (Tehran, Iran), were enrolled in the present cross-sectional study. DSE was performed for each case before CABG. Those with positive findings underwent CABG alone and those with negative results underwent concomitant CABG and mitral valve repair. The patients were followed up for a minimum of 60 months.

Results: Of the 110 patients, 47 (42.72%) had positive test results and underwent CABG alone and 63 (57.28%) had negative DSE results and underwent concomitant CABG and mitral valve repair. The MR degree had decreased from 2.8 ± 0.3 preoperatively to 1.46 ± 0.6 early during the hospital stay and 1.9 ± 0.7 during late follow-up in the CABG group. It had decreased from 2.84 ± 0.4 preoperatively to 0.93 ± 0.65 postoperatively but then increased to 1.41 ± 0.9 during late follow-up, for a significant decrease in the combined group ($P < .05$).

Conclusions: Despite its utility in selecting CABG patients with moderate ischemic MR for valve repair from a short-term perspective, the use of DSE cannot predict the long-term outcomes of these patients. (J Thorac Cardiovasc Surg 2014;148:1323-7)

ACD

Ischemic mitral regurgitation (IMR) occurs as a result of ischemia-induced mitral valve functional insufficiency.[1,2] Despite advances in the management of IMR, it has proved to be adversely associated with survival, even in mild to moderate severity.[2-5] In addition, the prevalence of IMR subsequent to myocardial infarction has been reported to be 20% to 40%.[2,6,7] With the large number of patients experiencing myocardial infarction, IMR has continued to impose a huge burden on the healthcare system.[2,4,7,8]

The ideal management of IMR remains a clinical dilemma because of the suboptimal available therapeutic options.[9-13] Because the long-term prognosis of uncorrected IMR has been documented to be poor,[10,14] some investigators have proposed surgical correction of IMR, using either repair or replacement, concurrent with coronary artery bypass grafting (CABG).[10,12,15-18] However, the greater morbidity and mortality of a combined approach has kept surgeons from widely performing such a correction technique for moderate IMR.[4,19-23]

Recently, attention has been given to a selection approach in the management of simultaneous coronary artery diseases and moderate IMR.[1,24,25] The selective approach is used preoperatively to measure the probability of IMR reversibility after CABG.[26,27]

To determine which patient with moderate IMR will benefit from intervening on the mitral valve and which patient should undergo CABG alone, we previously reported on the valuable utility of low-dose dobutamine stress echocardiography (DSE) in selecting patients who would be undergoing CABG to receive concurrent mitral valve repair.[26] In a continuation of that study, we investigated the benefits of DSE in predicting the long-term outcomes.

METHODS

Study Population

From November 2002 to May 2010, 110 candidates for first-time CABG, who had been admitted to the cardiac surgery department in Day General Hospital (Tehran, Iran), were consecutively enrolled in the present cross-sectional study. The inclusion criteria were candidacy for CABG and

From the Departments of Cardiology[a] and Cardiac Surgery,[b] Day General Hospital, Tehran, Iran; Department of Surgery,[c] Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran; and School of Medicine,[d] Kashan University of Medical Sciences, Kashan, Iran.

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Address for reprints: Saeed Shoar, MD, Departments of Cardiology and Cardiac Surgery, Day General Hospital, No. 1434873111, Tavanir St, Vali e Asr Ave, Tehran, Iran (E-mail: ssht84@yahoo.com).

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Abbreviations and Acronyms
CABG = coronary artery bypass grafting
DSE = dobutamine stress echocardiography
EF = ejection fraction
IMR = ischemic mitral regurgitation
MR = mitral regurgitation

the presence of grade 2 and 3 (referred to as moderate) functional MR on a scale of 1 to 4, using quantitative echocardiography, measured by 2 independent cardiologists, who were unaware of the study protocol. Patients with structural MR, including a ruptured chordae tendinea or papillary muscle, abnormal leaflet thickening, annular calcification, and ventricular aneurysms or other congenital or acquired valvular diseases, and those considered for other concomitant surgical procedures were excluded from the present study.

The institutional review board of Day General Hospital approved the study protocol on human subjects, and each patient provided informed consent before enrollment in the present study.

Dobutamine Stress Echocardiography

Dobutamine was infused at doses of 2.5, 5.0, 7.5, and 10.0 μg/kg/min after the echocardiogram at rest was finished. The patients were closely monitored by their physician during the dobutamine infusion for any symptoms of distress. The DSE findings were considered positive if echocardiographic MR had decreased in response to the dobutamine infusion and negative if the degree of MR had remained unchanged or had increased.

DSE-positive patients were assigned to the CABG-alone group, with no additional procedure on the valves. The DSE-negative patients underwent concomitant CABG and mitral valve repair.

Preoperative Echocardiography

The patients underwent the echocardiographic assessment in a left lateral decubitus position with a multifrequency phased-array probe (VIVID 7, GE Medical Systems, Little Chalfont, UK; and iE33, Philips Medical Systems, Best, The Netherlands) before and after dobutamine infusion in an at rest and stress status, respectively, to assess the myocardial viability and severity of MR. The instrument settings were kept constant during all echocardiographic studies. The settings included the rate of pulse repetition, transducer frequencies, and optimal gain. The optimal gain for intracardiac blood flow imaging and the detection of the extension area related to the regurgitant signals was adjusted to the level at which the background noise began to faintly appear.

The digital recording of each echocardiography was analyzed for segmental wall motion abnormality using the American Society of Echocardiography 16-segment convention by 2 independent observers who were unaware of the purpose of the study. The ejection fraction (EF) was measured using the modified biplane Simpson method. MR was graded using a combination of quantitative and qualitative variables, including color Doppler jet characteristics, width and area of the jet, continuous wave Doppler intensity, shape of the spectral recording, mitral inflow and evaluation of pulmonary vein flow, using the proximal isovelocity surface area method, and calculation of the effective regurgitant orifice area, regurgitant volume, and regurgitant fraction. Two independent observers reached a consensus in the analysis of all the recordings.

Operation Technique

The left internal mammary artery for the left anterior descending artery and a greater saphenous vein graft for other involved coronary arteries were harvested and distally anastomosed after a full midline sternotomy. The cardiopulmonary circulation was bypassed, along with preservation of the myocardium by administration of iced saline to provide topical and systemic hypothermia to 28°C. According to the assigned treatment group, concomitant CABG and valve repair using complete ring annuloplasty was performed. The size of the mitral annuloplasty ring (Carpentier-Edwards Physio Ring; Edwards Life Sciences, Irving, Calif) was determined by a standard measurement of the intertrigonal distance and anterior leaflet height after downsizing was performed. Finally, intraoperative transesophageal echocardiography was performed to assess the severity of MR in the surgical patients.

Postoperative Echocardiography

The echocardiographic study was repeatedly performed for all patients 4 to 7 days and 5 to 6 months postoperatively and then annually to assess the EF, wall motion, and MR severity.

Statistical Analysis

The data were analyzed using the Statistical Package for Social Sciences, version 16 (SPSS, Chicago, Ill). The Student t test was applied for a comparison of the clinical outcomes between the 2 groups. One-way repeated measurement analysis of variance was also used for the measurement of the within-subject effects for EF, MR, and New York Heart Association function class.

RESULTS

Patients Characteristics

A total of 110 patients were enrolled in our study. Of these 110 patients, 47 (42.72%) had DSE-related MR improvement (1 ± 0.62) and underwent CABG alone and 63 patients (57.28%) did not have DSE-related MR improvement (0.14 ± 0.2) and underwent concomitant CABG and mitral valve repair. The mean $\pm$ standard deviation duration of follow-up was 81.5 ± 17.7 and 77.5 ± 19.2 months in CABG and combined groups, respectively. The demographics and primary characteristics of the study patients are listed in Table 1. No significant difference was found between the 2 groups in terms of the primary characteristics ($P > .05$).

Echocardiographic Evaluation

Regarding the echocardiographic features for the patients undergoing CABG or concomitant CABG and valve repair, the size of the annulus was 37.70 ± 3.78 mm in group 1 and 37.30 ± 3.97 mm in group 2, which was not a statistically significant difference ($P > .05$). The effective regurgitant orifice area had a mean $\pm$ SD of 28.83 ± 5.57 cm^2 in group 1 and 28.90 ± 5.83 cm^2 in group 2, with no significant differences ($P > .05$). The mean $\pm$ SD coaptation depth was measured at 7.77 ± 1.02 mm in group 1 and 7.76 ± 0.91 mm in group 2, with no significant difference ($P > .05$). In addition, the MR degree did not differ significantly ($P > .05$) between groups 1 and 2 (mean $\pm$ SD of 2.87 ± 0.33 and 2.84 ± 0.36, respectively). The EF for the 110 patients was a mean $\pm$ SD of $39.04\% \pm 5.95\%$ in group 1 and $40.95\% \pm 5.59\%$ in group 2. The difference was also not statistically significant ($P > .05$). The left ventricular end-diastolic and end-systolic volume was 140.72 ± 33.37 mL and 90.23 ± 21.05 mL in group 1