Indian Heart Journal xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Indian Heart Journal

journal homepage: www.elsevier.com/locate/ihj

Original Article

Alterations in echocardiographic left ventricular function after percutaneous coronary stenting in diabetic patients with isolated severe proximal left anterior descending artery stenosis

Maryam Nabati [a,*], Morteza Taghavi [b], Naser Saffar [b], Jamshid Yazdani [c], Babak Bagheri [a]

[a] Department of Cardiology, Faculty of Medicine, Mazandaran University of Medical Sciences, Sari, Iran
[b] Student Research Committee, Faculty of Medicine, Mazandaran University of Medical Sciences, Sari, Iran
[c] Department of Biostatics, Faculty of Health, Mazandaran University of Medical Sciences, Sari, Iran

ARTICLE INFO

Article history:
Received 14 April 2016
Accepted 11 August 2016
Available online xxx

Keywords:
Diabetes mellitus
Coronary angioplasty stent
Diastolic function
Doppler echocardiography

ABSTRACT

Background: There are conflicting theories regarding the use of percutaneous coronary intervention (PCI) of isolated severe proximal left anterior descending (LAD) artery stenosis in place of left internal mammary artery grafting in diabetic patients. The aim of this study was to investigate the effect of PCI on left ventricular function and determine difference between diabetics and non-diabetics.

Methods: A prospective study was conducted on 50 patients with isolated severe proximal LAD stenosis: 23 diabetic and 27 non-diabetic patients. Successful PCI with everolimus-eluting stents was performed for all of the patients. These patients underwent transthoracic echocardiography within 24 h before and 1 month after PCI, and alterations in the left ventricular parameters were compared between the two groups.

Results: There was a significant 12% increment in the mitral annular peak systolic velocity (s') ($p = 0.02$), 21% decrement in the trans mitral early filling deceleration time (DT) ($p < 0.001$), 10% decrement in the systolic left ventricular internal dimension (LVIDs) ($p = 0.002$), significant increment in the left ventricular ejection fraction (LVEF) ($p = 0.004$), and significant decrement in the left atrial diameter ($p = 0.006$) in the diabetic patients after performing PCI. Conversely, the non-diabetic patients showed a statistically significant 14% increase in the DT, 6.3% decrease in the s' velocity, 8% increase in the LVIDs, significant increment in the left atrial diameter and no change in LVEF after PCI.

Conclusion: Our study demonstrated that everolimus-eluting stents favorably improved the markers of left ventricular systolic and diastolic function in diabetic patients with isolated severe proximal LAD stenosis compared with those of non-diabetic patients with the same condition.

1. Introduction

In total, 15–20% of patients who undergo coronary revascularization are diabetic.[1] The long-term results of percutaneous coronary intervention (PCI) and coronary artery bypass graft are less desirable in diabetic patients. This outcome is most likely due to a faster progression of atherosclerosis and a higher rate of restenosis. While the use of stents has improved the short- and long-term outcomes of PCI in diabetic patients, the consequences of PCI are still less favorable in diabetics compared with non-diabetic patients. New angioplasty techniques, such as drug-eluting stents, most likely have a critical role in improving the results of PCI in diabetic patients. Thus, there are indications for angioplasty in diabetics to be extended even more in the near future.[2] Echo Doppler studies have reported that patients with asymptomatic left ventricular (LV) diastolic dysfunction have a higher incidence of all-cause mortality. Mild diastolic dysfunction and moderate to severe dysfunction were associated with 8.3-fold and 10.2-fold increased risks of mortality, respectively. The overall mortalities of symptomatic patients with diastolic or systolic heart failure are very similar.[3] Trans mitral Doppler flow velocities have previously been used for evaluating the variations in LV diastolic function after PCI.[4]

The left atrial (LA) diameter, early filling deceleration time (DT), E/e' ratio and peak atrial reversal flow velocity of the pulmonary

* Corresponding author at: Department of Cardiology, Fatemeh Zahra Teaching Hospital, Faculty of Medicine, Mazandaran University of Medical Sciences, Artesh Boulevard, Sari 48188-13771, Iran.
E-mail address: Dr.mr.nabati@gmail.com (M. Nabati).

http://dx.doi.org/10.1016/j.ihj.2016.08.004

veins are relatively independent of preload and are a more reliable index of LV relaxation. Additionally, the LV ejection fraction (LVEF), regional LV wall motion and peak systolic velocity (s') of the mitral annulus have been used as an index of the global LV systolic function. Few studies have compared the echocardiographic systolic and diastolic parameters between diabetics and non-diabetics after PCI on left anterior descending (LAD) artery. These studies showed that PCI on LAD induced more increase in LVEF compared with angioplasty on other vessels. Furthermore, existence of DM did not have negative effect in LVEF improvement after angioplasty on LAD. However, other systolic and diastolic variables were not separately compared between diabetic and non-diabetic patients.[5] Improvements in systolic and diastolic LV function are associated with better outcome and functional capacity.

Therefore, our study was designed to determine the changes in LV systolic and diastolic function after successful PCI and drug-eluting stenting of isolated stenosis of the proximal LAD artery in diabetic patients compared with non-diabetic patients.

2. Methods

2.1. Patients

From 2012 to 2013, a prospective clinical study was conducted in the Fatemeh Zahra teaching hospital. In total, 23 consecutive elective diabetic patients were considered for enrollment who presented with typical chest pain and documented myocardial ischemia with a considerable amount of anterior or anteroseptal ischemia on single-photon emission computerized tomography and who underwent successful angioplasty after displaying isolated severe proximal LAD coronary artery stenosis (>75% luminal diameter) in a recent angiography. Additionally, 27 non-diabetic patients were assigned to the control group. Then, alterations in the echocardiographic variables after the procedure were compared between the two groups.

The study was performed according to the guidelines of the Helsinki Declaration and was approved by the ethics committee of the hospital. Written informed consent was obtained from all of the patients. Patients with lesions in the first diagonal branch, total occlusion of the LAD or multivessel coronary artery disease were excluded from our study. None of the study patients had congenital, significant valvular heart disease (equal or more than moderate severity) or cardiomyopathy and atrial fibrillation. Additionally, patients with systemic diseases, such as cancer, collagen vascular diseases or amyloidosis, were excluded.

2.2. Echocardiography

Transthoracic echocardiography was performed at baseline within 24 h before PCI and was repeated 1 month after PCI for all patients by a Vivid S5 (GE Healthcare, Wauwatosa, WI, USA), 1–3 MHz transducer. All of the measurements represent the average of three consecutive beats between normal heart rate ranges, 60–100 beat per minute. The images were stored on a hard disk for better offline measurements, and the results were confirmed by an echocardiographer who was blind to the patient's information. Patients with a poor echo window were excluded from the study.

Estimates of the LV systolic and diastolic dimensions were derived from the LV minor-axis dimensions with the transducer in the parasternal position so that the cursor was perpendicular to the interventricular septum and posterior wall at the mid-papillary muscle level. The EF and wall motion abnormalities (WMA) were determined. The EF was defined as the end diastolic volume minus the end systolic volume divided by the end diastolic volume from biplane apical two and four chamber views using a modified Simpson's technique. To assess the reproducibility of determination of EF by a modified Simpson's technique, this index was measured in 10 randomly selected patients and was repeated 1 day later to calculate the intra-observer correlation coefficients, which was found to be 0.94.

Pulse Doppler recordings of the diastolic trans mitral flow velocity were obtained with the sample volume located at the tips of the mitral leaflets from the apical four chamber view. The peak early diastolic velocity (E wave), peak late diastolic velocity (A wave), early filling DT and E/A velocity were measured. Tissue Doppler imaging of the mitral annulus was obtained from the apical four chamber view. A 5 mm sample volume was placed at the septal and lateral mitral annuli. The following measurements were determined: the peak systolic velocity (s') and early diastolic velocity (e'). An analysis was performed for the average of each velocity at the two annular sites. Then, the E/e' ratio was calculated. The pulmonary venous flow velocity profile was obtained from an apical four chamber view. The pulse Doppler sample volume was placed 1 cm into the pulmonary vein, and the peak systolic flow velocity (S wave), peak diastolic velocity (D wave) and peak atrial reversal flow velocity (AR) were determined. The LA diameter was measured in the parasternal long-axis view from a 2D image at end systole.

Blood samples were obtained during fasting, and the levels of plasma glucose, total cholesterol (T-chol), high density lipoprotein (HDL)-chol, low density lipoprotein (LDL)-chol, and triglycerides (TG) were measured. The systolic and diastolic blood pressures were measured after 5 min of rest. The height and weight were measured, and the body mass index (BMI) was calculated as the body weight divided by the height squared. Hypertension was defined as a systolic blood pressure $\geq$140 mmHg, a diastolic blood pressure $\geq$90 mmHg[6] or the requirement for antihypertensive medication. The diabetes mellitus (DM) was defined according to the criteria of the American Diabetes Association[7] or the requirement for insulin or oral hypoglycemic drugs. A family history of coronary artery disease (CAD) was defined as having a first-degree relative (a male <55 years or female <65 years) with a history of myocardial infarction, coronary revascularization, or sudden death.[8] The history of smoking was determined by a face-to-face questionnaire.

Coronary angiography was performed for all of the patients using a cardiac angiography system (Siemens AG, Medical Solutions, Erlangen, Germany), and they all underwent PCI. PCI was performed by standard techniques, and XIENCE stents (Everolimus-Eluting Coronary Stent System, Santa Clara, CA, USA) were used.

Procedural success was defined as the successful deployment of the stent and residual stenosis of less than 30%.[9] Procedural anticoagulation was achieved with unfractionated heparin; glycoprotein IIb/IIIa inhibitors were used whenever needed. Patients received 300 mg of aspirin before the intervention. A 300 mg oral dose of clopidogrel was recommended before the procedure. Thereafter, 80 mg of aspirin and 75 mg of clopidogrel were prescribed daily. Other standard drugs (angiotensin converting enzyme inhibitors, beta blockers, statins and oral hypoglycemic agents) remained unchanged during the study in order to minimize the effects of alterations on the echocardiographic variables.

2.3. Statistical analysis

Continuous variables are expressed as the mean ± SD. Percentage changes in all of echocardiographic variables following PCI were determined. These variables were considered as new variables, separately. Then, two groups were compared for these new variables by an independent t-test. Paired-samples t were used for comparing

Please cite this article in press as: Nabati M, et al. Alterations in echocardiographic left ventricular function after percutaneous coronary stenting in diabetic patients with isolated severe proximal left anterior descending artery stenosis, *Indian Heart J.* (2016), http://dx.doi.org/10.1016/j.ihj.2016.08.004