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ORIGINAL ARTICLE

Impact of elective PCI on left intraventricular mechanical dyssynchrony in patients with chronic stable angina (tissue Doppler study)

Shaimaa A. Mostafa *, **Heba A. Mansour, Tarek H. Aboelazm, Khaled E. Elrabat, Shaimaa Sabry**

Benha University, Faculty of Medicine, Egypt

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Abstract *Aim:* To detect the impact of elective PCI on left intraventricular mechanical dyssynchrony in patients with chronic stable angina.
Methods: 100 patients with chronic stable angina were included and divided into two groups according to LV systolic and diastolic mechanical dyssynchrony measured by TSI 12-segments SD and Te-SD. 24 h then 1 month after PCI, patients with dyssynchrony were reclassified into improved vs persistent LV mechanical dyssynchrony.
Results: At baseline 72% had LV systolic mechanical dyssynchrony. Patients with LV systolic mechanical dyssynchrony were significantly older (58.42 ± 4.617 vs. 54.64 ± 3.456, respectively, $p < 0.001$), diabetic (36.11% vs. 14.3% p value < 0.05), higher prevalence of pseudo-normal and restrictive filling patterns (p value < 0.05), significantly larger LVESV (39.88 ± 13.67 vs. 32.93 ± 9.79 ml, $p < 0.05$), lower EF% (54.13 ± 6.69% vs. 58.54 ± 6.4%, p value < 0.05) and greater WMSI (1.3 ± 0.25 vs. 1.15 ± 0.13, p value < 0.05). 24 h after PCI, 16 (22.22%) improved. 1 m after PCI 61 (84.72%) improved from baseline. Latest activated segment improved in 21.02% after 24 h and 41.69% improved after 1 m. Age was only variable independently associated with non-improvement of LV systolic mechanical dyssynchrony on multivariate analysis. Of the 23 patients with normal EF and WMSI, 13 had systolic dyssynchrony at baseline, 6 improved after 24 h and all improved at 1 m. Diastolic dysfunction improved in 18 (28.125%) 24 h after PCI. After 1 m improved in 50 (78.125%) and remained unchanged in 14 (21.875%), and was closely correlated to the grades of LV diastolic dysfunction.
Conclusion: PCI had significant effect on LV systolic and diastolic mechanical intraventricular dyssynchrony.

* Corresponding author.
E-mail address: shaimaa.desouky@fmed.bu.edu.eg (S.A. Mostafa).
URL: http://www.Bu.edu.eg (S.A. Mostafa).

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1. Introduction

Mechanical dyssynchrony is increasingly used to describe the mechanical effects of asynchronous ventricular contraction and relaxation, which may or may not be associated with electrical conduction delay. Although LV dyssynchrony was initially recognized as a phenomenon related only to electrical conduction delay in systolic heart failure with widened QRS complexes, previous studies have reported that it also exists in approximately 30–40% of patients with a normal QRS duration[1] and in a significant number of patients with heart failure and preserved ejection fraction.[2]

Coronary artery disease (CAD) is one of the commonest causes of heart failure with preserved EF; however, there are limited results about mechanical dyssynchrony in CAD patients with preserved EF. Acute myocardial ischemia leads to delayed onset and slower rate of contraction and relaxation in regional myocardial segments and thus may generate LV mechanical dyssynchrony,[3] which may in turn compromise LV systolic and diastolic performance and lead to clinical HF.

Until now however, evaluation of systolic function of the myocardium has mainly depended on detection of global function or analyze changes in time and the conduction function of the heart. New approaches have been developed to investigate local myocardial conduction and systolic function such as Doppler tissue imaging, strain rate imaging and especially TSI.[4]

Schiller et al. used the TSI method to evaluate the myocardial dyssynchrony before and after cardiac pacemaker treatment. They reported that the TSI method is an easy and applicable method in the quantitative detection of regional dyssynchrony.[5]

The aim of the present study was to detect the impact of elective PCI on left intraventricular mechanical dyssynchrony (both systolic and diastolic) in patients with chronic stable angina.

2. Patients and methods

This prospective single center study was conducted at the cardiology department of "Benha University Hospital" from March 2012 to February 2014. The study included 132 patients with chronic stable angina scheduled for elective percutaneous coronary intervention (PCI). Thirty-two patients were excluded from the study due to incomplete follow-up so the final study population comprised 100 patients.

Consent from the patients and the approval from the ethics committee were obtained.

According to the presence of LV systolic mechanical dyssynchrony at baseline measured by TSI 12-segments SD, patients were classified into two groups. The first group included patients with LV systolic mechanical dyssynchrony. The second group included patients without LV systolic mechanical dyssynchrony. One month after PCI patients of the first group were reclassified into patients with improved LV systolic mechanical dyssynchrony and patients with persistent LV systolic mechanical dyssynchrony.

According to the presence of LV diastolic mechanical dyssynchrony at baseline measured by Te-SD, patients were classified into two groups. The first group included patients with LV diastolic mechanical dyssynchrony. The second group included patients without LV diastolic mechanical dyssynchrony. One month after PCI, patients of the first group were reclassified into patients with improved LV diastolic mechanical dyssynchrony and patients with persistent LV diastolic mechanical dyssynchrony.

2.1. Exclusion criteria

Patients with:

(1) Prior myocardial infarction.
(2) Bundle branch block (BBB).
(3) Atrial fibrillation (AF) or flutter.
(4) Previous pacemaker implantation.
(5) Restrictive or dilated cardiomyopathy.
(6) Rheumatic heart disease.
(7) Prosthetic valves.
(8) Severe mitral annular calcification.

2.2. Methods

The following data were collected:

(1) Patient characteristics:
- Demographics data (age and sex) and admission details as Risk factors (DM, HTN, smoking, dyslipidemia and family history of CAD).
- History of ischemic chest pain.
- Physical examination including heart rate and rhythm, systolic and diastolic blood pressure, neck veins, and chest and heart auscultation.

(2) Investigations
- *ECG (electrocardiography)* which was done to detect the presence of:
  - o Ischemic changes in the form of Q waves, ST depression and T wave changes.
  - o AF.
  - o Bundle branch block.
- *Laboratory tests:* Including electrolytes (Na and K), serum creatinine and Lipid profile (cholesterol, triglyceride, HDL and LDL).
- Transthoracic echocardiography:
  Echocardiography was done before PCI, 24 h and one month after elective PCI. All patients were examined in the left lateral position using (Vivid 7, Vingmed-General Electric, Horten, Norway) machine with multi-frequency transducer equipped with DTI software.

I- Conventional echocardiography
- o *Global LV function* was assessed by measuring LV end-diastolic volume (LVEDV), LV end-systolic volume (LVESV) and LVEF from the conventional apical 2- and 4-chamber images, using the biplane Simpson's method.[5]
- o *Wall motion score index (WMSI):* The American Society of Echocardiography has recommended a 16-segment model. This model consists of six seg-