

Research Article

Assessment of Left Ventricular Systolic Function After Acute Anterior Wall Myocardial Infarction Treated with Primary Percutaneous Coronary Intervention at 24 Hours and 6 Weeks After the Procedure

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Abstract

Background: Acute total occlusion of left anterior descending artery causes acute anterior wall myocardial infarction (AWMI) which could lead to left ventricular (LV) systolic dysfunction. Intervention by primary percutaneous coronary intervention (pPCI) can prevent severe LV systolic dysfunction by timely reperfusion of myocardium preventing irreversible damage.

Objective: The aim of the study was to assess the LV systolic function by ejection fraction (EF) on transthoracic echocardiography (TTE) after pPCI in patients presenting with acute AWMI at 24 hours after procedure and 6 weeks follow-up. We also want to observe if duration of appearance of chest pain and time taken by patient to reach tertiary care hospital with pPCI setup has any link with the improvement of LV systolic function.

Methods: The descriptive case series type of study conducted at Chaudhary Pervaiz Elahi Institute of Cardiology, Multan for one year. Patients with acute AWMI who were treated with pPCI were included in study. LV function was assessed by EF calculated by eye ball method on TTE at 24 hours and 6 weeks interval. Duration of chest pain was noted.

Results: Total 68 patients were included in the study. Mean age of patients was 44.82 years with standard deviation of 9.06 years. 82.4% patients were male. 45.6% patients were presented between 2 to 6 hours of chest pain. Maximum improvement in EF at 6 weeks follow up was seen in patients who presented within 30 minutes and patients have regained full LV function. 11 patients who presented after 6 hours of chest pain had no improvement in EF at 6 weeks follow-up.

Conclusion: Timely intervention by pPCI after acute AWMI can prevent LV systolic dysfunction.

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Introduction

ST-segment Elevation Myocardial Infarction (STEMI) causes extensive necrosis which leads to

reduction in left ventricular (LV) systolic function affecting the morbidity and mortality of patients presenting with acute STEMI^{1,2}. The preferable method of treatment to save the myocardium at risk is to treat

acute STEMI with primary percutaneous coronary intervention (pPCI)³. Restoring the blood flow in the culprit vessel as early as possible not only reduces mortality but also preserves LV function by limiting the infarct size by reperfusing the myocardial tissue leading to maintenance of integrity of myocytes and their function⁴.

The greatest decrease in LV function occurs after occlusion of left anterior descending (LAD) artery by causing anterior wall myocardial infarction (AWMI) as it supplies 45-55% of the LV⁵. Occlusion of blood flow in the myocardium leads to hibernation or stunning of the myocardium leading to reduction in LV function⁶. Both of these conditions are reversible. In hibernation ischemia is still going on and needs restoration of blood flow while in stunning blood flow to the myocardium has been restored⁶. With the restoration of blood supply timely, the LV function can be recovered.

Our institution has reorganized its structure for pPCI and it now offers to the maximum number of patients in its capacity. However, the lack of pre-discharge and follow-up assessment of LV systolic function results in sparse data regarding the prevalence of LV systolic dysfunction and improvement in LV function during follow-ups. The assessment of LV function can be easily done by assessing ejection fraction (EF) on two dimension transthoracic echocardiography (TTE). The aim of the study was to assess for LV function after acute AWMI in patients undergoing pPCI at 24 hours after the procedure and at 6 weeks follow-up. We also wanted to study the effect of duration between appearance of chest pain and patient presentation at tertiary care hospital with pPCI setup on improvement of EF at 6 weeks follow-up.

Methods

The descriptive case series type of study was conducted at Chaudhary Pervaiz Elahi Institute of Cardiology, Multan for the duration of one year from 1st of January, 2019 to 31st of December, 2019. After explaining the purpose of study and taking informed consent, the patients of either gender with age range of 20 to 60 years presenting to Emergency department with history of chest pain or heaviness of less

than 12 hours and ST segment elevation with convexity upward of more 2mm in leads v2-v4, no contraindication to pPCI like known case of chronic kidney disease, first time presentation with STEMI and no previous history of angina or revascularization were included in the study. Co-operative patients who agreed for proper follow-up were included in the study. Patients were asked about the duration of chest pain after which they presented to our hospital. After 24 hours of procedure the LV systolic function was assessed by EF via eye ball assessment by a senior consultant cardiologist on TTE. Patient was discharged on medication after 48 hours of hospital stay with advice for follow-up TTE at 6 weeks interval. LV function was again assessed by EF via eye ball assessment by a senior consultant cardiologist. All the information was recorded on a preformed proforma.

Data was entered and analyzed on computer software SPSS 20. Mean and standard deviation was calculated for age. Frequency and percentages were calculated for gender, duration of chest pain, EF at 24 hours and 6 weeks after procedure and improvement in EF. Cross tabulation was done between duration of chest pain with EF at 24 hours, 6 weeks and improvement in EF. Chi-square test was applied. P-value of less than 0.05 was considered significant.

Results

Total 68 patients with acute AWMI were included in the study. Mean age of the patients was 44.82 years with standard deviation of 9.06 years. There were 82.4% (56) male patients and 17.6% (12) female patients. 16.2% (11) patients presented to us within 30 minutes of chest pain. 13.2% (9) patients upto 2 hours, 45.6% (31) patients within 2 to 6 hours and 25% (17) patients presented for duration of more than 6 hours after the chest pain. Assessment of LV function after 24 hours of pPCI showed that 4.4% (3) patients with EF of 30%, 47.1% (32) with EF 35%, 25% (17) with EF 40%, 17.6% (12) with EF 45%, 2.9% (2) with EF 50%, 2.9% (2) patients with EF 60%. Assessment of LV function after 6 weeks of pPCI showed 10.3% (7) patients with EF 35%, 33.8% (23) with EF 40%, 27.9% (19) with EF 45%, 5.9% (4) with EF 50%, 5.9% (4) with EF 55% and 16.2% (11) with EF of

60%. At 6 weeks follow-up no improvement in EF was seen in 23.5% (16) patients, 5% improvement was seen in 39.7% (27) patients, 10% improvement in 20.6% (14), 15% improvement in 13.2% (9) patients and 20% improvement in 2.9% (2) patients. We have also observed that all the 11 patients who presented within 30 minutes of onset of symptoms got improvement in LV systolic function at 6 weeks. While out of 17 patients who presented after six hours of onset of symptoms, 11 patients did not show any

improvement in EF. Table 1 shows cross tabulation of duration of chest pain with EF at 24 hours and p value was 0.0001 showing results were significant. Table 2 shows cross tabulation of duration of chest pain with EF at 3 months and p value was 0.0001 showing significant results. Table 3 shows cross tabulation of duration of chest pain with improvement in EF and p value was 0.0001 showing results were significant.

Table 1: Cross tabulation of duration of chest pain with EF at 24 hours after procedure

		EF at 24 hours						Total
		30%	35%	40%	45%	50%	60%	
Duration of chest pain	30 minutes	0	0	2	5	2	2	11
	Up to 2 hours	0	3	5	1	0	0	9
	2 to 6 hours	0	22	6	3	0	0	31
	more than 6 hours	3	7	4	3	0	0	17
Total		3	32	17	12	2	2	68

P-value 0.0001 (significant)

Table 2: Cross tabulation of duration of chest pain with EF at 6 weeks after procedure

		EF at 6 weeks						Total
		35%	40%	45%	50%	55%	60%	
Duration of chest pain	30 minutes	0	0	0	0	0	11	11
	Up to 2 hours	0	0	3	2	4	0	9
	2 to 6 hours	0	16	13	2	0	0	31
	more than 6 hours	7	7	3	0	0	0	17
Total		7	23	19	4	4	11	68

P-value 0.0001 (significant)

Table 3: Cross tabulation of duration of chest pain with improvement in EF at 6 weeks after procedure

		Improvement in EF					Total
		none	5%	10%	15%	20%	
Duration of chest pain	30 minutes	2	0	2	5	2	11
	Up to 2 hours	0	1	4	4	0	9
	2 to 6 hours	3	20	8	0	0	31
	more than 6 hours	11	6	0	0	0	17
Total		16	27	14	9	2	68

P-value 0.0001 (significant)

Discussion

Myocardial necrosis after acute STEMI causes LV dilatation resulting into LV systolic dysfunction due

to remodeling⁷. Left ventricular EF after acute STEMI is an important marker for morbidity and mortality⁸. Pre-discharge TTE contributes to the risk stratification in terms of 6 month mortality and

assessment of left ventricular function after acute STEMI 1. Systematic use of pPCI for acute STEMI significantly reduces the incidence of severe LV systolic dysfunction (EF<40%)⁹.

In the study conducted by Stolfo et al 19% patients showed EF of less than 40%¹⁰. Similarly Stutton et al reported LV ejection fraction of < 35% in 20% of the patients after acute STEMI¹¹. Our study showed quite a different result. Assessment of LV function after 24 hours of pPCI showed that 4.4% patients with EF of 30%, 47.1% with EF 35% and 25% with EF of 40%. This higher prevalence of severe LV systolic dysfunction (EF < 40%) in our study seems to be due to late presentation of patients to the tertiary care hospital with the facility of pPCI. Secondly this could be due to a different study population. Stolfo et al reported that 72% patients had EF of more than 35% at 3 months follow-up¹⁰. Similarly Solholm et al reported 64% patient with EF of > 35% at 3 months follow-up¹². Our study showed that at 6 weeks follow-up assessment of LV function showed 10.3% patients with EF 35%, 33.8% with EF 40%, 27.9% with EF 45%, 5.9% with EF 50%, 5.9% with EF 55% and 16.2% with EF of 60%. The recovery of LV function after pPCI in our study is linked with the duration of appearance of symptoms and presentation of patient at our setup. We have seen that restoring blood flow proved beneficial more in patients who presented within 30 minutes or up to 2 hours as compared to those who presented late. Similar results were reported by Munk et al. They reported 69% of patients with improved and good LV function at 30 days follow up and only 8% patients with severe LV dysfunction at 30 days follow-up¹³. Munk et al also attributed this improvement to timely intervention and revascularization of the occluded artery leading to restoration of blood to myocardium preventing necrosis and thus LV function¹³. Similarly Bax et al also showed improvement in hypokinesia and regional wall motion abnormality over the time in 6 months follow-up in patients with acute AAMI⁴.

Time to reperfusion not only determines the size of infarct but also determines the systolic function^{14, 15} but there are only a few studies regarding this aspect. Prasad et al showed that delayed re-

perfusion is associated with lower EF¹⁵. Similar results were also reported with Shacham et al¹⁶. Our study also showed that the time taken by patient from appearance of chest pain to reach a tertiary care hospital with the facility of pPCI determines the improvement in LV systolic function. We have seen that a considerable number of patients present even after 6 hours of appearance of chest pain. This could be due to poor knowledge of the symptoms or poor understanding of the gravity of the condition or poor transport facilities.

This study also has limitation. It is an observational study with a small sample size. Secondly we assessed LV systolic function only in patients with acute AAMI by eye ball assessment of EF at 24 hours and 6 weeks after follow-up. A study with more randomized control trial with larger sample size and more detailed assessment of LV function should be done to establish the relation with the time taken by patient to reach hospital from the appearance of symptoms.

Conclusion

In the light of results of this study we concluded that patients who are timely treated with primary PCI for acute AAMI tend to get more benefit in terms of improvement of LV function at 6 weeks as compared to those patients who have longer presentation time at the tertiary care hospital with the facility of primary PCI.

References

1. Nicolosi G L, Latini R, Marino P, Maggioni A P, Barlera S, Franzosi M G et al. The prognostic value of pre-discharge quantitative two-dimensional echocardiographic measurements and the effects of early lisinopril treatment on left ventricular structure and function after acute myocardial infarction in the GISSI-3 trial. *Eur Heart J.* 1996; *17*:1646–56
2. Busk M, Maeng M, Kristensen S D, Thuesen L, Krusell L R, Mortensen L S et al. Timing, causes, and predictors of death after three years' follow-up in the Danish Multicenter Randomized Study of Fibrinolysis versus Primary Angioplasty in Acute Myocardial Infarction (DAN-AMI-2) trial. *Am J Cardiol.* 2009; *104*: 210–5

3. Andersen H R, Nielsen T T, Rasmussen K, Thuesen L, Kelbaek H, Thayssen P et al. A comparison of coronary angioplasty with fibrinolytic therapy in acute myocardial infarction. *N Engl J Med*. 2003; 349:733–42.
4. Bax M, De Winter R J, Schotburgh C E, Koch K T, Meuwissen M, Voskuil M et al. Short- and Long-Term recovery of left ventricular function predicted at the time of primary percutaneous coronary intervention in anterior myocardial infarction. *JACC*. 2004;43(4): 534-541
5. Corr P B, Pearle D L, Hinton J R, Roberts W C, Gillis R A. Site of Myocardial Infarction: A Determinant of the Cardiovascular Changes Induced in the Cat by Coronary Occlusion. *Circulation Research*. 1976; 39(6): 840-847
6. Heusch G, Schulz R. Characterization of hibernating and stunned myocardium. *Eur Heart J*. 1997; 18 (Suppl D): 102-110
7. Banarjee P. Preserving Left Ventricular Function during Percutaneous Coronary Intervention. *J Invasive Cardiol*. 2007; 19(10): 440-443
8. Galema T W, Geleijnse M L, Yap S C, Domburg R T, Biagini E, Vletter W B et al. Assessment of left ventricular ejection fraction after myocardial infarction using contrast echocardiography. *European Journal of Echocardiography*. 2008; 9(2): 250–4
9. Abou R, Leung M, Goedemans L, Hooslag G E, Schalij M J, Marsan N A. Effect of Guideline-Based Therapy on Left Ventricular Systolic Function Recovery After ST-Segment Elevation Myocardial Infarction. *Am J Cardiol*. 2018; 122(10):1591-7
10. Stolfo D, Cinquetti M, Merlo M, Santangelo S, Barbati G, Alonge M et al. ST-elevation myocardial infarction with reduced left ventricular ejection fraction: insights into persisting left ventricular dysfunction. A pPCI-registry analysis. *Int J Cardiol*. 2016; 215: 340–5
11. Sutton N R, Li S, Thomas L, Wang T Y, de Lemos J A, Enriquez J R et al. The association of left ventricular ejection fraction with clinical outcomes after myocardial infarction: Findings from the Acute Coronary Treatment and Intervention Outcomes Network (ACTION) Registry-Get with the Guidelines (GWTG) Medicare-linked database. *Am Heart J*. 2016; 178: 65–73
12. Soholm H, Lonborg J, Andersen M J, Vejstrup N, Engstrom T, Moller J E et al. Repeated echocardiography after first ever ST-segment elevation myocardial infarction treated with primary percutaneous coronary intervention—is it necessary. *Eur Heart J Acute Cardiovasc Care*. 2015; 4: 528–36
13. Munk K, Andersen N H, Schmidt M R, Nielsen S S, Terkelsen C J, Sloth E et al. Remote Ischemic Conditioning in Patients With Myocardial Infarction Treated With Primary Angioplasty Impact on Left Ventricular Function Assessed by Comprehensive Echocardiography and Gated Single-Photon Emission CT. *Circulation: Cardiovascular Imaging*. 2010; 3(6): 656-62
14. Hasche E T, Fernandes C, Freedman S B, Jeremy R W. Relation between ischemia time, infarct size, and left ventricular function in humans. *Circulation*. 1995; 92: 710–719.
15. Prasad S B, See V, Brown P, McKay T, Narayan A, Kovoor P et al. Impact of duration of ischemia on left ventricular diastolic properties following reperfusion for acute myocardial infarction. *Am J Cardiol*. 2011; 108: 348–354.
16. Shacham Y, Steinvil A, Lesham-Rubinow E, Assa E B, Karan G, Roth A, et al. Association between time to reperfusion and echocardiography assessed left ventricular filling pressure in patients with first ST-segment elevation myocardial infarction undergoing primary coronary intervention. *Cardiology Journal*. 2014 ;21(4): 357-363.