Original Article

DOI: 10.17354/ijss/2016/12

Role of Ultrasound in the Assessment of Dengue Fever

K S Vedaraju[1], K R Vijay Kumar[1], T V Vijayaraghavachari[2]

[1]Associate Professor, Department of Radio-Diagnosis, Bangalore Medical College and Research Institute, Bengaluru, Karnataka, India, [2]Post-graduate Student, Department of Radio-Diagnosis, Bangalore Medical College and Research Institute, Bengaluru, Karnataka, India

Abstract

Background: Dengue fever (DF) is caused by a single-stranded RNA virus of Flaviviridae transmitted by mosquitoes. The incidence of DF has increased 30-fold in the last four decades, and more than half the world's population are now threatened with infection from dengue virus.

Objective: The purpose of our study was to describe sonographic findings and the role of ultrasonography (USG) in the assessment of patients with DF, and its complications and to find out whether ultrasound is an adjunct to clinical and lab profile in the diagnosis of DF.

Materials and Methods: 102 patients who were serologically diagnosed as having DF between July and September 2015 were referred for ultrasound scanning of the abdomen and thorax, and the findings were analyzed. The various ultrasound features were expressed as percentages. Association of various sonological findings with different age groups or platelet count was assessed through Chi-square test of statistical significance. $P \leq 0.05$ was considered for statistical significance.

Results: Out of the 102 patients, 85 had gall bladder (GB) wall thickening (83.3%), 55 had ascites (53.9%), 28 had bilateral pleural effusion (27.4%), 21 had only right pleural effusion (20.6%), 12 had only left pleural effusion (11.7%), 34 had hepatomegaly (33.3%), 30 had splenomegaly (29.4%), 2 had pericardial effusion (1.9%), and 3 had no abnormal ultrasound findings (2.9%). The sonographic abnormalities, including GB wall thickening, ascites, pleural effusion, hepatomegaly, and splenomegaly, were significantly higher in patients with significantly decreased platelet count ($P < 0.05$).

Conclusion: USG is an important accessory tool for the early diagnosis of plasma leakage signs and for prediction of the disease severity, identifying mild and severe cases of dengue hemorrhagic fever, besides contributing in the differential diagnosis with other causes of febrile disease.

Key words: Complications, Dengue, Ultrasonography

INTRODUCTION

Dengue fever (DF) is caused by a single-stranded RNA virus of flaviviridae transmitted by mosquitoes.[1] DF is widely distributed in many countries in Southeast Asia, Central and South America, and the Western Pacific regions.[2] The incidence of DF has increased 30-fold in the last four decades, and more than half the world's population are now threatened with infection from dengue virus (DEN).[3]

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www.ijss-sn.com

Month of Submission : 11-2015
Month of Peer Review : 12-2015
Month of Acceptance : 01-2016
Month of Publishing : 01-2016

The purpose of our study was to describe sonographic findings and the role of ultrasonography (USG) in the assessment of patients with DF, and its complications and to find out whether ultrasound is an adjunct to clinical and lab profile in the diagnosis of DF.

MATERIALS AND METHODS

All ultrasound examinations were performed with Siemens Antares and Philips IU 22 machines, using 3.5-5 MHz probes. Abdominal scanning is done after 6 h of fasting to allow better distension of gall bladder (GB). GB wall thickening is measured by placing the calipers between the two layers of the anterior wall. Thoracic scanning is done in either sitting or supine posture. Both the pleural spaces are evaluated through an intercostal approach. Pericardial space is also evaluated for

Corresponding Author: Dr. T V Vijayaraghavachari, No 42/1, I Floor, K. No 4th Street, Narayana Pillai Street Cross, Shivaji Nagar, Bengaluru - 560 072, Karnataka, India. Phone: +91-8861125627. E-mail: chari.vijay89@gmail.com

effusion subcostally. In all the patients, serological tests for dengue will be performed. The serological investigations for dengue including non-structural protein-1 Ag test and dengue immunoglobulin M/immunoglobulin G test were performed to confirm the diagnosis.

102 patients (54 males and 48 females) who were serologically diagnosed as having DF between July and September 2015 were referred for ultrasound scanning of the abdomen and thorax, and the findings were analyzed.

RESULTS (TABLES 1-3)

Out of the 102 patients, 85 had GB wall thickening (83.3%) (Figures 1 and 2), 55 had ascites (53.9%) (Figure 3), 28 had bilateral pleural effusion (27.4%), 21 had only right pleural effusion (20.6%) (Figure 4), 12 had only left pleural effusion (11.7%), 55 had ascites (53.9%) (Figure 5), 34 had hepatomegaly (33.3%), 30 had splenomegaly (29.4%), 2 had pericardial effusion (1.9%), and 3 had no abnormal ultrasound findings (2.9%).

In our study, DF was most commonly seen in the age group of 20-39 years (48.0%).

GB wall thickening was the most common finding noted in 85 patients (83.3%), followed by pleural effusion in 61 patients (59.8%), and ascites in 55 patients (53.9%). The least common sonological finding was pericardial effusion (1.9%).

In patients with pleural effusion, bilateral (27.4%) and right (20.6%) pleural effusion were more common than left sided pleural effusion (11.7%).

Ascites was more common in 0-19 years age group (90.3%), while GB wall thickening was more common in the 20-39 years age group (87.7 %) and >40 years age group (86.4%).

Table 1: Incidence of different sonographic findings in DF

USG findings	Number of patients	Percentage
Gall bladder wall thickening	85	83.3
Ascites	55	53.9
Pleural effusion		
Bilateral	28	27.4
Right	21	20.6
Left	12	11.7
Hepatomegaly	34	33.3
Splenomegaly	30	29.4
Pericardial effusion	2	1.9
Normal	3	2.9

Total number of cases=102. DF: Dengue fever, USG: Ultrasonography

Table 2: Incidence of USG findings in relation to different age groups

USG findings	0-19 years	20-39 years	>40 years
Total	31	49	22
Gall bladder wall thickening	23	43	19
Ascites	28	19	8
Pleural effusion	24	28	9
Hepatomegaly	6	23	5
Splenomegaly	6	16	8
Pericardial effusion	2	0	0
Normal	1	2	0

USG: Ultrasonography

Table 3: Correlation of USG findings with platelet count

USG findings	<40,000	40,000-80,000	80,000-150,000	>150,000
Total	54	33	12	1
Gall bladder wall thickening	53	29	3	0
Ascites	34	18	3	0
Pleural effusion	34	20	7	0
Hepatomegaly	18	10	6	0
Splenomegaly	20	5	5	0
Pericardial effusion	2	0	0	0
Normal	0	0	0	3

USG: Ultrasonography

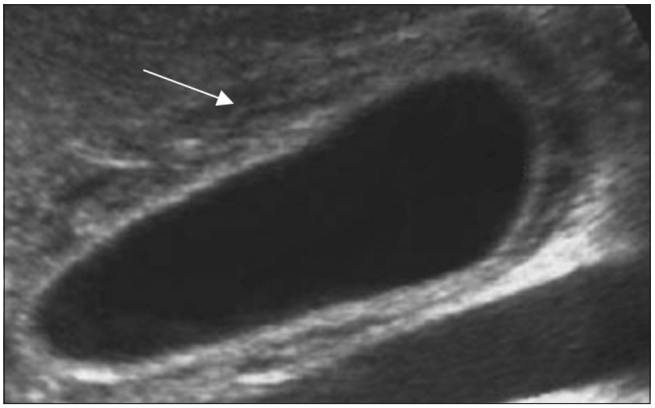

Figure 1: A 22 years male patient with dengue fever, ultrasound shows thickened and edematous gall bladder wall (arrow)

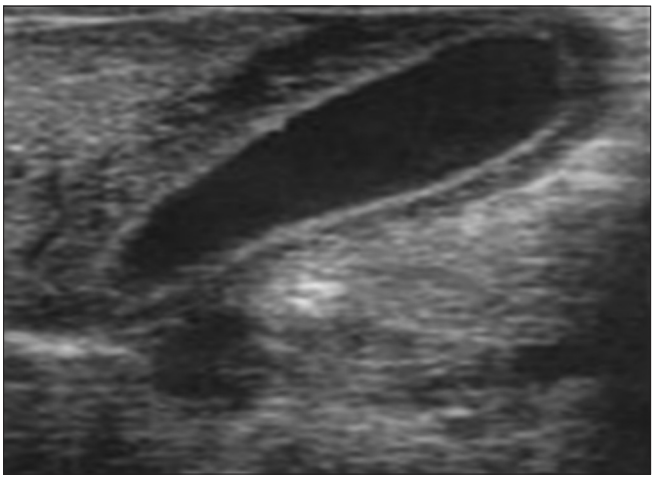

Figure 2: A 47 years female patient with dengue fever, ultrasound shows thickened and edematous gall bladder wall (arrow)

GB wall thickening was seen in most of the patients whose platelet count was <40,000 (98.1%). Ascites (62.9%) and pleural effusion (62.9%) were the other common findings seen in patients whose platelet count was <40,000.

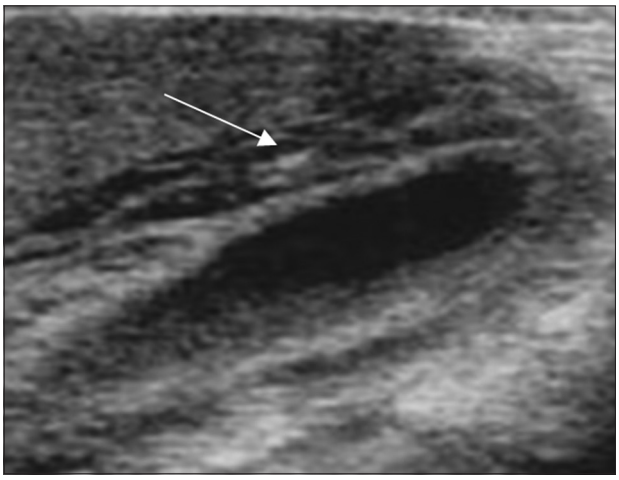

Figure 3: An 11-year-old male child, with dengue fever showing thickened and edematous gall bladder wall (arrow)

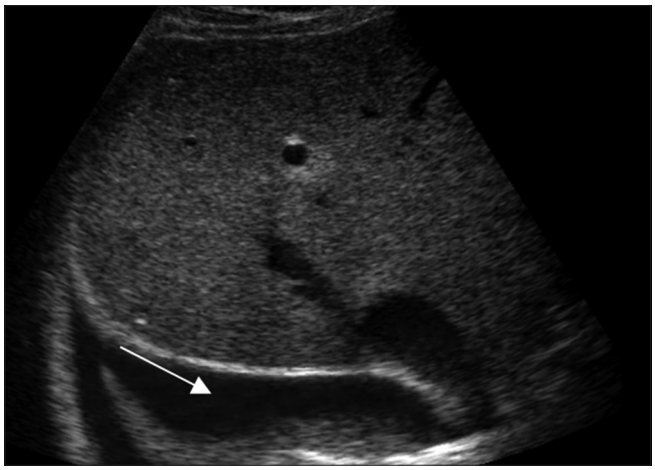

Figure 4: A 42-year-old male patient with dengue fever, ultrasound shows moderate right pleural effusion (arrow)

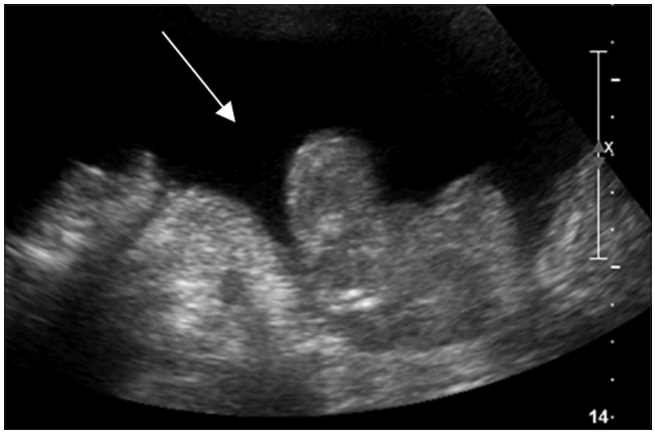

Figure 5: A 17-year-old female patient with dengue fever, ultrasound shows minimal to moderate free fluid (arrow) in the peritoneal cavity with surrounding bowel loops

In patients with platelet count of 40,000-80,000, GB thickening is most common finding (87.8%), followed by pleural effusion (60.6%).

In patients whose platelet count was 80,000-150,000, pleural effusion (58.3%) was more common than GB wall thickening (25%).

In three patients with platelet count more than 150,000, no sonological abnormality was detected.

DISCUSSION

Dengue is the most rapidly spreading mosquito-borne viral disease in the world. In the last 50 years, incidence has increased 30-fold with increasing expansion to new countries and in the present decade, from urban to the population.

An estimated 50 million dengue infections occur annually, and approximately 2.5 billion people live in dengue-endemic countries.[4]

DEN is a single-stranded RNA virus with four distinct serotypes (DEN-1 to -4). These serotypes of the DEN belong to the genus Flavivirus, family Flaviviridae. Among them, genotypes of DEN-2 and DEN-3 are frequently associated with severe disease accompanying secondary dengue infections.[5-7]

The various serotypes of the DEN are transmitted to humans through the infected *Aedes* mosquitoes, principally *Aedes aegypti*, widely distributed throughout tropical and sub-tropical countries. Dengue transmission also occurs through *Aedes* albopictus, *Aedes polynesiensis,* and several species of the *Aedes scutellaris* complex. Each species has a particular ecology and geographical distribution.[8]

After an incubation period of 4-10 days, the infection can produce a wide spectrum of illness, although most infections are asymptomatic or subclinical infections. Primary infection is thought to induce lifelong immunity to the infecting serotype.[9] Individuals suffering an infection are protected from illness with a different serotype within 2-3 months of the primary infection but with no long-term cross-protective immunity.

Clinically dengue manifests with sudden onset of high fever with chills, muscle and joint pain, intense headache, retro-orbital pain, and backache. Fever usually lasts for about 5 days, but rarely for more than 7 days.[10] Recovery is usually complete by 7-10 days. A small proportion of persons who have previously been infected by one dengue serotype develop bleeding on infection with another dengue serotype. This is termed dengue hemorrhagic fever (DHF).

DHF causes endothelial leakage which results in hemoconcentration and serous effusions and can lead to circulatory collapse. This can lead to dengue shock syndrome, which poses a greater fatality risk than bleeding alone.[11,12]

Leukopenia is observed near the end of the febrile phase of illness. Lymphocytosis, with atypical lymphocytes, usually develops before defervescence or shock. Patients with dengue have significantly lower total white blood cell and platelet counts than patients with other febrile illnesses in dengue-endemic populations.[13]

The ultrasound findings in DF include GB wall thickening, pericholecystic fluid, minimal ascites, pleural effusion, pericardial effusion, and hepatosplenomegaly.[14]

In a similar study conducted by Venkata Sai *et al.*, GB wall thickening was the most common finding (100%), followed by pleural effusion (93.1%) and ascites (53.2%).[14]

In a study conducted by Santhosh *et al.* (2014), out of 96 sero-positive dengue cases, 66.7% patients showed edematous GB wall thickening, 64.5% patients showed ascites and 50% patients had pleural effusion.[15]

In our study, GB wall thickening was the most common finding (83.3%), followed by pleural effusion (59.8%), and ascites (53.9%). Furthermore, GB wall thickening, ascites, and pleural effusion were more common in patients with platelet count less 80,000. Thus, severity of the disease, which is usually assessed by clinical features and platelet count, can also be assessed by sonography.

DF is typically a self-limiting illness with a mortality rate of <1%. With treatment, DHF has a mortality rate of 2-5%. Dengue hemorrhagic fever has a mortality rate as high as 50% without treatment. Survivors usually recover without sequelae and develop immunity to the infecting serotype.

CONCLUSION

USG is a relevant and important ancillary tool for the early diagnosis of plasma leakage signs and for prediction of the disease severity, identifying mild and severe cases of DHF, and contributing in the differential diagnosis with other causes of febrile disease.

Furthermore, diagnosis can be made early in the course of disease compared with other modes of diagnosis. During an epidemic of dengue, ultrasound findings of GB wall thickening with or without polyserositis in a febrile patient should suggest the possibility of DF/DHF.

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How to cite this article: Vedaraju KS, Kumar KRV, Vijayaraghavachari TV. Role of Ultrasound in the Assessment of Dengue Fever. Int J Sci Stud 2016;3(10):59-62.

Source of Support: Nil, **Conflict of Interest:** None declared.