Original Article

FREQUENCY OF LEFT VENTRICULAR THROMBUS AFTER ANTERIOR WALL ST-SEGMENT ELEVATION ACUTE MYOCARDIAL INFARCTION

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ABSTRACT

INTRODUCTION:

Left ventricular thrombus (LVT) formation is a well known complication seen in patients presenting with acute anterior wall ST-segment elevation myocardial infarction (STEMI). In previous studies the incidence of this complication, after acute myocardial infarction (AMI) has been reported to be 4% to 60% in large anterior wall STEMI, depending significantly upon the method as well as time of reperfusion therapy after STEMI.

OBJECTIVE:

The objective of this descriptive case series study was to evaluate the frequency of left ventricular thrombus formation in patients after acute anterior wall ST-Segment elevation myocardial infarction.

METHODOLOGY:

In this study, 100 patients with anterior wall STEMI presenting to cardiac emergency or coronary care unit (CCU) of Cardiac complex, Gulab Devi Hospital, were selected on non-probability, purposive sampling meeting inclusion criteria, after taking written informed consent. All the patients were treated initially for management of acute STEMI, including use of thrombolytics where indicated. 2-D Transthoracic echocardiography (TTE) was performed during the same admission to assess presence of LV thrombus (LVT).

RESULTS:

The mean age of the patients was 54.3 ± 11.4 years. There were 84(84%) male patients and 16 (16%) female patients. LVT was present in 28 (28%) patients on TTE. Among those, there were 23 (82.1%) male and 5 (17.9%) female patients. However, out of 84 male patients 27.4% develop LVT and among 16 female patients this ratio was 31.3%. The LV thrombus was independent of age and gender. LV thrombus was significantly less in thrombolytic group as compared to those who were not given this therapy, i.e. p value <0.05.

CONCLUSION:

Patients with anterior wall acute STEMI not infrequently develop the complication of development of LV thrombus. In this study the frequency of LV thrombus formation after anterior wall acute STEMI was 28%.

KEY WORDS:

Anterior wall STEMI, LV Thrombus, Reperfusion Therapy, 2-D Transthoracic Echocardiography, Contrast Enhanced Echocardiography.

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INTRODUCTION:

Acute Myocardial infarction (AMI) is the leading cause of death all over the world and also among the most important reason for morbidity in hospitalized patients.[1] The composite mortality rate for the patients who die before reaching the hospital or during course of treatment after acute myocardial infarction is more than 30%. However, this morbidity and mortality rate is gradually declining with the ongoing evolution in the treatment strategy for this dreadful health issue over the past 30 years including the development of the coronary care unit, fibrinolytic therapy, and catheter-based reperfusion. The situation in the developing countries is also worsening as the number of patients having myocardial infarction and related complications is approaching close to that found in the developed world.[2]

According to a consensus document reported by Alpert JS et al, AMI has been redefined as the detection of a rise and/or fall in cardiac biomarkers with at least one value above the 99th percentile of the upper reference limit (URL), together with evidence of ischemia. Myocardial ischemia has been defined as any symptom suggestive of ischemia, electrocardiographic (ECG) changes indicating development of new ischemia, development of pathologic Q waves on ECG or evidence of infarction in imaging studies.[3] The most commonly used markers among multiple available cardiac biomarkers are Troponin-T (Trop-T) and Creatine Kinase (CK) - MB isoenzyme level. A rapid test kit is also available these days to assess Trop-T level in blood that helps diagnosing this grave illness at bedside in emergency department.[4]

The most important initiating event in the development of AMI is coronary artery plaque fissuring or rupture that leads to the exposure of underlying subendothelial matrix to formed elements of blood. That further leads to cascade of events resulting in activation of platelets and thrombin generation leading to formation of thrombus. The development of occlusive thrombus within the lumen of coronary artery in the absence of collateral blood vessels most often results in the development of acute ST-segment elevation myocardial infarction (STEMI).[5]

Left ventricular (LV) thrombus formation is not an uncommon complication developing in patients suffering from AMI. While reviewing most of the past research articles, the incidence of LV thrombus complicating the AMI have been found to be 20-40%, and in some of these studies as high as 50-60% with large anterior wall MI. However, the incidence of this complication in patients with non-anterior wall MI the incidence was close to 5%.[6–7]

The pathophysiologic mechanism for LV thrombus formation can be explained by so called "Virchow's triad" that is commonly found in patients suffering from AMI. The three components of this triad are stasis of blood, endocardial injury or dysfunction and a hypercoagulable state.[6–7] The LV thrombus generally develops within 1 to 2 weeks of development of AMI.[6]

Among many factors that are associated with a higher risk of LV thrombus formation after acute anterior wall MI, more commonly seen are large infarct size and extent, presence of congestive cardiac failure, severe global and regional LV systolic dysfunction, elevated end-systolic volume, LV dilatation or aneurysm formation, presence of spontaneous contrast on echocardiogram and abnormal flow patterns visible within the left ventricle.[6–9] Increased level of C-reactive protein[10] and advanced age[11] at the time of AMI have also been found to be related to increased risk. There is about 10% risk of embolization after development of thrombi.[7] Factors that increase the risk of embolization are mobility, protrusion into the LV cavity and central echolucency of the clot.[6]

Transthoracic echocardiography (TTE) is the most commonly used imaging modality to make a diagnosis of LV thrombus and has a sensitivity of 90%-95% and specificity of 85%-90%.[6] Multiple echocardiographic criteria have been devised for detection of LV thrombus that include an echodense mass within the LV cavity that is although contiguous with underlying myocardium, yet quite distinct from this layer. This mass should be seen throughout the cardiac cycle and visualized in at least two orthogonal views. Other important associated findings are underlying region of severe wall motion abnormality, usually severe hypokinesis, akinesis, dyskinesis, and/or aneurysmal dilatation.[6–7,12–13] LV thrombus can rarely develop in association with stunned myocardium that regains its normal motility at the

time of detection of thrombus. Along with an echodense mass, a spontaneous echo contrast or "smoke effect" is commonly seen within left ventricular cavity of the patients diagnosed to have intracardiac thrombi.[6]

During multiple research studies, thrombolytic drugs have been found to reduce the overall morbidity and mortality in patients with AMI.[14–16] While reviewing this data to evaluate for the development of LV thrombus after acute STEMI, some of the articles show a reduction in the incidence of LV thrombus with early thrombolysis while others show no significant impact of this therapy in this regard. In recent studies, the frequency of LV thrombus has been found to be significantly decreased in patients treated with early catheter based revascularization with or without use of intensive parenteral antiplatelet therapy as compared to the use of thrombolytics.[7] However, some data show comparable rate of LV thrombus formation when thrombolytics are compared with use of recent advances in early revascularizaton.[17]

The purpose of this study is to assess the burden of the potentially lethal complication of LV thrombus formation in hospitalized patients after acute anterior wall STEMI, and to realize the importance of its early detection so that prompt medical therapy could be instituted in time to prevent the potential risk of embolization of the LV thrombus resulting in further complications that can be life threatening, like stroke.

PATIENTS AND METHODS:

STUDY DESIGN: Descriptive case series.

SETTING: Study was conducted in patients admitted to Cardiac Complex Gulab Devi Hospital, Lahore.

SAMPLE SIZE: The sample size of 100 cases was calculated with 95% confidence level (CI), 8% margin of error, and taking expected percentage of LV thrombus formation i.e. 20% in patients after acute anterior wall STEMI.

SAMPLING TECHNIQUE: Non-probability purposive sampling.

SAMPLE SELECTION:

INCLUSION CRITERIA

- Patients of all ages and from both genders suffering from acute anterior wall STEMI suggested by clinical history, ECG changes and/or cardiac enzyme level.

EXCLUSION CRITERIA:L

- Old inferior wall MI with current anterior wall MI
- Cardiomyopathy
- Valvular heart disease
- Acute Pericarditis
- Myocarditis
- Patients with other comorbidity like moderate to severe chronic kidney disease [diagnosed by serum creatinine level ≥2 mg/dl (Normal 0.4-1.2 mg/dl), abdominal ultrasound showing renal parenchymal disease] and decompensated chronic liver disease (diagnosed by history and on abdominal ultrasound showing cirrhosis and related changes of decompensation like splenomegally, portal vein dilation, and/or ascites).

DATA COLLECTION:

100 patients admitted to cardiac emergency department or coronary care unit Gulab Devi Hospital Lahore, with the diagnosis of acute anterior wall STEMI, treated with thrombolytic agent or conservatively, were selected for study after written informed consent. Demographic profile was obtained from the patients. Transthoracic echocardiography (TTE) was performed on 5th day of admission by the single consultant expert in performing echocardiography, to assess LV function and evidence of LV thrombus according to operational definition.

DATA ANALYSIS:

All data was analyzed by the SPSS version 16. Quantitative variables like age were presented by mean and standard deviation. Qualitative variables like gender and LV thrombus were presented as frequency and percentage. Data was stratified for use of thrombolytic agent and conservative management to address effect modifier.

RESULTS:

Among 100 patients having acute anterior wall STEMI, the mean age of the patients was 54.3 ± 11.4 years and the age range was 60 years with the minimum and maximum age of 25 and 85 years respectively. There were 9 (9%) patients in the age group of less than 40 years, 53 (53%) patients in

the age group of 40 to 59 years and 38 (38%) patients were in the age group of 60 or more years.

There were 84 (84%) male and 16 (16%) female patients in the study population. All 9 (100%) patients in less than 40 years age group were male. In 40 to 59 years age group, 47 (88.7%) were male and 6 (11.3%) female patients. In the age group of 60 or more years old patients, 28 (73.3%) were male and 10 (26.3%) female patients. Thus majority of male patients i.e. 47 (56%) of 84 belonged to 40 to 59 years age group while 10 (62.5%) out of 16 female patients were among 60 or more years age group.

Left ventricular thrombus development was seen in 28 (28%) patients out of the total study population of 100 patients. Among those 28 patients, 2 (7.1%) patients were in age group of less than 40 years, 19 (67.9%) patients in 40 to 59 years age group and 7 (25%) patients in 60 years or more age group.

In the data stratification considering the use of thrombolytics i.e. IV streptokinase infusion, 64 (64%) out of 100 patients in the study group were given this drug during their initial management plan while 36 (36%) patients were not treated with IV streptokinase either due to late presentation or having some contraindication to this therapeutic agent. Out of 28 patients who developed LV thrombus, 11 (39.3%) were given IV streptokinase while 17 (60.7%) were not treated with this thrombolytic agent. Thus out of 64 patients who were given thrombolytic agent 11 (17.2%) developed LV thrombus while 17 (47.2%) out of 36 patients who were not treated with thrombolytic agent developed LV thrombus.

Table: Frequency of LV thrombus in different age groups, gender and thrombolytic status

			LV Thrombus		***Total***	***p-value***
			Present	***Absent***		
Age groups (years)	***≤40***	**No. of patients**	**2**	**7**	**9**	**0.174 (NS)**
		% within age groups	22.2%	77.8%	100.0%	
		% within LV Thrombus	7.1%	9.7%	9.0%	
	41-59	**No. of patients**	**19**	**34**	**53**	
		% within age groups	35.8%	64.2%	100.0%	
		% within LV Thrombus	67.9%	47.2%	53.0%	
	≥60	**No. of patients**	**7**	**31**	**38**	
		% within age groups	18.4%	81.6%	100.0%	
		% within LV Thrombus	25.0%	43.1%	38.0%	
Total		**No. of patients**	**28**	**72**	**100**	**NA**
		% within age groups	28.0%	72.0%	100.0%	
		% within LV Thrombus	100.0%	100.0%	100.0%	
Gender	***Male***	**No. of patients**	**23**	**61**	**84**	**???**
		% within Thrombolytic	27.4%	72.6%	100.0%	
		% within LV Thrombus	82.1%	84.7%	84.0%	
	Female	**No. of patients**	**5**	**11**	**16**	
		% within Thrombolytic	31.3%	68.8%	100.0%	
		% within LV Thrombus	17.9%	15.3%	16.0%	

Total		**No. of patients**	**28**	**72**	**100**	**NA**
		% within Thrombolytic	28.0%	72.0%	100.0%	
		% within LV Thrombus	100.0%	100.0%	100.0%	
Thrombolytic	***Given***	**No. of Patients**	**11**	**53**	**64**	**0.002 (Sig)**
		% within gender	17.2%	82.8%	100.0%	
		% within LV Thrombus	39.3%	73.6%	64.0%	
	Not given	**No. of Patients**	**17**	**19**	**36**	
		% within gender	47.2%	52.8%	100.0%	
		% within LV Thrombus	60.7%	26.4%	36.0%	
Total		**No. of Patients**	**28**	**72**	**100**	**NA**
		% within gender	28.0%	72.0%	100.0%	
		% within LV Thrombus	100.0%	100.0%	100.0%	

DISCUSSION:

Left ventricular thrombus (LVT) formation is a well known and a relatively frequent complication that develop in patients presenting with anterior wall ST-segment elevation acute myocardial infarction (STEMI). In previous studies, the incidence of LV thrombus formation after anterior wall acute STEMI has been reported to be 20-40% and may reach as high as 60% among the patients with large anterior wall acute STEMI.[18] Patients with LV thrombus after anterior wall acute STEMI have a worse prognosis with about 10% thrombi resulting in systemic embolization leading to potentially lethal complications like stroke. Therefore, to prevent these complications, important strategies should be made as an independent therapeutic goal.

Traditionally, the causes of LV thrombus formation after anterior wall acute STEMI include segmental dysfunction of the infarcted myocardium resulting in stasis of blood, endocardial tissue inflammation that provides a thrombogenic surface and a hypercoagulable state[7,19] There is also evidence given in literature that LV thrombus develop within a few days after acute STEMI.[20,21]

2-D Transthoracic echocardiography (TTE) is most commonly used imaging modality to make a diagnosis of LV thrombus and has a sensitivity of 90%-95% and specificity of 85%-90%.[6] Multiple echocardiographic criteria devised to detect LV thrombus include an echodense mass within the LV cavity contiguous with LV wall, but can be distinguished from the adjacent endocardium, should be seen throughout the cardiac cycle and also visible in at least two orthogonal echocardiographic views. An associated underlying region of severe wall motion abnormality, usually severe hypokinesis, akinesis, dyskinesis, and/or aneurysmal dilatation of LV wall is also usually visible.[6–7,12–13] Rarely, no wall motion abnormality is found along with thrombus detection. This might happen when thrombus develops adjacent to the area of stunned myocardium that regains normal motility at the time of detection of thrombus. Another important clue is the presence of spontaneous echo contrast or "smoke effect" that is commonly seen within left ventricular cavity of the patients developing intracardiac thrombi after MI.[6]

Contrast enhanced echocardiography has been found to show better results in diagnosis of LV thrombus after anterior wall acute STEMI in some studies. The study conducted by Siebelink HM et al[22] to assess the value of contrast echocardiography for left ventricular thrombus detection postinfarction and impact on antithrombotic therapy revealed that this echo technique can detect LV thrombus in postinfarction state when conventional echocardiography is inconclusive and can

differentiate multiple artifacts or myocardial structures initially suspected for presence of LV thrombus.[22]

In our study the mean age of the patients was 54.3 ± 11.4 years with 53 (53%) patients in the age group of 40 to 59 years of age. The majority of patients were males (84%). This pattern of age and gender distribution is in accordance with many previous studies. In the study of 434 patients with acute myocardial infarction conducted by Abid A R et al[15] to determine in-hospital outcome of acute myocardial infarction in patients receiving streptokinase (SK), the mean age of patients in SK group was 51.58 ± 11.02 years and in Non-SK group was 55.78 ± 10 years. The majority of the patients were male i.e. 83% in SK group. Shabbir M et al[16] studied 250 patients to determine the predictors of fatal outcome in acute myocardial infarction. In their study population mean age was 57.94 ± 14.00 years and 74.4% patients were males. An important point to note in age group distribution in our study was that there was no female patient in age group less than 40 years of age as compared to 9 male patients in this group. It can possibly be a reflection of decreased incidence of atherosclerotic coronary heart disease in premenopausal females.

LV thrombus was detected in 28 (28%) patients in our study and among these patients 23 (82.1%) were males and 5 (17.9%) females. However the proportionate distribution of male and female patients was 23 out of 84 (27.4%) and 5 out of 16 (31.3%) respectively that does not show a gross difference in distribution of the LV thrombus formation with respect to specific gender. However, the study results show a significant effect of the use of thrombolytic agent i.e. streptokinase to decrease the development of LV thrombus in patients having anterior wall acute STEMI. Out of 64 patients who were treated with streptokinase 11 (17.2%) patients developed LV thrombus while 17 (47.2%) out of 36 patients who did not receive streptokinase developed LV thrombus (p value <0.05).

The results of the past studies show a wide range of frequency distribution for the development of LV thrombus after anterior wall acute STEMI. Some of these studies show decreased frequency of development of this complication with the use of effective and early reperfusion strategies like use of thrombolytic agents like Streptokinase, IV glycoprotein IIb/IIIa inhibitors and use of primary percutaneous coronary intervention (PCI). The results of some other studies show no significant difference in LV thrombus formation after anterior wall acute STEMI with the use of thrombolytics.

In the study done by Mooe T et al[23] to determine the frequency of left ventricular thrombus formation after anterior wall myocardial infarction with or without thrombolytic agent, 74 out of total 99 patients in study group were treated with streptokinase. The results showed a frequency of thrombus formation in 46% patients among the thrombolytic group and in 40% of the patients in non-thrombolytic group. These results do not show any gross benefit of thrombolytic agent in the prevention of LV thrombus formation. These results are not in accordance with our study.

Rehan A et al[7] conducted a study to determine the incidence of post myocardial infarction left ventricular thrombus formation in the era of primary percutaneous intervention and glycoprotein IIb/IIIa inhibitor. In their study, 92 patients with acute STEMI treated with PCI and GP IIb/IIIa inhibitors were studied for the development of LV thrombus. Only 4 (4.3%) patients had LV thrombus representing a significantly low number of patients to develop this complication while being treated with effective reperfusion therapy. However, in this study they did not find any superiority of contrast echo study over conventional 2-D echocardiography in the detection of LV thrombus.

In the study conducted by Zielinska M, et al[8] to determine the development of left ventricular mural thrombus early after acute myocardial infarction, 3158 patients who had underwent successful primary PCI within 12 hours of AMI were retrospectively analyzed. LV thrombus was found in 79 (2.5%) patients. Among these patients, 93% had anterior wall acute STEMI. The results of this study prove marked benefit of early effective reperfusion therapy in the prevention of LV thrombus formation.

Porter A et al[9] conducted their study to determine the frequency of development of LV mural thrombus after anterior wall acute STEMI in patients treated with aggressive reperfusion therapy along with the use of anti-aggregants. The results showed the development of LV thrombus

formation in 23.5% patients in study population that shows a higher incidence of this complication in patients with anterior wall STEMI. This frequency is also close to the results of our study.

CONCLUSION:

The frequency of development of left ventricular thrombus after anterior wall acute STEMI has been found to be 28% in our study of 100 patients. The use of thrombolytic agent has been found to be related with significantly decreased frequency of LV thrombus formation after anterior wall acute STEMI. When primary PCI is not an option, the use of thrombolytic drugs is strongly recommended in patients presenting with acute STEMI that do not have any contraindication for the use of these agents.

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