https://www.banglajol.info/index.php/BJMM/index

Bangladesh Journal of Medical Microbiology

July 2024, Volume 18, Number 2, Page 101-108

ISSN (Print) 2070-1810

ISSN (Online) 2072-3105

Original Article ***Open Access***

Evaluation of Cardiac Dysfunction among Children with Dengue Fever

Nevis Wadia[1], Sayeema Kabir[2], Suraiya Lutfa Jahan[3], Aditi Chowdhury[4], AFM Arshedi Sattar[5]

[1]Resident Physician, Department of Pediatrics, Delta Medical College and Hospital, Dhaka, Bangladesh; [2]Junior Consultant (Paediatrics), Upazila Health Complex, Sarail, Brahmanbaria, Bangladesh; [3]Registrar, Department of Paediatrics, Dhaka Medical College Hospital, Dhaka, Bangladesh; [4]Junior Consultant (Paediatrics), OSD, Directorate General of Health Services, Ministry of Health and Family Welfare, Dhaka, Bangladesh; [5]Associate Professor, Department of Microbiology, National Institute of Neurosciences and Hospital, Dhaka, Bangladesh

Abstract

Background: Evidence is increasing that dengue can also cause myocardial impairment, arrhythmias and, occasionally, fulminant myocarditis. Defining the role of cardiac dysfunction in the haemodynamic compromise of severe dengue has potentially important management implications. **Objectives:** The aim of this present study was to explore the incidence of cardiac dysfunction in children with dengue infection and to evaluate the features of cardiac involvement with the severity of dengue fever. **Methodology:** This cross-sectional study was conducted in Department of Paediatrics at Universal Medical College & Hospital, Dhaka, Bangladesh. Children with clinical features suggestive of dengue and further confirmed by dengue NS1 antigen or IgM antibody positivity between the ages of 1 month and 16 years were evaluated. Patients were classified as severe dengue, dengue with/without warning signs as per World Health Organization (WHO) criteria. All included children underwent cardiac assessment in form of clinical examination, cardiac markers, electrocardiograms (ECG) and echocardiograms. Differences in cardiac function were correlated with severity of dengue. **Results:** Mean age of the patients was 8.5±3.9 years and male: female ratio 2.0:1. Acute onset of fever and severe headache was commonest presentation (100.0%). Duration of fever was 3-5 days in maximum cases (67.7%). On clinic-pathological evaluation dengue fever was categories into three classes. In this study dengue without warning sign was 53(55.2%) cases, dengue with warning sign was detected in 25(26.0%) and severe dengue was 18(18.75%) patients. The most common ECG abnormality was T wave inversion noted in 21.8% of patients, low amplitude QRS complexes in 12 patients and ST depression in 14 patients. Echo findings were normal in 75.0% cases. Ejection Fraction <55% was noted in 12 cases, pericardial effusion in 8 patients, tricuspid regurgitation in 3 patients and regional wall motion abnormality detected in 4 cases. **Conclusion:** In conclusion, an association between cardiac involvement and the severity of dengue is found in this study among the children.

Keywords: Dengue fever; severe dengue; cardiac dysfunction

Bangladesh Journal of Medical Microbiology, July 2024;18 (2):101-108

Introduction

Dengue virus (DENV) belongs to the family *Flaviviridae*, genus *Flavivirus*, and is transmitted to humans by Aedes mosquitoes, mainly Aedes *aegypti*.

Correspondence: Dr. Nevis Wadia, Resident Physician, Department of Pediatrics, Delta Medical College and Hospital, Dhaka, Bangladesh; Email: nevis.wadia@gmail.com; Cell No.: +8801957964548;
ORCID: https://orcid.org/0000-0002-0845-2859

DOI: https://doi.org/10.3329/bjmm.v18i2.77108

Based on neutralization assay data, four serotypes (DENV-1, DENV-2, DENV-3, and DENV-4) can be distinguished[1]. In the year 2019 there was significant increase in number of cases of dengue occurring throughout the country and even from the rural areas though the case fatality rate (CFR) was not very high. Dengue virus infections may be asymptomatic or may lead to undifferentiated fever, dengue fever, or dengue haemorrhage fever (DHF) with plasma leakage that may lead to hypovolaemic shock Dengue Shock Syndrome (DSS). This range of manifestations of

dengue virus infection may be defined as Dengue Syndrome[2]. Infection with any of the DENV serotypes may be asymptomatic in the majority of cases or may result in a wide spectrum of clinical symptoms, ranging from a mild flu-like syndrome (known as dengue fever [DF]) to the most severe forms of the disease, which are characterized by coagulopathy, increased vascular fragility, and permeability (dengue hemorrhagic fever [DHF]). Recent study reported that cardiovascular dysfunction is common in dengue. Study showed an association between cardiac involvement and the severity of dengue[3, 4].

All four DENV serotypes have emerged from syllabic strains in the forests of South-East Asia[5]. They may be asymptomatic or may give rise to undifferentiated fever, dengue fever, dengue haemorrhagic fever (DHF), or dengue shock syndrome. Annually, 100 million cases of dengue fever and half a million cases of DHF occur worldwide[6]. Infection with one dengue serotype elicits immunity to that serotype but does not provide long-term cross-protective immunity to the remaining serotypes. Subsequent infection with a different serotype results in the binding of the new virus to cross reactive nonneutralising antibody from the previous infection facilitating the uptake by mononuclear phagocytes enabling amplified viral replication. The resulting increase in viral load then drives an immunopathogenic cascade and the resultant exaggerated cytokine response leads to a transient increase in microvascular permeability[7]. The dengue viruses are unique in that a single dengue infection may "sensitize" individuals to severe and fatal disease accompanying infection with a second serotype[8].

The pathogenesis of severe dengue is particularly intriguing with the involvement of different immune factors. Also, the epidemiology of dengue in South East Asia is undergoing a change in the human host, the dengue virus and the vector bionomics[9-10]. Shift in affected age groups, sex differences and expansion to rural areas are evident, while the virulence and genotype of the virus determine the severity and time interval between sequential infections. The Aedes mosquito, a potent and adaptive vector, has evolved in longevity and survival, affected by seasonality and climate variability, socio cultural and economic factors of human habitation and development[9]. DF is manifested as an incapacitating disease in older children, adolescents, and adults. It is characterized by the rapid onset of fever in combination with severe headache, retro-orbital pain, myalgia, arthralgia, gastrointestinal discomfort, and usually rash[10].

Leukopenia is a common finding, whereas thrombocytopenia may occasionally be observed in DF, especially in those with hemorrhagic signs[11-12]. Reports from different studies have shown a 16.7% to 71.0% incidence of cardiac involvement with features like cardiac failure, elevated cardiac enzymes (e.g. troponin T, creatine phosphokinase–myocardial band [CPK-MB]), abnormal electrocardiogram like sinus tachycardia, sinus bradycardia, T wave inversions, heart block and echocardiogram changes reduced ejection fraction[13-14]. The variation in symptoms can be attributed to the different criteria used for defining cardiac manifestations.

Clinically, cardiac involvement can differ broadly, from subclinical to severe myocarditis which can be fatal. Myocardial involvement may be attributed to direct viral invasion or cytokine-induced immune damage, or both. Previous study among the 130 dengue patients shows, 62(47.7%) had ECG changes, the majority of which belonged to the dengue with warning signs group. A significant correlation was noted between the ECG findings and the severity of dengue (P=0.022)[3]. Study in All India Institute of Medical Sciences, New Delhi, among the fifty-four children (less than 12 years old) with DF reported that ejection fraction was reduced (less than 50.0%) in 9/54 (16.7%) children; 2 of these had significant reductions (less than 35.0%). These 9 children belonged to all stages of clinical severity[14]. Increased capillary permeability in dengue can manifest as pleural effusions, ascites, and narrowing of pulse pressure; in a small proportion of patients, plasma leakage can cause hypovolaemia and cardiovascular collapse[13].

Functional myocardial impairment and electrocardiographic abnormalities are observed in many patients hospitalized with dengue, and can be caused by a subclinical myocarditis, myocardial oedema, or circulating myocardial depressant factors[13]. Differences in cardiac function between DF and DHF were most pronounced around the time of plasma leakage. Early diastolic wall motion of the left ventricle was decreased in dengue cases with plasma leakage compared to those without. Decreased left ventricular wall motility was more common in dengue patients compared to non-dengue cases particularly in cases with plasma leakage. Cardiac dysfunction is transient and did not require treatment. Transient elevated troponin-T levels were more common in DHF cases compared to DF (14.5% vs 5%, p = 0.028)15. Nevertheless, research on cardiac manifestations of dengue is limited in the pediatric population of

Bangladesh; therefore, the aim of this study was to explore the incidence of cardiac dysfunction in children with dengue infection and to evaluate the features of cardiac involvement with the severity of dengue fever.

Methodology

Study Settings and Population: This cross-sectional study was conducted in Department of Paediatrics at Universal Medical College & Hospital, Dhaka, Bangladesh among the children between the ages of 1 month to 15 years with wide clinical presentation of dengue infection, together with subsequent positive dengue NS1 antigen and/or IgM ELISA tests. Children with existing congenital or acquired heart diseases and other coexisting disease conditions, chronic hematologic or immunologic conditions were excluded from the study. Patients identified with dengue NS1 or as dengue IgM-positive were grouped according to WHO criteria[16] as having dengue fever, dengue with warning signs, and severe dengue. Children with all grades of severity of DHF/DSS were included to see if there was any variation in myocardial dysfunction.

Study Procedure: Patients were treated according to World Health Organization (WHO) guidelines[17]. The patients were encouraged to drink. Intravenous fluid was administered in cases with dehydration and inadequate oral fluid intake. The rate and amount of fluid were adjusted according to the clinical status and the severity of dehydration. In shock cases, 10 ml/kg fluid was given as bolus or within one hour for resuscitation and the rate of fluid was adjusted subsequently according to clinical status. All patients were clinically examined and assessed for the following cardiac manifestations: bradyarrhythmia, tachyarrhythmia, pericardial rub, presence of gallop, regurgitation (murmur grade >2/6), and capillary filling time (CFT). On the third day of admission, the following were performed: electro-cardiogram (ECG), two-dimensional echocardiography (ECHO), and creatine phosphokinase–myocardial band (CK-MB) tests. Based on reports from previous studies, cardiac involvement was considered present if dengue-positive (NS1/IgM) patients exhibited any two or more of the following factors: elevated CPK-MB, abnormal ECG findings, and/or abnormal echocardiography findings18-20. Those patients with features suggestive of cardiac involvement were placed on follow-up with the pediatric cardiologist.

Electrocardiography (ECG) Manifestation: The electrocardiography (ECG) manifestation of cardiac involvement was determined from the 12 lead ECGs based on the presence of any of the following features: ST-segment elevation in ≥2 contiguous leads (>1 mm in limb leads, and >2 mm in chest leads), T wave inversions in V5 and V6, widespread ST-segment depressions (sustained horizontal ST-segment depression for 0.08 seconds or longer), and pericardial involvement such as a low-voltage QRS complex (QRS <5 mm in limb leads and <10 mm in the chest leads), ST-elevation with concavity upwards (>1 mm in limb leads, and >2 mm in chest leads), or T wave inversion in V5 and V63. Echocardiography was performed on all dengue-positive patients. Cardiac manifestations included left ventricular dysfunction (left ventricular ejection fraction <55%), left ventricular cavity enlargement (according to body size/weight), right ventricular dysfunction (pulmonary artery systolic pressure estimated using tricuspid regurgitation, right ventricular systolic function visual inspection), segmental wall motion abnormalities (hypokinetic, akinetic, or dyskinetic regions), and pericardial findings such as pericardial effusion (mild, <100 mL; moderate, 100–500 mL)[3]. Plasma samples were assayed for routine hematological and biochemical tests. Cardiac enzymes analyzed for creatine kinase MB (CK-MB) isoenzyme levels by ELISA. The assay range was 0.2–60 ng/ml.

Statistical Analysis: The patient information was recorded and included in data collection sheet. The demographic indices, for example, age, sex, and residence, along with clinical data, including the associated symptoms, vital signs, and general and systemic examination, were recorded. The data were collected and statistical analysis was performed using SPSS software version 23. The results were represented as categorical data, and chi-square test was used. We reported statistically significant P values ($P \leq 0.05$) and their 95% confidence intervals.

Ethical Consideration: All procedures of the present study were carried out in accordance with the principles for human investigations (i.e., Helsinki Declaration 2013) and also with the ethical guidelines of the Institutional research ethics. Formal ethics approval was granted by the local ethics committee. Participants in the study were informed about the procedure and purpose of the study and confidentiality of information provided. All participants consented willingly to be a part of the study during the data collection periods. All data were collected anonymously and were analyzed using the coding system.

Results

According to the questionnaire, history of all the 96 selected cases were taken, the clinical examination was carried out meticulously. In the study, the maximum number of patients (36.4%) was seen in the age group 6-10 years, mean age of the patient was 8.5±3.9 years. Maximum numbers of respondents (88.5%) came from urban area 88.5%, and socioeconomically middle class (56.2%) comprising the major percentage of the patients (Table 1).

Table 1: Demographic Characteristics of Study Population (n=96)

Demographic Features	Frequency	Percent
Age Group		
• Less Than 1 Years	13	13.5
• 1 to 5 Years	27	28.1
• 6 to 10 Years	35	36.4
• 11 to 15 Years	21	21.8
Mean ± SD (Years)	8.5±3.9	
Residence		
• Urban	85	88.5
• Rural	11	11.5
Economic Class		
• Poor	26	27.0
• Middle	54	56.2
• High	16	16.7

Acute onset of fever and severe headache was commonest presentation (100.0%) followed by retro-orbital pain in 85.4%; nausea and vomiting in 56.2%; petechiae/ecchymosis/purpura in 23.9% of patients. In most series, fever is almost universal at the onset. Fever is of sudden onset and in most cases (61.5%) was 38.0°C-40°C, in 38.5% patients found high grade (>40° C) accompanied with chills and rigors. Duration of fever was 3-5 days in maximum cases (67.7%). Tachycardia was in 43.7% and bradycardia in 17.7% of patients. Positive tourniquet test had been detected in 12.5% subjects. Crepitation was found on lungs in 4.1% of patients (Table 2)

On clinic-pathological evaluation dengue fever was categories into three classes. In this study dengue without warning sign was 53(55.2%) cases, dengue with warning sign was detected in 25(26.0%) and severe dengue was 18(18.75%) patients (Figure I).

Electrocardiograms findings revealed that repolarization abnormalities were the most common abnormalities. The most common ECG abnormality was T wave inversion noted in 21.8% of patients and involved the anterior lead (V1-V3) in twelve cases, the inferior lead (II, III, aVF) in seven cases, and the inferolateral (II, III, aVF, V5, V6) in two cases. Prolonged Q-Tc interval (0.46 (0.05) seconds) was noted in 11(11.4%) patients. Other abnormalities were low amplitude QRS complexes in 12 patients and ST depression in 14 patients. Echo findings were normal in 75.0% cases. Ejection Fraction <55% was noted in 12 cases, pericardial effusion in 8 patients, tricuspid regurgitation in 3 patients and regional wall motion abnormality detected in 4 cases. Raised CKMB found in 58 patients. Present study demonstrated that, prevalence of cardiac dysfunction was 37(38.5%) in children with dengue. Total 59(61.5%) patients revealed normal findings (Figure 3).

Table 2: Distribution of Cases according to Clinical Manifestation (n=96)

Manifestation	Frequency	Percent
Symptoms		
Acute onset of fever (Core Temperature > 38°C)	96	100.0
Severe Headache	96	100.0
Retro-orbital pain	82	85.4
Nausea, vomiting	54	56.2
Petechiae/ ecchymosis/ purpura	23	23.9
Respiratory distress	18	18.7
Sign		
Temperature		
38.0°C-40°C	59	61.5
>40°C	37	38.5
Duration of fever		
<3 days	17	17.7
3-5 days	65	67.7
>5 days	14	14.6
• Tachycardia	42	43.7
• Delayed capillary felling	18	18.7
• Bradycardia	17	17.7
• Positive tourniquet test	12	12.5
• Crepitation over lung	4	4.1

*Multiple respondents

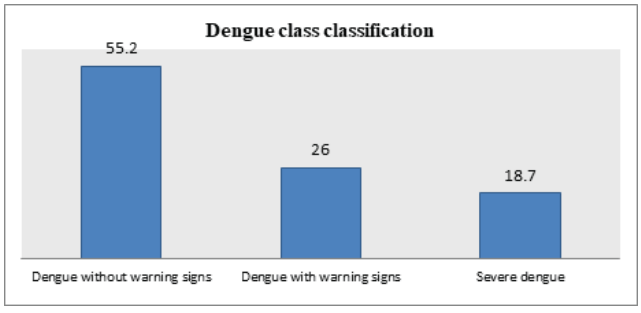

Figure I: Dengue Class Classification by Severity (n=96)

Table 3: Findings of Cardiac Evaluation (n=96)

Cardiac evaluation	Frequency	Percent
ECG change		
• Sinus tachycardia	42	43.7
• Sinus bradycardia	17	17.7
• T-wave abnormality (inverted/ flattening)	21	21.8
• ST depression	14	14.5
• Low amplitude QRS complexes	12	12.5
• Prolonged QTc intervals	11	11.4
• Left ventricular hypertrophy	7	7.2
• Normal ECG	51	53.1
ECHO findings		
• Ejection Fraction <55%	12	12.5
• Pericardial effusion	8	8.3
• Tricuspid regurgitation	3	3.12
• Regional wall motion abnormality	4	4.16
• Normal ECHO	72	75.0
CKMB		
• Elevated	58	60.5
• Normal	38	39.5

The positive correlation between cardiac findings and dengue severity was recorded. Among the 37 patients of cardiac dysfunction, the majority of cases were belonged to the severe dengue (88.9%) & dengue with warning signs group (56.0%). A significant correlation was noted between the cardiac abnormalities and the severity of dengue (P=0.014) (Table 4).

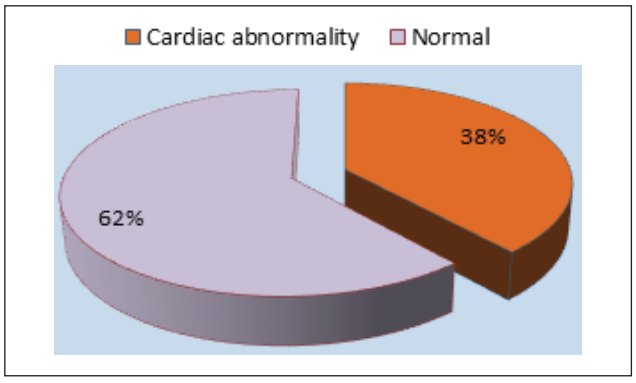

Figure II: Overall prevalence of cardiac dysfunction in dengue patient (n=96)

Discussion

This prospective cross-sectional study was conducted to explore the incidence of cardiac dysfunction in children with dengue infection and to evaluate the features of cardiac involvement with the severity of dengue fever. Total 96 children were selected. Maximum number of patients (36.4%) was seen in the age group 6 to 10 years, mean age of the patient was 8.5±3.9 years. Gender destruction revealed that male: female ratio was 2.0:1.

Kabra et al[14] demonstrated that mean (±SD) age of the children was 6.3(2.9) years (range 0.5 to 12 years). Abhinayaa et al[3] reported that most of the patients were 5 to 9 years of age (n=26, 43.3%) in their study. There were 60 (46.2%) males and 70 (53.8%) females. The final study group comprised 56 (43%) patients with dengue fever, 52 (40%) with dengue with warning signs, and 22 (17%) with severe dengue.

According to the WHO classification, all subjects were classified into three categories. Dengue without warning sign was 53(55.2%) cases, dengue with warning sign was detected in 25(26.0%) and severe dengue was 18(18.75%) patients. Findings accordance with the result of previous study. Menwal et al[21] have noted that maximum number of subjects, that is, 39 (65.0%), belonged to "dengue with warning signs" category followed by 19 (31.7%) subjects in "probable dengue" category. Only 2(3.3%) subjects were classified under "severe dengue" category in their study. The most common symptom was vomiting, pain in abdomen, rashes; bleeding manifestation. Siddappa et al[22] found that nineteen (48.0%) children had dengue without warning signs, 13 (33.0%) had dengue with warning signs and 7(17.0%) had severe dengue.

There is a paucity of data on cardiac involvement in dengue infection; however, there is an increasing trend of cardiac involvement in dengue patients being reported. In this study prevalence of cardiac dysfunction was 37(38.5%) in children with dengue. Among the 37 patients of cardiac dysfunction, the majority of cases were belonged to the severe dengue

Table 5: Correlation between Cardiac Findings and Dengue Severity (n=96)

Cardiac Evaluation	Dengue Severity			Total	P value
	Without Warning Sign	With Warning Sign	Severe Dengue		
Normal Cardiac Status	46(86.7%)	11(44.0%)	2(11.1%)	59	
Cardiac Dysfunction	7(13.2%)	14(56.0%)	16(88.9%)	37	0.014
Total	**53**	**25**	**18**	**96**	

(88.9%) & dengue with warning signs group (56.0%). A significant correlation was noted between the cardiac abnormalities and the severity of dengue (P=0.014).

Siddappa et al[22] have reported cardiac abnormalities were seen in 5 (71%) out of 7 patients with severe dengue, 10 (52%) out 19 with dengue without warning signs and 7 (53%) out of 13 with dengue with warning signs[22]. In 2007, Kularatne et al[23] investigated cardiac complications in 120 DHF patients between 13 to 76 years of age. They found that 75/120 (62.5%) of the patients had ECG abnormalities (e.g., T inversion, ST depression, bundle branch blocks). Moreover, 5/75 (6.66%) of the patients had LVEF less than 55.0% cases. They concluded that cardiac involvement in DHF was common and early recognition and differentiation from DSS is crucial. In the same year, Khongphatthanayothin et al[24] conducted a study to determine the prevalence of myocardial depression and its effect on the clinical severity in 91 patients with DF, DHF, and DSS. They found that during the critical stage, LVEF less than 50.0% cases was present in 2(6.7%) cases, 5(13.8%) cases and 9(36.0%) patients with DF, DHF and DSS, respectively.

Cardiac manifestations of dengue include functional myocardial impairment, arrhythmias, and myocarditis, which can occur through a number of mechanisms. Proposed viral and immune mechanisms involved in the cardiac and vascular manifestations of dengue. DENV is taken up into macrophages with the resulting T cell activation and release of vasoactive and proinflammatory cytokines implicated in the capillary leak and possibly also in myocardial impairment. The interaction between the NS1 and the glycocalyx layer of the vascular endothelium is thought to increase capillary permeability. The resulting plasma leakage can contribute to the cardiac dysfunction in the form of reduced preload, altered coronary microcirculation, and myocardial interstitial oedema[13].

There have been reports that the increased resting diastolic calcium ion levels present in the myocardium precipitated by dengue can be attributed to the arrhythmia and diminished left ventricular function noted in these patients[3]. Similar study reported that overall cardiac involvement among dengue patients was 46.2%, predominantly in the severe dengue group, most common features suggestive of cardiac involvement noted T wave depression and pericardial effusion[3]. Severity of dengue was also directly proportional to the length of hospitalization. Similar findings have been reported by Mishra et al[25]. We also found elevated CK-MB levels in the majority of dengue patients. The level of CK-MB is an independent marker of myocardial damage in children with dengue infection[3,18].

Abnormalities in ECG tend to occur during any phase of dengue illness, and many patients require hospitalization. In this present study, the abnormal ECG findings in dengue patients with cardiac involvement were T wave inversions, sinus bradycardia, ST elevation/depression, pathological Q waves, and changes to the QRS complex. Similar observation was also noted in previous study[3,21]. Abhinayaa et al[3] reported a higher proportion of T wave depression. However, Siddappa et al. reported a higher incidence of sinus tachycardia, while T wave inversions were seen in a small number of patients, which was comparatively lower when compared to our study[22]. These abnormalities are benign, and such ECG abnormalities may be the only sign of cardiac involvement with normal biomarker levels and echocardiogram. Electrolyte and calcium changes, altered autonomic tone, or subclinical myocarditis are the possible mechanisms for ECG abnormalities in dengue fever. In our study, children with abnormal ECG findings were monitored until discharge.

Abnormal echocardiography findings were more prevalent among severe dengue patients in our study. These findings are consistent with earlier studies showing that cardiac functional abnormalities in echocardiography are significantly associated with disease severity[26]. In a study performed by Satarasinghe et al[27] echocardiograph abnormalities were present in 24.0% of patients, with none having clinical features of overt myocarditis. Increased cytokine production causes increased vascular permeability and abnormal leakage of plasma, leading to pericardial effusion. The possible mechanism for reduced left ventricular ejection fraction was immune-mediated and direct viral invasion of cardiac muscle cells in myocarditis[28].

Wali et al[29] conducted a study to evaluate cardiac involvement in 17 consecutive patients with DHF, by use of radionuclide ventriculography, ECHO, and ECG during the epidemic of DEN-2. They found that the mean left ventricular (LV) ejection fraction (LVEF) was 41.7% cases and 7 patients (41.17%) had LVEF < 40%. Moreover, global hypokinesia was detected in 12 patients (70.59%) and was found to revert to normal within 3 weeks. They concluded that acute reversible cardiac involvement was present in DHF or DSS and could be responsible for clinical shock. Hence, the role

of ECG, ECHO, and radionuclide ventriculography in the clinical evaluation of DHF and DSS patients should be considered tools to improve the prognosis in these patients. In the same year, Kabra et al[14] conducted a study to evaluate cardiac involvement in 54 pediatric patients admitted to the hospital with various grades of DVI (DF/DHF/DSS). They found that 9/54 (16.7%) children had LVEF less than 50.0% and 2/54 (3.7%) had LVEF less than 35.0% cases. They concluded that cardiac functions need to be assessed in patients with DVI, especially those with hypotension, with adequate hydration.

A significant proportion of dengue patients have cardiac involvement. Evaluation for cardiac involvement in pediatric patients with dengue fever should be performed via ECG, ECHO, CK-MB, and other similar tests, and would help in the early identification of myocarditis and interventions to prevent further complications. The spectrum of cardiovascular manifestations in dengue is broad, ranging from myocardial impairment and arrhythmias to vascular barrier dysfunction causing plasma leakage and haemodynamic compromise. Myocardial impairment can contribute to haemodynamic instability during the critical phase of capillary leakage. These complications are often under-reported, highlighting large gaps in our knowledge.

Conclusions

In conclusion, significant proportion of dengue patients present with cardiac manifestations; however, most findings are subclinical and do not require further clinical interventions. The predominance of cardiac involvement in dengue patients among children suggests that cardiac screening in all patients with dengue infection, with ECG, echocardiogram, and CK-MB tests, contributes to effective treatment of myocarditis. This study reports an association of cardiac involvement with the severity of dengue infection in children.

Acknowledgements
We thank Acme pharmaceuticals Ltd. for supplying blood culture bottles.

Conflict of Interest
There are no any potential conflicts of interest; this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Financial Disclosure
The author(s) received no specific funding for this work.

Authors' contributions
Wadia N, Kabir S, Jahan SL conceived and designed the study, analyzed the data, interpreted the results, and wrote up the draft manuscript. Chowdhury A, Sattar AFMA contributed to the analysis of the data, interpretation of the results and critically reviewing the manuscript. Chowdhury A, Sattar AFMA involved in the manuscript review and editing. Wadia N as collector of Data and Data Analyst. All authors read and approved the final manuscript.

Data Availability
Any inquiries regarding supporting data availability of this study should be directed to the corresponding author and are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate
Ethical approval for the study was obtained from the Institutional Review Board. As this was a prospective study the written informed consent was obtained from all study participants. All methods were performed in accordance with the relevant guidelines and regulations.

Wadia N, Kabir S, Jahan SL conceived and designed the study, analyzed the data, interpreted the results, and wrote up the draft manuscript. Chowdhury A, Sattar AFMA contributed to the analysis of the data, interpretation of the results and critically reviewing the manuscript. Chowdhury A, Sattar AFMA involved in the manuscript review and editing. Wadia N as collector of Data and Data Analyst. All authors read and approved the final manuscript.

How to cite this article: Wadia N, Kabir S, Jahan SL, Chowdhury A, Sattar AFMA. Evaluation of Cardiac Dysfunction among Children with Dengue Fever. Bangladesh J Med Microbiol, 2024;18(2):101-108

ORCID
Nevis Wadia: https://orcid.org/0000-0002-0845-2859
Sayeema Kabir: https://orcid.org/0009-0009-4893-0323
Suraiya Lutfa Jahan: https://orcid.org/0009-0006-7534-5056
Aditi Chowdhury: https://orcid.org/0009-0009-4893-0323
AFM Arshedi Sattar: https://orcid.org/0009-0009-5216-1088

Article Info
Received: 7 February 2024
Accepted: 2 March 2024
Published: 1 July 2024

References

1. Martina B, Koraka P and Osterhaus A. Dengue Virus Pathogenesis: An Integrated View. Clinical microbiology Reviews 2009; 22(4): 564–581.
2. Islam Q. National Guideline for Clinical Management of Dengue Syndrome. National Malaria Elimination & Aedes Transmitted Diseases Control Program, Disease Control Unit, Directorate General of Health Services, Dhaka. 4th Edition 2018: 1-98.
3. Abhinayaa J, James S, Jebaraj R, Vinoth PN. Incidence of Cardiac Manifestations in Children with Dengue Fever: A Cross-sectional Study. Rambam Maimonides Med J 2021;12 (2):e0014
4. Shivanthan M, Navinan M, Constantine G, Rajapakse S. Cardiac involvement in dengue infection. J Infect Dev Ctries 2015; 9(4):338-346.
5. Zaman A. An Overview on the Prevalence and Diagnosis of Dengue. Thesis for MS Microbiology, BRAC University, Dhaka

2018: 4-39.
6. Malavige GN, Fernando S, Fernando D, Seneviratne SL. Dengue viral infections. Postgrad Med J 2004; 80:588–601.
7. Sellahewa K. Pathogenesis of Dengue Haemorrhagic Fever and Its Impact on Case Management. Hindawi Publishing Corporation, ISRN Infectious Diseases 2013; 571646: 1-6.
8. Messina JP, Brady O, Scott T, Zou C, Pigott D, Duda K. Global spread of dengue virus types: mapping the 70-year history. Trends in microbiology 2014; 22(3): 138-146
9. Islam Q. Changing Epidemiological and Clinical pattern of Dengue in Bangladesh 2018. J MEDICINE 2019; 20: 1.
10. Bhatia R, Dash AP, Sunyoto T. Changing epidemiology of dengue in South-East Asia. WHO South-East Asia J Public Health 2013;2:23-7.
11. Guilarde AO, Turchi MD, Jr JB, Feres VC, Rocha B, Levi JE, et al. Dengue and dengue hemorrhagic fever among adults: clinical outcomes related to viremia, serotypes, and antibody response. The Journal of infectious diseases. 2008;197(6):817-24.
12. Kittigul L, Pitakarnjanakul P, Sujirarat D, Siripanichgon K. The differences of clinical manifestations and laboratory findings in children and adults with dengue virus infection. Journal of Clinical Virology. 2007;39(2):76-81.
13. Yacoub S, Wertheim H, Simmons C, Screaton G and Bridget W. Cardiovascular manifestations of the emerging dengue pandemic. Nat. Rev. Cardiol. 11, 335–345 (2014)
14. Kabra SK, Juneja R, Jain Y, Singhal T, Dar L, Kothari SS, Broor S. Myocardial dysfunction in children with dengue haemorrhagic fever. The national medical Journal of India 1998;11(2): 59-61
15. Kirawittaya T, Yoon I-K, Wichit S, Green S, Ennis FA, Gibbons RV, et al. Evaluation of Cardiac Involvement in Children with Dengue by Serial Echocardiographic Studies. PLoS Negl Trop Dis 2015;9(7): e0003943.
16. World Health Organization. Dengue. Guidelines For Diagnosis, Treatment, Prevention and Control. 2009. Available at: https://www.who.int/tdr/publications/ documents/dengue-diagnosis.pdf (accessed March 1, 2022).
17. Dengue Hemorrhagic Fever: diagnosis, treatment, prevention and control. 2nd ed. World Health Organization; 1997
18. Salgado DM, Eltit JM, Mansfield K, et al. Heart and skeletal muscle are targets of dengue virus infection. Pediatr Infect Dis J 2010;29:238–42.
19. Gupta VK, Gadpayle AK. Subclinical cardiac involvement in dengue haemorrhagic fever. Indian Academy of Clinical Medicine 2010;11:107–11.
20. Yadav DK, Choudhary S, Gupta PK, et al. The Tei index and asymptomatic myocarditis in children with severe dengue. Pediatr Cardiol 2013;34:1307–13.
21. Menwal U, Rawat A, Rawat A, Chandar V. Cardiac Manifestations of Dengue Fever in Pediatrics Age Group. Indian J Child Health. 2020; 7(9):363-365
22. Siddappa FD, Koushik H, V H Ratageri, P K Wari. Cardiac Manifestations of Dengue Fever in Children. Pediatric Oncall Journal October 2017; 14(4): 82-85.
23. Kularatne SA, Pathirage MM, Kumarasiri PV, Gunasena S, Mahindawanse SI. Cardiac complications of a dengue fever outbreak in Sri Lanka, 2005. Trans R Soc Trop Med Hyg 2007; 101: 804-808.
24. Khongphatthanayothin A, Lertsapcharoen P, Supachokchaiwattana P, La-Orkhun V, Khumtonvong A, Boonlarptaveechoke C, Pancharoen C. Myocardial depression in dengue hemorrhagic fever: prevalence and clinical description. Pediatr Crit Care Med 2007; 8: 524-529.
25. Mishra S, Ramanathan R, Agarwalla SK. Clinical profile of dengue fever in children: a study from Southern Odisha, India. Scientifica (Cairo) 2016;2016:6391594.
26. Leowattana W, Leowattana T. Dengue hemorrhagic fever and cardiac involvement. World J Meta-Anal 2021; 9(3): 286-296
27. Satarasinghe R, Arulnithy K, Amerasena NL, Bulugahapithiya U, Sahayam DV. Asymptomatic myocardial involvement in acute dengue virus infection in a cohort of adult Sri Lankan admitted to a tertiary referral centre. Br J Cardiol 2007;14:171–3.
28. Papalkar P, Sarode R, Acharya S, Kumar S. Cardiac Manifestations in Dengue. Indian J Med Specialties 2019;10:30–4. 34.
29. Wali JP, Biswas A, Chandra S, Malhotra A, Aggarwal P, Handa R, et al. Cardiac involvement in Dengue Haemorrhagic Fever. Int J Cardiol 1998; 64: 31-36