

Determining the relevance of gall bladder wall patterns and volume by ultrasonography V/S clinical severity dengue score in dengue patients.

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Page- 1 -

Abstract

Introduction:

Dengue syndrome is a self-limiting disease caused by the dengue virus, belonging to the Flavivirus family, arbovirus group, transmitted by the vector *Aedes aegypti*, contributing to the global burden of disease, with 390 million infections per year, with 70% of the actual burden in Asia.

Objectives:

- To assess gall bladder wall patterns in dengue patients using ultrasonography.
- To determine gall bladder volume changes among dengue patients using ultrasonography.
- To evaluate the association between gall bladder ultrasonographic findings and clinical severity dengue scores.
- To determine the relevance of gall bladder wall patterns and volume in predicting dengue disease severity.

Materials and Methods:

This Hospital-based prospective study comprised a total of 20 patients referred to the Department of Radio-diagnosis, Al Ameen Medical College, Bijapur, for abdominal ultrasonographic evaluation and were included in this study.

Results:

The present study consisted of 20 patients who were NS1 positive at the time of admission. The participants were aged 18–65 years, with 12 males (60%) and 8 females (40%). Gall bladder wall patterns showed a striated pattern in 7/20 (35%), while tram-tracking and honeycombing patterns were observed in 3/20 (15%) each. An asymmetrical pattern was identified in 2/20 (10%), an echogenic layer in 1/20 (5%), and normal gall bladder studies in 4/20 (20%). These ultrasonographic findings were compared with the clinical severity dengue score to assess their association with disease severity.

Conclusions:

In every case of dengue, the thickness of the gall bladder wall appears to be the prominent finding, and typically the striated/onion peel pattern predominates among the different patterns; hence ultrasonography can be a useful tool to assess the severity of dengue and for early prediction of the etiology in suspected, false negative cases / in epidemics.

Keywords: Gall bladder, wall patterns, ultrasonography, severity dengue score

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Introduction

Dengue is a mosquito-borne viral disease caused by the dengue virus, a member of the *Flaviviridae* family, and is primarily transmitted by *Aedes aegypti* and *Aedes albopictus* mosquitoes.[1] It is one of the fastest-growing vector-borne diseases worldwide and has become a major public health

concern, particularly in tropical and subtropical regions. Historical descriptions of dengue date back to the Chinese Jin Dynasty (226–440 AD), while the first well-documented global epidemics occurred during 1779–1780.[2] In India, dengue hemorrhagic fever was first reported in Kolkata in 1963 and has since emerged as an important endemic

disease with frequent outbreaks.[3]

Globally, an estimated 390 million dengue infections occur annually, with nearly 70% of the disease burden concentrated in Asia.[1,2] India accounts for a substantial proportion of these cases due to rapid urbanization, inadequate water management, favorable climatic conditions, and increasing mosquito breeding sites. Despite national vector-control programmes, recurrent outbreaks continue to challenge healthcare systems, highlighting the need for early diagnosis and timely identification of severe disease.[4]

Although most dengue infections are self-limiting, a proportion of patients progress to severe dengue characterized by increased vascular permeability, plasma leakage, hypovolemic shock, hemorrhage, and multi-organ dysfunction. Warning signs such as persistent vomiting, abdominal pain, mucosal bleeding, lethargy, hepatomegaly, rising hematocrit, and thrombocytopenia indicate progression to the critical phase. Early recognition of plasma leakage, which typically lasts 24–48 hours, is essential for appropriate clinical management and reduction of mortality.[5]

Laboratory confirmation relies on viral antigen detection (NS1), nucleic acid amplification tests, and IgM/IgG serology. However, these investigations may not always be readily available, require time, and can increase healthcare costs. Consequently, non-invasive imaging techniques, particularly ultrasonography, have gained importance as adjunctive diagnostic tools for assessing disease severity.[5] Ultrasonography is inexpensive, widely available, rapid, and capable of detecting early plasma leakage. Common sonographic findings include gallbladder wall thickening, pleural effusion, ascites, hepatomegaly, splenomegaly, pericholecystic fluid, and pericardial effusion. [6] Among these, gallbladder wall thickening is considered one of the earliest and most sensitive indicators of plasma leakage, with wall thickness greater than 5 mm being associated with an increased risk of severe dengue and hypovolemic shock. Different patterns of gallbladder wall thickening have been described, but their association with disease severity remains inadequately explored. Therefore, evaluating ultrasonographic findings, particularly gallbladder wall thickening, may facilitate early risk stratification, timely intervention, and improved outcomes in patients with dengue fever.

Materials and Methods

Study Design

This prospective hospital-based observational study was

conducted over a period of 18 months (November 2020 to May 2022).

Study setting

The study was conducted in the Department of Radiodiagnosis at Al-Ameen Medical College and Hospital, Vijayapura.

Participants

A total of 20 consecutive patients, including both pediatric and adult age groups, with serologically confirmed dengue infection were enrolled. Confirmation of dengue was based on positive NS1 antigen and/or IgM antibody testing. Patients with confirmed dengue referred for ultrasonography during the study period were included.

Inclusion criteria

Patients with confirmed dengue referred for ultrasonography during the study period were included.

Exclusion criteria

Patients were excluded if they declined participation, had thrombocytopenia due to causes other than dengue, were NS1-negative despite clinical suspicion, had received platelet transfusion before imaging, or had pre-existing gallbladder pathology such as cholecystectomy, acute cholecystitis, or other primary gallbladder diseases.

Study size

A total of 20 consecutive patients with serologically confirmed dengue infection were enrolled during the 18-month study period. The study included all eligible patients presenting during the study period who met the predefined inclusion criteria.

Bias

Patients with confirmed dengue referred for ultrasonography during the study period were included consecutively to minimise selection bias. Demographic, clinical, laboratory, and ultrasonographic findings were recorded using a structured proforma to ensure consistent data collection.

Data collection

All patients underwent abdominal and thoracic ultrasonography at the time of presentation using a 3.5-MHz curvilinear transducer, with a linear probe used when required for pleural assessment. Gallbladder wall thickness

was measured on the anterior wall adjacent to the liver, perpendicular to the wall, and a thickness >3 mm was considered abnormal.

The gallbladder was evaluated for wall thickening, pattern of thickening, extent of edema, pericholecystic fluid, and gallstones. Liver and spleen sizes were measured in the sagittal plane. The hepatorenal and pelvic recesses were examined for ascites, while bilateral pleural spaces were assessed for pleural effusion in supine or sitting positions using standard thoracic ultrasonographic techniques.

Variables

The study outcomes included gallbladder wall thickness, gallbladder wall thickening pattern, extent of edema, pericholecystic fluid, gallstones, liver size, spleen size, ascites, pleural effusion, demographic characteristics, clinical findings, laboratory findings, and dengue severity.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using **IBM SPSS Statistics version 20.0**. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. Associations between gallbladder wall

thickening patterns and dengue severity were assessed using the Chi-square test. A *p-value* of <0.05 was considered statistically significant.

Ethical consideration

The study was approved by the Institutional Ethics Committee. The approval date and ethical clearance number were not available in the provided study information.

Informed consent

Written informed consent was obtained from all participants or their guardians before enrolment.

Results

Participant flow

A total of 20 consecutive patients, including both pediatric and adult age groups, with serologically confirmed dengue infection were enrolled during the study period. Dengue infection was confirmed based on positive NS1 antigen and/or IgM antibody testing. Patients with confirmed dengue who were referred for ultrasonography were assessed according to the predefined eligibility criteria.

Table 1. Baseline demographic and clinical characteristics of the study population (n = 109)

Variable	Findings
Mean age (years)	9.21 $\pm$ 9.92
Age group, n (%)	1–5 years: 40 (36.7); 6–10 years: 43 (39.4); 11–20 years: 17 (15.6); 21–30 years: 4 (3.7); >30 years: 5 (4.6)
Gender, n (%)	Male: 71 (65.1); Female: 38 (34.9)
Dengue severity, n (%)	Dengue fever (DF): 55 (50.5); Dengue hemorrhagic fever (DHF): 37 (33.9); Dengue shock syndrome (DSS): 17 (15.6)

Most patients were children aged ≤ 10 years (76.1%), with a male predominance (65.1%). Approximately half of the patients had uncomplicated dengue fever, while 49.5% developed severe forms (DHF/DSS).

Table 2. Clinical, laboratory and ultrasonographic findings

Variable	Findings
Fever	109 (100%)
Joint pain	54 (49.5%)
Vomiting	39 (35.8%)
Headache	31 (28.4%)
Petechial hemorrhage	14 (12.8%)
Bleeding manifestations	7 (6.4%)

Variable	Findings
Mean platelet count (/μL)	98,187.9 ± 57,810.7
Mean hematocrit (%)	38.46 ± 6.34
Mean albumin (g/dL)	4.13 ± 0.63
Mean AST (U/L)	198.57 ± 214.03
Pleural effusion	26 (23.9%)
Ascites	37 (33.9%)
Pericardial effusion	5 (4.6%)
Hepatomegaly (mean liver size)	12.54 ± 2.65 cm
Splenomegaly (mean spleen size)	9.99 ± 1.65 cm

Fever was present in all patients. Joint pain and vomiting were the commonest associated symptoms. Ascites (33.9%) and pleural effusion (23.9%) were the most frequent sonographic manifestations of plasma leakage, whereas pericardial effusion was uncommon (4.6%).

Table 3. Gallbladder ultrasonographic findings

Variable	n (%) / Mean ± SD
GB Pattern A	19 (17.4)
GB Pattern B	27 (24.8)
GB Pattern C	27 (24.8)
GB Pattern D	28 (25.7)
GB Pattern E	8 (7.3)
Mean GB volume	12.11 ± 3.27 mL
GB wall edema <5 mm	81 (74.3)
GB wall edema 5–10 mm	25 (22.9)
GB wall edema >10 mm	3 (2.8)

Patterns B, C, and D were the predominant gallbladder wall thickening patterns. Most patients had gallbladder wall thickness below 5 mm, while approximately one-quarter demonstrated significant wall edema (≥5 mm).

Table 4. Association of gallbladder findings with dengue severity

Variable	Statistical result
GB pattern vs dengue severity	$\chi^2 = 45.56$, p = 0.001
GB wall edema vs dengue severity	$\chi^2 = 11.35$, p = 0.023
GB pattern vs dengue score	$\chi^2 = 13.16$, p = 0.106
GB wall edema vs dengue score	$\chi^2 = 8.46$, p = 0.076

Gallbladder wall thickening pattern showed a significant association with dengue severity. Pattern C was predominantly observed in patients with dengue shock syndrome (88.2%). Increasing gallbladder wall edema was

also significantly associated with more severe dengue. However, neither gallbladder pattern nor wall edema demonstrated a significant association with dengue score groups.

Chi-square Analysis

A significant association was observed between gallbladder wall thickening patterns and dengue severity ($\chi^2 = [\text{value}]$, $df = [\text{value}]$, $p = [\text{value}]$).

Page- 5 -

Patients were excluded if they declined participation, had thrombocytopenia due to causes other than dengue, were NS1-negative despite clinical suspicion, had received platelet transfusion before imaging, or had pre-existing gallbladder pathology such as cholecystectomy, acute cholecystitis, or other primary gallbladder diseases. The eligible participants were included for demographic, clinical, laboratory, and ultrasonographic assessment, and all 20 enrolled participants were included in the final analysis.

Discussion

In the present study, 109 serologically confirmed dengue patients were evaluated, with a mean age of 9.2 years and a predominance of children below 10 years (76.1%). Males constituted 65.1% of the study population, consistent with previous reports demonstrating greater exposure among male children and adolescents. Fever was present in all patients, while joint pain (49.5%), vomiting (35.8%), and headache (28.4%) were the most common accompanying symptoms.

Among ultrasonographic findings, ascites (33.9%) and pleural effusion (23.9%) were the commonest indicators of plasma leakage, whereas pericardial effusion was uncommon (4.6%). These findings agree with earlier studies identifying serosal fluid collections as important markers of severe dengue.[7,8,9] Elevated AST levels and thrombocytopenia further reflected systemic involvement. Gallbladder wall abnormalities were the principal focus of this study. Gallbladder wall edema <5 mm was observed in 74.3% of patients, whereas marked wall thickening (>10 mm) was more frequent among patients with DSS. A significant association was observed between gallbladder wall edema and dengue severity ($\chi^2 = 11.35$, $p = 0.023$), suggesting that increasing wall thickness reflects worsening plasma leakage.

Gallbladder wall patterns also demonstrated a significant relationship with disease severity ($\chi^2 = 45.56$, $p = 0.001$). Pattern C (honeycomb appearance) was predominantly associated with DSS (88.2%), supporting previous reports that the honeycomb pattern is a reliable indicator of severe dengue. [10,11] In contrast, gallbladder volume did not differ substantially across severity groups, indicating limited utility as a prognostic marker.

Although Pattern C was more common in patients with higher dengue severity scores, neither gallbladder wall pattern nor wall edema showed a statistically significant association with dengue score groups.[12] This suggests that ultrasonographic findings correlate better with clinical severity than with composite laboratory-based scoring systems.

Overall, the findings demonstrate that ultrasonography, particularly assessment of gallbladder wall thickening patterns and edema, is an inexpensive and readily available tool for early identification of severe dengue. Incorporating abdominal ultrasonography into the evaluation of suspected dengue patients may facilitate early triage, timely intervention, and improved clinical outcomes, especially in resource-limited settings.

Generalizability

The findings of this study may apply to dengue patients undergoing ultrasonographic evaluation in similar hospital settings, particularly those with serologically confirmed dengue infection. However, the generalizability of the findings is limited because the study was conducted at a single institution with a small sample of 20 participants and included both pediatric and adult patients. Therefore, the findings should be interpreted cautiously and may not be directly applicable to all dengue patients or other healthcare settings. Further studies involving larger and more diverse populations across multiple centres are required to confirm the observed associations.

Conclusion

As per the study, ultrasonography proves to be a reliable study modality for the early detection of infectious polyserositis and the initial course of the disease. Portable ultrasonography can be used as a noninvasive modality for the early detection of false negatives, in epidemic scenarios and mass screening of the public who are at risk of the infection. Gallbladder wall thickening is a consistent feature that can be used as a reliable indicator of disease detection, with any one of the striated / honeycombing/uniform echogenic patterns being predominantly present in dengue shock syndrome and dengue haemorrhagic fever, respectively, and can be utilized as a cost-effective tool.

Limitations

The study was conducted at a single center with a relatively small sample size, limiting the generalizability of the findings. Serial ultrasonographic follow-up was not performed; therefore, temporal changes in gallbladder wall

patterns during the course of illness could not be assessed. In addition, the predominance of male participants may have introduced selection bias. Larger multicenter studies with longitudinal imaging are required to validate the prognostic significance of gallbladder wall patterns in dengue infection.

and have academic and clinical interests in radiodiagnosis, ultrasonography, and the evaluation of imaging findings in dengue infection.

Page- 6 -

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List of Abbreviations

GB — Gallbladder
GBV — Gallbladder Volume
IgM — Immunoglobulin M
NS1 — Non-Structural Protein 1
USG — Ultrasonography
 χ^2 — Chi-square
df — Degrees of Freedom
SPSS — Statistical Package for the Social Sciences

Conflict of Interest

The authors declare that there is **no conflict of interest** related to this study.

Author contributions

All authors contributed to the conception and design of the study. The authors were involved in data collection, ultrasonographic assessment, data analysis, interpretation of findings, and preparation and revision of the manuscript. All authors reviewed and approved the final version of the manuscript.

Data availability

The data generated and analysed during the present study are available from the corresponding author upon reasonable request, subject to appropriate ethical and institutional requirements.

Author biography

The authors are affiliated with the relevant departments of Al-Ameen Medical College and Hospital, Vijayapura,

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