

Research Article

IMPACT OF 3D STRAIN ECHOCARDIOGRAPHY IN POST COVID PATIENTS WITH MYOCARDIAL INVOLVEMENT

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Introduction: COVID-19 infection can affect the heart also. Transthoracic echocardiography used for diagnosis, prognosis and treatment purpose.

Objective: To determine the impact of left ventricular global longitudinal strain (LVGLS) in post covid complicated children for LV function with other transthoracic echocardiography parameters.

Material and method: This was cross sectional study with consecutive sampling. All confirmed post-covid complicated children having age 1 to 15years were included in the study admitted to The University of Child Health science for 6 months from November 2021 after ethical committee approval. After entering data in SPSS 25 software, statistically significant outcomes were analyzed. Descriptive analysis was used to describe the basic features of the data. The chi-square test was used to measure the association among the different categorical variables.

Results: 45 confirmed post covid patients selected who were referred for cardiac evaluation. The average post covid period was ± 13.7 weeks (Min=1 wk , max= 44weeks). Male to female ratio was 2:1. Mean age was ± 8.6 years. Similarly mean weight was ± 29.2 kg with mean BSA was 1.029m.

Standard laboratory tests to confirmed post covid exposure were used. The mean of all laboratory test was markedly high. Cardiac function was assessed by different echocardiographic parameters. Out of 45 patients, the mean LV-GLS found to be $-16\% \pm 4.3$. In this study 28.8 % patients had abnormal LV function while 40% patient showed abnormal GLS value irrespective to age.

Conclusion: Strain Echocardiography is considered to be an excellent modality to evaluate heart function in post covid children also like in adult.

Key words: Covid-19, Echocardiography, LV function assessment, Global strain

Abbreviations: LV-GLS= left ventricular global longitudinal strain, TTE= Transthoracic echocardiography

INTRODUCTION

COVID-19 infection initially it presented with pyrexia, cough, tiredness and diarrhea [1]. The cardiac damage caused by direct viral injury, ischemia, hyper immune response, epicardial coronary plaque rupture and cardiomyopathy [2]. Transthoracic echocardiography is non-invasive and the easiest initial test for assessment of COVID-19 cardiac involvement, and is helpful for managing such cases [3].

A various types of heart diseases reported with COVID-19, like acute myocarditis, cardiomyopathy, ventricular arrhythmias, leading congestive cardiac failure and cardiogenic shock [4,5]. Some current study showed that up to 80% of patients after COVID-19 had abnormal cardiac MRI findings [6]. That showed that longstanding cardiac complication in such patients without heart involvement.

Left ventricular global longitudinal strain is a good modality for detection of left ventricular dysfunction in sub-clinical disease along with prognosis in various cardiac conditions, like cardiac failure and valvular disease [7,8]. Similarly, some study supported that abnormal LV-GLS value detected before appearance of left ventricular dysfunction [9,10,11].

Very few studies done in our setup to noticed myocardial function through global longitudinal strain especially in children. Therefore, we selected this study to see the effectiveness of LV- GLS with other echocardiographic parameters to assess the ventricular function in pediatric population.

MATERIAL AND METHODS:

It was a cross sectional study in which consecutive sampling technique was used. All patients, who were admitted with suspected cardiac issues at cardiology department of The Children hospital, Lahore with proven Post-Covid IGg positive, having age 1 to 15years were included in the study. Data collected from the cardiology department of The Children Hospital and Institute of Child Health Lahore for last 6 months from November 2021 after ethical committee approval.

Lab test:

The demographic data of admitted patients with suspected cardiac issues were collected. Baseline laboratory test were taken, including hemoglobin, CBC and differential (white blood cell count). Inflammatory markers like, C-reactive protein (CRP), D-dimer and Troponin-I, Lactate dehydrogenase (LDH), serum ferritin, Pro-BNP, and covid antibodies were also collected during admission to ward.

Echocardiography parameters:

Transthoracic echocardiography was performed using a Vivid S95 with M5-S probe (GE Healthcare) and analyzed according to the protocol of American Society of Echocardiography recommendations. All studies were reviewed by two consultant pediatric cardiologist and only optimized views were included. Irritable and crying patients were sedated before performing the echocardiography or re-performed with stable. LV dimensions and ejection fraction was recorded through M mode and/or 2D measurements along with diastolic function of left ventricle were assessed by E and A waves (V_{maxE} , V_{maxA}), E/A ratio, (E') of the basal mitral annulus also.

Myocardial deformation analysis:

Global (GLS) was calculated in apical 4-chamber view, Apical 2-chamber view, and parasternal long-axis views. The endocardial shape was adjusted manually, segmental tracking was adjusted to eliminate the artifact. Complete deformation analysis was performed in all 45patients. The images were obtained and off-line automated analysis was done using commercially available EchoPac software.

Inclusion criteria: The study included all confirmed post covid children admitted to children hospital with diagnosis of MIS, Kawasaki disease or cardiomyopathies.

Exclusion criteria: All those patients who were not covid positive but with usual infection. Non-cooperating or uncomfortable patient for echocardiography due to long time taking process.

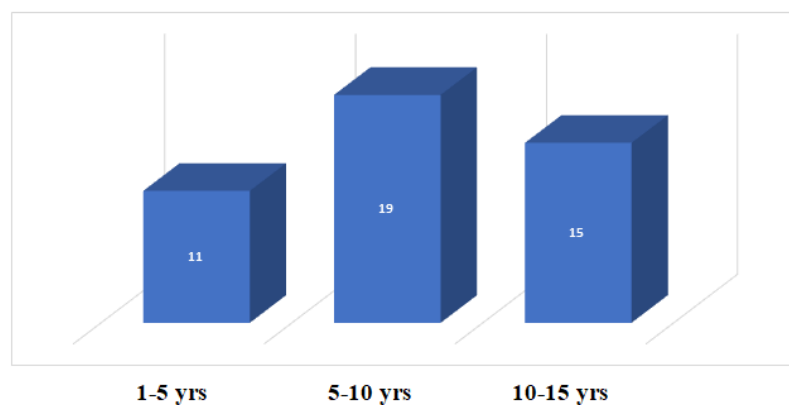
STATISTICAL ANALYSIS:

All the data was entered in SPSS 25 and then analyzed for statistically significant result. Descriptive analysis and the chi-square test were used to find the association among the different categorical variables.

RESULTS:

45 confirmed post covid patients selected, who were referred for cardiac evaluation from medical ward. 23 patients were evaluated for cardiac function came from medical units were admitted for management of MIS –C, 7 patients admitted as Kawasaki disease and 15 patients admitted due to cardiomyopathy. The average post covid period was ± 13.7 weeks (Min=1 wk, max= 44weeks). There was twice male than female. Mean age was ± 8.6 years with minimum of 1 year. Out of 45 patients 11 were from age of 1to 5 years, 19 were from 6 to 10 years and 15 were from 11 to 15 years of age (Fig-1).75% of study population was belong to age more than 5 years. Similarly mean weight was ± 29.2 kg and mean BSA was 1.029m^2 .

Figure-1: Frequency of Age distribution (n=45):



Standard laboratory tests to confirm post covid exposure used were covid antibodies, D-dimers LDH, Serum ferritin, Trop-I, Pro-BNP and CRP. The mean of all laboratory test was markedly high (Table-1).

Cardiac function was assessed by echocardiographic parameters included, MAPSE, Ejection fraction, Fractional Shortening, E' , A' , E/A ratio, and global longitudinal strain. the mean MAPSE was 20.93 mm (SD = ± 5.070) with minimum of 10mm, Ejection fraction was 60.87 % (SD = ± 14.384) with minimum of 15%, E was 0.152 m/s (SD = ± 0.03) with minimum value of 0.08 m/s. A 'was 0.084 m/s (SD = ± 0.024) with minimum of 0.03 m/s, global Longitudinal strain was - 16% (SD= ± 4.304) with minimum of -5% (Table-2).

Out of 45 patients, 71% patients had GLS between -15% to -25% that was normal and were examined between 8 to 25 weeks after discharge. 15% had between -11% to -15%. 13% patients were between -5% to -10% (Figure-2).

Table-1: Laboratory Finding (n=45):

Lab. Test	Mean	STD. Deviation
Covid antibodies, (IU/ml)	106.1238	48.27090
D-dimers, (µg/ml)	3.30627	3.246543
LDH, (IU/ml)	486.809	194.6639
Serum ferritin, (ng/ml)	887.9931	908.99232
Trop-I, (ng/ml)	.62984	.966533
Pro-BNP, (pg/ml)	9087.2842	12425.56768
CRP, (mg/dl)	81.4756	53.85041

NORMAL RANGES: Covid antibodies = <25 IU/mL, D-dimer = <0.5 µg/mL, LDH = 105-333 IU/L, Ferritin = 7-140 ng/mL, Trop I = <0.1 ng/mL, Pro-BNP = <125 pg/mL, CRP = 0-10 mg/dL.

Table-2: Echocardiographic Findings of LV functions (n=45):

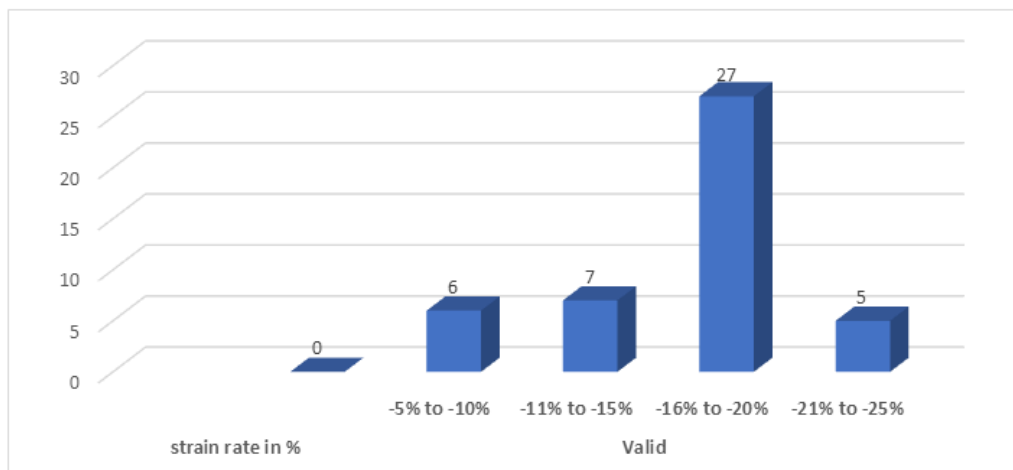
Echocardiographic Parameters	N	Range	Minimum	Maximum	Mean	Std. Deviation
Mitral annular plane systolic excursion (MAPSE) mm	45	21	10	31	20.93	5.070
Ejection Fraction (EF) %	45	69	15	84	60.87	14.384
E' in m/s	45	.11	.08	.19	.1524	.03024
A' in m/s	45	.10	.03	.13	.0844	.02473
E/A ratio	45	3.53	.81	4.34	1.8856	.58118
GLS in %	45	17.0	-22.0	-5.0	-16.100	4.3047

NORMAL RANGES: MAPSE=10-20mm, Ejection Fraction=58-85%, Fractional Shortening=28-46%, E'=0.09-0.15m/s, A'= 0.03-0.11m/s, E/A ratio=0.8-2 and GLS= -15 to -25%.

In different age groups between 1-5 years, we noticed maximum patients had LV dysfunction ie 54.6% but GLS showed 63.6% ventricular dysfunction. While at 5-10years of age group other echocardiographic parameters showed 15.3% ventricular dysfunction but GLS showed 21% and at age group of above 10-year other echo parameters revealed 26.6% ventricular dysfunction but 46% patients had ventricular dysfunction through GLS (Table-3). Regarding coronaries sizes from 1-5years group only one patient had LCA abnormality, from age 5-10years 3 patients had abnormal coronaries and from age above 10 years 4 patients had abnormality in size of coronaries. The abnormal coronary found from 1-5 year of age group was diagnoses Kawasaki disease, while at

age group of 6-10 years out of 3 patients having abnormal coronaries 1 was admitted as MIS-C and 2 were admitted as DCMP. At age group above 10-year coronaries abnormality in size was found in all cases admitted as DCMP (Table-4).

Figure: 2 Global Longitudinal strain Finding of post covid patients (n=45):



As the P value of Ejection Fraction, and MAPSE is greater than 0.05, so statistically the relation between GLS and above parameters is insignificant. P value of Fractional shortening and E/A ration is less than 0.05 so they have significant relationship with GLS (Table-5).

Table-3: Echocardiographic parameters of ventricular function with age groups.

AGE IN YEARS	1-5 yrs. (11)		6-10 yrs. (19)		11-15 yrs. (15)	
	NORMAL	ABNORMAL	NORMAL	ABNORMAL	NORMAL	ABNORMAL
MAPSE	7	4	18	1	13	2
EF	5	6	16	3	11	4
FS	5	6	16	3	11	4
E'	10	1	18	1	13	2
A'	10	1	18	1	13	2
E/A	10	1	13	6	12	3
GLS	4	7	15	4	8	7

Table 4: Coronaries sizes according to age (n=45):

Age in year	1-5yr (11)		6-10yr (19)		11-15yr (15)	
	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal
RCA	11	0	18	1	13	2
LCA	10	1	16	3	11	4
LCx	11	0	17	2	14	1

Table-5: Chi square tabulation (n=45):

MAPSE in mm * GLS in %	533.1	.250
FS in % * GLS in %	79.018	0.028
E/A ratio * GLS in %	109	0.001
Ejection Fraction in % * GLS in %	79.9	0.074

DISCUSSION:

Echocardiography is the best modality for assessing Left ventricular function by various parameters with global longitudinal strain (GLS). GLS found to be better parameters to assess LV function in indolent covid disease. As we noticed in our study that 28.8 % patients had abnormal LV function while 40% patient showed abnormal GLS value irrespective to age while Hezzy Shmueli study showed overall 23% adult patients had LV dysfunction with 85% GLS abnormal value [12]. It means in his study more than 3 times patients had abnormal GLS value than other parameters of assessment of LV function. Our study also reflected double abnormal GLS value in post-covid patient.

In normal LV ejection fraction, LV-GLS is better echocardiography parameters for evaluating cardiac damage. In one study the mean LVGLS in normal patients was reported to be 18.8%, with a lower limit (two SDs) of 15.2% while in covid patients it was noted $-11.93\% \pm 4.2$ [13]. In our study the mean LV-GLS found to be $-16\% \pm 4.3$.

Strain Echocardiography is considered to be an excellent modality to evaluate heart functioning in post covid patients. As early evaluation can help in giving medication to the patient and cure myocardial damage caused by the virus and severe damages can be prevented.

CONCLUSION:

Strain Echocardiography is considered to be an excellent modality to evaluate heart function in post covid children also like in adult. Similarly strain echocardiography can predict long term outcome and prognosis of post covid children and help from management point of view to save lifelong sequela.

LIMITATIONS:

The sample size was inadequate and collected from single center. Other parameters of assessment of left ventricle function not included as in children it was difficult to take all parameters at time. Further studies are required to support this hypothesis along with long-term outcome and prognosis.

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Potential Conflict of Interest:

Nil.

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