

Spectrum and Frequency of Imaging Findings in Dengue Fever

DURR-E-SHAHWAR HAYAT¹, ANUM SULTAN¹, ZEBA ADEEL¹, SAHAR FATIMA², MUHAMMAD ALI¹, BHESHAM KUMAR¹

¹Resident, Department of Radiology, Dr Ziauddin University Hospital, Karachi city, Sindh, Pakistan

¹Senior Registrar, Department of Radiology, Dr Ziauddin University Hospital, Karachi city, Sindh, Pakistan

¹Registrar, Department of Radiology, Dr Ziauddin University Hospital, Karachi city, Sindh, Pakistan

²Department of Medicine, Flinders Medical Centre, SA, Australia

¹Associate Professor of Radiology, Department of Radiology, Dr Ziauddin University Hospital, Karachi city, Sindh, Pakistan

¹Assistant Professor Radiology, Department of Radiology, Dr Ziauddin University Hospital, Karachi city, Sindh, Pakistan

Correspondence to: Dr. Durr-e-Shahwar Hayat, Email ID: hayatshahwar@gmail.com, Mobile No.: +92 332 3735054

ABSTRACT

Objective: The dengue fever is the infectious disease that is caused by the bite of species *Aedes aegypti* or *Aedes albopictus*. The dengue outbreak is a periodic major health issue in Pakistan with the recurrence of the disease reported every year. The purpose of this study is to evaluate the spectrum and frequency of radiological findings in dengue fever with a positive serological test.

Materials and Methods: A retrospective analysis of all patients showing positive findings on different imaging modalities was included. Of the total 390 patients, 171 underwent different radiological imaging. The male to female ratio was 2.1:1, with a mean age of 35.9 years. Frequency of radiological findings was evaluated using chest and abdominal sonography as the initial diagnostic modalities. Cerebral haemorrhage and encephalitis were evaluated using CT and MRI contrast studies. Age distribution and frequency of radiological findings were evaluated.

Results: The most common finding was mild ascites recorded in 72 patients followed by mild right-sided pleural effusion and edematous gall bladder wall thickening. Splenomegaly was a more frequent finding compared to hepatomegaly. The newly encountered finding of renal parenchymal changes was recorded in 7 patients. Only two patients had cerebral encephalitis and haemorrhage. Liver abscess was recorded in 1 patient.

Conclusion: In a nutshell, the patients with the clinical presentation of dengue infection and radiological findings of ascites, pleural effusion, and gall bladder wall oedema during an epidemic should imply the diagnosis of dengue fever until proven otherwise. The economic and timely available modality of ultrasound helps in the early commencement of medical treatment before the availability of serology. The commonly encountered findings of mild ascites, pleural effusion, liver changes, and renal parenchymal disease attribute to the different antigenic factors and demographic variation. However, more studies are required with targeted evaluation of these visceral changes in disease.

Key Words: Dengue, Ultrasound, Computed Tomography, Magnetic Resonance Imaging.

INTRODUCTION

The dengue fever is a mosquito-borne infectious disease that is caused by the bite of species *Aedes aegypti* or *Aedes albopictus*. The prevalent dengue virus occurs in four serotypes that are antigenically indistinct. The disease is now endemic in tropical and subtropical countries due to different climate with high prevalence in both underdeveloped and developed countries. According to the World health organization, the estimated prevalence of dengue fever is fifty million worldwide, with the majority of cases reported in Asia. The arthropods vector-borne dengue infection has been reported to cause 10,000 deaths and 100 million infections every year in more than 120 countries.¹ The dengue outbreak is a periodic major health issue in Pakistan due to the increase in urbanization and change in climatic conditions. The recurrence of the disease has been reported in Pakistan every year in both rural and urban populations. The statistics of nearly 23,000 confirmed cases of dengue fever in 2017 to approximately 3200 cases in 2018 from across Pakistan showed a sharp decline in disease.^{2,3}

Clinical presentation of dengue virus infection ranges from mild dengue fever, dengue hemorrhagic fever (DHF) to severe dengue shock syndrome (DSS).⁴ The self-limiting illness of dengue fever usually presents clinically with symptoms of fever, muscle pain, headache, and body rash.

The initial findings of leucopenia, thrombocytopenia, and metabolic acidosis are the changes encountered in dengue disease followed by microbiological testing that confirms the diagnosis.⁵ However, the severity of the disease can be assessed by different imaging modalities, including ultrasound abdomen, chest x-ray, MRI, and CT scan.⁶

Recent clinical studies have demonstrated various sonographic findings in dengue fever, including gallbladder (GB) wall thickening, pleural effusion, ascites, and hepatosplenomegaly.⁷ These are warning signs of severe dengue infection.⁸ By now, insufficient data is demonstrating the spectrum and frequency of imaging findings including the ultrasound findings of renal parenchymal changes, MRI findings of encephalitis and cerebral haemorrhage in an altered level of consciousness, changing pattern of disease presentation in different patients concerning severe dengue infection along with a wide range of symptoms during the endemic season.⁹⁻¹¹

The purpose of this study is to evaluate the spectrum and frequency of radiological findings in dengue fever with a positive serological test. The worth of study lies in the evaluation of the course of the disease using various modalities in all patients that are required for early diagnosis and management.

MATERIAL AND METHODS

The Institutional Review Board approved this retrospective study and required neither patient approval nor informed consent for our review of patient images and medical records.

A retrospective analysis of all patients with diagnosed dengue infection presented to our tertiary care center from 1st January 2019 to 31st December 2019 was done. Of the total 390 patients with diagnosed dengue infection based on serology, 171 patients had positive findings on different imaging modalities and were included in the study. Patients who did not undergo any radiological test despite positive serology were excluded. There was a slight male predilection with 117 males (68.4%) and 54 females (31.4%). The male to female ratio was 2.1:1, with the mean age of 35.9 years (Age ranges from 5 months to 86 years). Most of the affected patients were between 31 and 40 years. Frequency of patients according to age distribution is given in Figure-1.

Chest and abdominal sonography are the initial diagnostic modalities used for the evaluation of disease. Cerebral haemorrhage was evaluated using CT scan imaging and encephalitis evaluated through MRI contrast studies in patients presenting with neurological deficits.

Ultrasound of the abdomen, pelvis, and chest was carried out with real-time ultrasound scanners (Toshiba Aplio 500) using 3.75 & 5.0 MHz transducers. The liver, gall bladder, spleen, and kidneys were the mainstay of evaluation. Gallbladder wall thickness greater than 3 mm was considered abnormal. Liver size greater than 17 cm and spleen measuring greater than 12.5 cm was taken enlarged. The presence of any free fluid in the peritoneal

cavity and chest were also recorded and categorized into mild, moderate, and severe on qualitative assessment.

Similarly, an MRI of the brain with contrast was performed on Siemens Magnetom Avento (1.5 Tesla). Multiple sequences, including T1W, T2W, FLAIR, DWI, ADC, and post gadolinium T1W images (T1WC+) were obtained. CT of the brain was done on Alexion 16 Slice, Toshiba, in some patients who had the query of haemorrhage. For x-rays of the chest, we used Shimadzu ceiling-mounted 500ma machine.

RESULTS

The most common finding was mild ascites recorded in 72 patients (42.1%), followed by mild right-sided pleural effusion in 49 patients (28.7%).

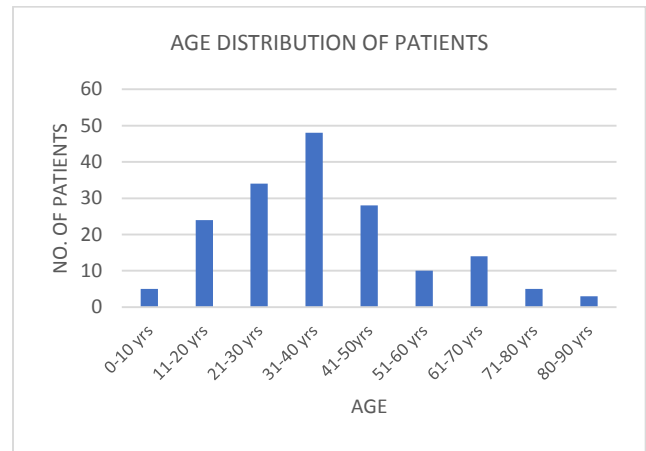


Figure 1: Frequency of patients according to age distribution

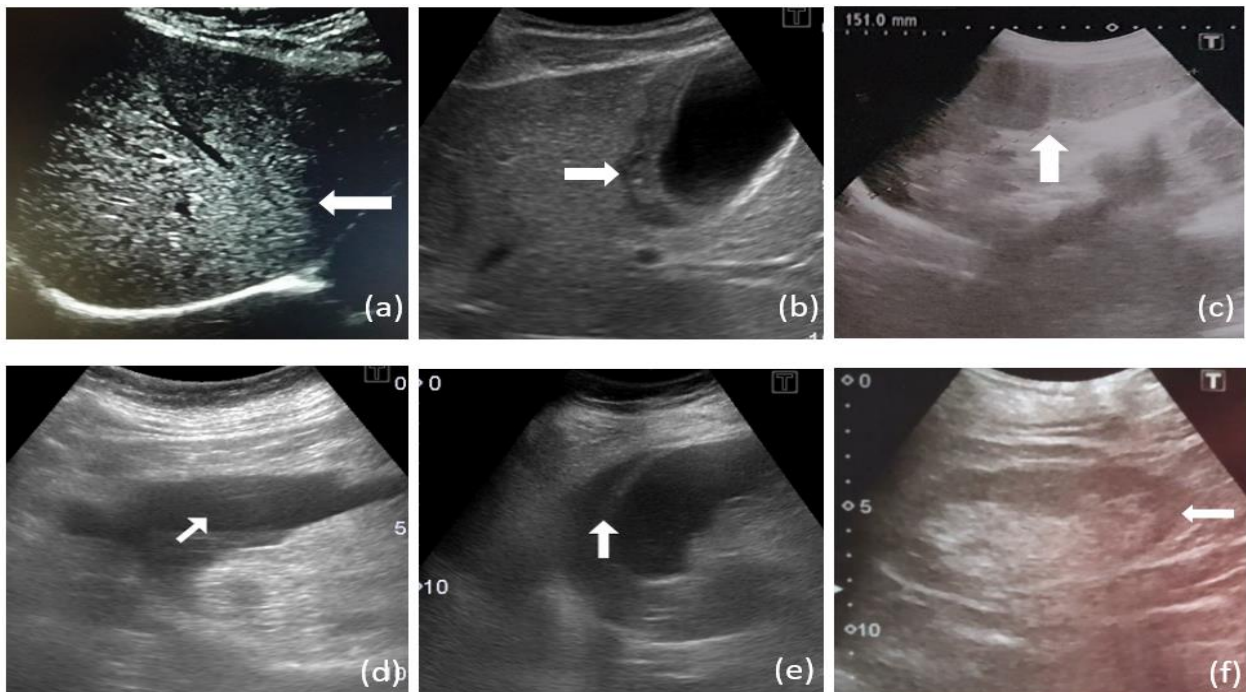


Figure 2: Ultrasound images of different patients showing hypoechoic liver (a), edematous gall bladder (b), splenomegaly (c), ascites (d), pleural effusion (e) and increased parenchymal echogenicity of left kidney (f).

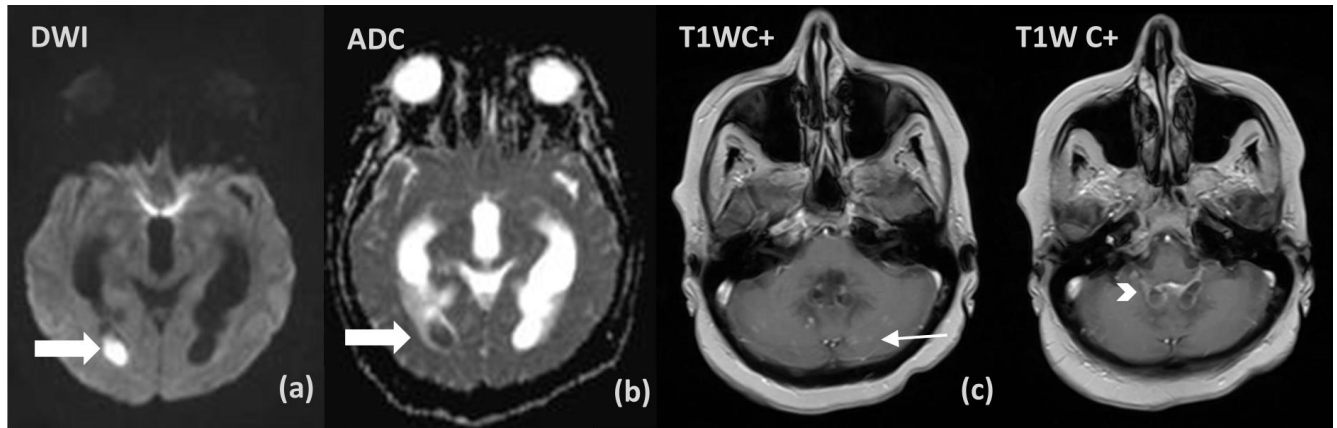


Figure 3: MRI brain axial images showing diffusion restriction in the occipital horn of right lateral ventricle as shown thick arrows (a, b). Patchy areas of postcontrast enhancement seen in bilateral cerebellar hemispheres as shown by arrow (c). Enhancement of basal cisterns and bilateral foramina of Luschka meninges also noted shown by arrowhead (d).

Table 1: Frequency of radiological findings in dengue patients.

Variable	Number of Patients (N)	Frequency (%)
Visceral changes		
Hypoechoic liver	43	25.1
Prominent Portal Triad	32	18.7
Edematous Gallbladder	66	38.6
Hepatomegaly	20	11.7
Splenomegaly	27	15.8
Renal parenchymal changes	7	4.1
Liver abscess	1	0.6
Presence of effusion or ascites		
Mild ascites	72	42.1
Moderate ascites	1	0.6
Severe ascites	0	0
Mild right pleural effusion	49	28.7
Moderate right pleural effusion	4	2.3
Severe right pleural effusion	1	0.6
Mild left pleural effusion	36	21.1
Moderate left pleural effusion	1	0.6
Severe left pleural effusion	0	0
Intracranial complications		
Dengue Encephalitis	2	1.2
Intracranial hemorrhage	2	1.2

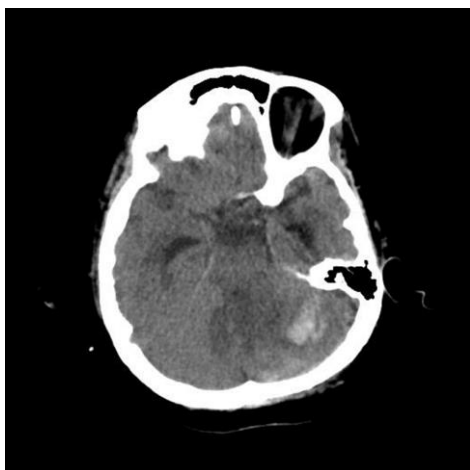


Figure 4: CT scan axial image showing hemorrhage in left cerebellar hemisphere in similar patient shown in figure 2.

Mild left-sided pleural effusion seen in 36 patients (21.1%). Mild right-sided pleural effusion was more common than on the left side. Edematous gall bladder wall thickening was another common finding recorded in 66 patients (38.6%). Splenomegaly was a more frequent finding as compared to hepatomegaly. The newly encountered finding of renal parenchymal changes was recorded in 7 (4.1%) patients. (Figure 2). The least common finding of dengue encephalitis and intracranial haemorrhage was recorded in 2 (1.2%) patients (Figure 3,4). Liver abscess was recorded in just one patient (0.6%). The overall frequency of different radiological imaging findings is given in table 1.

DISCUSSION

Dengue fever is a self-limiting global and mostly endemic disease, with a wide range of clinical symptoms affecting hepatobiliary, cutaneous, neurological, and renal systems. Various laboratory and imaging modalities like Chest X-ray, ultrasound, and MRI play a significant role in the assessment of the severity of the disease.¹²

Limited studies on the complete spectrum of imaging findings of dengue fever have been reported so far. In a study by Chandak S et al., the most common ultrasonographic finding of dengue fever was hepatomegaly (62%) followed by splenomegaly (45%). In his study, only 38 patients (45%) showed GB wall oedema.¹³ The results of our study show that ascites was the most common finding seen in 72 patients (42.1%). Gall bladder oedema is the second common finding seen in 66 patients (38.1%). Only 20 patients (11.7%) had hepatomegaly, and 27 patients had splenomegaly (15.8%). The results of our study are inconsistent with the findings of Chandak S et al. We propose that this difference in results could be due to infection acquired by different strains of viral antigen in different climatic regions.¹³

A study done by Molta M et al. showed ascites is the most common presentation of dengue fever followed by gall bladder wall oedema, hepatomegaly, and splenomegaly.¹⁴ The results of our study are in concordance with the results of their study; however, mild right pleural effusion (28.7%) was a more common finding in our study as compared to hepatomegaly and splenomegaly. Hu T et al. reported that pleural effusion is

seen in 21 out of 34 patients (61.7%) and is the most frequent finding in his study. Pleural effusion has been seen as one of the common findings in previous studies more common on the right side with isolated left-sided pleural effusion being exceedingly rare.¹⁵

Nephropathy is the known complication of dengue fever, and various studies on dengue induced nephropathy have been reported.¹⁶ However, no definitive study is available on its radiological manifestation. We also found out the striking feature of renal parenchymal changes in 7 patients (4.1%) without known co-morbid and any prior history of kidney disease. Hu T et al., also reported nephropathy in 3 cases (14.3%).¹⁵ His reported results are consistent with the results of our study and strongly supports the changes in renal function in dengue fever. This finding emphasizes the fact that baseline and regular follow up evaluation of renal function should be done in patients with dengue fever.

A histopathological study done by Pova TF et al. showed hepatocyte vacuolar nuclear degeneration, inflamed mitochondria that were assessed by ultrastructure analysis corresponds to the apoptotic process.¹⁷ In our study, changes in the liver were recorded as hypoechoic liver with prominent portal triads. The hypoechoic liver was recorded in 43 (25.1%) patients and a prominent portal triad in 32 (18.7) patients. The typical appearance is also called starry sky appearance that has been demonstrated in different infectious hepatitis or can be seen in viral etiologies affecting the liver but with its specification with dengue fever has not been given previously.¹⁸

Mathew T et al. and Soni BK et al. showed different case reports of encephalitis in dengue fever in their studies. Our study has shown at least 2 (1.2%) cases of severe dengue fever with encephalitis that is in concordance with the radiological findings in brain imaging given previously.^{19,20} A study done by Koshy JM et al. showed different neurological findings, both symptomatically and radiologically, including encephalopathy and intracranial haemorrhage. Our study showed a similar finding of intracranial haemorrhage in 2 patients (1.2%).²¹

Limitations of this study include that it was not immune from selection and observer bias as there may be inter-observer variability in quantitative analysis of effusion and ascites in mild, moderate, and severe. Furthermore, the study was limited to a single center having a limited sample size.

CONCLUSION

In a nutshell, the patients presenting with signs and symptoms of dengue infection along with the findings of ascites, pleural effusion, and gall bladder wall oedema during an epidemic should imply the diagnosis of dengue fever until proven otherwise. The economic and timely available modality of ultrasound helps in the early commencement of medical treatment before the availability of serology. Our study also concluded the new manifestations of renal parenchymal changes in dengue fever. The commonly encountered findings of mild ascites, pleural effusion, liver, and renal parenchymal changes attribute to the different antigenic and demographic variables from patient to patient. However, more studies

are required with targeted evaluation of these visceral changes in disease.

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