Original Article

COMPARISON OF SYSTOLIC STRAIN BETWEEN PATIENTS HAVING LEFT MAIN STEM AND THOSE NOT HAVING LEFT MAIN STEM CORONARY ARTERY DISEASE IN NON-ST-ELEVATION ACUTE CORONARY SYNDROME

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Author's Contribution

MKI:Study Design, Study writing, Basic concept, DATA collection, DATA analysis, Drafting, Proof reading. AM:Concept and Rationale of study, DATA interpretation, DATA analysis, Proof reading. UMB: DATA collection, Making output sheets of SPSS, Drafting and proof reading. IW: Main concept, Sample size calculation, DATA entry, Figures and Table. SMB: Study designing, Speckle tracking concepts, SPSS output after DATA analysis, Discussion writing. ST: DATA collection, DATA entry, SPSS output sheets, Speckle tracking on echocardiography machine

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ABSTRACT:

OBJECTIVE: To compare the average global longitudinal peak systolic strain (GLPS-AVG) between patients having and those not having left main coronary artery (LMCA) disease in non ST elevation acute coronary syndrome (NSTEACS).

MATERIAL AND METHODS: A cross-sectional descriptive study at Jinnah Hospital, Lahore from July 2018 to August 2019. 160 patients of NSTEACS having ejection fraction of left ventricle (LVEF) of ≥60% were included. Echocardiographic parameters i.e. left ventricular end diastolic dimension (LVEDD), left ventricular end systolic dimension (LVESD) and LVEF were measured. Speckle tracking echocardiography was done to measure global longitudinal peak systolic strain in apical long axis view (GLPS-APLEX), in apical 4-chamber view (GLPS-A4C), in apical 2-chamber view (GLPS-A2C) and average of these (GLPS-AVG). Coronary angiography of each patient was looked for presence or absence of LMCA disease.

RESULTS: Of 160 patients, 92 (57.5%) were males and 68 (42.5%) were females. Patients having and not having LMCA disease were 24 (15%) and 136(85%) respectively. Of the patient having LMCA disease, 9.4% (n=15) had unstable angina and 5.6% (n=9) had NSTEMI. The means of age, LVESD, LVEDD, LVEF and GLPS-AVG were 53.9±11.3, 22.3±2.2, 46.3±3.6, 64.0±3.4, 19.0±1.2 respectively. In patients not having LMCA disease, GLPS-AVG was 19.2±1.1 while in those having LMCA disease, it was 17.9±0.8. GLPS-AVG was noticeably reduced in LMCA disease patients as compared to absent LMCA disease (t-test, p-value <0.001). An important negative correlation was observed between presence of LMCA disease and GLPS-AVG (spearman's rank correlation coefficient -0.416, p <0.001).

CONCLUSION: Global longitudinal peak systolic strain (GLPS-AVG) was noticeably decreased in patients with LMCA disease in acute coronary syndrome and appreciable negative correlation may be observed between presence of LMCA disease and GLPS-AVG.

KEY WORDS: Systolic Strain, Acute coronary syndrome, Left main coronary disease.

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INTRODUCTION:

Non-ST-elevation MI is a fatal entity having high morbidity and mortality throughout the world. It comprises of both the non ST-elevation myocardial infarction (NSTEMI) and unstable angina.[1] Despite the best medical and health facilities, the patients with acute coronary syndrome having non ST-elevation myocardial infarction and unstable angina have a mortality rate of 8% and 13% respectively within 6 months and 9.1% within 30 days of the disease.[2,3,4] Throughout the globe, 2-2.5 million hospital admissions are caused by NTSEMI acute coronary syndrome each year.[5] The frequency of coronary artery disease (CAD) was reported as 11% in India in the year 2001.[6] Ischemic heart disease (IHD) causes 11% of all deaths in Pakistan making it the second commonest cause of mortality in all ages.[7] According to a Pakistani study, NSTEMI contributed to 55% and unstable angina to 28.2% of all patients who present with typical left sided chest pain which lead to a total of 83.2% patients having NSTEACS.[8]

Majority of patients with NSTEMI have normal ejection fraction (EF) on echocardiography.[1] Still angiography reveals major coronary artery disease (CAD) in these patients. Some even have left main coronary artery (LMCA) disease. Left main coronary artery (LMCA) disease leads to devastating outcome in NSTEACS and thus its early detection and intervention produces better outcomes.[9] So many studies have been conducted to find out clinical or laboratory parameters which can predict LMCA disease before the angiography is actually done in NSTEACS.[10]

The speckle tracking derived global longitudinal peak systolic strain (GLPS) has been seen to detect LV dysfunction at earlier stages before the conventional parameters like ejection fraction (EF) are deranged.[11] In the previous studies, GLPS has not only been used to diagnose[12,13] the patients of NSTEACS and to predict the adverse outcomes[14] but also been correlated with severity of CAD in angiography.[15] There is however very much less DATA available on the detection of LMCA disease by the use of this advanced modality of echocardiography. This study was carried out to compare the global longitudinal peak systolic strain (GLPS) between patients having and those not having LMCA disease in non ST-elevation acute coronary syndrome (NSTEACS). An attempt was made to find a correlation of the presence of LMCA disease with GLPS in patients with NSTEMI so that we could use this novel parameter to detect LMCA disease before the patient has been shifted to angiography laboratory.

MATERIAL AND METHODS:

A cross-sectional, descriptive study was carried out at the department of Cardiology, Jinnah Hospital, Lahore from July 2018 to August 2019. A purposive, non-probability sampling was done in this study. Sample size was calculated to be 149 keeping confidence interval as 95% (z-score =1.6), margin of error as 6% and expected percentage of NSTEACS in the previous study to be 83.2%.[8] One hundred and sixty patients of NSTEACS (diagnosis was made by history taking, examination and doing ECG) having age ≥18 years and EF of ≥60% were included after taking informed consent. Patients with age <18yrs, history of open heart surgery or coronary intervention, recent or old ST-elevation myocardial infarction (STEMI), left or right bundle branch block or non sinus rhythm on ECG and severe valvular heart disease were excluded.

Echocardiography was performed on GE VIVID-7 machine. Left ventricular end systolic dimension (LVESD) and left ventricular end diastolic dimension (LVEDD) were measured on parasternal long axis view. Left ventricular ejection fraction (LVEF) was calculated by Simpson's biplane method. Automated function imaging (AFI) software was used to perform speckle tracking and global longitudinal peak systolic strain. (GLPS) was measured in apical long axis view (GLPS-APLEX), apical 4-Chamber view (GLPS-A4C) and apical 2-Chamber view (GLPS-A2C). Average global longitudinal peak systolic strain (GLPS-AVG) was also measured.

All patients underwent coronary angiography and looked for presence or absence of LMCA disease. LMCA disease was said to be present if ≥50% of lumen diameter was stenosed on angiography.

SPSS version 22.0 was used to analyze the data. Categorical variables like gender, diagnosis, presence or absence of LMCA disease were presented by frequencies and percentages. Scale variables like age, LVEDD, LVESD, LVEF, GLPS-APLEX, GLPS-A4C, GLPS-A2C and GLPS-AVG were presented by means and standard deviation. Independent samples t-test was applied to compare mean of GLPS-AVG between the presence and absence of LMCA disease groups. Spearman's rank correlation coefficient test was then applied to see the correlation between the presence of LMCA disease and average global longitudinal peak systolic strain (GLPS-AVG).

RESULTS:

92 (57.5%) patients were males and 68 (42.5%) were females. Unstable angina and NSTEMI were the diagnoses in 94 (58.8%) and 66(41.2%) respectively. The means of age, LVESD, LVEDD, LVEF and GLPS-AVG were 53.9±11.3, 22.3±2.2, 46.3±3.6, 64.0±3.4, 19.0±1.2 respectively. There were 24 (15%) patients who were having LMCA disease and rest 136(85%) did not have

Table-I: General characteristics of the study subjects

	N (%)	Age (yrs)	LVESD	LVEDD	LVEF	GLPS-AVG
Unstable Angina	94(58.8%)	53.4±11.6	22.2±2.2	46.0±3.7	63.7±3.2	19.0±1.1
NSTEMI	66(41.2%)	54.7±10.9	22.5±2.2	46.8±3.6	64.5±3.6	19.1±1.2
Total	160(100%)	53.9±11.3	22.3±2.2	46.3±3.6	64.0±3.4	19.0±1.2

Table-II: Comparison of general characteristics between patients having or not having LMCA disease.

	DIAGNOSIS			LVESD	LVEDD	LVEF
	Angina Unstable	NSTEACS	Total			
LMCA disease absent	79(49.4%)	57(35.6%)	136(85%)	22.2±2.2	46.3±3.5	64.3±3.5
LMCA disease present	15(9.4%)	9(5.6%)	24(15%)	22.9±2.1	46.6±4.2	62.2±2.0
Total	94(58.8%)	66(41.3%)	160(100%)	22.3±2.2	46.3±3.6	64.0±3.4

Table-III: Comparison of different types of global longitudinal peak systolic strains between absence and presence of LMCA disease. Also t-test and spearman's rank test applied between these two groups.

		GLPS-APLEX	GLPS-A4C	GLPS-A2C	GLPS-AVG
LMCA disease absent		19.1±1.4	19.6±1.5	19.1±1.5	19.2±1.1
LMCA disease present		17.6±1.0	18.2±1.2	17.8±0.8	17.9±0.8
p-value (t-test)		<0.001	<0.001	<0.001	**<0.001**
Spearman's Rank	Correlation Coefficient	-0.337	-0.304	-0.335	**-0.416**
	p-value	< 0.001	<0.001	<0.001	**<0.001**

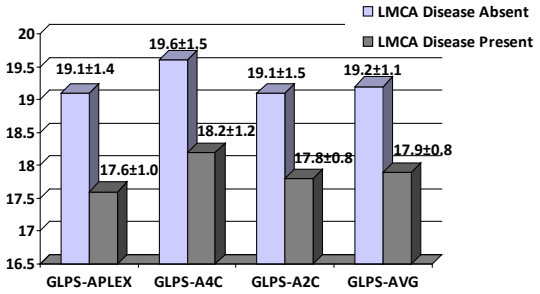

Figure-I: Graph between LMCA disease and different types of global longitudinal peak systolic strains (GLPS)

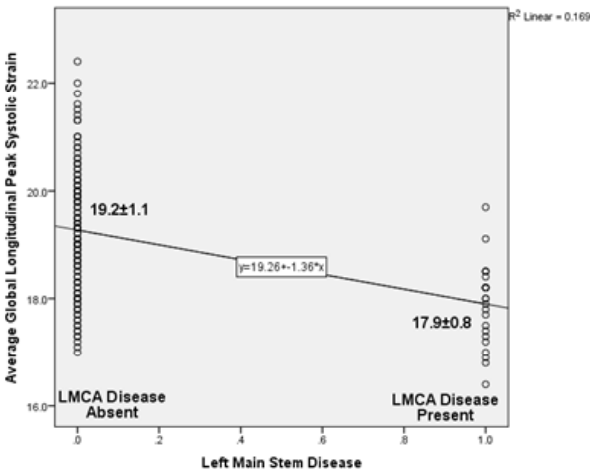

Figure-II: Scatter graph between average global peak systolic strain and LMCA disease

LMCA disease. In patient having LMCA disease, 9.4% (n=15) had a diagnosis of unstable angina and 5.6% (n=9) had NSTEMI.

Comparing patients with absence or presence of LMCA disease, there was not much difference in LVESD, LVEDD and LVEF between these two groups. In patients having no LMCA disease, GLPS in apical long axis view (GLPS-APLEX), in apical 4-chamber view (GLPS-A4C), in apical 2-chamber view (GLPS-A2C) and their average (GLPS-AVG) were 19.1±1.4, 19.6±1.5, 19.1±1.5 and 19.2±1.1 respectively while these measures were 17.6±1.0, 18.2±1.2, 17.8±0.8 and 17.9±0.8 respectively in the patients who had LMCA disease.

Applying independent samples t-test to compare the means of all types of GLPS (i.e GLPS-APLEX, GLPS-A4C, GLPS-A2C and GLPS-AVG) between the patients with absent or present LMCA disease, yielded the p value of <0.001 in all types of global longitudinal peak systolic strains.

Spearman's rank correlation coefficient between the presence of LMCA disease and GLPS-AVG showed a significant negative correlation between the two (correlation coefficient= -0.416, p <0.001). So presence of LMCA disease leads to significant decrease in GLPS-AVG.

Similarly, a noteworthy negative correlation also exists between the presence of LMCA disease and all of the GLPS-APLEX (coefficient=-0.337, p<0.001), GLPS-A4C (-0.304, p<0.001) and GLPS-A2C (-0.335, p<0.001).

DISCUSSION:

Non ST-elevation MI is an important underlying pathology of morbidity and mortality throughout the world. Almost half of the 17 million deaths

worldwide are caused by acute coronary syndromes.[8] For a country like Pakistan, this health problem is even much bigger.[7] There have been a number of studies to predict the extent of CAD in patients with NSTEACS from clinical predictors[5] or from the global longitudinal systolic strain assessed by speckle tracking echocardiography.[15] There have been however much less data available for the pre-angiographic prediction of LMCA disease by systolic strain assessed by speckle tracking echocardiography. People have however related ECG changes with LMCA disease in NSEACS patients for early prediction of LMCA disease before angiography.[16]

In this study, we compared global longitudinal peak systolic strain (GLPS) between patients having and those not having LMCA disease and thus tried to find a correlation between LMCA disease and GLPS. We included 160 patients of NSTEACS. Out of these, 58.8% (94) patients had unstable angina with toponins negative results while 41.2% (66) patients had troponins test positive making a diagnosis of NSTEMI. This finding was in consistent with Mahmood M et al.17 who showed frequency of unstable angina and STEMI as 50.1% and 49.9% respectively.

In the present study, significant LMCA disease was present in 24 (15%) while rest of the 136 (85%) patients showed absence of significant LMCA disease in their angiography. This frequency of LMCA disease was more as compared to previous study by Mahmood M et al. who showed only 4.7% patients of NSTEACS with LMCA disease but there were 29.3% patients who had 3-vessel CAD and/or LMCA disease. May be that overlap of any vessel CAD with LMCA disease caused this difference. Another cause may be that now the frequency of disease may have increased since 2013. So another study by Sharma AK et al.[18] showed 18 (20.9%) out of 86 patients of NSEACS had LMCA disease.

In our study, non-appreciable difference was noticed between patients with or without LMCA disease regarding left ventricular systolic (LVESD) and diastolic (LVEDD) dimensions as well as ejection fraction (LVEF). These were the same findings present in the studies by Sharma AK et al.[18] and Hoshi H et al.[19] both of which compared the systolic strain between high risk patients having three vessel/ LMCA disease and low risk patients not having this severe CAD. Also we included the patients with normal LVEF (i.e patients having EF >60%) so these findings were already expected.

When the two groups (LMCA disease absent and present) were compared regarding average global longitudinal peak systolic strain (GLPS-AVG) measured by 2D speckle tracking, a significant difference was seen between the two groups (p value by t-test <0.001). Similar significant difference was noted between these groups regarding GLPS-APLEX, GLPS-A4C and GLPS-A2C (p value in all were <0.001). All these GLPS were significantly low in the group of patients having LMCA disease. These findings were consistent with the earlier studies by Sharma AK et al18, Hoshi H et al[19] and Bakhoum SWG et al[20]. All these three studies compared the systolic strain between high risk group (patient with 3-vessel CAD/LMCA disease) and low risk group (not having 3-vessel CAD/ LMCA disease) and found that peak systolic strain was significantly lower in high risk group as compared to low risk group (Sharma p value <0.001, Hoshi p value =0.007, Bakhoum p value =0.03). The only difference was that Sharma AK et al18 used tissue doppler method while Hoshi H et al19 and Bakhoum et al[20] used speckle tracking method to measure the peak systolic strain. None of these took the LMCA disease as a separate entity as we did in our study which differentiates this study from earlier research work.

When the Spearman's rank correlation test was used to see the correlation between the presence of LMCA disease and GLPS-AVG we found a significant negative correlation between the two variables (correlation coefficient -0.416, p <0.001). This meant that with the presence of LMCA disease, the GLPS-AVG decreased significantly and there was reverse relationship between these two. The same relationship was also found in each of the GLPS-APLEX, GLPS-A4C and GLPS-A2C (table-III) but the average value of GLPS (GLPS-AVG) has more value and reliability. It has always been given more importance than the previous three.

As we know that LMCA disease in patients of NSTEACS have grave consequences and its early treatment in the form of percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) leads to improvement in prognosis. So in this study, we wanted to correlate the LMCA disease to systolic strain so that we can early predict the LMCA disease in these patients before coronary angiography is done. Thus a non invasive method can lead to risk stratify and sort out the patients for early angiography and then early treatment leading to better prognosis. It is already mentioned that global longitudinal systolic strain has been least

studied for this purpose in our country, Pakistan and even in the west. We however need further larger studies in this respect.

CONCLUSION:

Global longitudinal peak systolic strain (GLPS-AVG) was noticeably decreased in patients with LMCA disease in acute coronary syndrome and appreciable negative correlation may be observed between presence of LMCA disease and GLPS-AVG.

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