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Role of Ultrasound in Dengue Infection

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Abstract: ***Dengue has become a major national and international public health concern in recent years. Though for all practical purposes serology of dengue virus remains the gold standard in diagnosing the disease, ultrasound abdomen can detect early signs of the disease. Our study was performed to highlight and demonstrate ultrasound findings of dengue fever, assess efficacy USG findings, suspect and predict the progression of mild dengue fever to severe dengue fever by USG and its complications, thus helping in further management of patients with dengue fever. Total 200 patients with complaints and clinical findings pertaining to Dengue fever (dengue positive by IgM MAC ELISA) are evaluated by Toshiba's Xario USG machine in our department. Mean age of presentation was-22.45 years and 15, 26 years for females and males respectively. There was significant statistical difference noted between mild and severe cases of dengue fever related to sonological variables like ascites, pleural effusion, and perinephric edema. Ultrasound abdomen is useful for early prediction of the severity of dengue fever, thus helps in triage and prevention of those cases which will further progress to dengue haemorrhagic fever or dengue shock syndrome.***

Keywords: GBWT (Gallbladder wall thickening), DHF, DSS, perinephric edema, Ascites, pleural effusion

1. Introduction

Dengue is the most significant mosquito-borne viral disease in the world today. A staggering 3 billion people worldwide live in areas at risk for transmission of the dengue flavivirus by the Aedes aegypti mosquito, and an estimated 100 million people worldwide are infected with the virus each year. A significant increase in the incidence of this infectious disease has taken place in the last 20 years and Dengue has become a major international public health concern in recent years. The increase of DF is due to uncontrolled population growth and urbanization in the absence of appropriate water management, global spread of dengue strains via travel and trade and due to erosion of vector control programs (1)

According to the WHO the diagnosis of BF is made clinically based on the following Evidence of plasma leakage

1) Fever or history of acute fever lasting 2 to 7 days.
2) Haemorrhagic tendencies evidenced by at least one of the following: a positive tourniquet test, petechiae, purpura, ecchymosis, bleeding from mucosa, gastrointestinal tract, injection sites or other location; hematemesis and melena.
3) Thrombocytopenia (100, 000 platelets/pl or less)
4) Hem concentration (20% or more rise in the haematocrit (Hot) value relative to baseline average for the same age and sex) or evidence of plasma leakage (e.g. pleural effusion, ascites and/or hypoproteinaemia)

Ultrasound of the abdomen is an important adjunct to clinical and laboratory profile in diagnosing DF and further ultrasound is useful in predicting the severity of the disease. The ultrasound findings in early milder form of BF include GB (gall bladder) wall thickening, pericholecystic fluid and hepatospleenomegaly. Severe forms of the disease are characterized by fluid collection in the perirenal and para-renal region, hepatic and splenic subcapsular fluid more commonly generalized ascites.

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. By identifying these patients early, hospital resources could be more discharged earlier. Secondly, ultrasound could be used as a cheaper less invasive means of monitoring for plasma leakage (ascites, pleural effusion and perinephric edema). It is also a less expensive, safe, rapid and widely available non-invasive imaging modality which can be used to know the presence and degree of plasma leakage at various sites in the body in patients with dengue fever to facilitate early management and hence prevent fatal complications.

Study Objectives

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 haemorrhagic fever and Dengue shock syndrome)
4) To help in further management of patients with dengue fever by predicting the prognosis of dengue fever.

2. Review of Literature

Dengue virus infection is recognized as one of the most important mosquito borne human infections in the 21th century (2). It has many names like dandy fever, denguero, denge, dunga, breakbone fever, bouguet, seven day fever, chapenonad, tok-kive-Ana and coup-bare.

The virus Dengue virus (DEN) is a small single-stranded RNA virus comprising four distinct serotypes (DEN-1 to -4). These closely related serotypes of the dengue virus belong to the genus Flavivirus, family Flaviviridae.

The vectors: The various serotypes of the dengue virus are transmitted to humans through the bites of infected Aedes mosquitoes, principally Aedes aegypti. Dengue outbreaks have also been attributed to Aedes albopictus, Aedes polynesiensis and several species of the Aedes scutellaris complex.

After an **incubation period** of 4 to 10 days, infection by any of the four virus serotypes can produce a wide spectrum of illness, although most infections are asymptomatic orsubclinical. Primary infection is thought to induce lifelong protective immunity to the infecting serotype (3). Young children in particular may be less able than adults to compensate for capillary leakage and are consequently at greater risk of dengue shock.

Clinical Presentation of Dengue infection-Infection with dengue viruses in children can have varied presentations, ranging from asymptomatic infection to severe shock and death. Various forms of dengue infection are undifferentiated fever, Classic Dengue Fever, Dengue Haemorrhagic Fever and Dengue Shock Syndrome.

Severe dengue complications include liver dysfunction, encephalitis, cardiomyopathy (usually reversible), pancreatitis, acalculous cholecystitis, peripheral neuropathy and acute renal failure.

Diagnosis Dengue infection can be diagnosed via serologic method, virus isolation, or molecular methods.

Sonographic Implications

In recent years several studies concluded that Ultrasonography of the chest and abdomen can be an important adjunct to clinical profile in diagnosis DF and diagnosis can be made early in the course of disease compared to other modes of diagnosis (4). 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 resource. Ultrasound allows detection of capillary leakage, as well as hepatomegaly, splenomegaly and thickening of the gallbladder wall in patients with dengue haemorrhagic fever. 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. The risk for shock is higher during critical phase which extends from the third to the fifth day of febrile disease in children, where gallbladderwall thickening and cavitary 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.

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 **>3.0mm**. 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 >3.0mm and <5.0mm presents a sensitivity of 93.8% and may be utilized as a criterion for patients hospitalization and monitoring (5). An increased GBWT also significantly correlated with decreased platelet count and increased haematocrit. Patients with low platelets (less than100, 000 cells/mm3) had a mean GBWT of 6.12 mm compared with 3.04 mm in those with normal platelet count. 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 (6)

Pleural Effusion: The onset of pleural effusion occurs immediately after defervescence, between the third and seventh day. In children, however, the onset with 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 (5).

Pleural effusion was notedmore commonly in DHF than in classical dengue, requiring rigorous observation (7). It is the most frequent sonographic finding in cases of plasma leakage, and is present, evensubtlety, in children affected by classical dengue, where this abnormality is usually transitory and of rapid resolution (5).

Ascites: Ascites is detected in 26% to 34% of cases with mild DHF, and in 94% to 95% of cases with severe DHF. 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.

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.

Volumetric increase of organs (hepatomegaly and splenomegaly): Volumetric increase of organs is a nonspecific finding. Hepatomegaly, splenomegaly and less frequently, volumetric increase of pancreases have been described in several studies, but these findings are observed with a similar frequency in the midland severe DHF presentations, with highest incidence of hepatomegaly.

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 notmimic those of BF. 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 and perinephric fluid collection in addition to GB wall thickening and polyserositis. Leptospirosis also shows gross abnormalities involving hepatic and renal parenchyma- (8)

3. Material and Method

1) Selection of study subjects: The following observational study was conducted during a period of two years (August2012-August2014). All patients of all ages presenting in the Medicine and paediatrics outpatient and inpatient Department with complaints and clinical findings pertaining to Dengue fever (who were dengue positive by IgM MAC ELISA) are referred to Department of Radiology for evaluation by ultrasound.

i) Clinical features of patients with Dengue fever -Fever, Headache, Petechial rashes, Nausea, Vomiting, Abdominal pain.

ii) Related Investigations: Dengue IgM MAC ELISA, Platelet count, Haematocrit, differential count, Chest X-ray, Ultrasound thorax and abdomen

iii) Equipment facilities– Toshiba's Xario USG machine.

a. Inclusion criteria

1) Patients with clinical findings of Dengue~
2) Serological +ve (IgM) DHF patients of all ages and gender.

b. Exclusion criteria

1) Patients who did not undergo serological test for dengue fever
2) Whose serological reports were not available andwho were seronegative for dengue fever.

Ultrasonography of the abdomen and pelvis was performed for all the patients by using 3-7MHz convex probes. In addition to this the Ultrasonography of the thorax was performed to asses for pleural effusion. All ultrasoundexaminations were performed with the Toshiba's Xario USG machine using 3.5MHzand 5 MHZ probes. Abdominal scanning was done preferably after 4 h of fasting to allow better distension of gall bladder (GB) and better visualization of solid organs. GB wall thickening, hepatomegaly, splenomegaly, ascites and pleural effusion along with perinephric edema was evaluated.

Following study variables were evaluated.

(a) Demographic variables age and sex of the patients,

(b) Clinical variables -clinical symptoms and signs, related investigations and clinical grade of severity of the patients.

(c) Sonographic variables

1) Thickened GB wall: present/ absent
2) Pericholecysticfluid: present / absent.
3) Hepatomegaly: present / absent
4) Splenomegaly. Present/absent
5) Ascites present / absent
6) Pleural effusion present/absent
7) Perinephric edema present/absent

(d) Haematological variables

1) Platelet count -thrombocytopenia present / absent
2) Haematocrit –raised/ normal|

Data from the structured data collection sheet were entered into a computer to generate a data base for subsequent analysis. For all the observed measurements, the data were initially summarised into frequency distribution tables. Based on these findings the patients were classified into mild and severe groups. Mild group (DF and UHF grade HI) and the severe group (DHF grade III - lV) i.e. with shock.

Case definition of dengue fever (9):

Dengue fever: Fever of 2 to 7 days duration, with two or more of the following
Headache, retro orbital pain, myalgia, arthralgia, rash, haemorrhagic manifestation, Leukopenia, and supportive serology or occurrence at the same location and time as other confirmed cases of dengue.

Dengue haemorrhagic fever: All of the following criteria must be fulfilled:

1) Fever or history of acute fever, lasting 2 to 7 days, occasionally biphasic.
2) Haemorrhagic manifestations in the form of at least one of the following: > A positive tourniquet test > Petechiae, ecchymosis or purpura> Bleeding from the mucosa or injection sites > Hematemesismelena, haematochezia and haematuria increased menstrual flow.
3) Thrombocytopenia (<1 lac per mm3)
4) Objective evidence of plasma leakage caused by increased vascular permeability as evidenced by one or more of the following:
   - A rise in the haematocrit (defined as >20°/over baseline)
   - A drop in haematocrit following volume Replacement treatment <20°/o of baseline
   - Low albumin
   - Pleural effusion, ascites or other effusions.

Dengue shock syndrome: DHF plus evidence of circulatory failure manifested by shock or all of the following:

- Rapid and weak pulse
- Narrow pulse pressure (<20mm Hg) or hypotension for age (systolic pressure <80mmHg for children younger than 5 years of age or <90mm Hg for children 5 years of age and older).
- Cold, clammy skin and altered mental status.

4. Observations and Result

Out of the 200 cases of Dengue Fever studied, 150 patients belong to Mild Dengue and 50 belong to Severe Dengue.

Table 1: Total number of Dengue cases studied

Total number of cases	Mild Dengue	Severe Dengue
200	150	50

Table 2: Gender Distribution

Gender	Mild Dengue (n= 150)	Severe Dengue (n=50)
Male (134)	110	32
Female (66)	48	18

In the present study out of 200 cases studied, 67 % of them were males and 22 % of them were female with Male to Female ratio 2.03: 1

Table 3: Age Distribution

Age group (years)	Female	Male	TOTAL
0-10	14	24	38
10-20	20	46	66
20-30	20	22	42
30-40	6	24	30
40-50	4	10	14
>50	2	8	8
TOTAL	66	134	200

Table 4: Age distribution in mild and severe Dengue Fever

Age group (Years)	Mild	Severe	TOTAL
0-10	22	16	38
10-20	48	18	66
20-30	36	6	42
30-40	28	2	30
40-50	10	4	14
>50	6	4	10
TOTAL	150	50	200

The maximum number of patients belongs to group 10-20 yrs (33%). The mean age of presentation in the present study was 22.45 years in female populations and 15.56 years in male population.

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

	Mild Dengue (n=150)	Severe Dengue (n=50)
Fever	150 (100%)	50 (100%)
Vomiting	40 (26.67%)	36 (72%)
Abdominal pain	60 (40%)	40 (80%)
Malena	2 (1.37%)	10 (20%)
Petechiae	0 (0%)	36 (72%)
CNS involvement	0 (0%)	10 (20%)
Hepatomegaly	46 (30.67%)	22 (44%)
Splenomegaly	8 (5.37%)	18 (36%)
Hypotension	4 (2.7%)	22 (44%)

Table 6: Lab parameters among Mild and Severe dengue fever (P value – 0.0).

Haematocrit	Mild	Severe	TOTAL
RAISED	4	32	36
WNL	146	18	164
TOTAL	150	50	200

Table 7: Lab parameters among Mild and Severe dengue fever

Lab parametes	Mild N=75 (Mean +/- SD)	Severe n=25 (Mean+/- SD)	P value
Platelets counts	1.49 +/- 1.19	0.45 +/- 0.28	0.0

Table 8: Comparison between clinical features of male and female

USG Findings	Female	Male	p value	Chi square
GBWT	58	102	0.166	1.91
Pericholecysticedema	54	100	0.6564	0, 41
Ascites	44	74	1.19	0.27
Pleural effusion	34	52	0.229	1.45
Hepatomegaly	20	72	0.03	4.5
Perinephric edema	10	10	0.2281	1.45

Table No 9: Distribution of USG findings according to severity

USG findings	Mild N=150	Severe N=50	p value	Chi square
GBWT	114	46	0.08	3
Pericholecystic edema	108	46	0.03	4.23
Ascites	70	48	0.0000152	18.86
Pleural effusion	52	34	0.00355	1.98
Perinephric edema	0	20	0.0000019	33.33
Splenomegaly	8	4	0.6268	0.1217

Gall bladder wall thickness (>= 3mm): Among the 200 cases of dengue fever studied, it was seen in 160 (80%) cases. 46 (92%) cases of severe dengue showed GBWT whereas 57 (76%) had GBWT in mild group. Which showed no statistical difference (p=9: 008).

Pericholecysticoedema: Among the 200 cases of dengue fever studied, it was seen in 154 (77°/o) cases. 46 (92%) cases of severe dengue showed pericholecystic edema, whereas 108 (72%) had in mild group. Which showed no statistical difference (p=0.03).

Ascites: Among the 200 cases of dengue fever studied, it was seen in 118 (60%) gases. 48 (96%) cases of severe dengue showed ascites, whereas 70 (46.66%) had ascites in mild group. This difference was statistically significant (p=0.00001 5).

Pleural effusion: Among the 200 cases of dengue fever studied, it was seen in 86 (43%) cases. Out of which 34 (68%) cases of severe dengue showed pleural effusion, whereas 52 (34.66%) had pleural effusion in mild group. This difference was statistically significant (p=0.003).

Hepatomegaly: Among the 200 cases of dengue fever studied, it was seen in 80 (40%) cases. This difference was statistically significant (p=0.003). 14 (28%) cases of severe dengue showed hepatomegaly, whereas 66 (44%) had in mild group. Which showed no statistical difference (p=0.15).

Splenomegaly=among the 200 cases of dengue fever studied, it was seen in12cases 6% cases. Out of which 4 (33%) cases of severe dengue showed Splenomegaly, whereas 8 (66%) had in mild group. Which showed no statistical difference (p= 0.65)

Perinephric edema = Among the 200 cases of Dengue fever studied, it was seen in 20 (10 %) cases.Out of which 0 (0 %) cases of mild and 20 (100 %) cases of severe dengue showed perinephric edema. This difference was statistically significant (p = < 0.00001).

5. Discussion

Dengue is the most rapidly spreading mosquito-borne acute febrile viral disease in the world. Epidemics of Dengue have hit several Indian cities in the last decade and it remains a health problem with Endemicityboth in urban and rural areas which are infested with AidesAegyptus mosquitoin 1998. It was the most important tropical mosquito borne transmitted infectious disease surpassed only by malaria (4)

The increase of dengue fever is due to uncontrolled population growth and urbanization in the absence of appropriate water management, global spread of Dengue strain via travel and trade, inadequate vector control programmes. (10)

The pathophysiology of Dengue haemorrhagic fever is related to an increased vascular permeability leading to the loss of plasma and albumin from intravascular compartment. Though the serology remains the main stay of diagnosis of Dengue fever, haem agglutinationinhibition antibodies usually appears at detectable level by the day to 6 of febrile illness. The diagnosis of dengue fever often delayed owing to time taken for availability of results (4) Ultrasound can detect small amount of from body cavities and visceral changes in patients suspected to have Dengue haemorrhagic fever. So ultrasound can be used as 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 the Dengue fever it can predict and suspect the progression of the disease into the more severe forms.

Total number of positive cases of Dengue fever studied (i.e. fever with other clinical manifestations of Dengue) during our study period of the two years the cases studied were 200. All these cases were subjected to ultrasound of the abdomen and thorax, the findings were noted, analysed statistically and the following inferences were drawn from the observations.

Table 10: Incidence among number of suspected cases subjected to USG turned Dengue positive on serology.

Sr. No	Name of study	Place	Year	No. of suspected cases	No. of cases turned to be Dengue positive	% of cases turned to be Dengue positive
1	Setiwan et al (29)	Jakarta	1990-1994	178	148	83
2	Venkatasai et al (22)	Chennai	2005	128	88	68.75
3	Present study	Mumbai	2012-2014	300	200	66.66

Age distribution maximum number of patients belongs to age group 10-20 years (33%) followed by 20-30 years= 21%, 0-10 years = 19 %, 30-40 years = 15 %, 40-50 years 7 % and > 50 years = 5 %. The mean age of presentation in the present study was 22.45 years in female population and 15.56 years in male population

Table 11: Distribution of Age in various studies

Sr. No.	Study	Year	No. of Dengue positive cases	Places	Age
1	Setiwan et al (11)	1990-1994	148	Jakarta	5 mts to 14 years
2	Venkatasai et al (12)	2005	88	Chennai	2-9 years
3	Mehdi SA et al (4)	2011	50	Faisalabad	6 mts to 59 years
4	Present study	2012-2014	200	Mumbai	1mt to 60yrs

Gender distribution

The incidence of males that were affected is slightly more in our study, the ratio being 2.03: 1.Similar observations were made in Setiwan M W et al and Venkatasai PM et al.

Table 12: Gender distribution in various studies

Sr No.	Study	Year	No. of dengue positive cases	Places	M: F ratio
1	Setiwan et al (11)	1990-1994	148	Jakarta	1.20: 1
2	Venkatasai PM et al (12)	2005	88	Chennai	1.6: 1
3	Mehdi S et al (4)	2011	50	Faisalabad	1.94: 1
4	Present study	2012-2014	200	Mumbai	2.30: 1

Symptomatology

When signs and symptoms were compared with the severity of dengue fever was noted in all cases of Mild and Severe Dengue. Most of signs and symptoms were common in severe dengue. Hypotension and features of thrombocytopenia like petechial rashes, and melena were noted only in cases of Severe dengue.

Table 13: Symptomatology in various studies.

Sr. N	Study	No. of cases	Fever	Vomiting	Abdominal pain	Malena	Hypotension
1	Chatterjee R et al (13)	96	100 %	56.25 %	62.5 %	55.2 %	16.67 %
2	Mia M W et al (10)	100	96 %	76 %	14 %	39 %	17 %
3	Setiwan et al (11)	148	100 %	-	74 %	49 %	51 %
4	Present study	200	100	36 %	28 %	6 %	13 %

Abdominal pain was comparable to other studies except Mai et al where it was seen in only 14 % of cases. Hypotension was seen less cases in Chatterjee et al and Mia M W and the present study, but more in the study by Setiwan et al probably more cases included in the study.

Sonographic variables

Gall bladder wall thickness (>3mm)

Gall bladder thickening in children with DHF was first reported by Pramujio and Harun (1991), in a study describing sonographic finding in 29 children with severe DHF (14)

Although age adjusted normal values of GBWT are not well established. The definition of GBWT has generally been accepted to be above 3mm. Literatures says that, the duration of gall bladder wall edema is ranged between 2 to 4 days . So there is a higher probability of detection when ultrasound scan is performed at second or third febrile day (15)

In the present study, GBWT was seen in 80% of total number of cases. Incidence of GBWT indengue fever in our study is comparable with the study done by Chaterjee R et al from Maharashtra and VenkatSai PM et al from Chennai and incidence of GBWT observed in various other studies include.

Table 14: Incidence of GBWT among the total number of case studied

Sr No.	*Study*	*Places*	*GBWT >3MM) TOTAL 100*
1	Chaterjee et al (13)	Loni, Maharashtra	83.33 %
2	Venkatasai PM et al (12)	Chennai	100 %
3	Mia M W et al (10)	Dhaka, Bangladesh	38 %
4	Present study	Mumbai, Maharashtra	80 %

In comparing the severity among total Dengue cases studied, all cases (100%) of Severe Dengue had gallbladder wall thickness, where as it was 76 % in milder group of Dengue and 92 % in Severe group, with significant difference noted between severe and mild Dengue (p= 0.08).This indicates that, gall bladder wall thickness is not a good sonological variable in predicting the severity of Dengue fever Other comparable study include.

Table 14.1: Comparison of GBWT between Mild and Sever Dengue

Sr. No.	Study	Place	Mild Dengue	Severe Dengue
1	Setiawan et al (11)	Jakarta	32 %	95 %
2	Mehdi et al (10)	Faisalabad	86.6 %	100 %
3	Pramuljio and Harun (14)	Jakarta	-	28 %
4	Present study	Mumbai	76 %	92 %

The above mentioned studies show that GBWT is not a good sonological indicator of severity of dengue fever similar to our study.

A study in Indonesia by Setiwan et al noted in 95 % of gallbladder thickness in severe dengue and that Gallbladder thickness is a good indicator to predict severity of Dengue fever (11) which is contrary to our study. In another study done by Mehdi SA et al recommended that, in an epidemic area thickened gallbladder wall more than 5 mm with absent Murphy sign can be used as supporting evidence to diagnose dengue haemorrhagic fever (12)

Pericholecystic edema

In the present study Pericholecystic edema was seen in 77% of total number of cases. Incidence of Pericholecystic edema in Dengue fever in our study is comparable with the study done by Chaterjee R et al from Maharashtra and VenkatSai PM et al from Chennai and incidence of Pericholecystic edema Observed in various other studies include.

Table 15: Incidence of Pericholecystic Edema among the number of cases

Sr. No.	Study	Places	Pericholecystic Edema
1	Chaterjee et al (13)	Loni	83.33 %
2	Ventakasai et al (12)	Chennai	100 %
3	Mia MW (10)	Dhaka	02 %
4	Present study	Mumbai	77 %

In comparing severity, in our study Pericholecystic Edema was seen in 92% cases of Severe Dengue, where it was 72 % in milder form dengue, with significant difference noted between severe and mild Dengue (p= 0.03). This indicatethat, pericholecystic edema is also good sonological variable in predicting the severity of Dengue Fever and it can support the diagnosis insuspected cases. Other comparable study includes related to severity include.

Table 15.1: Comparison of Pericholecystic edema between Mild and Severe Dengue

Sr No.	Study	Place	Mild Dengue	Severe Dengue
1	Mehdi et al (10)	Faisalabad	44.4%	60 %
2	Present study	Mumbai	72 %	92 %

Similar study in developing countries done by Mehdi et at m 2012 concluded that pericholecystic edema will support the diagnosis along with other sonographical variable. Vekatsai PM et al in 2005, study done in Chennai 1 round that pericholecystic edema seen in milder form of Dengue and ml If severe form.

Ascite

In present study ascites was seen in 59% of total number of cases incidence of ascites in Dengue fever in our study is comparable with the study done by VenkatSai PM et al from Chennai") and Incidence of ascites observed in various other studies include.

Table 16: Incidence of Ascites among the total number of cases studied

Sr. No.	Study	Place	Ascites (TOTAL)
1	Chaterjee (13)	Loni	77.08 %
2	Venkatasai (12)	Chennai	53.2 %
3	Mia M WET et al (10)	Dhaka	41 %
4	Present study	Mumbai	59 %

In comparing the severity, in our study ascites was present in 46.6 % in mild cases and 96 % in severe cases and there was statistically significant difference among two groups (p= 0.000015) indicating that ascites is a good sonographical variable in predicting the severity of dengue fever. Comparable studies related to severity include.

Table 16.1: Comparison of Ascites between Mild and Severe Dengue.

Sr. No.	Study	Place	Mild dengue	Severe Dengue
1	Setiwan et al	Jakarta	34 %	95 %
2	Mehdi S A et al	Faisalabad	17.7 %	60 %
3	Pramuljo and Harun	Jakarta	-	69 %
4	Present study	Mumbai	46.6 %	96 %

In our study we found ascites m 100% 0f Severe cases the reason being ours is tertiary carecentre children were referred at the later stage of the disease. Setiwan et al and Mehdi noted 95 % and 60 % of the ascites in severe dengue. They also concluded that ascites is a good indicator to – predict severity of dengue fever.

Pleural effusion Pleural effusion is the most frequent sonographic findings. Chest ultrasound has been reported to be more sensitive than upright chest x-ray in detecting pleural fluid in dengue fever cases. In the present study, Pleural effusion was seen in 55.3% of the total number of cases. Incidence of pleural Effusion in Dengue fever in our study is comparable with the study done by Chaterjee R et al from Maharashtra and incidence of pleural effusion observed. **Incidence in** various other Studiesas follows.

Table 17: Incidence of Pleural effusion among the total number of cases studied

Sr. No.	Study	Place	Pleural effusion total
1	Chaterjee et al	Loni	45.83 %
2	Venkatasai PM et al	Chennai	71.8 %
3	Mia M W et al	Dhaka	42 %
4	Present study	Mumbai	43 %

In comparing the severity among Dengue positive, 68 % of severe dengue had pleural effusion, where as it was 34.66 % in milder form of dengue, with significant difference noted between severe and mild dengue (p= 0.003). This indicates that, pleural effusion is a good sonographical variable in predicting the severity of dengue fever. Pleural effusion right sided and bilateral only observed not left sided pleural effusion. Other comparable studies include.

Table 17.1: Comparison of Pleural effusion between Mild and Severe Dengue

Sr. No.	Study	Place	Mild dengue	Severe Dengue
1	Setiwan et al	Jakarta	30 %	95 %
2	Mehdi S A et al	Faisalabad	8.8 %	60 %
3	Pramuljo and Harun	Jakarta	-	100 %
4	Present study	Mumbai	34.66 %	68 %

Study by Pramuljo and Harun found pleural effusion in all 29 severe cases of dengue fevere. Our study is consistent with study done by Setiwan et al in predicting the severity of dengue fever as p= < 0.01

Hepatomegaly -Volumetric increase of organs is a non-specific finding and can be taken into consideration in both clinical and sonographic context of plasma leakage.

At autopsy, Bhamaraprathi et al. Found enlarged liver in dengue caseswith fatty change, focal necrosis and haemorrhages demonstrable onhistology. (16)

In the present study, Hepatomegaly was seen in 40% of total number of cases. Incidence of Hepatomegaly in dengue fever in our study is comparable with the study done by Mia M W et al from Dhaka and incidence of hepatomegaly observed in various other studies include.

Table 18: Incidence of Hepatomegaly among the total number of cases studied

Sr. No.	Study	Place	Hepatomegaly Total
1	Chaterjee et al	Loni	87.5 %
2	Venkatasai PM et al	Chennai	34.3 %
3	Mia MW et al	Dhaka	54 %
4	Present study	Mumbai	40 %

In comparing severity, our study found that 44 % of mild and 28 % of severe dengue cases Hadhepatomegaly with no significant difference between them (p= 0.15) Comparable studies include.

Table 18.1: Comparison of Hepatomegaly between Mild and Severe Dengue

Sr. No.	Study	Place	Mild Dengue	Severe Dengue
1	Setiwan et al	Jakarta	49 %	56 %
2	Mehdi S A et al	Faisalabad	26.6 %	60 %
3	Present study	Mumbai	44 %	28 %

Our study correlate with the study done by Setiwan et al with no significant difference found between mild and severe dengue, starting that it supports the diagnosis rather than predicting the severity.

Splenomegaly

In the present study, splenomegaly was seen in 6 % of total number of cases. Incidence of Splenomegaly in Dengue fever in our study is comparable with the study done by Venkatasai et al and incidence of splenomegaly observed in various other studies include.

Table 19: Incidence of Splenomegaly among the total number of cases studied.

Sr. No.	Study	Place	Splenomegaly
1	Chaterjee	Loni	35. 4 %
2	Venkatasai PM et al	Chennai	15.5 %
3	Mia M W et al	Dhaka	18 %
4	Present study	Mumbai	6 %

In comparingseverity, splenomegaly was found in 5.3 % of the mild cases and 8 % in severe cases with no significant difference noted between two groups (p = 0.65). Indicating that it does not predict the severity. Other comparable studies include.

Table 19.1: Comparison of Splenomegaly between Mild and Severe Dengue

Sr. No.	Study	Place	Mild	Severe
1	Setiwan et al	Jakarta	16 %	16 %
2	Mehdi SA et al	Faisalabad	22.2 %	40 %
3	Present study	Mumbai	5.3 %	8 %

The study done by Setiwan also concluded that, Splenomegaly does not predict the severity.

Perinephric edema

Perinephric edema is usually noted on the fourth to fifth day of illness. The pararenal and perirenal Fluid collections may be a sign of severe illness.

In the present study, perinephric edema as seen in 10 % of the total number of cases. Incidence of Perinephric edema in Dengue fever in our study is comparable with the study done by Setiwan et al. Incidence of perinephric edema observed in various other studies include.

Table 20: Incidence of perinephric edema among the total cases studied

Sr. No	Study	Place	Perinephric edema
1	Mia MW et al	Dhaka	15 %
2	Setiwan et al	Jakarta	78 %
3	Present study	Mumbai	10 %

In comparing the severity in our study 40 % cases of severe dengue had perinephric edema and none of the mild cases of dengue fever showed it, with significant difference noted between the two groups (p = 0.000001) indicating that it is a highly significant sonological variable to predict the severity.

Table 21: Comparison of perinephric edema between mild and severe dengue

Sr. No.	Study	Place	Mild cases	Severe cases
1	Setiwan	Jakarta	Nil	78 %
2	Present study	Mumbai	Nil	40 %

One case of perinephric edema was found in mild dengue, which is comparable to the observations made by Setiwan et al where no case has been reported in the mild dengue fever.But study done by Mia MW etal noted four cases (8.6%) of grade it DHF (belong to mild group as Per our categorization) having perinephric edema explaining that perinephric edema can be seen in mild Group but prop monitoring of child is needed to ensure that, he/she does not progress to severe dengue (Shock).

Sonographic findings of dengue fever have been described in severe literature. Some authors even conclude that during an epidemic the ultrasonic finding of gall bladder wall thickening with or without Poly-serositis in a febrilepatient should suggest the possibility of dengue fever. Since there is a variation in sonographic findings with comparison to other studies, these may be because of viral virulence, genetic back ground, immunological responses and increases pathogenesis of specific Serotype, Evidence from the difference studies show that pathogenesis of the haemorrhagic fever may be Multifactorial and the understandings remain incomplete. Furthermore, demographic, economic, behaviour and social factors are often plays a key role for effective communication of disease control thus dengue fever epidemics vary in severity with some epidemics having high mortality rate.

In our study the incidence of GBWT, pericholecystic edema is 80% among the total dengue cases studied. Along with ascites, pleural effusion supported by hepatomegaly, splenomegaly and other clinical features can be used as sonographical markers for early diagnosis of dengue fever during dengue epidemics.

There was significant difference noted between mild and severe cases of dengue fever related to sonographical variable like ascites, pleural effusion and perinephric edema with (p= 0.0001, 0.003, 0.000001), respectively, thus proving that these parameters play a role in predicting the severity of Dengue fever.

Though ultrasound abdomen can detect early signs of disease and predict severity in diagnosed Cases for all purposes serology of dengue virus remains gold standards in the diagnosis of the disease.

6. Summary

- Total number of cases studied 200.
- Male to female ratio was 2.0: 1 Male=134, female=66
- Maximum number of patients belonged to the age group of 10-20yr (33%) >20-30yr (21%) >O-10yr (19%) >30-40yr (15%) > 40-50yr (7%) >more than 50yr (4%)
- Mean age of presentation was--; 22.45years and 15, 26years for females and males respectively.
- Fever was the most common and prominent symptom in both the groups and those with hypotension were grouped under severe dengue group. Dengue fever cases were divided into mild dengue fever (DF and DHFI- II i.e. without shock) and severe dengue fever group (DHF III-IV with shock).Mild dengue fever group constituted 75% of the cases and severe Dengue group 25% of the cases. Rising haematocrit values and decreasing platelet count associated with severity of dengue fever.
- Ultrasonography done during the critical period of dengue fever i.e. within 3-7days of fever, showedfollowing incidences among total number of cases studied --GBWT=80%, pericholecystic edema =77%, Ascites = 60%, pleural effusion 40%, hepatomegaly=54%, splenomegaly=13% and perinephric edema = 10%.
- Ultrasonography in the mild group revealed---GBWT=76%, pericholecystic edema = 72%, ascites = 46.66%, pleural effusion = 34.66%, hepatomegaly = 44%, splenomegaly = 5.33% and perinephric edema = 0%.
- Ultrasonography in the severe group revealed --GBWT = 92%, pericholecystic edema = 92%, ascites = 96% pleural effusion = 68%, hepatomegaly = 84%, splenomegaly = 36% and perinephric edema = 40%.
- There was significant statistical difference noted between mild and severe cases of dengue fever related to sonological variables like ascites, pleural effusion, and perinephric edema. Which help in predicting the severity of Dengue fever. GBWT. Pericholecystic edema is seen in

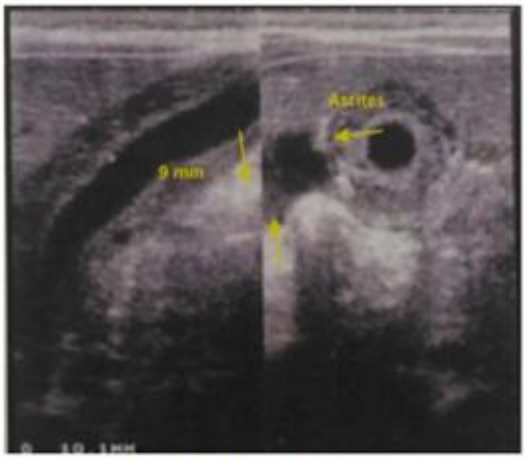
more than 80% of dengue Cases. Supported by hepatomegaly, splenomegaly and other clinical Features can be used as sonographical markers for early diagnosis of Dengue fever during an epidemic.

7. 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 is useful for early prediction of the severity of dengue fever, thus helps in triage and prevention of those cases which will further progress to dengue. haemorrhagic fever or dengue shock syndrome.
- Ultrasound abdomen supported with lab parameters like rising haematocrit 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.

IMAGES

USG showing GB pseudo wall thickening



USG showing GB pseudo wall thickening (magnified)

USG showing gross ascites

Mild Hepatomegaly in 5 yrs old, Male patient

Mild Spleenomegaly in Same patient

Mild Ascites in same patient

USG showing perinephric hypoechoic area s/o Perinephric edema

USG showing perinephric edema in another case.

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