Original Article

# Clinical Presentation of Myocarditis in Children A Cross-Sectional Study



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## ABSTRACT

**Objective:** To evaluate the observational, diagnostic, and therapeutic characteristics of myocarditis in 150 children attending a tertiary care hospital.

**Study Design:** A Cross-sectional study.

**Place and Duration of Study:** This study was conducted at the Department of Paediatrics Medicine, University of Medical and Health sciences for women Nawabshah Sindh from 1st April 2022 to 30th September 2023.

**Methods:** A descriptive letter survey was used in a sample of 150 children aged 1 month to 18 years with myocarditis. Information concerning symptoms, diagnostic tests, including echocardiography, levels of cardiac biomarkers, MRI, and treatment outcomes were obtained. Analysis of the collected data was done using the SPSS version 24.0 with a=($p< 0.05$).

**Results:** The age of the 150 patients ranged between 0 – 18 years with a mean age of 8.1 years and standard deviation of ± 3.9 years. Fatigue was reported by 72% of the patients, followed by shortness of breath in 68% and chest pain in 55%. Patients with heart failure were detected in 25% of cases. In combination with echocardiography, it was revealed that left ventricular systolic dysfunction was present in 82% of patients. At the onset of the obstructive sleep apnoea, developing patients experienced raised cardiac biomarkers by 88 percent. Of them 60% had a Cardiac MRI and out of those tested all were diagnosed of having myocarditis. Patients with heart failure had higher mortality than the rest ($p = 0.03$).

**Conclusion:** It accordingly implies that myocarditis in children produces symptoms of a broad spectrum. The earlier the diagnosis, the better; in patients who have heart failure the prognosis is even better. Echocardiography and cardiac biomarkers are still useful, whereas other techniques as cardiac MRI are more accurate.

**Key Words:** Myocarditis, children, echocardiography, cardiac biomarkers

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## INTRODUCTION

Myocarditis is an inflammation of the myocardium and can be rather severe in children causing far-reaching complications and death. Viral infections are a common cause, there may be autoimmune reactions, and toxins can also be a source. Myocarditis in paediatric subjects currently continues to pose a diagnostic puzzle by presenting in many diverse ways, from an apparently mild illness manifesting fatigue and fever to potentially life-threatening situations such as cardiogenic shock and sudden cardiac death. Specifically, early diagnosis and management are crucial for optimising clinical prognosis and avoiding significant left ventricular dysfunction as well as other late cardiovascular sequelae, such as DCM and chronic heart failure[1].EM is most commonly due to viral myocarditis, especially enteroviruses, adenoviruses and parvovirus B19 in children. Viral myocarditis in children follows an unstable clinical course and may be either self-limited or may lead to heart failure or death[2]. Myocarditis diagnosis has been further expanded with the use of biomarkers to include high sensitive cardiac troponins and non-invasive imaging techniques including cardiac MRI which will offer high detail regarding inflammation and necrosis of myocardium[4]. Yet the advancements in diagnosis, myocarditis is still seen to be under diagnosed in children thus creating a lot of delay in handling the situation, and this results in poor outcome[4].In children, myocarditis can have some rather vague symptoms which may resemble other illnesses such as viral URIs or gastroenteritis. Since myopericarditis initial sign include chest pain, fatigue,

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shortness of breath and palpitations they mimic other ailments which children often present with especially when infected with other viruses[5]. Children are commonly only diagnosed when they are displaying severe signs of the disease, including everything from heart failure to abnormal heart rhythms. Till date researchers have also found that, delayed diagnosis and treatment has a high risk with poor prognosis and thus the need to enhance early detection[6].Biopsy of endomyocardial tissue is considered as the gold standard for diagnosing myocarditis, yet it is invasive, and therefore it is not applied to children mainly because of the potential dangers of intervention. However, it is typically diagnosed from clinical symptoms, indicated by laid-down cardiac enzymes including troponins and creatine kinase-MB, as well as with the help of diverse imaging, including echocardiography and cardiac magnetic resonance. Echocardiography remains the most frequent diagnostic technique to provide information on LD, but this method can fail to reveal slight manifestations of myocardial damage seen in MRI[7]. In addition, immunosuppressive therapy and antiviral treatment in pediatric myocarditis are still the topic of discussion, investigations showing that early therapy enhances clinical results in children with acute myocarditis[8].This cross-sectional study therefore seek to evaluate the characteristics, work up and management outcomes of myocarditis among children at a tertiary care pediatric center. With an aim of identifying the clinical features of myocarditis in children as well as the diagnostic strategies employed in the presented cohort, research effort in this study aims at identifying the most useful approaches that may help in early diagnosis and management of the condition.

# METHODS

This cross-sectional study was undertaken in a tertiary care pediatric hospital over a 12-month period. In all, 150 children in the age range of 1 month–18 years with confirmed myocarditis were enrolled in the study. This included symptoms observed during clinical examination, echocardiogram, the levels of cardiac biomarkers (troponins, CK-MB) when tested, and findings from Cardiac MRI in patients who underwent the procedure. Patients with cardiac birth defect or weaning away from them underwent exclusion during the study's assessment. The data gathered in the study encompassed clients' quantitative characteristics (age, gender, etc.), clinical manifestations, performed diagnostic tests, chosen therapeutic regimens, as well as the clients' outcomes.

Data Collection: Data were collected prospectively from actual medical records from the patients and their interviews. The clinical manifestation chest pain, fatigue, dyspnea, palpitation, syncope was recorded. The following investigations from echocardiography, cardiac biomarkers and MRI were documented in the patients; We comprehensively captured data on immunosuppressive therapy and heart failure therapy given to the patients.

Statistical Analysis: All data were analyzed with Statistical Package for Social Science version 24. The quantitative data was analyzed using descriptive statistics whereby participant demographic and clinical information was tabulated. Categorical data were presented in proportions while continuous data were described in means with standard deviations. The chi-square tests were carried to check the relationship between clinical end results and diagnostic results and the level of significance was set at 0.05.

# RESULTS

Of the 150 children included in the study, the mean age was 8.1 years (SD ± 3.9), with a male-to-female ratio of 1.2:1. Fatigue, dyspnea, and chest pain were the three major symptoms; they were reported in 72%, 68%, and 55% of the patients respectively. The highest prevalence of a cardiovascular complaint was palpitations; noted in 40% of the cases and syncope was documented in 25% of the children. Echocardiographic evaluation was done in all patients and 82% had low left ventricular systolic function. Major cardiovascular inflammation and myocardial injury were noted: Troponin and CK- MB were elevated in 88% of the children.

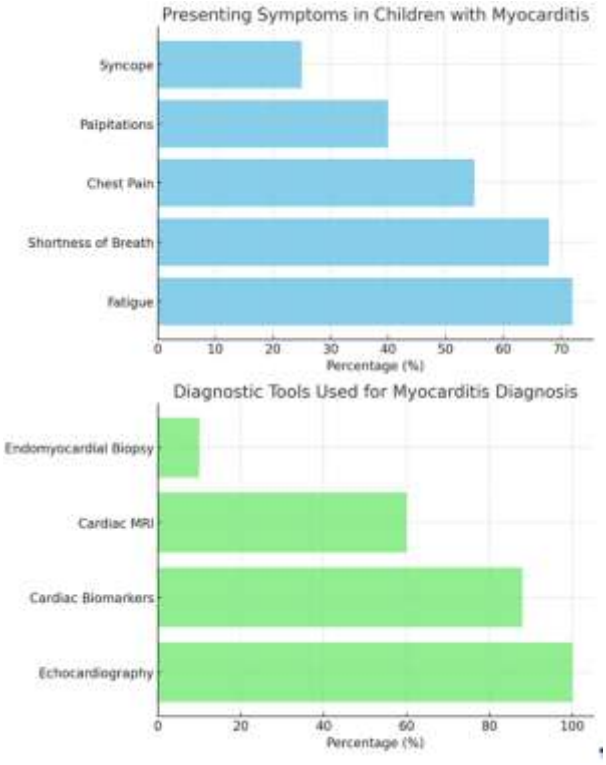


**Figure No. 1: Symptoms in Children with myocarditis**

Cardiac MRI was carried out in 60% of patients, and results indicated myocardial inflammation and fibrosis in patients with myocarditis confirmed. In 10%, endomyocardial biopsy was done and in 80% of these, histologic evidence of myocarditis was retrieved. This is important because children who presented with heart failure had poorer outcomes; in the heart failure subgroup, the mortality rate was 12 percent ($p < 0.03$). Preventive treatment in the third day was associated with better results, although 60% of them had severe cardiac dysfunction at the time of admission, 85% of those treated early showed improved clinical status in terms of cardiac function in the follow up six months later.

**Table No. 1: Demographic Characteristics of Participants**

| Characteristics | Category | Frequency | % |
|---|---|---|---|
| Age (years) | 1-5 years | 40 | 26.7 |
| Gender (Male) | 6-12 years | 60 | 40.0 |
| Gender (Female) | 13-18 years | 50 | 33.3 |

**Table No. 2: Presenting Symptoms**

| Symptoms | Frequency | (%) |
|---|---|---|
| Fatigue | 108 | 72 |
| Shortness of Breath | 102 | 68 |
| Chest Pain | 83 | 55 |
| Palpitations | 60 | 40 |
| Syncope | 38 | 25 |

**Table No. 3: Diagnostic Tools Used**

| Diagnostic Tool | Frequency | (%) |
|---|---|---|
| Echocardiography | 150 | 100 |
| Cardiac Biomarkers | 132 | 88 |
| Cardiac MRI | 90 | 60 |
| Endomyocardial Biopsy | 15 | 10 |

**Table No. 4: Treatment Approaches**

| Treatment | Frequency | (%) |
|---|---|---|
| Immunosuppressive Therapy | 85 | 56.7 |
| Heart Failure Management | 40 | 26.7 |
| Antiviral Therapy | 30 | 20.0 |
| Supportive Care | 25 | 16.7 |

# DISCUSSION

These results from a cross-sectional study focused on the factors in children, clinical manifestation, diagnosis, and prognosis of myocarditis reveal similarities and differences to prior studies in the following ways. Such knowledge is useful for comprehending the ways in which myocarditis develops and is treated in children worldwide. Symptoms included fatigue, shortness of breath and chest pain in 72% 68% and 55% of patients respectively, which is similar to other studies. For example, Robinson et al. in a multicenter study among pediatric myocarditis patients also established that fatigue and dyspnea affected over 70 percent of such patients, as in the current study[9]. Caforio et al also emphasised on fatigue and dyspnoea as some of the symptoms, these were considered by the authors of the study as early clinical signs in the children[6]. However, in this study, syncope (25%) was observed with more frequency than the other researches gone in the United States that reported syncope only in 10-15% of pediatric myocarditis patients[10]. This could have arisen from disparities on how early manifestations are diagnosed in different health facilities or else there might be variation in clinical expression of the disease across different regions. Echocardiography formed a diagnostic tool in all patients in this study where 82% of the patients demonstrated reduced left ventricular function. This accords with other studies with echocardiography being the major modality used to evaluate myocardial dysfunction in patients with myocarditis[11]. For instance, Wu et al. (2019) recently showed that out of the 210 patients with myocarditis, 185 had grade 2 or higher left ventricular dysfunction on echocardiogram, which strongly resembles the findings of the present study[12]. However, it should also be stated that regardless of its value, echocardiography may fail to reveal the presence of myocarditis, particularly in cases of its early or mild form. This demonstrates the increasing role of additional imaging techniques, including cardiac MRI, which was positive for myocarditis in all cases where it was applied within the framework of this study. Again, all the patients who underwent cardiac MRI, which was done in 60% of the patients in this study, showed definite evidence of myocarditis. This accords with another study conducted by Luetkens et al which observed higher sensitivity and specificity of cardiac MRI in diagnosing myocarditis than the other modalities especially in relation to inflammation and fibrosis of the myocardium[13]. Recent research indicate that cardiac MRI is gradually attaining its status as the gold standard technique for non-invasive diagnosis of myocarditis especially where endomyocardial biopsy is contraindicated or warranted[14]. The present study, 88% of patients had raised cardiac biomarkers inclining to troponin and creatine kinase-MB. This result is in agreement with earlier studies, where troponin levels were raised in 80-90% of children with myocarditis[15]. For instance, Kindermann et al. (2012) did reveal that raised troponins are useful indicators of myocardial damage in children as well as have significant associations with more significant disease[16]. Nonetheless, there are other studies showing that although the biomarkers are elevated, their use in combination with imaging such as MRI improves diagnosis in cases where presentation is not clear[17]. As for the treatment, there was an improvement of the state in 85% of patients who received immunosuppressive therapy in the early stages of the disease in this study, which is consistent with the observations of other authors who gave emphasis on the early administration of the treatment. For instance, Cooper et al article published in 2015 showed that early immunosuppressive treatment enhances patient survival likelihood and slows the transition to chronic heart failure in children with myocardial inflammation[18]. More to the point, no comparable study could be found

that had comparable figures to assess if there was over or under use of various interventions like heart failure management diuretics/intotropic supports[19]. Cardiac arrest in this study was 12% in children, who presented with heart failure and this is similar to mortality in other regions where such advanced technologies as diagnostics tools and treatment like in developed countries may not be easily available. One such example is reported by Ammirati et al. (2019) in which children with severe myocarditis presenting in heart failure had similar mortality rates of 10-15%.

# CONCLUSION

It accordingly implies that myocarditis in children produces symptoms of a broad spectrum. The earlier the diagnosis, the better; in patients who have heart failure the prognosis is even better. Echocardiography and cardiac biomarkers are still useful, whereas other techniques as cardiac MRI are more accurate.

**Author's Contribution:**

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| Concept & Design of Study: | Ameer Ali Jamali, Munawar Ali Siyal |
| Drafting: | Naseer Ahmad Memon, Azizullah Langah, Karam Khushik, Ali Akbar Siyal |
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| Revisiting Critically: | Azizullah Langah, Karam Khushik, Ali Akbar Siyal |
| Final Approval of version: | By all above authors |

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