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### Recommended Citation

M. Melika, Amir S. (2018) "Improvement of diastolic dysfunction after percutaneous coronary intervention in patients with ischemic cardiomyopathy," *Journal of Medicine in Scientific Research*: Vol. 1: Iss. 4, Article 14.

DOI: [https://doi.org/10.4103/JMISR.JMISR\\_67\\_18](https://doi.org/10.4103/JMISR.JMISR_67_18)

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# Improvement of diastolic dysfunction after percutaneous coronary intervention in patients with ischemic cardiomyopathy

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## Abstract

### Introduction

Impaired systolic cardiac function in patients with ischemic cardiac disease is well known. Diastolic cardiac dysfunction is also found in these patients, so we aimed to show whether percutaneous coronary intervention (PCI) could improve diastolic function.

### Patients and methods

Twenty patients with chronic ischemic cardiomyopathy (with cardiac ejection fraction <45%) were examined at baseline and at 2 weeks after PCI diastolic function was evaluated by transmitral pulsed wave Doppler.

### Results

Before PCI 60% of patients (12 patients) showed nonrestrictive filling pattern and 40% of patients (eight patients) showed restrictive filling pattern. Following PCI, diastolic function showed an improvement in most patients with only two patients still having an restrictive filling pattern. In addition, after revascularization, most parameters of pulsed wave Doppler of diastolic function improved significantly.

### Conclusion

Ischemic heart disease patients with impaired systolic function had marked improvement of diastolic dysfunction and all parameters of the diastolic filling pattern after PCI.

**Keywords:** Chronic ischemic cardiomyopathy, diastolic dysfunction, percutaneous coronary intervention

## INTRODUCTION

The most important clinical parameter, left ventricular (LV) diastolic dysfunction, is correlated with a substantial risk for the development of congestive heart failure and reduced survival, similar to what occurs in systolic dysfunction [1]. The incidence of diastolic cardiac dysfunction is more than the systolic cardiac dysfunction and is commonly increased with advancing age [2]. This point has an importance as the rate of mortality in asymptomatic diastolic dysfunction patients is fivefold more than the general population [3].

Regional evaluation of the LV diastolic function is an excellent way to show regions of myocardium with impaired coronary artery flow and reduced perfusion.

In 35–42% of the patients with heart failure symptoms, diastolic heart failure has been observed [3,4]. On the other

hand, 30–40% of the patients with heart failure, who were with normal ejection fraction (EF), complained of clinical heart failure symptoms. But, these patients like those with low EF level are liable to risk factors and heart failure [5]. It is important to take into consideration that the diagnostic criteria for diastolic heart failure has not been definitively clarified.

Percutaneous coronary intervention (PCI) is a procedure performed to relieve ischemic symptoms in patients with coronary artery disease. It is used to prevent heart failure equally as coronary artery bypass grafting. Coronary

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DOI:  
10.4103/JMISR.JMISR\_67\_18

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**How to cite this article:** Melika AS. Improvement of diastolic dysfunction after percutaneous coronary intervention in patients with ischemic cardiomyopathy. *J Med Sci Res* 2018;1:289-91.

stenosis, in case it is neglected, can result in heart failure and consequently systolic and diastolic heart failure [6].

Diastolic dysfunction occurs because of risk factors including diabetes, hypertension, and aging, comprising about 50–55% of all cardiac dysfunctions. Most of the drug and nondrug therapy methods, with well-documented efficacy in the treatment of systolic dysfunctions, have been ineffective in treating diastolic heart failure or have had little clinical effects [6–8]. In other words, after analyzing diastolic heart indices after the intervention, the disagreement over the effects of PCI on the systolic and diastolic function of the heart makes it worthwhile [9].

Patients with severe coronary disease and depressed systolic function usually shows areas of the LV, which, while are chronically dysfunction, may nonetheless remain viable and amenable to recovery [10–12]. Many studies have much interest in this observation, and have demonstrated that if viable myocardium is present, revascularization may improve LV EF and prognosis [13–17]. Myocardial viability assessment has become an important step in the workup of patients diagnostically and prognostically.

## PATIENTS AND METHODS

From January 2016 to January 2017 many patients in the National Heart Institute Imbaba, Giza, who underwent diagnostic coronary angiography were screened. The inclusion criteria were:

- (1) Coronary artery disease more than 70% stenosis in one coronary artery or more
- (2) LV systolic dysfunction as estimated by EF less than 45%
- (3) Stable hemodynamic state.

Exclusion criteria were:

- (1) Severe valvular stenosis or regurgitation
- (2) Heart block of any degree
- (3) Atrial fibrillation
- (4) Pulmonary hypertension
- (5) Serum creatinine more than 2 mg%.

### Baseline echocardiography

For every patient complete echocardiographic study was done obtaining the following criteria:

- (1) LV EF% according to the modified Simpson's rule
  - (2) Peak early diastolic flow velocity (E)
  - (3) Peak flow velocity of atrial contraction (A)
  - (4) E/A ratio
  - (5) Deceleration time (DT) from peak to the point when E wave descent intercepted the zero line
  - (6) Isovolumic relaxation time (IVRT) was calculated from the end of aortic flow to the onset of mitral flow
- Restrictive filling pattern was defined when E/A was more than 1.5 and DT was less than 150 ms; nonrestrictive filling pattern when E/A was less than 1 or E/A was more than 1 and was more than 150
- (a) Two weeks after PCI complete echocardiographic study was repeated for every patient obtaining

full data about the diastolic parameters previously recorded.

## RESULTS

After revascularization, in 18 patients, we found a nonrestrictive filling pattern and only two patients still had an restrictive filling pattern. In addition, there was significant improvement in most pulsed wave-derived-parameters of diastolic function after revascularization, in particular A-wave. Velocity significantly increased with a significant decrease in E/A ratio and prolongation of both DT and IVRT.

Alterations after revascularization in echocardiographic parameters in the whole population.

## DISCUSSION

In this study, all patients had suffered from systolic and also diastolic dysfunction, which improved significantly after coronary intervention. Echocardiographic parameters improved significantly in global systolic function, which support the concept that both systolic and diastolic function go together, either worsen or improve. These findings demonstrate that coronary revascularization in chronically viable myocardium improves diastolic dysfunction. Virtually, all patients with heart failure had diastolic dysfunction [18–20]. In addition, on the basis of Doppler evaluation of transmitral flow, the distinct filling pattern has been described representing various degrees of diastolic impairment [21–25]. High LV filling pressure was reflected by the restrictive pattern at the end of the spectrum [20,26], which has been linked with worse clinical and hemodynamic status and increased mortality compared with a nonrestrictive filling pattern.

Namazi and colleagues have not shown a significant impact of PCI on the E/A index, which is in agreement with the findings of our study (Table 1). They also showed a decline for DT and E/Ea indices. They did not show any significant change in the IVRT index, but in our study, it significantly decreased. This difference may be justified by a longer period of re-evaluation as their patients were investigated 6 months after PCI, in comparison with the IVRT index, in our study [27]. Contrary to our results, one study showed no significant changes in DT and IVRT level 3 months after PCI in the patients, but these indices had a declining trend. They observed after intervention a significant decline in E/A ratio which is against our results [28].

**Table 1: Echocardiographic study**

	Baseline	Follow-up
Systolic function (EF%)	33±5	42±18
E velocity (m/s)	0.75±11	0.67±18
A velocity (m/s)	0.69±30	0.86±21
E/A ratio	1.73±11	0.91±65
DT (ms)	209±76	235±65
IVRT (ms)	94±26	109±21

## CONCLUSION

Ischemic heart disease patients with impaired systolic function had marked improvement of diastolic dysfunction and all parameters of the diastolic filling pattern after PCI.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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