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Original Research Article

Ultrasonographic Findings in Dengue Fever and Their Correlation with Clinical Disease Severity: A Hospital-Based Cross-Sectional Study

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Abstract

Background: Dengue is a major mosquito-borne viral illness with clinical manifestations ranging from uncomplicated febrile disease to severe dengue with plasma leakage, haemorrhage, and organ dysfunction. Ultrasonography (USG), being rapid, non-invasive, accessible, and radiation-free, can demonstrate early features of plasma leakage and visceral involvement, potentially assisting assessment of disease severity.

Aims & Objectives: To evaluate the spectrum of ultrasonographic findings in patients with dengue and determine their correlation with clinical dengue infection severity.

Material & Methods: This cross-sectional study was conducted in the Department of Radio-diagnosis, Basaveshwara Medical College and Hospital, Chitradurga, from October 2022 to September 2023. Hospitalized dengue patients referred from General Medicine were selected by simple random sampling and underwent ultrasonographic assessment for relevant abdominal and thoracic abnormalities. Statistical analysis was performed using Microsoft Excel and SPSS, with data presented in percentages.

Results: Among the participants, 54.3% had dengue with warning signs, 30.0% dengue without warning signs, and 15.7% severe dengue. Among severe dengue cases, perinephric fluid was observed in 45.5%, pleural effusion in 18.2%, and splenomegaly and pericholecystic fluid in 9.1% each. Among patients with warning signs, gallbladder wall thickening occurred in 31.6%, hepatomegaly in 28.9%, ascites in 15.8%, pleural effusion in 13.2%, and splenomegaly in 10.5%.

Conclusion: USG provides valuable supportive evidence of dengue severity. Gallbladder wall thickening emerged as the most sensitive finding, while pleural effusion was the most specific, supporting ultrasonography as a useful adjunct for timely severity assessment.

Keywords: Dengue fever; Ultrasonography; Severe dengue; Gallbladder wall thickening; Pleural effusion; Plasma leakage.

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Introduction

Dengue fever is an important mosquito-borne viral disease and remains a substantial public-health challenge, particularly in tropical and subtropical regions. Global estimates suggest approximately 390 million dengue infections annually, with South and Southeast Asia contributing a major proportion of the disease burden. [1,7] The continuing geographical expansion of dengue, including outbreaks beyond traditionally endemic regions, further emphasizes its growing epidemiological importance. [5,6] The thesis similarly highlights the considerable burden of dengue and its importance as a cause of morbidity and mortality from vector-borne disease. Dengue is caused by dengue virus, a member of the Flaviviridae family, with antigenically distinct serotypes capable of producing a broad spectrum of clinical manifestations. Circulation of multiple serotypes and secondary infection may contribute to more severe clinical presentations, making early recognition and appropriate assessment particularly important. [2-4] Clinical disease ranges from an

uncomplicated febrile illness to potentially life-threatening severe dengue characterized by plasma leakage, haemorrhage, shock, or organ dysfunction. [8] The WHO classification categorizes patients as dengue without warning signs, dengue with warning signs, and severe dengue, facilitating clinically meaningful risk stratification. [8-10] Warning features such as abdominal pain, persistent vomiting, fluid accumulation, mucosal bleeding, hepatomegaly, rising haematocrit, and declining platelet counts can indicate progression toward severe disease.

Increased vascular permeability is a central feature of severe dengue and may result in detectable fluid leakage and visceral abnormalities. Ultrasonography (USG) offers a rapid, non-invasive, widely available, radiation-free approach for demonstrating manifestations such as gallbladder wall thickening, ascites, pleural effusion, pericholecystic fluid, and hepatosplenomegaly. Consequently, incorporation of USG findings alongside clinical assessment may provide valuable supportive evidence for recognizing disease progression and stratifying severity. The present study therefore evaluates the spectrum of ultrasonographic findings in dengue and their correlation with clinical dengue infection severity, with the potential to strengthen timely assessment and appropriate clinical management.

Literature Review: Dengue infection represents a dynamic systemic illness with considerable variation in clinical presentation, ranging from self-limiting febrile disease to severe forms associated with haemorrhage, circulatory compromise and multiorgan involvement. Rare complications, including acute pancreatitis and neurological manifestations such as seizures, further illustrate the potential for significant organ dysfunction in severe dengue.[11] The disease has remained particularly important in South-East Asia, where favourable climatic conditions, vector abundance and sustained transmission contribute substantially to its public-health burden. [12,13]

Rigau-Pérez et al. described dengue haemorrhagic fever as a severe manifestation characterized predominantly by increased vascular permeability, haemoconcentration and plasma leakage. [14] Recognition of these pathophysiological alterations is clinically important because progression may occur rapidly during the critical phase. WHO recommendations consequently emphasize systematic assessment of warning signs, haemodynamic status, bleeding manifestations and evidence of organ involvement to facilitate timely identification and appropriate management of severe disease. [15] Difficulties encountered with earlier dengue classifications also encouraged development of a clinically oriented classification based on dengue with or without warning signs and severe dengue. [16] The parent study similarly emphasizes these classification-related limitations and the importance of assessing plasma-leakage manifestations. Ultrasonography has emerged as a valuable adjunct in this context. Venkata Sai et al. demonstrated its utility in identifying gallbladder wall thickening, pericholecystic fluid, ascites, pleural effusion and hepatosplenomegaly in dengue. [17] These findings reflect vascular leakage and visceral involvement and may therefore complement clinical assessment of disease severity. Accordingly, evaluating the spectrum of USG abnormalities and their relationship with clinical dengue severity provides a scientifically relevant approach for supporting earlier recognition and risk stratification of patients.

Aims & Objectives: The aim of this study is to-

To evaluate the spectrum of ultrasonographic findings in patients with dengue and determine their correlation with clinical dengue infection severity.

Methodology

Study Design: The present study was designed as a hospital-based cross-sectional study to evaluate the spectrum of ultrasonographic abnormalities in dengue fever and determine their relationship with clinical disease severity. It was conducted in the Department of Radio-diagnosis, Basaveshwara Medical College and Hospital, Chitradurga, from October 2022 to September 2023. Simple random sampling was employed for participant selection.

Study Type: This was an observational cross-sectional study, in which eligible hospitalized dengue patients underwent systematic clinical, laboratory and ultrasonographic assessment during the study period.

Study Population: The study population comprised 70 patients admitted through the Department of General Medicine with clinically and laboratory-supported dengue infection. The calculated sample size was 71 participants.

Inclusion and Exclusion Criteria

Inclusion Criteria: Patients presenting with acute febrile illness, thrombocytopenia and positive NS1 antigen were considered eligible for inclusion.

Exclusion Criteria: Patients with chronic liver disease, cholelithiasis, chronic renal failure, congestive cardiac failure or immune thrombocytopenic purpura (ITP) were excluded to minimize potential confounding of sonographic and laboratory findings.

Data Collection Methods: Data were recorded using a predesigned structured proforma incorporating sociodemographic characteristics,

clinical history, examination findings, complete haemogram, relevant biochemical investigations, dengue serology and ultrasonographic observations. Informed consent was obtained before enrolment.

Procedure: Eligible patients underwent ultrasonography of the abdomen, pelvis and chest. Abdominal examination was preferably performed after 4–6 hours of fasting. Pleural spaces were assessed through an intercostal approach. Gallbladder wall thickness >3 mm indicated oedema; liver size >15 cm and splenic size >12 cm were considered hepatomegaly and splenomegaly, respectively. USG findings—including gallbladder wall thickening, pericholecystic fluid, ascites, pleural effusion, perinephric fluid and hepatosplenomegaly—were correlated with clinical severity indicators.

Data Analysis: All collected data were entered into Microsoft Excel and analysed using SPSS version 20.0. Categorical variables were expressed as frequencies and percentages, while quantitative variables were summarized using mean and standard deviation. Chi-square, independent-samples t-test and ANOVA were applied as appropriate, with $p < 0.05$ considered statistically significant.

Observations & Results:

Demographic and Clinical Characteristics

Table 1: Demographic Characteristics of Study Participants (n = 70)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	10–20	22	31.4
	21–30	18	25.7
	31–40	13	18.6
	41–50	12	17.1
	>50	5	7.1
Gender	Male	37	52.9
	Female	33	47.1
Total		**70**	**100**
Mean age:	**29.7 ± 12.1 years**		

Statistically Significant at p < 0.05

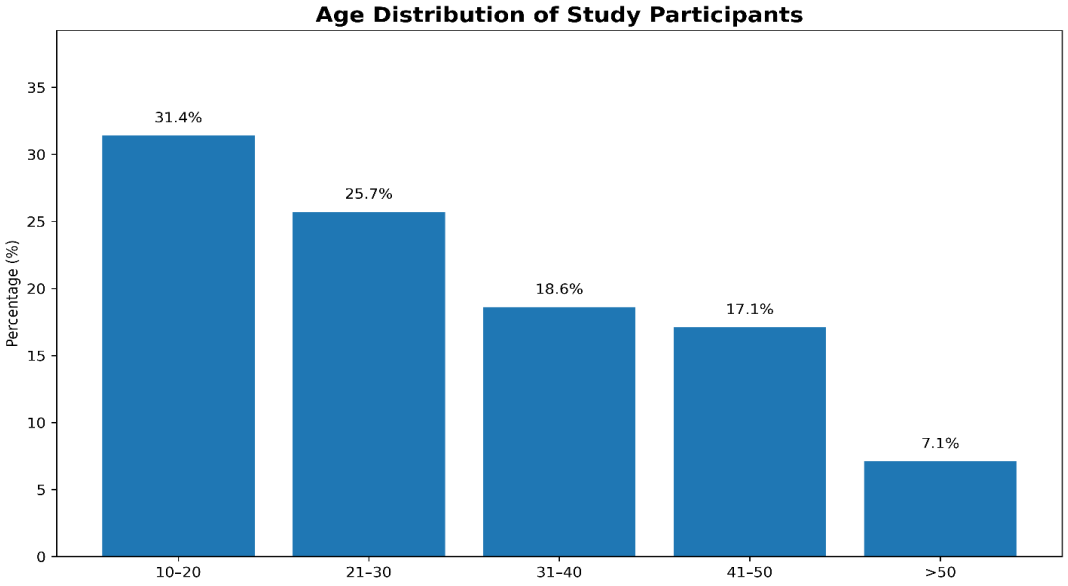

Figure 1: Age distribution of study participants

Interpretation: The study population demonstrated a relatively young demographic profile, with the largest proportion (31.4%) belonging to the 10–20-year age group, followed by 25.7% aged 21–30 years. The mean age was 29.7 ± 12.1 years. Male participants constituted 52.9%, while females represented 47.1%, indicating a nearly balanced gender distribution with slight male predominance. This demographic pattern provides a broad basis for assessing dengue-related ultrasonographic abnormalities across age groups.

Table 2: Distribution of Major Clinical Severity Indicators (n = 70)

Clinical Parameter	Present n (%)	Absent n (%)
Raised haematocrit	52 (74.3%)	18 (25.7%)
Fall in pulse pressure	27 (38.6%)	43 (61.4%)
Bleeding manifestations	37 (52.9%)	33 (47.1%)

Statistically Significant at $p < 0.05$

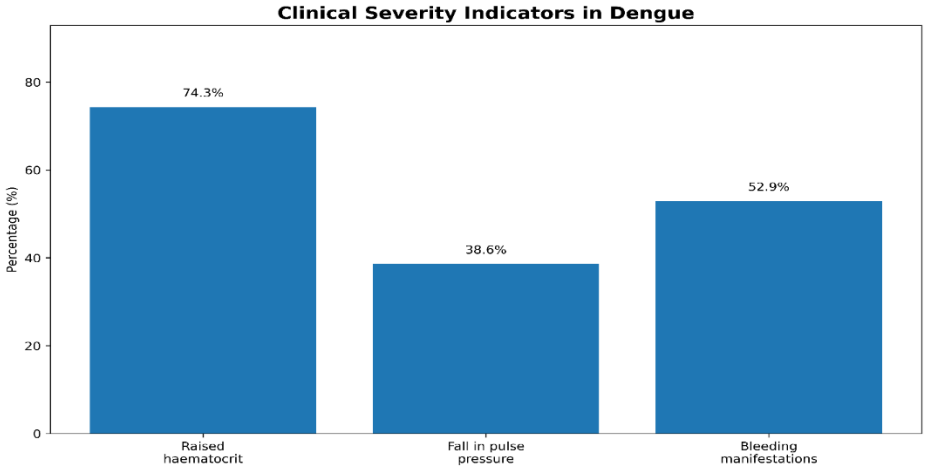

Figure 2: Clinical severity indicators in dengue

Interpretation: The Raised haematocrit was the most frequent clinical severity indicator, occurring in 74.3% of patients, suggesting that haemoconcentration was prominent in the study population. Bleeding manifestations were documented in 52.9%, whereas a fall in pulse pressure occurred in 38.6%. Collectively, these findings demonstrate substantial clinical evidence of vascular permeability and haemodynamic involvement among hospitalized dengue patients and provide clinically meaningful parameters for correlation with ultrasonographic manifestations of plasma leakage and disease severity.

Table 3: Clinical Classification of Dengue Fever (n = 70)

Clinical Classification	Frequency (n)	Percentage (%)
Dengue without warning signs	21	30
Dengue with warning signs	38	54.3
Severe dengue	11	15.7
Total	**70**	**100**

Statistically Significant at $p < 0.05$

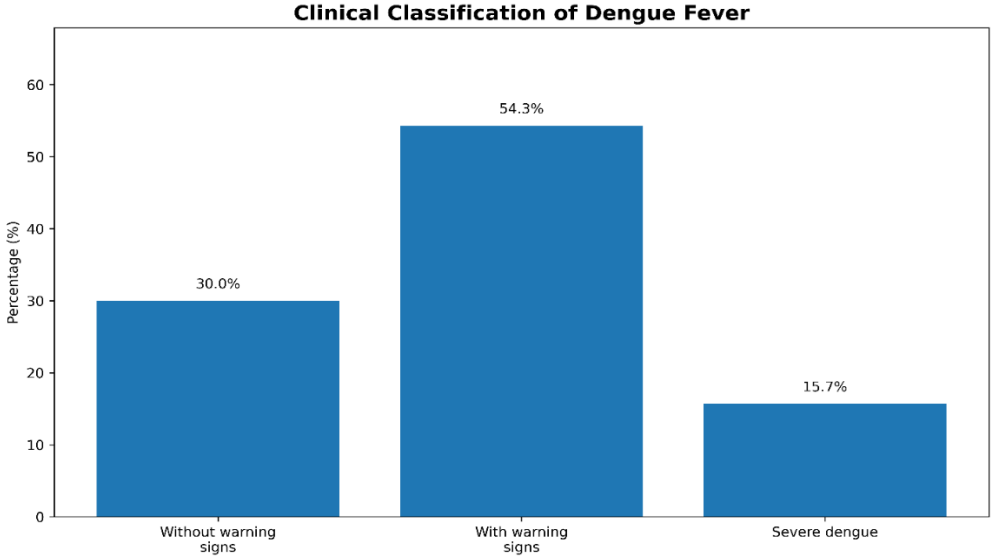

Figure 3: Clinical classification of dengue fever

Interpretation: More than half of the participants (54.3%) were classified as dengue with warning signs, representing the predominant clinical category. Dengue without warning signs accounted for 30.0%, while 15.7% fulfilled the classification for severe dengue. Thus, approximately seven out of ten hospitalized patients exhibited either warning signs or severe disease. This distribution is particularly relevant to the study objective because it permits meaningful evaluation of ultrasonographic abnormalities across progressively important clinical severity categories.

Table 4: Spectrum of Ultrasonographic Findings in Dengue Patients (n = 70)

USG Finding	Frequency (n)	Percentage (%)
Gallbladder wall thickening	20	**28.6**
Hepatomegaly	17	**24.3**
Ascites	10	**14.3**
Pleural effusion	7	**10**
Splenomegaly	7	**10**
Perinephric fluid	5	**7.1**
Normal findings	3	**4.3**
Pericholecystic fluid	1	**1.4**
Total	**70**	**100**

Statistically Significant at p < 0.05

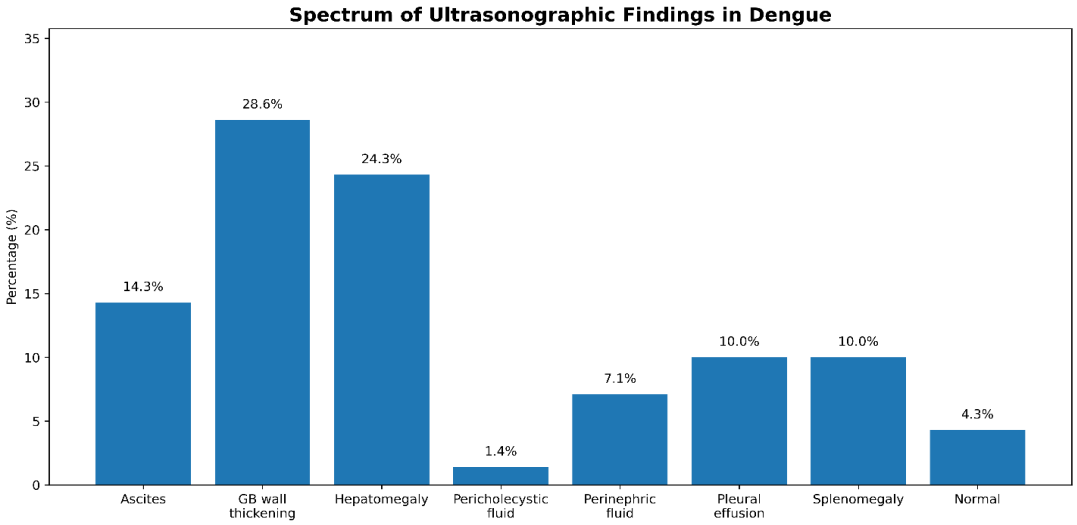

Figure 4: Spectrum of ultrasonographic findings in dengue

Interpretation: Gallbladder wall thickening was the predominant ultrasonographic abnormality, observed in 28.6% of participants, followed by hepatomegaly in 24.3% and ascites in 14.3%. Pleural effusion and splenomegaly were each present in 10.0%, while perinephric fluid occurred in 7.1%. Only 4.3% demonstrated normal ultrasonography. The high frequency of sonographic abnormalities supports the clinical utility of USG for identifying visceral involvement and manifestations related to plasma leakage in patients with dengue fever.

Table 5: Association of Ultrasonographic Findings with Clinical Dengue Severity (n = 70)

USG Finding	Dengue Without Warning Signs n=21	Dengue With Warning Signs n=38	Severe Dengue n=11	Chi-square (χ^2)	df	p-value
Ascites	2 (9.5%)	6 (15.8%)	2 (18.2%)	**50**	**14**	**<0.001***
Gallbladder wall thickening	8 (38.1%)	12 (31.6%)	0			
Hepatomegaly	6 (28.6%)	11 (28.9%)	0			
Pericholecystic fluid	0	0	1 (9.1%)			
Perinephric fluid	0	0	5 (45.5%)			
Pleural effusion	0	5 (13.2%)	2 (18.2%)			
Splenomegaly	2 (9.5%)	4 (10.5%)	1 (9.1%)			
Normal finding	3 (14.3%)	0	0			

Statistically Significant at p < 0.05

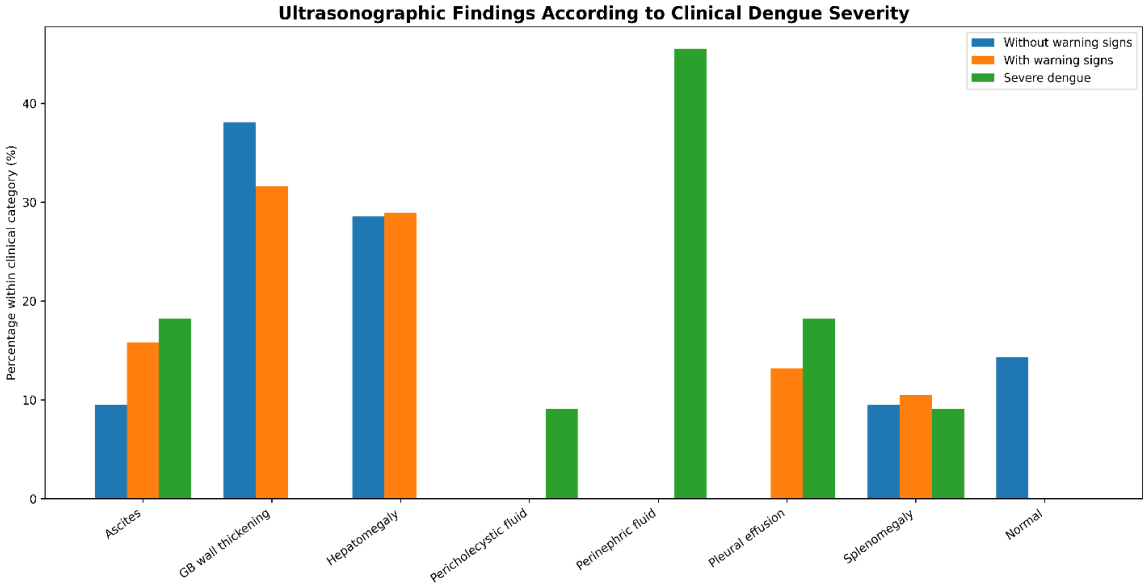

Figure 5: Ultrasonographic finding according to clinical dengue severity

Interpretation: Ultrasonographic findings demonstrated a highly significant association with clinical dengue severity (χ^2=50.0, df=14, p<0.001). Perinephric fluid was particularly prominent among severe dengue patients (45.5%), while pleural effusion occurred in 18.2%. Ascites increased from 9.5% in dengue without warning signs to 18.2% in severe dengue. Importantly, normal ultrasonography occurred only among patients without warning signs. These findings strongly support USG as a valuable adjunct for identifying severity-related changes in dengue infection.

The source thesis specifically concludes that ultrasonography is useful for identifying plasma-leakage manifestations and that USG findings correlate with clinical severity, particularly in dengue with warning signs and severe dengue.

Discussion

The present study demonstrates that ultrasonography provides clinically meaningful information in dengue fever by identifying manifestations of plasma leakage and visceral involvement across different grades of disease severity. Among the 70 participants, 54.3% had dengue with warning signs, 30.0% had dengue without warning signs, and 15.7% had severe dengue.

Raised haematocrit was observed in 74.3%, bleeding manifestations in 52.9%, and reduced pulse pressure in 38.6%, indicating substantial haemodynamic and vascular involvement within the study population. These clinical characteristics are consistent with established concepts of dengue pathophysiology, where increased capillary permeability, haemoconcentration and circulatory disturbances signify progression toward more severe disease. [10,21,22] Gallbladder wall thickening was the most frequent USG abnormality, occurring in 28.6% of patients, followed by hepatomegaly in 24.3% and ascites in 14.3%. Pleural effusion and splenomegaly were each detected in 10.0%, while perinephric fluid was present in 7.1%. These observations support the findings of Thulkar et al., who demonstrated characteristic sonographic evidence of fluid redistribution and visceral abnormalities in adults with advanced dengue haemorrhagic fever. [18] Such findings are biologically plausible because increased microvascular permeability permits fluid movement into pleural, peritoneal and perivisceral spaces. [19]

A particularly important observation was the significant relationship between sonographic abnormalities and clinical dengue severity (χ^2=50.0, df=14, p<0.001). Perinephric fluid was detected in 45.5% of severe dengue cases, while pleural effusion and ascites occurred in 18.2% each. Conversely, normal ultrasonography was confined to patients without warning signs. This pattern suggests that increasing sonographic evidence of plasma leakage parallels clinically important disease progression. The epidemiological importance of dengue in India and its substantial morbidity have been emphasized by Baruah and Dhariwal. [20] National and regional guidelines similarly advocate early identification of warning signs and plasma leakage to prevent deterioration. [19,22] In this context, the present findings reinforce ultrasonography as a rapid, non-invasive and readily repeatable adjunct to clinical and laboratory assessment. Its ability to demonstrate early fluid accumulation and organ involvement may strengthen severity stratification, guide closer monitoring and facilitate timely management of patients at risk of severe dengue.

Implications for Clinical Practice: The findings of this study highlight the practical value of ultrasonography as a supportive tool for assessing dengue severity. Its ability to demonstrate gallbladder wall thickening, hepatomegaly, ascites, pleural effusion, perinephric fluid and other manifestations of plasma leakage can complement routine clinical and laboratory evaluation. The significant association between USG abnormalities and clinical severity ($p<0.001$), particularly the prominence of perinephric fluid in severe dengue, indicates its potential contribution to risk stratification. As a rapid, non-invasive, radiation-free and repeatable investigation, USG can be particularly valuable for hospitalized patients requiring close monitoring. Incorporating focused ultrasonography alongside warning signs, haematocrit, platelet parameters and haemodynamic assessment may facilitate earlier recognition of evolving plasma leakage, support appropriate escalation of surveillance and assist timely clinical decision-making. Thus, judicious use of USG may strengthen comprehensive dengue assessment and contribute to more responsive, severity-oriented patient management.

Limitations: The present study has certain limitations that should be considered while interpreting its findings. The relatively small sample of 70 hospitalized patients and single-centre design may limit the generalizability of observations to broader populations. The cross-sectional nature of the study restricted evaluation of sequential changes in ultrasonographic findings throughout different phases of dengue illness. Additionally, ultrasonography is inherently operator-dependent, and subtle abnormalities may vary with examination technique and timing. The study primarily correlated selected sonographic manifestations with clinical severity; therefore, larger multicenter prospective studies incorporating serial USG examinations could further validate these findings and strengthen their clinical applicability.

Conclusion

The present study demonstrates that ultrasonography is a valuable, non-invasive adjunct for evaluating the spectrum and severity of dengue infection. A substantial proportion of patients exhibited sonographic evidence of plasma leakage and visceral involvement, with gallbladder wall thickening being the most frequent abnormality, followed by hepatomegaly and ascites. Importantly, ultrasonographic findings showed a highly significant association with clinical dengue severity ($\chi^2=50.0$, $p<0.001$). Perinephric fluid was particularly prominent in severe dengue, while pleural effusion and ascites also demonstrated greater representation with increasing clinical severity. Normal ultrasonography was confined to patients without warning signs, further emphasizing the relevance of abnormal findings in disease stratification. Thus, integrating focused ultrasonography with clinical examination, haematological parameters and established warning signs may facilitate earlier recognition of plasma leakage and evolving severe disease. Its accessibility, repeatability and absence of ionizing radiation make USG particularly suitable for serial assessment, supporting timely monitoring and appropriate management of patients with dengue fever.

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