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**Original Research Article**

# Clinical, laboratory and ultrasonographic correlation in assessing severity and outcome in dengue infection

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## ABSTRACT

**Background:** Dengue infection is a major public health concern with clinical manifestations ranging from mild febrile illness to life-threatening shock syndrome. Early prediction of disease progression is vital for reducing morbidity and mortality. This study aimed to document the clinical profile of pediatric patients and evaluate the correlation of liver enzymes, viral serotypes, and abdominal ultrasonographic findings with the severity and outcome of dengue infection.
**Methods:** A prospective observational study was conducted over a period of 20 months involving 65 children (n=65) aged 1 month to 18 years admitted with confirmed dengue infection. Clinical features, liver function tests (AST, ALT, ALP), serotypes and abdominal ultrasound findings were analyzed. Statistical analysis was used to correlate these findings with disease severity.
**Results:** The majority of the study population were males (58.46%) with the highest incidence in the 1–5 year age group (35.38%). Fever was universally present, while hepatomegaly was observed in 20% of cases. DENV-2 was the predominant serotype (49.23%). Significant statistical differences were noted in Alkaline Phosphatase (ALP) and alanine transaminase (ALT) levels among different serotypes ($p<0.05$). Ultrasonography revealed warning signs such as ascites (36.9%) and gall bladder edema (30.7%). A statistically significant association was found between dengue severity and ultrasound warning signs ($p<0.0000001$), with an area under the ROC curve of 0.96.
**Conclusions:** Ultrasound warning signs are strong predictors of dengue severity in children. While liver enzyme levels vary significantly by serotype, abdominal ultrasonography serves as a highly sensitive and reliable non-invasive tool for the early prediction of severe dengue infection and timely management of pediatric dengue patients.

**Keywords:** Dengue infection, Liver enzymes, Viral Serotypes, Ultrasonography, Severity and outcome

## INTRODUCTION

Dengue infection is the most prevalent arthropod-borne viral illness in humans, caused by the dengue virus of the Flaviviridae family. It remains one of the most important tropical infectious diseases globally. In the past 50 years, the prevalence of dengue fever has increased 30-fold, with geographic expansion to new countries and a shift from urban to rural setting. An estimated 50-100 million dengue infections occur annually, with approximately 2.5 billion people living in endemic regions. While case fatality rates range from 1% to 5%, appropriate treatment can reduce this to less than 1%.[1] The 2009 World Health Organization criteria classify dengue into three levels of severity: dengue without warning signs, dengue with warning signs (abdominal pain, persistent vomiting, fluid accumulation, mucosal bleeding, lethargy, liver enlargement, increasing hematocrit with decreasing platelets), and severe dengue (severe plasma leakage, severe bleeding, or organ failure).[2] According to recent national guidelines for clinical management of Dengue fever in 2015, dengue cases are classified as mild, moderate and severe dengue based on symptoms as described in figure-1 and ultrasound findings considered

as warning signs are pleural effusion, ascites, gall bladder edema, hepatomegaly and splenomegaly.[3] Although the liver is not a major target organ, hepatic dysfunction is a well-recognized feature of dengue, which shows a spectrum of liver function tests ranging from mild transaminase elevation to severe injury with liver cell failure.[4-8] This dysfunction is more common in children with severe dengue and may result from direct viral effects on liver cells or dysregulated host immune responses.[9,10] Additionally, abdominal ultrasound (USG) can detect polyserositis features such as gallbladder thickening, ascites, and pleural effusion, which are often associated with severe disease.[11]

Despite the burden of disease, few studies have focused on predicting severity and outcome in children using a combination of clinical, biochemical, and radiological parameters.[12-14] This study was intended to predict the severity and outcome of dengue infection based on clinical parameters, liver enzymes (AST, ALT), viral serotypes, and abdominal ultrasound findings.

## METHODS

This study was conducted in the Department of Pediatrics at Kamineni Academy of Medical Sciences and Research Centre, a tertiary care hospital in Hyderabad, Telangana. A prospective observational study was conducted over a period of 20 months during July 2023 to December 2024 consisting of 65 children (n=65) aged 1 month to 18 years diagnosed with dengue infection (dengue NS1 or IgM positive). Informed consent was obtained from parents/guardians of all study subjects.

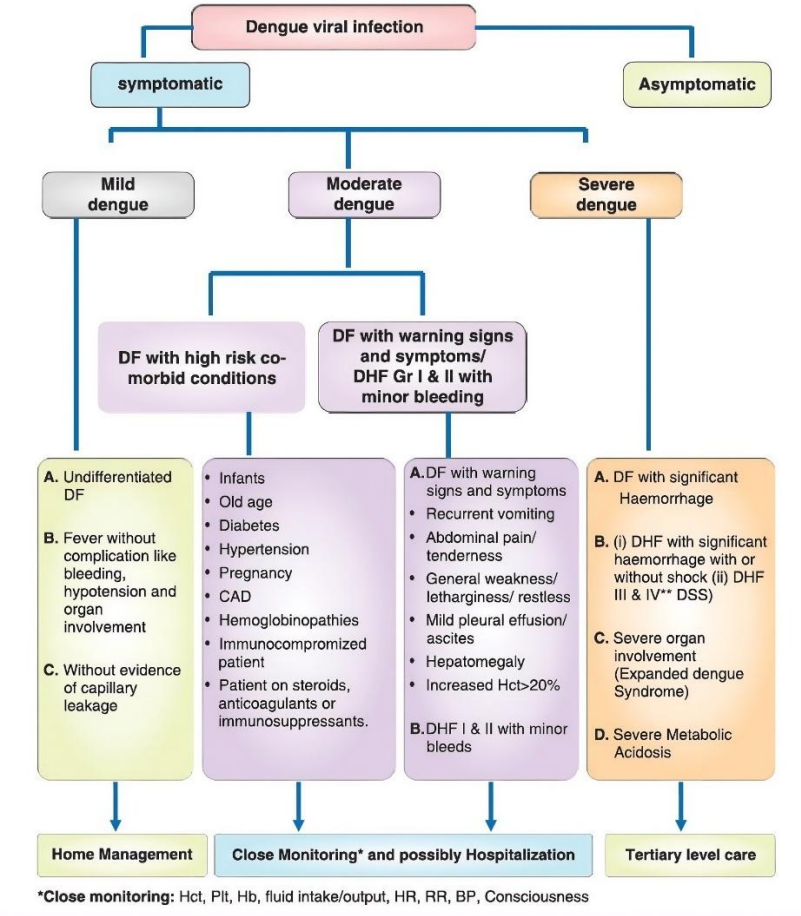


**Figure 1: Classification of dengue cases.**

### *Exclusion criteria*

Children with known case of liver disease, heart disease, on antitubercular drugs, anticonvulsants, long-term steroid therapy and on regular blood transfusions for Thalassemia are excluded from the study.

The study involved the assessment of clinical profiles, including presenting symptoms (fever, vomiting, pain abdomen, bleeding manifestations) and signs (rash, hepatomegaly, splenomegaly). Laboratory investigations included complete blood counts, dengue serology (NS1, IgM, IgG), and liver function tests (AST, ALT, ALP). Viral serotyping was performed to identify the circulating strains (DENV-1, DENV-2, DENV-3). Abdominal

ultrasonography was performed to identify findings such as hepatomegaly, splenomegaly, ascites, pleural effusion, and gallbladder (GB) edema. These findings were correlated with the severity of the disease based on WHO classification.

### *Statistical analysis*

The data was entered in Microsoft Excel spreadsheet. Data was analyzed using Microsoft Excel 2010 and Epi Info 7.2.0.

## RESULTS

### *Demographic profile*

The study included 65 children. The age distribution (Figure 2) showed a peak in the 1–5-year age group (35.38%), followed by 11–15 years (32.30%) and 6–10 years (29.23%). Infants (age <1 year) constituted 3% of the population. Males comprised 58.46% of the study group, while females accounted for 41.54%.

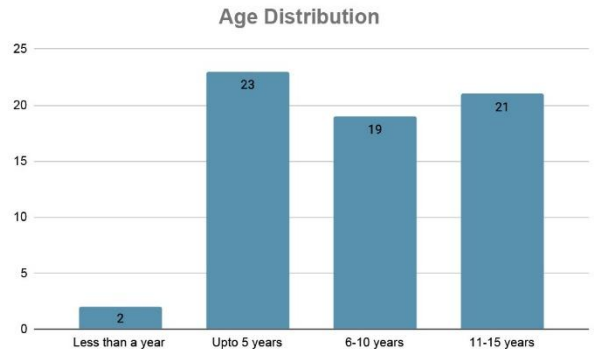


**Figure 2: Frequency of age wise distribution among dengue cases.**

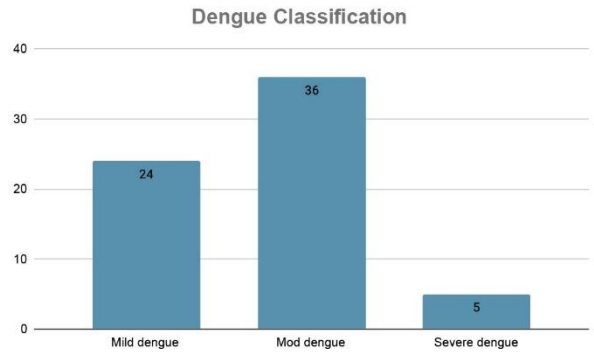


**Figure 3: Distribution of cases according to dengue classification.**

### *Clinical presentation*

Fever was the universal symptom, present in 100% of cases. Vomiting was the second most common symptom (30.77%), followed by cold (29.33%), abdominal pain (21.54%), melena (10.77%), and loose stools (9.23%). Less common symptoms included dark-colored urine, shortness of breath, headache, epistaxis, and seizures, each contributing less than 5%. On examination, rash was observed in 73.85% of patients. Hepatomegaly was detected clinically in 20% of cases, and splenomegaly in 7.69%.

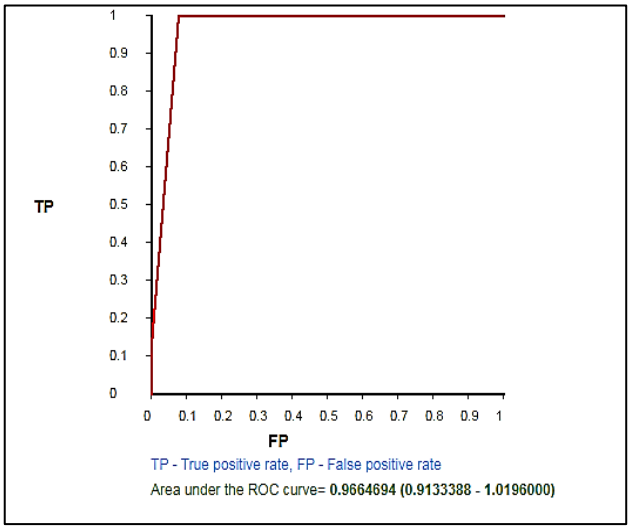


**Figure 4: ROC Curve showing the association between dengue severity and presence of warning signs.**

### *Dengue serology and serotyping*

NS1 antigen was positive in 69.23% of cases, IgM in 55.38%, and IgG in 41.54%. Serotyping data revealed that dengue serotype 2 was the predominant strain (49.23%), followed by serotype 3 (29.23%) and serotype 1 (21.54%).

### *Radiological findings*

USG revealed abnormalities in 60% of cases. The most common findings were ascites (36.9%) and gallbladder edema (30.76%). Hepatomegaly was noted in 20% and splenomegaly in 7.69% of cases on USG. Chest X-rays were normal in 89.23% of cases, while 9.23% showed bilateral pleural effusion.

### *Disease severity*

Based on WHO classification, figure 3 showing 55.38% of patients had moderate dengue, 36.92% had mild dengue, and 7.69% had severe dengue.

### *Correlations and associations*

*Liver enzymes vs serotypes*

There was a statistically significant difference in alkaline phosphatase (ALP) and alanine transaminase (ALT)

values across different serotypes (p=0.005 for ALP and p=0.00001 for ALT). The association between AST values and serotypes was not statistically significant (p=0.2).

*USG findings vs severity*

A strong correlation was observed between the severity of dengue and the presence of warning signs on ultrasound. Among patients with mild dengue, 100% had normal USG findings. In contrast, among those with moderate dengue, 34 out of 36 had abnormal USG findings. All 5 patients with severe dengue had abnormal USG findings. This association was statistically significant with a p value of <0.0000001.

***Treatment and outcome***

Platelet transfusion was required in 10.77% of cases. There was zero mortality in the study population; all 65 patients improved and were discharged.

**Table 1: Distribution of cases according to symptoms.**

| Symptom | Frequency | % |
|---|---|---|
| **Fever** | 65 | 100 |
| **Vomiting** | 20 | 30.77 |
| **Cold** | 19 | 29.23 |
| **Pain abdomen** | 14 | 21.54 |
| **Black colored stool** | 7 | 10.77 |
| **Myalgia** | 7 | 10.77 |
| **Loose stools** | 6 | 9.23 |
| **SOB** | 2 | 3.08 |
| **Red colored urine** | 1 | 1.54 |
| **Headache** | 2 | 3.08 |
| **Epistaxis** | 1 | 1.54 |
| **Seizure** | 1 | 1.54 |

**Table 2: Distribution of cases according to dengue serotypes.**

| Dengue serotype | Frequency | % |
|---|---|---|
| **DENV 1** | 14 | 21.54 |
| **DENV 2** | 32 | 49.23 |
| **DENV 3** | 19 | 29.23 |
| **Total (n=65)** | 65 | 100.00 |

**Table 3: Distribution of cases according to ultrasonography findings.**

| USG finding | Frequency | % |
|---|---|---|
| **Normal** | 26 | 40 |
| **Ascites** | 24 | 36.9 |
| **GB edema** | 20 | 30.76 |
| **Hepatomegaly** | 13 | 20 |
| **Pleural effusion** | 10 | 15.38 |
| **Splenomegaly** | 5 | 7.69 |
| **Hypoplastic left kidney** | 1 | 1.53 |

**Table 4: Association between AST, ALT and ALP with serotypes.**

| Dengue serotype | ALP | ALT | AST |
|---|---|---|---|
| **1** | 188.85±182.15 | 110.21±251.9 | 77.78±80.8 |
| **2** | 243.093±194.97 | 86.37±92.2 | 111.31±124.5 |
| **3** | 209.78±92.46 | 89± 111.9 | 122.78±124.6 |
| **P value** | 0.005** | 0.00001** | 0.2 |

**Statistically significant p value.

**Table 5: Association of USG findings with severity.**

| Severity of Dengue | USG findings | | Total | P value |
|---|---|---|---|---|
| | Normal | Abnormal (warning signs present) | | |
| **Mild** | 24 | 0 | 24 | Chi square: 57.13 Dof : 2 <0.000001 |
| **Moderate** | 2 | 34 | 36 | |
| **Severe** | 0 | 5 | 5 | |
| **Total** | 26 | 39 | 65 | |

## DISCUSSION

The present study provides a comprehensive clinical and laboratory profile of pediatric dengue patients. The mechanisms and pathogenesis of dengue hemorrhagic fever (DHF) are complex.[15,16] Proposed risk factors include virus virulence, immune enhancement, cytokine storm and host genetic factors.[17-22] The fluid loss due to increased capillary permeability leads to hypovolemic shock and multi-organ failure.[23]

***Demographics and clinical profile***

The finding that the 1–5-year age group was most affected (35.38%) contrasts with Chacko and Subramanyan, who reported a mean age of 7.87 years.[12] However, the male predominance (58.46%) is consistent with findings by Subbalaxmi et al (57.4%) and Sigera et al (66.3%).[13,24] Fever was the constant symptom (100%) across all studies compared. The study reported a significantly higher incidence of rash (73.85%) compared to Chacko et al and Subramanyan et al (5.48%) and Pooja et al (7%).[12,14]

***Ultrasound findings and severity***

USG abnormalities were prevalent, with ascites (36.9%) and GB edema (30.76%) being common. This is comparable to Subbalaxmi et al who reported ascites in 30.5%.[13] The rate of pleural effusion (15.38%) was slightly lower than the 21% reported by Subbalaxmi et al.[13] Previous studies by Santhosh et al have noted that sonographic features like thickened GB wall and

polyserositis strongly favor a diagnosis of severe dengue.[25] The ROC analysis (AUC 0.96) reinforces that USG warning signs are robust indicators for stratifying patients at risk.

### *Outcome*

The zero-mortality rate in the study reflects the efficacy of timely management protocols, which compares favorably to the 2.74% mortality reported by Chacko and Subramanyan et al.[12] This success is notable given the serious global impact of dengue, which is responsible for an estimated 20,000 deaths annually, predominantly in secondary dengue cases.

### *Limitations*

This was a single-centre study conducted at a tertiary care hospital, which may limit the generalizability of findings to the broader community or different geographic regions. The sample size was relatively small (n=65), and the exclusion of children with pre-existing comorbidities (e.g., liver or heart disease) means results cannot be extrapolated to these high-risk groups. Additionally, as there was no mortality in this cohort, the study could not identify predictors specifically associated with fatal outcomes. Future multicentric studies with larger sample sizes are recommended to validate these findings.

## CONCLUSION

This study comprehensively delineates the clinical profile and virological characteristics of pediatric dengue, identifying fever as a universal clinical feature and DENV-2 as the predominant serotype associated with significant hepatic dysfunction. This study validates abdominal ultrasonography not merely as a diagnostic tool, but as a definitive prognostic standard; the presence of warning signs-specifically gallbladder wall edema, ascites, and pleural effusion demonstrated a profound statistical correlation ($p<0.0000001$) with disease severity. These findings establish a crucial evidence base for prioritizing sonographic screening in pediatric protocols, demonstrating that using USG markers to guide early intervention is a viable strategy for reducing mortality, as evidenced by the 100% survival rate achieved in this cohort.

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*Ethical approval: The study was approved by the Institutional Ethics Committee*

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