



ROLE OF ULTRASOUND IN DENGUE FEVER

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ABSTRACT

Dengue is the most significant mosquito-borne viral disease in the world today caused by flavivirus by the *Aedes aegypti* mosquito. Many dengue cases are self-limiting but complications such as hemorrhage and shock can be life-threatening.

The aim of the present study is to highlight and demonstrate the importance of ultrasound in the Dengue fever.

1. To demonstrate the ultrasound findings of dengue fever.
2. To assess efficacy of each findings.
3. To suspect and predict the progression of mild dengue fever to severe dengue fever and its complications.(Dengue hemorrhagic fever and Dengue shock syndrome)
4. To thus help in further management of patients.

The ultrasound findings in early milder form of DF include GB wall thickening, pericholecystic fluid and hepatosplenomegaly. Severe forms of the disease are characterized by fluid collection in the perirenal and pararenal region, hepatic and splenic subcapsular fluid more commonly generalized ascites and mild to moderate.

KEYWORDS :

Dengue Hemorrhagic Fever

DHF a potentially fatal illness marked by high fever, hemorrhagic manifestations and evidence of plasma leakage. DHF begins with the sudden onset of a high temperature that lasts 2 to 7 days, with accompanying chills, flu-like constitutional symptoms and a flushed face. As the fever subsides, patients may recover or progress to a state of plasma leakage. Features of plasma leakage include ascites, pleural effusion (right-sided in most cases), and rarely, pericardial effusion associated with a high mortality. If untreated, the condition may deteriorate rapidly to profound shock and death within hours.

DHF is classified into four grades according to severity. Grade I is characterized by fever, general symptoms and positive tourniquet test. Grade II shows signs and symptoms of grade I plus spontaneous hemorrhage on the skin, gums, gastrointestinal tract and other areas. Signs and symptoms of grade III include those of grade II plus circulatory shortage and agitation. Grade IV shows shock and non-detectable arterial pressure. In all phases, there is thrombocytopenia and hemoconcentration.

Laboratory abnormalities associated with DHF include thrombocytopenia, leucopenia, prolonged prothrombin time and activated partial thromboplastin time, elevated fibrin degradation products, low serum albumin and elevated liver enzymes, atypical lymphocytosis (15%) and electrolyte abnormalities also may be seen.

Dengue Shock Syndrome

Most patients who have DHF do not develop DSS. DSS occurs during defervescence 3 to 6 days after the onset of symptoms and has a high mortality rate of 10% to 47%. Warning signs of DSS include severe abdominal pain; persistent vomiting (with or without blood); abrupt change of temperature from fever to hypothermia and altered mental status, including irritability, somnolence or obtundation. In DSS, capillary leakage and loss of intravascular volume result in shock rather than in hemorrhagic.

Ultrasound has two potential uses in the management of dengue fever. Firstly, as a prognostic indicator, ultrasound could potentially be used to assess which patients are at severe risk of entering the

critical phase. Secondly, ultrasound could be used as a cheaper less invasive means of monitoring for plasma leakage (ascites).

Recent data suggest that endothelial cell activation could mediate plasma leakage (64,100,101). Activation of infected monocytes and T cells, the complement system and the production of mediators, monokines, cytokines and soluble receptors may also be involved in endothelial cell dysfunction. This plasma leakage is responsible for the pericholecystic collection, gall bladder wall edema and third space fluid collections which are apparent on ultrasound (7,10,17)

Sonographic Implications

Ultrasound may be a promising alternative to radiography in support of dengue case management and triage in developing nations. As a prognostic indicator, ultrasound could potentially be used to assess which patients are at risk for entering the critical phase. Identifying these patients early could improve case management and outcome, as well as enable a more efficient allocation of hospital resources.

Ultrasound allows detection of capillary leakage (eg, pleural effusion, ascites), as well as hepatomegaly, splenomegaly and thickening of the gallbladder wall in patients with dengue. (16,17,10,9) It can be used as a first-line imaging modality in patients with suspected dengue fever to detect early signs suggestive of the disease prior to obtaining serologic confirmation test results, especially in a dengue fever epidemic area. (22)

Increased capillary permeability is the main feature of DHF, with leakage of albumin out of the vascular space, leading to capillary effusion and hemoconcentration with increase in the hematocrit levels described as polyserosities. The risk for shock is higher during critical phase which extends from the third to the fifth day of febrile disease in children, where gallbladder wall thickening and capillary effusion are observed in addition to severe abdominal pain, persistent emesis and increased hematocrit levels. Despite the non-specificity of sonographic findings, ultrasonography is useful for the early diagnosis in patients with DHF and for differential diagnosis of other febrile disease. (10)

Gall bladder thickening: The normal value for gall bladder wall

thickness is still to be well established in the literature, such finding is considered in cases where the gall bladder wall thickness is $>3.0\text{mm}$. In patients with DHF, the striated pattern predominates, as a result of a probable fluid accumulation between the gallbladder wall layers producing striations, as a function of the osmotic intravascular pressure. There is a higher probability of detection US scan is performed at the second or third febrile day. In the cases of DHF, gall bladder wall thickness $>3.0\text{mm}$ and $<5.0\text{mm}$ presents a sensitivity of 93.8% and may be utilized as a criterion for patients hospitalization and monitoring⁽¹⁸⁾

An increased GBWT also significantly correlated with decreased platelet count and increased hematocrit. Patients with low platelets (less than $100,000\text{ cells/mm}^3$) had a mean GBWT of 6.12 mm compared with 3.04 mm in those with normal platelet count (19) studies have proved that gall bladder wall thickness more than 5 mm with Murphy's sign negative should be used as supportive diagnosis of DHF in endemic area⁽²⁰⁾



Pleural Effusion: The onset of pleura effusion occurs immediately after defervescence, between the third and seventh day. In children, however, the onset severe presentations is usually observed at about the third day, but not always associated with defervescence .

There is a correlation between pleural effusion, ascites, presence of fluid in the perirenal space, hepatic subcapsular collection and pericardial effusion with severity in cases of DHF in children^(18,17)

Pleural effusion was noted more commonly in DHF than in classical dengue, requiring rigorous observation⁽²⁵⁾

It is the most frequent sonographic finding in cases of plasma leakage, and is present, even subtly, in children affected by classical dengue, where this abnormality is usually transitory and of rapid resolution⁽¹⁸⁾. Most frequently, the onset of pleural effusion occurs

immediately after defervescence, between the third and seventh day⁽²⁵⁾. In children, however, the onset of severe presentations is usually observed at about the third day, but not always is associated with defervescence⁽¹³⁾. Some studies demonstrate that pleural effusion may be present up to one day before defervescence in some patients⁽¹⁸⁾. It may be right unilateral or bilateral . It is rarely observed as left unilateral.

ULTRASONOGRAPHIC SIGNS OF PLEURALEFFUSION

The ultrasonographic signs of pleural effusion include the detection of an anechoic space immediately deep to the thoracic walls. As the pleural effusions are sound conducting, deeply situated structures in relation to the effusions which are not normally visible, become visible when such a condition is present. Normally, when examining the thoracic wall thorough the liver, nothing is visible through it as the aerated lung interrupts the ultrasound beam. However, in the presence of pleural effusion, the posterior thoracic wall becomes visible.

A pleural effusion appears as a hypoechoic collection immediately above diaphragm and adjacent structures. One can separate the subjacent consolidated lung from the effusion, because the pulmonary consolidation is more dense and contains multiple aerial echogenic areas (air bronchograms) in its interior. A non-complicated effusion is totally anechoic, while a complex collection such as hemothorax or empyema has a thicker fluid with septations

The free fluid flows about the pleural space according to patient position. In dorsal decubitus, the fluid flows to the back of the liver and the lungs. If the patient is standing, the fluid flows between the lung and the diaphragm

There are two findings that have proven to be predictive of pleural fluid: the presence of a definite alteration in the form of a pleural density during inspiration and expiration, and the presence of mobile septations within the pleural lesion. Presumably, septations are fibrin bundles. The back and forth movement is unequivocal evidence that the fluid has a relatively lowviscosity

Doppler can also be helpful in distinguishing a pleural effusion from a pleural thickening. When a free pleural effusion is present, there is a colored sign between the visceral and parietal pleurae or near the costophrenic angle which is related with the respiratory movements. An organized pleural thickening appears like pleural lesion with no Doppler signals

Ascites: The presence of volumes as large as approximately 1,000 to 1,500 ml is necessary for clinical detection of free fluid, while ultrasonography can identify little as about 100ml.⁽¹⁰⁾Ascites is detected in 26% to 34% of cases with mild DHF, and in 94% to 95% of cases with severe DHF^(29,17)

Hepatic subcapsular fluid is little evidenced, and its presence is a sign of disease severity. However, it is a transitory finding (only one to two days) that may be observed at around the fourth to the fifth day after the disease onset⁽²⁹⁾.

The presence of fluid in the perirenal space could not be visualized in the cases of mild DHF. However, it could be seen in 77% of patients severely affected by DHF. Thus this is a significant marker for disease severity⁽¹⁷⁾.

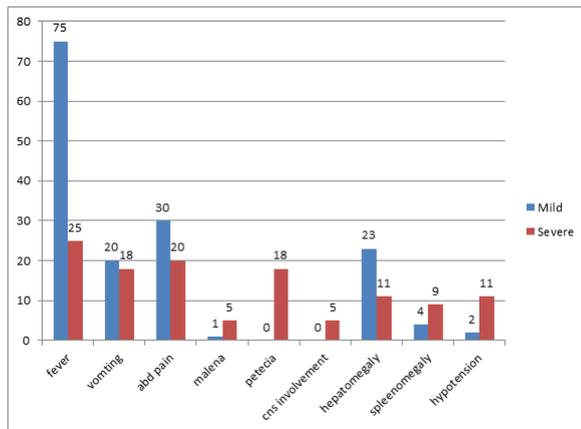
Volumetric increase of organs: Volumetric increase of organs is a nonspecific finding. Hepatomegaly, splenomegaly and less frequently, volumetric increase of pancreas have been described in several studies, but these findings are observed with a similar frequency in the mild and severe DHF presentations, with highest incidence of hepatomegaly. There is a correlation between pleural effusion, ascites, presence of fluid in the perirenal space, hepatic subcapsular collection and pericardial effusion with severity in cases of DHF in children.^(17,20)

During dengue epidemic, the diagnosis of DHF should be considered as ultrasonography demonstrated gall bladder thickness, ascites, splenomegaly and pleural effusion in a febrile patient with thrombocytopenia. These findings may also occur in other viral infections, enteric fever and leptospirosis, but in other viral infections the historical profile, symptom complex evolution and physical findings do not mimic those of DF. Ultrasound features of enteric fever include splenomegaly, intra-abdominal lymphadenopathy, bowel abnormalities in the form of intramural thickening of the terminal ileum and caecum, renal abnormalities like arteriectasis and perinephric fluid collection in addition to GB wall thickening and polyserositis. Leptospirosis also shows gross abnormalities involving hepatic and renal parenchyma.(24)

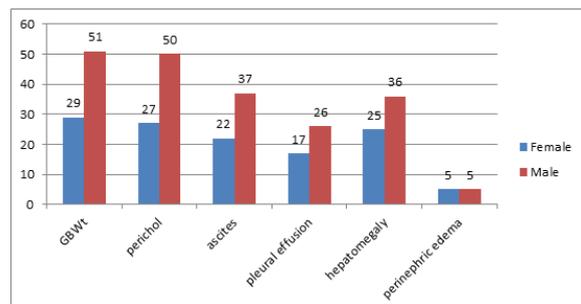
Table 5 : Comparison of clinical features among Mild and Severe Dengue Fever

	Total (n=60)	Mild Dengue (n=44)	Severe Dengue (n=16)
Fever	60 (100%)	75	25
Vomiting	25 (41.6%)	20	18
Abdominal pain	30 (50%)	30	20
Malaria	30 (50%)	1	5
Petechiae	36 (60%)	0	18
CNS involvement	23 (38.3%)	0	5
Hepatomegaly	28 (46.6%)	23	11
Splenomegaly	12 (20%)	4	9
Hypotension	16 (26.6%)	2	11

Graph 5 : Comparison of clinical features among mild and severe dengue fever.



Graph 8(6):Sonographical Parameters in Mild and Severe Dengue.



CONCLUSION

- In an epidemic area, ultrasound abdomen can be used as the first line investigation modality in patients with suspected dengue fever to detect early signs suggestive of the disease.
- Ultrasound abdomen supported with lab parameters like rising hematocrit and decreasing platelet count predicts the progression to severe form of the disease.
- Though ultrasound abdomen can detect early signs of the disease

for all practical purposes serology of dengue virus remains the gold standard in diagnosing the disease.

- Advantage of ultrasound abdomen over serology is that it not only detects early signs of the disease but also predicts the severity of the disease.

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