

ORIGINAL ARTICLE

Echocardiographic Evaluation of Acute Myocardial Infarction Complications

Abid Ullah Shah^{1*}, Muhammad Imran², Saeed Ullah³, Nayab Ali³, Sadia Menhas⁴, Rafique Nawaz Khan⁴

¹Department of Cardiology, College of Medical Technology, Bacha Khan Medical College, Mardan, Pakistan.

²Department of Cardiology, Institute of Paramedical Sciences, Khyber Medical University, Peshawar, Pakistan.

³Department of Cardiology, Medical Teaching Institution, Lady Reading Hospital, Peshawar, Pakistan.

⁴Department of Cardiology, Rehman College of Allied Health Sciences, Peshawar, Pakistan.

*Corresponding Author's Email: abidullahshah22@gmail.com

ABSTRACT

Acute myocardial infarction (AMI) has different complication and echocardiography is helpful in evaluation of major AMI complications like mitral regurgitation (MR), pericardial effusion (PE), left ventricular dysfunction, Ventricular aneurysm, ventricular septal rupture (VSR), and LV clot (LVT). This cross sectional study was conducted in tertiary care hospital, Peshawar from March to August 2018. A total of 150 patients of both gender having AMI were included, while patients with congenital VSDs, organic mitral regurgitations and cardiomyopathies were excluded. All data was analyzed by SPSS-23. AMI was more in male and majority of patients were with anterior wall MI 78 (52%) and ST elevation myocardial infarction 114 (76.0%), on echocardiography mitral regurgitation was found in 66 (44%), pericardial effusion in 25 (16.7%), left ventricular dysfunction in 90 (60%), Ventricular aneurysm in 4 (2.7%) and ventricular septal rupture in 3 (2.0%) and LV clot in 20 (13.3%) patients respectively. Echocardiography is an easy and standard tool in evaluation of major AMI complications and timely diagnosis of such complications helps in proper management and assessment of prognosis in AMI patients.

Keywords: Acute Myocardial Infarction, Echocardiography, Complications

Received 30.08.2020

Revised 06.10.2020

Accepted 04.11.2020

How to cite this article:

A U Shah, M Imran, S Ullah, N Ali, S Menhas, R N Khan. Echocardiographic Evaluation of Acute Myocardial Infarction Complications. Adv. Biores., Vol 11 (6) November 2020: 220-224

INTRODUCTION

In the current era echocardiography in CCU (coronary care unit) has a very important influence on the early detection, diagnosis and management of some of the major complications of acute myocardial infarction (AMI), i.e. Mitral valve regurgitation (MR), pericardial effusion (PE), ventricular septal ruptures (VSR), impaired left ventricular (LV) function, LV clots (LVT), ventricular aneurysm and others, also echocardiography facility has enabled us to accurately diagnose and detection of these complications after AMI.

In USA the leading cause of mortality above 65 years old is cardiovascular (CVS) diseases and in 2011 one of every 7 deaths was due to coronary heart disease and there were 375,295 deaths in 2011 as well due to same disease in USA and approximately 635,000 new cases and 300,000 recurrent attacks of acute myocardial infarction occur each year according to 2015 American Heart Association's (AHA) heart disease and stroke statistics [1, 2].

Acute myocardial infarction or heart attack is the ischemic necrosis of myocardium due to decrease or stoppage of coronary blood flow to myocardium, this occurs due to blockage of coronary arteries by dynamic atherosclerosis, i.e. thrombus builds on ruptured atheromatous plaque due to platelets aggregations, that blocks coronary arteries [3].

According to the universal definition of AMI for diagnosis there must be elevation or decrease (or both) of troponin I or T tests, specific for cardiac muscles damage with at least one value above the 99th percentile

of the upper limit of normal range along with at least one of the clinical evidences includes symptoms of ischemia like chest pain or heaviness or any proof of myocardial ischemia that may be ST segment elevation (STEMI), depression, new developing left bundle branch block (LBBB) or Q waves (pathological) on electrocardiography (ECG), or loss of viable myocardium or new wall motion abnormalities on echocardiography, or blockage by intracoronary thrombus on angiography [4].

Left ventricular thrombus, pericardial effusion, mitral valve regurgitation, impairment of left ventricular systolic function, ventricular septal ruptures, ventricular aneurysm are major complications of AMI, chances of these complications are more and nearly twenty five percent patients after AMI suffers these major complications but timely diagnosis and their management helps to prevent patients from further deteriorations [5, 6].

Mitral regurgitation is the flow of blood back from LV to LA during cardiac systole, occurs after AMI with different severity and study shows different frequency after AMI, i.e. 45% in one study [7], PE is also common complication after AMI and develops usually due to pericardial inflammation and found almost in 32% of AMI patients [8], VSR is a breach in between LV and RV usually occurs in muscular portion of IVS and is a rare complication, nowadays only develops in 0.2% of AMI patients due to improvement in reperfusion therapy [9].

Impaired LV function is also among the major AMI complication and develops with different frequency and usually in those patients, they have 40% or more of LV is damaged [10], ventricular aneurysm is a thinned out and scarred myocardium that bulges outward during systole and mostly present in setting of anterior infarction and located at or nearly at apex of LV [11]. LVT also depends upon site and severity of myocardial infarction usually develops with large anterior transmural wall MI and endothelial injury play major role in LVT formation [12].

Echocardiography is a non-invasive and reliable tool for immediate diagnosis of AMI and also for location of regional wall motion abnormalities after AMI, that correlates well with ECG findings [13]. AMI can leads to ischemic, arrhythmic, inflammatory, embolic and mechanical complications like ventricular septal rupture (VSR), papillary muscle rupture, impaired Left ventricular function and others, also echocardiography with its modalities is the choice of investigation in diagnosis of these mechanical complications [14].

The aim of this study was to evaluate the number of patients with major AMI complications through echocardiography in current progressed era in field of echocardiography, timely diagnosis and management of AMI complications helps in prevention of patients from their further progression and other complex complications.

MATERIAL AND METHODS

This cross sectional observational study was conducted in Department of Cardiology, Northwest General Hospital and Research Center, Peshawar for six months (March to August 2018). A total of 150 adult patients having AMI of both gender participated in this study and patients having congenital VSDs, organic mitral regurgitations and cardiomyopathies were excluded from the study. Data was collected after inform consent by filling questionnaire through convenience sampling under experienced Echocardiography Technologist from diagnosed admitted AMI patients.

Echocardiography was done for all AMI patient during their hospital stay, complete echocardiogram was done for all AMI patients using all required modalities applied like 2D, M mode, Doppler modalities (color flow imaging and others) and images were observed carefully by using standard transthoracic approach (parasternal long/short axis, apical, subcostal and also using modified views). Echocardiographic examination carefully done for major complications of AMI like mitral regurgitation, pericardial effusion, impaired LV function, ventricular aneurysm, interventricular septal ruptures and LV clot.

The echocardiographic diagnosis of mitral regurgitation was based on the detection of regurgitation jet entering from LV in to LA during systole and graded MR severity from minimal to severe according to recommended criteria and required criteria for diagnosis of pericardial effusion was the presence of persistent echo-free space during cardiac cycle in between visceral and parietal pericardium.

Impaired LV systolic function was determined on base of LV ejection fraction, obtained using Simpson's rule (biplane modified), eyeballing and sometime M mode as well and graded normal and impaired in accordance to recommended criteria (normal LV systolic function = EF >55%). LV aneurysm was diagnosed when there was thinned out myocardium that bulges during systole, ventricular septal ruptures was identified as a breach usually in muscular interventricular septum and colour flow crossing IVS and LV clot was detected on the base of echo dense mass in regions of akinesia, dyskinesia or hypokinesia.

All the variables like demographic, myocardial infarction data, its major complications and others were added and analyzed by using SPSS (statistical package for social sciences) software version 23.

RESULTS AND DISCUSSION

Echocardiography is diagnostic tool that use ultrasounds and the choice of investigation tool for assessing complications of acute myocardial infarction (AMI) like mitral regurgitation, pericardial effusion, impaired left ventricular function, left ventricular aneurysms, interventricular septal rupture and left ventricular clot [15].

The total participants in this study were 150 acute myocardial infarction (AMI) patients, The majority of AMI patients were male 106 (70.7%) and number of female patients were 44 (29.3%) during this study duration (Table 1), other studies also shows acute myocardial infarction more in male patients (8,16).

Table 1: Number of Male and Female Patients (n = 150)

Variables	Frequency	Percent
Male	106	70.7
Female	44	29.3
Total	150	100.0

Patient with minimum age was 28 years, maximum age was 85 years and mean age was 56.47 ± 11.55 , six patients were less than 35 years age, 17 patients in between 36-45 years age, 56 patients were in 46-55 years age and with majority in this age range, 42 patients in between 56-65 years age, 20 patients in between 66-75 years age and 9 patients were above 76 year age respectively (Table 2).

Table 2: Age Group of research participants (n = 150)

Age Groups (Years)	Frequency	Percent
<35	6	4.0
36-45	17	11.3
46-55	56	37.3
56-65	42	28.0
66-75	20	13.3
>76	9	6.0
Total	150	100.0

Number of male patients having AMI were more than female and majority of AMI patients 56 (37.3%) were in age range of 46-55 years and this was same with another study in relation with gender of research participants but in that study majority of patients (31.5%) were in between 51-60 years age and mean age (56 ± 18) in that study was close to this study (56.47 ± 11.55) (8).

Majority of patients presented with anterior wall MI 78 (52.0%) same to another study that also shows more anterior wall AMI than in other sites [16], among 150 AMI patients majority of patients 114 (76%) were with ST elevation myocardial infarction (STEMI) and 36 (24%) were with Non-STEMI, 48 (32%) patients were diabetic, among diabetic patients 26 patients were with anterior wall MI (Table 3).

Table 3: Summary of Acute Myocardial Infarction sites and Types with Diabetes (n=150)

Variables	Frequency	STEMI	NSTEMI	Diabetic
Anterior	78	61	17	26
Other	72	53	19	22
Total	150	114	36	48

Major AMI complications in this study observed through echocardiography as, MR in 66 (44%) patients, pericardial effusion in 25 (16.7%), Impaired LV function in 90 (60%), ventricular aneurysm in 4 (2.7%), IVS rupture in 3 (2.0%), LV clot in 20 (13.3%) patients (Table 4).

Table 4: Major Complications of Acute Myocardial Infarctions (n = 150)

Variables	Frequency	Percentage (%)
Mitral regurgitation	66	44.0
Pericardial effusion	25	16.7
Impaired LV function	90	60.0
Ventricular aneurysm	4	2.7
Ventricular septal rupture	3	2.0
LV clot	20	13.3

The major Echocardiographic findings of AMI complications in this study are somewhat higher and lower to another prospective multicentre study done for value of echocardiography to detect AMI complication and observed mitral regurgitation in 28% patients, pericardial effusion in 6.6%, VSR in 0.6%, LV clot in 2.4% respectively out of total 908 patients [17].

Result of another study showed mitral regurgitation in 27 (36%) out of total 75 AMI patients by using Doppler echocardiography and observed significant association with more frequent supraventricular tachycardia (SVT), ventricular arrhythmias, heart failure [18], pericardial effusion is also common complication after AMI with different severity and is detected by using echocardiography and two different studies shows somewhat lower frequency of PE than this study i.e. 18.1% and 5.6% frequency of pericardial effusion respectively [19, 20].

Echocardiography can also easily detect impaired LV systolic function and study shows that wall motion abnormalities like hypokinesia, akinesia and dyskinesia leads to reduced ejection fraction and LV systolic function becomes impaired and worse with time [15], one study define ventricular aneurysm is the systolic and diastolic myocardial bulging and results of that study shows higher number of patients with LV aneurysm in 35 (22%) patients out of total 158 AMI patients compared to 2.7% in this study, that study also shows majority of patients with anterior wall AMI same as in this study [21].

According to a study ventricular septal rupture is less common nowadays in reperfusion era and Doppler echocardiography is the choice of tool for diagnosis, estimates the size of shunt and also shows 1-2% incidence of VSR, close to 2% result in this study [22] and result of another study shows 0.2-0.31% incidence of VSR little lower than this study (2%) and additionally mortality was higher in patients with VSR [23].

Left Ventricular clot is important complication after AMI, observational study shows LV clot in 50 (17.86%) out of total 280 AMI patients compared to 13% result of this study that are detected by 2-D echocardiography (24), also another hospital based cross-sectional study done that shows higher number of LV clot (34.1%) than this study, this may be due to study population because all patients were with anterior wall MI [25].

According to one study early echocardiography after AMI increase accuracy and safety and helps in prevention to further complications, AMI is detected on echocardiography on base of regional wall motion abnormalities (RWMA), i.e. hypokinesia, dyskinesia, akinesia and aneurysm and these also indicate the prognostic factor after AMI, e.g. dyskinesia indicate bad prognosis after AMI [26].

Echocardiography is ultrasound based gold standard tool for the diagnosis of AMI complications like MR, pericardial effusion, VSR, LV clot, LV aneurysm [15], according to study echocardiography is non invasive, low expensive and safe tool (no biohazards) for patients, also play outstanding role in diagnosis and management of patients with AMI and in detection of its major complications and their management [27].

CONCLUSION

After acute myocardial infarction (AMI) many patients presents different AMI complications, echocardiography is easy and standard choice of diagnostic tool for detection and evaluation of major complications of AMI like mitral regurgitation, pericardial effusion, impairment of left ventricle function, LV aneurysm, ventricular septal rupture and LV clot. In addition echocardiographic diagnosis of AMI complications also helps in decision for proper surgical and medical management, guiding therapy and also helps in assessment of prognosis in AMI patients.

CONFLICT OF INTREST

The authors have no conflict of interest.

REFERENCES

1. Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, et al (2015). Heart Disease and Stroke Statistics—2015 Update. *American Heart Association Journal*; 131: 29–322.
2. Bajaj A, Sethi A, Rathor P, Suppogu N, Sethi A (2015). Acute Complications of Myocardial Infarction in the Current Era: Diagnosis and Management. *Journal of Investigative Medicines*; 63(7): 844–55.
3. Saleh M, Ambrose JA (2018). Understanding myocardial infarction. *F1000 Faculty Rev*; 7: 1–8.
4. Thygesen K, Alpert JS, Jaffe AS, Simoons ML, Chaitman BR, White HD (2012). Third Universal Definition of Myocardial Infarction. *Circulation*; 126: 2020–35.
5. Shah SFA, Hadi A, Faheem M, Ikramullah, Iqbal MA, Gul AM, et al (2013). Frequency of mechanical complications in patients with acute myocardial infarction. *Pak Heart Journal*; 46(02): 86–90.
6. Riaz A, Kaleem M, Mughal S (2017). Frequency of Complications of anterior wall myocardial infarction. *Pak Heart Journal*; 50(03): 190–3.
7. Fazlinezhad A, Dorri M, Azari A, Bigdelu L (2014). Frequency of ischemic mitral regurgitation after first-time

- acute myocardial infarction and its relation to infarct location and in-hospital mortality. *Journal of Tehran University Heart Center*; 9(4): 160–5.
8. Rehman H, Khan SB, Hadi A, Nawaz T, Shah ST, Ullah H, et al (2010). Frequency of pericardial effusion in patients with first myocardial infarction and its effects on in-hospital morbidity and mortality. *Journal of Ayub Medical College Abbottabad*; 22(2): 184–6.
 9. Deja MA, Szostek J, Widenka K, Szafron B, Spyt TJ, Hickey MSJ, et al (2000). Post infarction ventricular septal defect—can we do better? *European Journal of cardio-thoracic Surgery*; 18(2): 194–201.
 10. Hochman JS, Buller CE, Sleeper LA, Boland J, Dzavik V, Sanborn TA, et al (2000). Cardiogenic shock complicating acute myocardial infarction - Etiologies, management and outcome: A report from the shock trial registry. *Journal of American College of Cardiology*; 36: 1063–70.
 11. Schlichter J, Hellerstein HK, Kaatz LN. Aneurysm of the heart_ a correlative study one hundred and two proved cases. p. 43–86.
 12. Delewi R, Zijlstra F, Piek JJ (2012). Left ventricular thrombus formation after acute myocardial infarction. *Heart*; 98(23): 1743–9.
 13. Horowitz R, Morganroth J, Parrotto C, Chan C, Soffer J, Pauletto F (1982). Immediate Diagnosis of Acute Myocardial Infarction by Two-Dimensional Echocardiography. *Circulation*; 65: 323–9.
 14. Kuty RS, Jones N, Moorjani N (2013). Mechanical Complications of Acute Myocardial Infarction. *Cardiol Clin*; 31: 519–31.
 15. Wilansky S (1991). Echocardiography in the assessment of complications of myocardial infarction. *Texas Heart Institute Journal*; 18(4): 237–42.
 16. Sulhera SB, Shaukat K, Memoona MM, Awan AK (2014). Frequency of Thrombolysis and Comparison of Pericardial Effusion in Myocardial Infarction patients with and without Thrombolysis. *P J M H S*; 8(3): 747–50.
 17. Gueret P, Khalife K, Jobic Y, Fillipi E, Isaaz K, Baixas C, et al (2008). Echocardiographic assessment of the incidence of mechanical complications during the early phase of myocardial infarction in the reperfusion era : a French multicentre prospective registry. *Archives of Cardiovascular Diseases*; 101: 41–7.
 18. Kraska T, Liszewska-Pfeijfer D, Dziduszko-Fedorko E, Jakubowska-Najnigier M, Opolski G, Stanisławska-Nielepkiewicz J, et al (1990). Clinical significance of mitral valve insufficiency detected by Doppler echocardiography in acute myocardial infarction. *Polskie Archiwum Medycyny Wewnętrznej*; 84(4): 213–9.
 19. Shah AU, Imran M, Iqbal J, Khalil AA, Ullah SA, Ahmad W (2019). Frequency and severity of pericardial effusion after acute myocardial infarction. *International Journal of Biosciences*; 15(6): 441–9.
 20. Pierard LA, Albert A, Henrard L, Lempereur P, Sprynger M, Carlier J, et al (1986). Incidence and significance of pericardial effusion in acute myocardial infarction as determined by two-dimensional echocardiography. *Journal of the American College of Cardiology*; 8(3): 517–20.
 21. Visser CA, Kan G, Meltzer RS, Koolen JJ, Dunning AJ (1986). Incidence, timing and prognostic value of left ventricular aneurysm formation after myocardial infarction: A prospective, serial echocardiographic study of 158 patients. *The American Journal of Cardiology*; 57(10): 729–32.
 22. Birnbaum Y, Fishbein MC, Blanche C, Siegel RJ (2002). Ventricular septal rupture after acute myocardial infarction. *N Engl J Med*; 347: 1426–32.
 23. Moreyra AE, Huang MS, Wilson AC, Deng Y, Cosgrove NM, Kostis JB (2010). Trends in incidence and mortality rates of ventricular septal rupture during acute myocardial infarction. *American Journal of Cardiology*; 106(8): 1095–100.
 24. Rathi N, Maheswari N, Kumari D, Sachdewani RK, Memon NA MF (2009). Left ventricular thrombus in acute myocardial infarction. *Pakistan Heart Journal*; 42: 9–13.
 25. Jalal-ud-din M, Jadoon RJ, Qureshi A, Khan SA, Anwar A, Haroon MZ (2014). Left ventricular thrombus in patients with acute anterior wall myocardial infarction. *Journal of Ayub Medical College Abbottabad*; 26(4): 491–5.
 26. Toth C, Csomos M, Vadnay I (1997). Significance of early echocardiography in acute myocardial infarct. *Orvosi hetilap*; 138(13): 787–91.
 27. Katz AS, Harrigan P, Paris AF (1992). The value and promise of echocardiography in acute myocardial infarction and coronary artery disease. *Clinical Cardiology*; 15(6): 401–10.

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