A Retrospective Evaluation of the Role of Ultra Sonography in Diagnosis and Early Prediction of Severity of Dengue Fever: An Observational Study

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Abstract

Aim: The aim of the present study was to evaluate the sonographic findings in children with dengue fever (DF) and to determine its role in predicting the severity of the disease.

Material & Methods: The retrospective study was done in Department of Pediatrics. Serological test NS 1antigen, Dengue IgM and IgG Antibody tests were performed. 70 patients were found serologically positive for dengue, were referred for Ultrasound scanning of the abdomen and thorax.

Results: Among the total of 70 instances, 42 were identified as male, while the remaining 28 were identified as female. Among the total of 70 instances examined, it was seen that 4 cases were classified as belonging to the age group of less than 1 year, while 20 cases fell within the age range of 1 to 5 years. Additionally, 22 cases were found to be between the ages of 6 and 10 years, while the remaining 24 cases were categorized as belonging to an age group above 10 years. Among the total of 70 confirmed cases, 50 cases were categorized as belonging to the moderate dengue group, while the remaining 20 cases were classified as severe dengue fever patients. All instances had symptoms of elevated body temperature. Approximately 48.57% of the patients exhibited symptoms of vomiting, while 57.14% had discomfort in the belly. Additionally, 64.28% of the cases presented with Petechiae, and 52.85% displayed melena. Out of the total sample size, 32 individuals (45.71%) exhibited hepatomegaly, 18 individuals (25.71%) had splenomegaly, and 21 individuals (30%) presented with hypotension. In the dengue fever group, 55 individuals (78.57%) exhibited gall bladder wall edema, 40 individuals (57.14%) had ascites, 36 individuals (51.42%) presented with pleural effusion, 42 individuals (60%) had hepatomegaly, 22 individuals (32.42%) showed splenomegaly, and 11 individuals (15.71%) displayed perinephric edema. In the severe dengue group, all 20 individuals (100%) had gall bladder wall edema and ascites, 17 individuals (85%) had pleural effusion, 12 individuals (60%) had hepatomegaly, 8 individuals (40%) had splenomegaly, and 9 individuals (45%) had perinephric edema.

Conclusion: There was a notable positive correlation seen between the severity of thrombocytopenia and the presence of aberrant ultrasonography characteristics.

Keywords: Ascites, Dengue Fever, Hepatomegaly, Edematous Gallbladder Wall Thickening, Pleural Effusion, Splenomegaly, Thrombocytopenia, Ultrasound Features.

Introduction

The dengue virus, classified as a flavi virus, is a prevalent factor contributing to the occurrence of fever in tropical regions. Dengue is prevalent in over 100 nations, including the areas of the globe designated by the globe Health Organization (WHO). [1] Dengue is considered to be of secondary significance compared to malaria, since the World Health Organization (WHO) classifies Dengue as one of the sixteen neglected tropical illnesses. [2,3] Dengue fever is the result of an infection caused by a single-stranded RNA virus belonging to the Flaviviridae family, which is mostly spread by mosquito vectors. The user's text is too short to be rewritten in an academic manner. [4]

There are four identified serotypes of dengue; however, the manifestation of severe dengue fever is attributed to the presence of many serotypes in an individual's illness. There are five distinct strains of Dengue virus that may result in either symptomatic infections or silent seroconversion. [5] Dengue infection that presents with symptoms is characterized as a systemic and dynamic ailment. The clinical spectrum of this condition has a broad range of symptoms, varying in severity from severe

to non-severe. [6] Dengue presents clinically as an abrupt beginning of elevated body temperature accompanied by chills, accompanied by severe symptoms such as acute headache, muscular and articular discomfort, retro-orbital pain, and severe back pain. Typically, the duration of fever spans around five days, with instances of exceeding seven days being rare. [7] Hemorrhagic diathesis and thrombocytopenia, together with concomitant hemo-concentration, are consistently seen. [8] Dengue Hemorrhagic Fever (DHF) has the potential to induce heightened vascular permeability, leading to the leaking of plasma. This may manifest in several ways, including the development of pleural effusion and ascites. In the context of Diffuse Histiocytic Fibromatosis (DHF), it is possible for abdominal organs to undergo enlargement, including hepatomegaly, splenomegaly, and an enlarged pancreas. The timely diagnosis of DF is often hindered by the delay in obtaining serology test results. [9] Ultrasonography (USG) is an affordable, expeditious, and readily accessible imaging modality that does not need invasive procedures. The ultrasound results associated with Dengue fever include several observations, such as the thickening of the gall bladder wall, the presence of pericholecystic fluid, minor ascites, pleural effusion, pericardial effusion, and hepatosplenomegaly. [9] Ultrasonography (USG) is an affordable, expeditious, and readily accessible non-invasive modality for imaging purposes. [9,10] The ultrasonographic observations associated with Dengue fever include several manifestations, such as thickening of the gall bladder wall, presence of pericholecystic fluid, minor accumulation of ascitic fluid, effusion in the pleural cavity, effusion around the pericardium, and enlargement of the liver and spleen. [11] During pandemic scenarios such as the ongoing Covid-19 (Coronavirus Disease 2019) crisis, the practicality of employing a non-invasive and comparatively straightforward examination such as ultrasonography (USG) as a supplementary measure for timely identification and assessment of disease severity can prove beneficial in terms of efficient time allocation and ultimately mitigating mortality rates associated with dengue.

Therefore, the objective of this research was to evaluate the significance of ultrasonographic characteristics of the thorax and abdomen in the diagnosis and early assessment of the severity of dengue fever.

Materials & Methods

The retrospective study was done in Department of Pediatrics, SKMCH, Muzaffarpur, Bihar, India for one year. Serological test NS 1antigen, Dengue

IgM and IgG Antibody tests were performed. 70 patients were found serologically positive for dengue, were referred for Ultrasound scanning of the abdomen and thorax.

Inclusion criteria: All children of age group 2 month to

18 years with suspected dengue fever, having fever more than 3days and thrombocytopenia were included in the study.

Exclusion criteria: Children of less than 2 month, who were positive for meningitis, malaria, enteric fever and of chronic liver disease, were excluded from our study.

The ultrasound examination was performed with Sonoscape ultrasound machine using 3.5MHz and5MHz probes. Ultrasound scan of the abdomen and pelvis was performed six hours after fasting in order to attain better distension of gall bladder (GB). [13] Sonography was performed by radiologist and scanning was performed only once so there is on inter observer variation. Gall bladder wall edema, pleural effusion, ascites, splenomegaly, hepatomegaly and perinephric edema were measured by USG.

The children were classified as follows: [14]

1. DF-Fever of 2-7 days with two or more of following- Headache, myalgia, arthralgia, retro orbital pain leukopenia, thrombocytopenia and no evidence of plasma leakage.
2. DHF 1: Above criteria plus positive tourniquet test and evidence of plasma leakage. platelet count
3. <100,000/cu.mm and Hct rise more than 20% over baseline.
4. DHF II: Above plus evidence of spontaneous bleeding in skin or other organs & abdominal pain.
5. DHF III(DSS): Above plus circulatory failure (weak rapid pulse, narrow pulse pressure, hypotension) DHF IV(DSS): Profound shock with undetectable blood pressure or pulse DF, DHF I and DHF II were categorized as mild dengue while, DHF III (DSS) and DHF IV (DSS) were categorized as severe dengue.

Statistical Analysis: Data obtained was tabulated using version 21 of the statistical package for social science (SPSS published SPSS Inc.). Qualitative variables were expressed as percentages. Association of various variables were assessed through chi square test and ANNOVA. P value less than 0.05 was considered for statistical significance.

Results

Table 1: Demographic data

Gender	N%
Male	42 (60)
Female	28 (40)
Age groups	
Less than 1 year	4 (5.71)
1-5 years	20 (28.57)
6-10 years	22 (31.42)
More than 10 years	24 (34.28)

Out of 70 cases 42 were male and 28 were female. Out of 70 cases 4 cases were less than 1 year old, 20 aged 1-5 year, 22 aged 6-10 year and 24 cases were in more than 10-year age group.

Table 2: Clinical features among mild and severe dengue group

Clinical features	Total n = 70 (%)	Mild DF n = 50 (%)	Severe DF n = 20(%)	P value
Fever	70 (100)	50 (100)	20 (100)	<0.001
Vomiting	34 (48.57)	20 (40)	14 (70)	<0.001
Pain abdomen	40 (57.14)	22 (44)	19 (95)	<0.001
Petechiae	45 (64.28)	30 (60)	15 (75)	0.002
Melena	37 (52.85)	28 (56)	9 (45)	<0.001
Splenomegaly	18 (25.71)	8 (16)	9 (45)	<0.001
Hepatomegaly	32 (45.71)	19 (38)	12 (60)	<0.38
CNS involvement	5 (7.14)	2 (2)	4 (20)	<0.001
Hypotension	21 (30)	0 (0)	20 (100)	<0.001

Out of 70 confirmed cases, 50 cases were classified in mild dengue group and 20 cases were in severe dengue fever group. All cases had fever. About 34 (48.57%) cases had vomiting, 40 (57.14%) had pain abdomen, 45 (64.28%) had Petechiae, 37 (52.85%) had melena. 32 (45.71%) had hepatomegaly, 18 (25.71%) had splenomegaly and 21 (30%) had hypotension.

Table 3: USG findings among mild and severe dengue group

USG feature	Total n = 70 (%)	Mild DF n = 50 (%)	Severe DF n = 20 (%)	P value
Pleural effusion	36 (51.42)	18 (36)	17 (85)	<0.001
GB Wall edema	55 (78.57)	36 (72)	20 (100)	<0.001
Ascites	40 (57.14)	23 (46)	20 (100)	<0.001
Hepatomegaly	42 (60)	30 (60)	12 (60)	0.42
Splenomegaly	22 (31.42)	14 (28)	8 (40)	<0.001
Perinephric edema	11 (15.71)	3 (6)	9 (45)	<0.001

Gall bladder wall edema, ascites, pleural effusion, hepatomegaly, splenomegaly and perinephric edema were present in 55 (78.57%), 40 (57.14%), 36 (51.42%), 42 (60%), 22 (32.42%) and 11 (15.71%) in all dengue fever group while 20 (100%), 20 (100%), 17 (85%), 12 (60%), 8 (40%), and 9 (45%) in severe dengue group respectively.

Table 4: Correlation of sonographic finding with platelet count

USG features	Platelet count (In per µl) - Number (%)			P value
	<40000	40000 – 80000	80000 - 150000	
Total	34 (48.57)	15 (30)	4 (20)	
GB wall edema	65 (92.85)	46 (92)	9 (45)	<0.001
Pleural effusion	46 (65.71)	19 (38)	5 (25)	<0.001
Ascites	65 (92.85)	21 (42)	3 (15)	<0.001
Hepatomegaly	56 (80)	23 (46)	4 (20)	0.48
splenomegaly	29 (41.42)	11 (22)	3 (15)	0.026
Normal	5 (7.14)	4 (8)	10 (50)	0.56

All sonographic features had more significant association with severe dengue group (p <0.001) except hepatomegaly. All sonographic features had significant correlation (P value < 0.001) with severe thrombocytopenia except hepatomegaly.

Discussion

According to the World Health Organization (WHO), there has been a significant worldwide surge in dengue cases, with a thirty-fold rise seen over the course of the last five decades. It is estimated that there are around 50-100 million new infections occurring yearly in over 100 countries that are endemic to the disease. Annually, a significant number of severe cases emerge, leading to an estimated 20,000 fatalities. The serological method, namely the detection of immunoglobulin M (IgM) specific antibodies, is the established means of definitively diagnosing dengue fever (DF). On the other hand, the diagnosis of dengue hemorrhagic fever (DHF) relies on clinical assessment using the diagnostic criteria put out by the World Health Organization (WHO). [15] The recognition of plasma leakage for the diagnosis of dengue hemorrhagic fever (DHF) poses challenges in adhering to the criteria set out by the World Health Organization (WHO). The diagnosis of hemoconcentration, often defined as an increase in hematocrit more than 20%, is commonly made in a retrospective manner and requires several samples. Conversely, hypoproteinemia, a decrease in protein levels, is an uncommon observation. [16] Radiographic examinations, while capable of detecting effusions, often necessitate the use of multiple films to visualize ongoing collections in the pleural cavity. This approach increases the potential for radiation exposure. Conversely, ultrasound imaging can identify even smaller quantities of pleural effusion and ascites in children experiencing transient plasma leakage. Furthermore, ultrasound exhibits a high level of sensitivity in this regard. Gallbladder wall thickening (GBWT), characterized by a honeycomb pattern seen using ultrasonography (USG), is a highly specific indicator that may aid in the diagnosis and prognosis of severe dengue infection. [17] The utility of the Ultra-Sensitive Genotyping (USG) technique has been shown in its ability to effectively predict the occurrence of severe dengue infection during the first stages of sickness. [18]

Among the total of 70 cases examined, 42 were identified as male, while the remaining 28 were classified as female. Among the total of 70 instances examined, it was seen that 4 cases were within the age range of less than 1 year, while 20 cases were between the ages of 1 and 5 years. Additionally, 22 cases were found to be within the age range of 6 to 10 years, and the remaining 24 cases were categorized as belonging to the age group above 10 years. Among the total of 70 confirmed cases, 50 cases were categorized as belonging to the moderate dengue group, while the remaining 20 cases were classified as severe dengue fever patients. All instances had symptoms of elevated body temperature. Approximately

48.57% of the patients exhibited symptoms of vomiting, while 57.14% had discomfort in the belly. Additionally, 64.28% of the cases presented with Petechiae, and 52.85% displayed melena. Out of the total sample size, 32 individuals (45.71%) exhibited hepatomegaly, 18 individuals (25.71%) presented with splenomegaly, and 21 individuals (30%) had hypotension. The observed sex distribution aligns with other research indicating a higher prevalence of dengue illness among males. In the present investigation, it was shown that fever was the most often reported symptom, while hepatomegaly was the most frequently detected sign. These findings align with other studies that have reported similar patterns. [19,20] In our research, the prevailing hemorrhagic manifestation seen was Petechiae, which contrasts with previous investigations where hematemesis was more often reported. [21,22]

In the dengue fever group, a majority of patients exhibited gall bladder wall edema (78.57%), ascites (57.14%), pleural effusion (51.42%), hepatomegaly (60%), splenomegaly (32.42%), and perinephric edema (15.71%). In the severe dengue group, all patients presented with gall bladder wall edema (100%) and ascites (100%), while a significant proportion showed pleural effusion (85%), hepatomegaly (60%), splenomegaly (40%), and perinephric edema (45%). The study conducted by Venkata S et al examined a cohort of 88 children, aged two to nine years, who tested positive for dengue using serological analysis. The research revealed that all patients had gallbladder wall thickening when ultrasonography was conducted during the timeframe of the second to seventh day after the beginning of fever. Subsequently, pleural effusion ensued. [23] A research conducted by Sudhir Sachar et al examined a cohort of 20 individuals diagnosed with dengue fever, as verified via platelet count and serologic assays. The ultrasonography (USG) findings revealed that all patients (100%) had a thicker gallbladder (GB) wall. Additionally, ascites was seen in 15 patients (75%), splenomegaly was detected in 8 patients (40%), and pleural effusion was identified in 14 patients (70%). [24]

All sonographic characteristics had a stronger correlation with the severe dengue group (p <0.001), with the exception of hepatomegaly. All sonographic characteristics demonstrated a statistically significant connection (P value < 0.001) with severe thrombocytopenia, with the exception of hepatomegaly. The research done by Santhosh et al. (year) included the examination of 96 dengue patients who tested positive for antibodies using ultrasonography. The study revealed that 64 patients, accounting for 66.7% of the total sample, exhibited gallbladder wall thickening. Additionally, 62 patients, representing

64.5% of the sample, presented with ascites. Pleural effusion was seen in 48 patients, constituting 50% of the sample. Hepatomegaly was detected in 17 patients, corresponding to 17.7% of the sample. Furthermore, splenomegaly was identified in 16 patients, accounting for 16.7% of the sample. Lastly, ultrasonography results were determined to be normal in 17 patients, representing 17.7% of the sample. The prevailing combination of observations consisted of edema in the gallbladder wall, ascites, and pleural effusion, which manifested across all age cohorts. In the study, it was shown that GB wall edema was present in 97.8% of patients with a platelet count below 40,000. This was followed by ascites, which was seen in 86.9% of patients, and pleural effusion, which was detected in 58.6% of patients. No sonographic abnormalities were seen in individuals with platelet counts over 150,000. [25]

Conclusion

Ultrasonographic observations such as gallbladder wall edema, pleural effusion, and ascites serve as significant supplementary indicators for the prompt detection of dengue illness in a patient exhibiting symptoms of fever and thrombocytopenia. Ultrasound plays a significant role in the assessment of illness severity. There was a notable positive correlation seen between the severity of thrombocytopenia and the presence of aberrant ultrasonography characteristics.

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