

## Study of Acute Left Ventricular Dysfunction in Children Admitted at Paediatric Intensive Care Unit

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### Abstract

**Background:** Myocardial dysfunction remains an important cause of mortality and morbidity in children requiring intensive care. Cardiac impairment occurs in significant number of children with no pre-existing cardiac illness both congenital and acquired. Often cardiac impairment is overlooked due to lack of sensitive diagnostic tests. **Objectives:** To study the frequency, probable cause, clinical profile and immediate outcome of children with left ventricular dysfunction and its correlation with serum Creatine phosphokinase (CPK MB) level, ejection fraction, inotropic support and duration of ventilation. **Method:** It was Retrospective observational study. Case records of children with sepsis, cardiogenic shock, dengue, arrhythmia, Post COVID MIS-C (Multisystem inflammatory syndrome in children) who were evaluated with 2D ECHO in age group of 1 month to 18 years admitted to PICU were screened. Data was entered in pre-structured proforma and analysed statistically. **Results-** Out of 167 patients screened, 35 patients were included in the present study, most common age group was between 1 to 3years 11(31.43%). Majority were male-21(60%). The mean age of presentation was 4.42 years. Most common etiology was Post COVID MISC (45.71%) and Sepsis (40%). Fever (85.7%) was the most common symptom while tachypnoea (77.14%) was the most common sign observed. Survival was more in males (66.6%) as compared to females. Patients with severe dysfunction (22.86%) and on mechanical ventilation (57.14%) had more mortality (**p<0.001**). 75% of non-survivor had ejection fraction <30% (**P-0.007**). There was a significant association between ejection fraction more than >30 and survival (**p-0.007**). There was a significant Co-relation between length of PICU stay and ejection fraction (**p-0.02**). **Conclusion:** Left ventricular dysfunction had varied presentation and outcomes including death. It was imperative to initiate prompt treatment for better outcome. Severe dysfunction was associated with poor outcome(**p-0.027**). Early recognition and prevention of complications improves quality of life. There was a significant co-relation between severe dysfunction, mechanically ventilated patients and mortality (**p-<0.001**).

**Key Words:** Left ventricular dysfunction, Ejection fraction, Mechanical Ventilation, Echocardiography, Post COVID MIS-C, Sepsis.

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## Introduction

Left ventricle is the thickest chamber of the heart which is primarily responsible for pumping oxygenated blood to the vital organs of the body. LV dysfunction occurs when the left ventricle is either defective or damaged, thus disrupting health.

Left ventricular ejection fraction is the central measure of left ventricular systolic function. LVEF is the fraction of chamber volume ejected in systole in relation to the volume of the blood in the ventricle at the end of diastole (End -diastolic volume).<sup>(1)</sup>

Involvement of cardiovascular system in Multisystem inflammatory syndrome in children (MISC) is common and is a primary determinant of illness severity. LV dysfunction is seen in approximately 40-60% of patients with MIS-C with the mechanism of dysfunction incompletely elucidated.<sup>(4)</sup>

Myocardial dysfunction remains an important cause of mortality and morbidity in children requiring intensive care and prompt intervention. Cardiac impairment occurs in significant number of children with no pre-existing cardiac illness both congenital and acquired. Often cardiac impairment is overlooked due to lack of sensitive diagnostic tests.<sup>(5)</sup>

The use of inotropes such as dobutamine and milrinone may be necessary. Diuretics, Beta blockers and ACE inhibitors may help prevent re-modeling, Nitrates, Hydralazine relax blood vessels, digoxin assists in pumping process of heart.<sup>(1,2,5)</sup>

## Methodology

This retrospective observational study was conducted in the department of Paediatrics.

Case records of paediatric patients presenting with sepsis, cardiogenic shock, arrhythmia, severe dengue, post COVID MISC were screened. Demographic parameters, clinical symptomatology, laboratory parameters, echocardiography findings were noted. Data of routine investigations along with CPK-MB level and Echocardiography findings were entered in proforma and those showing left ventricular dysfunction fulfilling below mentioned criteria were included in study. Clinical course in form of use of Inotropes, mechanical ventilation and length of PICU stay were noted and immediate outcome of the study was measured in terms of mortality or discharge. **Institutional clearance was taken(IEC/497/22).**

### Case criteria

- Echocardiography Findings-Subtle to profound changes in global left ventricular, impaired systolic function as indicated by Left ventricular ejection fraction (LVEF).
- LVEF(%) as per the American college of Cardiology<sup>(1)</sup>:
  1. Normal= LVEF 50%-70%
  2. Mild dysfunction=LVEF-40-49%
  3. Moderate Dysfunction= LVEF -30-39%
  4. Severe dysfunction=LVEF <30%

### Study Population

Case records of children between age group of 1 month to 18 years of age admitted to paediatric intensive care unit.

### Inclusion & exclusion criteria

Case records of children between age group of 1 month to 18 years of age with echocardiographic findings suggestive of left ventricle dysfunction admitted to paediatric intensive care unit were included in the study while case records of children with underlying primary heart disease & incomplete records were excluded.

## Objectives

To study the frequency, probable cause, clinical profile and immediate outcome of children with left ventricular dysfunction and its correlation with serum CPK MB level, ejection fraction, inotropic support and duration of ventilation.

The case records were evaluated in detail and data was filled on preformed structured proforma. Detailed history, general examination and systemic examination was carried out.

## Results

**Table 1: Age and Gender wise distribution of children with LV dysfunction**

Age	Female Frequency(n-14) & (%)	Male Frequency(n-21) & (%)	Total Frequency(n-35) & (%)
<1 year	4(44.44)	5(55.56)	9(25.71)
1-3 years	3(27.27)	8(72.73)	11(31.43)
4-8 years	4(57.14)	3(42.86)	7(20.00)
>8 years	3(37.5)	5(62.50)	8(22.86)
<b>Total</b>	14(40.00)	21(60.00)	35(100.00)

**Table 2: Etiological distribution of children with LV dysfunction**

Etiology	Frequency(n-35) & (%)
<b>1) Post Infection</b>	17(48.5)
A) Post COVID MIS-C	16(45.71)
B) Post Diphtheria	1(2.86)
<b>2) Sepsis</b>	14(40)
A) Pneumonia	9(25)
B) Meningitis	2(5.7)
C) Meningoencephalitis	1(2.86)
D) Cellulitis	1(2.86)
E) Fever without Localising signs	1(2.86)
<b>3) Viral Fever</b>	3(8.5)
A) Non Dengue Fever	2(5.7)
B) Dengue Fever	1(2.86)
<b>4) Rhythm Abnormality</b>	1(2.86)

**Table 3: Clinical symptomatology and signs wise distribution of children with LV dysfunction**

Symptoms	Frequency & (%)	Sign on Examination	Frequency & (%)
<b>Fever</b>	30(85.7)	<b>Tachypnoea</b>	27(77.14)
<b>Breathlessness</b>	17(48.6)	<b>Tachycardia</b>	25(71.4)
<b>Vomiting</b>	13(37.1)	<b>Hypotension</b>	15(42.9)
<b>Cough</b>	13(37.1)	<b>Delayed Capillary refill Time</b>	15(42.9)
<b>Convulsion</b>	10(28.6)	<b>Coarse Crepitations</b>	9(25.7)
<b>Maculopapular Rash</b>	7(20)	<b>Altered sensorium</b>	4(11.4)
<b>Excessive Sleepiness</b>	3(8.6)	<b>Fine Crepitations</b>	4(11.4)
<b>Loose Motions</b>	2(5.7)	<b>Hepatomegaly</b>	4(11.4)

<b>Oliguria</b>	2(5.7)	<b>Neck Stiffness</b>	2(5.7)
-	-	<b>Muffled Heart Sounds</b>	2(5.7)
-	-	<b>Gallop Rhythm</b>	1(2.8)

**Table 4: Outcome according to Ejection fraction grade, Inotropic support, Mechanical ventilation of children with LV dysfunction.**

	<b>Total No of patients (n-35) &amp; (%)</b>	<b>Survivors(n-21) &amp; (%)</b>	<b>Non Survivors(n-14) &amp; (%)</b>	<b>P value</b>
<b>Ejection fraction</b>				
<b>Mild dysfunction</b>	24(68.57)	18(75)	6(25)	<b>0.027</b>
<b>Moderate dysfunction</b>	3(8.57)	1(33.33)	2(66.6)	
<b>Severe dysfunction</b>	8(22.86)	2(25)	6(75)	
<b>Inotropic support</b>	30(85.71)	17(56.67)	13(43.33)	0.32
<b>Mechanical Ventilation</b>	20(57.14)	6(30)	14(70)	<b>&lt;0.001</b>

**Table 5: Outcome of patients with LV dysfunction according to ejection fraction levels**

	<b>Ejection Fraction &lt;30 No of cases</b>	<b>Ejection fraction &gt;30 No of cases</b>	<b>P value</b>
<b>Survivors</b>	2(5.7%)	19((54.2%)	<b>P value- 0.007 Chi square statistic-7.20</b>
<b>Non survivors</b>	6(17.3%)	8(22.8%)	
<b>Duration of mechanical ventilation (Days) No of cases/mean +/- S.D.</b>	1 ± 0.5	1.27 ± 2.25	<b>P value-0.57 Unpaired t statistic-0.57</b>
<b>Length of PICU stay (Days) No of cases/mean +/- S.D.</b>	2 ± 2	5.231 ± 3.78	<b>P value-0.02 Unpaired t statistic-2.43</b>

## Results

- Out of 167 cases screened in last 15 months, there were 35 cases of left ventricular dysfunction.
- The mean age at presentation was 4.42 years (Range-1.5 months-15 years).
- Males were more involved than Female.
- Most common cause of Left ventricular Dysfunction was Post COVID MISC and sepsis.
- Most common symptoms was fever and most common sign seen was tachypnoea.
- In Comparison to males, Females had more mortality but statistically not significant.
- Patients with severe dysfunction had more mortality(P-0.027).
- Patients on ventilator had more mortality than patients who did not require ventilator support (P-<0.001)
- Chi-Square test was done to compare between ejection fraction and survivors. It was found that 75% of non-survivors had ejection fraction <30% (P-0.007).

## Discussion

- Various studies have shown that the most important measure in reducing the mortality is early identification of the condition and prompt initiation of therapy. The accurate measurement of left ventricular ejection fraction is very important for managing patients with cardiovascular disease. Left Ventricular Ejection fraction plays an important role in assessing the severity of a decrease in the systolic function of heart and thus is helpful in directing the management of various cardiovascular diseases. Myocardial dysfunction remains an important cause of mortality and morbidity in children requiring intensive care and prompt intervention can prevent mortality.
- Frequency of LVEF in study conducted by Aditi jain, Jhuma sankar, Dinesh kumar Yadav et al. <sup>(3)</sup> was 32% while in our study frequency was 20% this difference may be due to less sample size. Most common gender involved was male in our study which is similar to study conducted by Mannarino ,S., Raso ,I., Garbin , M. et al <sup>(7)</sup> and age group involved in their study was older age group , while in our study age group involved was 1-3 years, This difference was due to more numbers of post COVID cases. Most common presenting symptoms in our study was fever and breathlessness. As fever is a acute phase reactant and found to be raised in all patients . Most common signs were tachypnoea and tachycardia as many cases were Post COVID MIS-C and sepsis. Study of children with septic shock done by William and raj showed incidence of Left ventricular dysfunction up-to 44%. In our study also, the incidence of left ventricular dysfunction due to sepsis was 40%. Study conducted by Kim S, Lee JD, kim BK, Kim YH, Kim JH et al. <sup>(6)</sup> showed mild dysfunction in 51% while in our study it was 68%. This difference was due to more numbers of sepsis and Post COVID MISC in children . In their study severe dysfunction was in 18% and in our study severe dysfunction was seen in 22% which is similar. One study conducted by Li J Ning B, Wang Y et al. showed mortality upto 53% with children having ejection fraction<50%,which was comparable to our study, mortality rate was upto 57% with moderate and severe dysfunction <sup>(6)</sup>.
- Study done by Aditi jain, Jhuma sankar, Dinesh kumar Yadav et al. <sup>(3)</sup> showed that 22 (73%) children required ionotropic support similary to our study where 30(85%) children required ionotropic support. Cardiovascular involvement is mainly evident as acute myocardial dysfunction in MIS-C. Study done by Mannrino S. Raso I, Garbin, M. et al. <sup>(7)</sup> showed abnormal echocardiography findings in 44% of study population. Our study showed the same with Left ventricular dysfunction found in 45%. Study done by Aditi jain, Jhuma sankar, Dinesh kumar Yadav et al. <sup>(3)</sup> showed the need of mechanical ventilation in 44% with median duration of ventilation upto 1.45 days while in our study it was 57% with  $1 \pm 0.5$  (days) in survivor .

## Limitations

It was a retrospective study with small sample size , the findings cannot be generalised, also study of diastolic dysfunction and Right ventricular dysfunction were not included and as study was conducted during the Post COVID-19 era, the most common cause of LV dysfunction turned out to be Post COVID MIS-C but normally the most common cause of LV dysfunction is viral myocarditis.

## Conclusion

Left ventricular dysfunction has varied presentation and outcomes including death. It is imperative to initiate prompt treatment for better outcomes .In our study, Left ventricular dysfunction was seen frequently with Post COVID MIS-C and sepsis and Severe dysfunction was associated with poor outcome.

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**CONTRIBUTION:** Dr Harsh Mangal(JR) collected the data and entered in excel sheet , Dr Mrunalini Kulkarni(Associate Professor & PG Guide) and Dr Rahul Kawade (Assistant Professor) helped in writing Manuscript and analysed data statistically , Dr Mrunalini Kulkarni edited the manuscript, All three author agreed the final manuscript.