IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 15, Issue 12 Ver. VIII (December. 2016), PP 43-50
www.iosrjournals.org

Role of Ultrasonography in Diagnosing and Predicting the Severity of Dengue Fever

Dr Kanaga Durga S[1], Dr Sundari Natarajan[2], Dr Murali Nanjundan[3], Dr P.P.Balamurugan[4]
[1,2,3,4]*(Department Of Radiodiagnosis, Coimbatore Medical College, Tamilnadu, India)*

Abstract
Aim: *To evaluate whether ultrasonography could be used as a potential tool in addition to the clinical and laboratory profile in diagnosing and predicting the severity of dengue fever.*
Settings and Design: *Retrospective study. Ultrasonography was done in 210 patients who were suspected to have dengue fever between November2015 to February 2016. Upon follow up, 150 patients proved to be serologically positive and 60 patients proved negative. Ultrasonographic imaging findings in these patients were assessed and correlated with platelet count and the day of febrile illness.*
Results: *Among 150 patients, 96 (64%) had gall bladder wall edema, 46(30.6%) had bilateral pleural effusion, 32 (21.3%) had unilateral pleural effusion, 33(22%) had minimal ascites, 74(49.3%) had significant ascites, 52(34.7%) had splenomegaly and 47(29.3%) had hepatomegaly. Pericardial effusion was seen in 9 patients (6%). Gall bladder wall edema(odd's ratio 5.0), significant ascites(odd's ratio 3.2) and pleural effusion(odd's ratio 2.9) were more commonly seen when ultrasound was performed prior to fifth day. Gall bladder wall edema was (odds ratio – 10.1) more commonly seen in patients with lower platelet counts and also there was a significant statistical relationship of observing hepatomegaly(odds ratio 3.8), pleural effusion(odds ratio 6.8) and ascites(odds ratio 9.6) in patients with platelet count of less than 40000.Pericardial effusion was seen in 9 patients and all of them had platelet count less than 20000.Among 7 patients with platelet count of more than 120000, all of them had normal ultrasonographic study of abdomen.*
Conclusion: *GB wall edema, pleural effusion, ascites should strongly favor diagnosis of dengue fever in patient who present with fever and thrombocytopenia and the degree of thrombocytopenia showed a significant statistical correlation to the imaging findings.*
Keywords*: dengue fever, ultrasonography, platelet count, gall bladder wall edema*

I. Introduction

Dengue fever is an acute febrile illness caused by virus that belongs to flavi-viridae family and it is transmitted by *Aedes aegypti* mosquito. Dengue fever is endemic in tropical and subtropical countries and the disease has a seasonal pattern with the epidemics often occurring during rainy season due to increased breeding of vector mosquitoes [1].

Dengue fever manifests as sudden onset of high grade fever, headache, retro-orbital pain, muscle and joint pain. When the disease becomes severe, the bleeding manifestations and features of shock develop. There are four serotypes of viruses causing dengue. The severe form of dengue fever is caused by infection with more than one serotype[2]. The spectrum of dengue virus infection includes asymptomatic viral infection, symptomatic acute febrile illness, dengue hemorrhagic fever and dengue shock syndrome. Increased capillary permeability is the main pathological process that leads to various clinical, hematological and ultrasonographic manifestations of dengue[3].

The purpose of the study was to examine the ultrasonographic features in abdomen and thorax of the patients suffering from dengue fever, with the main aim of identifying if ultrasound would become an adjunct to clinical and laboratory profile to diagnose dengue fever. The second objective was to correlate the ultrasonographic features with the platelet count in order to assess whether ultrasonography can predict the severity of disease.

II. Materials And Methods

This retrospective study was performed in Department of Radio diagnosis, Coimbatore Medical College & Hospital(CMCH),Coimbatore, Tamilnadu during the period November 1st 2015to February 28th 2016.Our centre serves as a tertiary radiological referral hospital. An informed consent was not required as this was a retrospective study.

About 210 patients who were clinically suspected to have dengue fever during the study period were referred for ultrasonography. Upon follow up of these patients, it was found that 150 patients were serologically positive for dengue virus and 60 patients were serologically negative.

The ultrasound examination was performed with Sonoscape ultrasound machine using 3.5MHz and 5MHz probes. Ultrasound scan of the abdomen and pelvis was performed six hours after fasting in order to attain better distension of gall bladder(GB) [4]. Gall bladder wall thickening was measured by placing the caliper between the two layers of anterior wall of gall bladder [5]. Liver was measured in its cranio-caudal length in mid-clavicular line. The length of spleen was measured from its diaphragmatic end to its lower pole at the level of its hilum. The presence of free fluid in the abdomen and pelvis assessed and grouped into minimal ascites and significant ascites. The presence of minimal free fluid in the hepato-renal pouch or only in the pelvis was classified as minimal ascites. Free fluid exceeding the above criteria was grouped as significant ascites. Both pleural spaces were also assessed through intercostal approach. Pericardial spaces were assessed in the sub-costal approach.

Serological tests for dengue include the IgM antibody for dengue and Non-structural protein(NS1) antigen. The platelet counts of 210 patients were recorded. The day from the onset of fever to the day of performing ultrasound was also recorded

III. Results

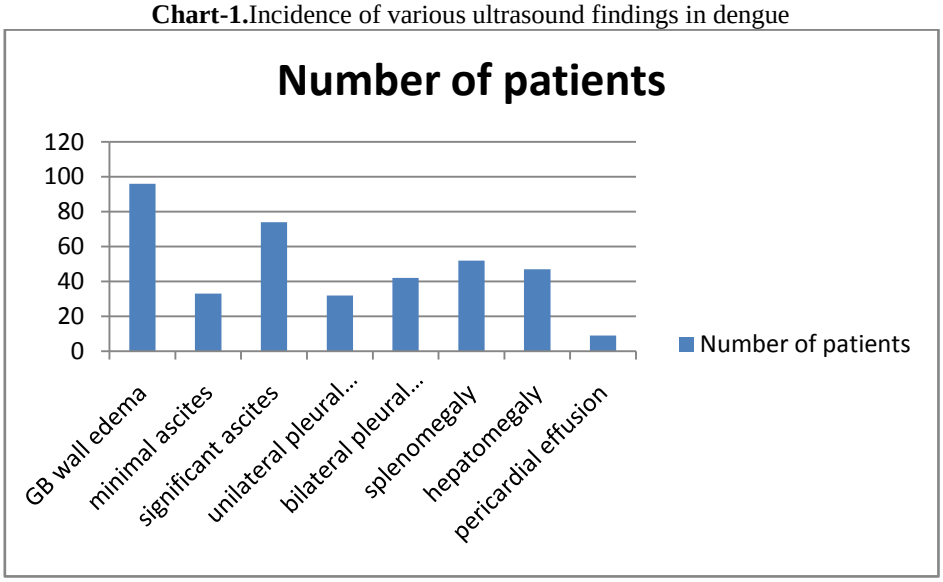
Ultrasound scan was performed for 210 patients suspected to have dengue fever. 150 patients were found to be serologically positive on follow up and the remaining 60 patients were found to be serologically negative. Among these 150 patients, 27 had normal ultrasonographic study of the abdomen and the remaining 123 had atleast one positive sonographic finding or a combination of sonographic findings**.**

In the study population, the incidence of the ultrasonographic features was expressed as percentages. The association of the various ultrasonographic features with age group, platelet count, day of performing ultrasound from the onset of fever were assessed with ANOVA(Analysis of variance) test and odds ratio of more than one was considered for statistical significance.

3.1 Incidence of various ultrasound findings in dengue

Among the total of 150 serologically positive patients, 96 (64%) had gall bladder wall edema, 32 (21.3%), had unilateral pleural effusion, 46 (30.6%) had bilateral pleural effusion, 74(49.3%) had significant ascites, 33 (22%) had minimal ascites, 52 (34.7%) had splenomegaly and 47 (29.3%) had hepatomegaly. Pericardial effusion was seen in 9 patients (6%).

Chart-1. Incidence of various ultrasound findings in dengue

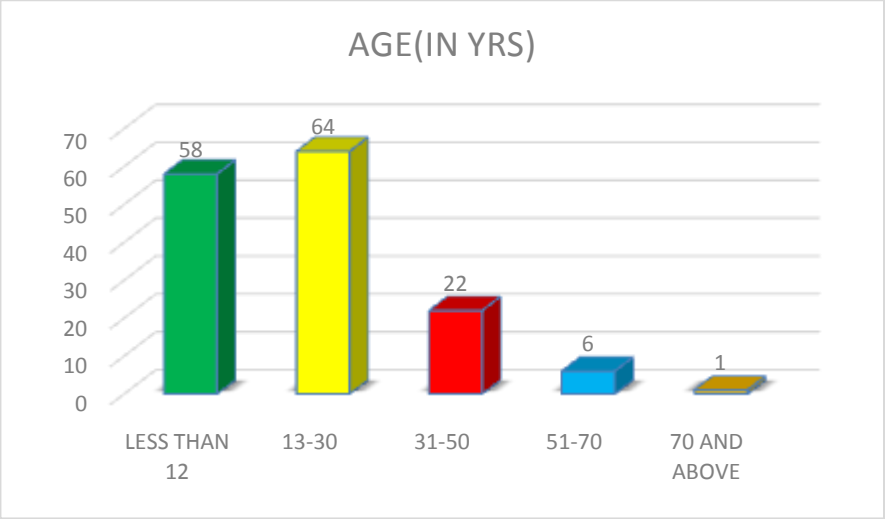


3.2.Significance of age difference between pediatric and adult population

In our study 39% of the study population belonged to pediatric age group(less than 12 years of age). Among the adult population, majority of the patients belonged to 13 to 30 years of age (42.7%) which comprised of 64 patients. Gall bladder wall edema, ascites, pleural effusion, pericardial effusions were more commonly seen in pediatric age group with odds ratio of 4.2, 5.2, 7.2, 1.2, respectively, suggestive of statistical

significance. Hepatomegaly, splenomegaly and minimal ascites did not have statistical significance as their odds ratio was less than one.

Chart-2. Age distribution of 150 dengue fever patients in the study



3.3. Incidence of sonographic features in relation to day of performance of ultrasonography

For 48 patients, ultrasound scan was performed from third to fifth day from the onset of fever. 102 patients had ultrasonography done beyond the fifth day. The analysis proved that when the scan was performed before the fifth day from the onset of fever, there are more chances of obtaining positive findings compared to ultrasound scan done after the fifth day. The odd's ratio for the ultrasonographic findings of gall bladder wall edema, significant ascites, pleural effusion were 5.0, 3.2 and 2.9 respectively. Thus, it was proved in our study that gall bladder wall edema, significant ascites and pleural effusion were more commonly seen when ultrasound was performed from the third to the fifth day, which corresponded to the critical phase of dengue fever in which the capillary leak is maximum.

Chart-3. Distribution of patients referred for USG with respect to the day of onset of fever

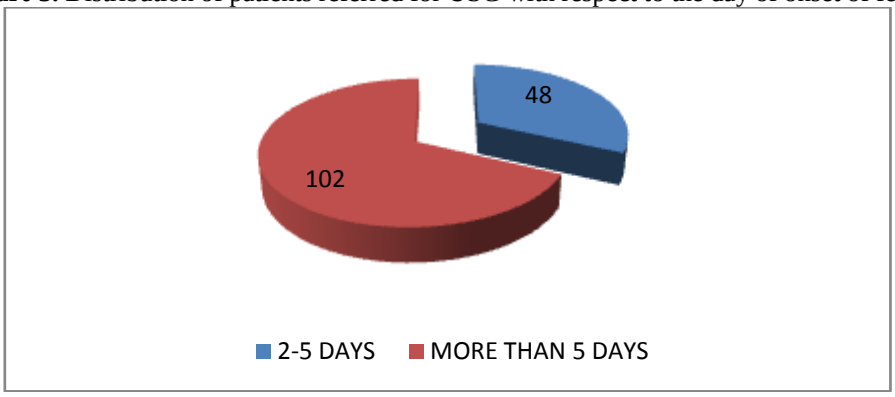
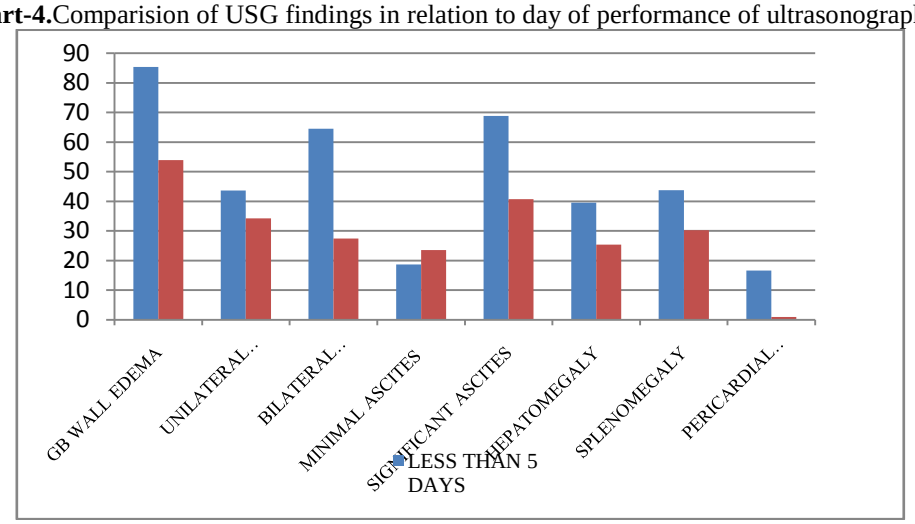


Table-1.Comparision of USG findings in relation to day of performance of ultrasonography

Usg Findings	< 5 Days Of Fever Onset	> 5 Days Of Fever Onset
Gb Wall Edema	85.4%	53.9%
Unilateral Pleural Effusion	43.7%	34.3%
Bilateral Pleural Effusion	64.5%	27.4%
Minimal Ascites	18.7%	23.5%
Significant Ascites	68.8%	40.7%
Hepatomegaly	39.5%	25.4%
Splenomegaly	43.8%	30.3%
Pericardial Effusion	16.6%	0.98%

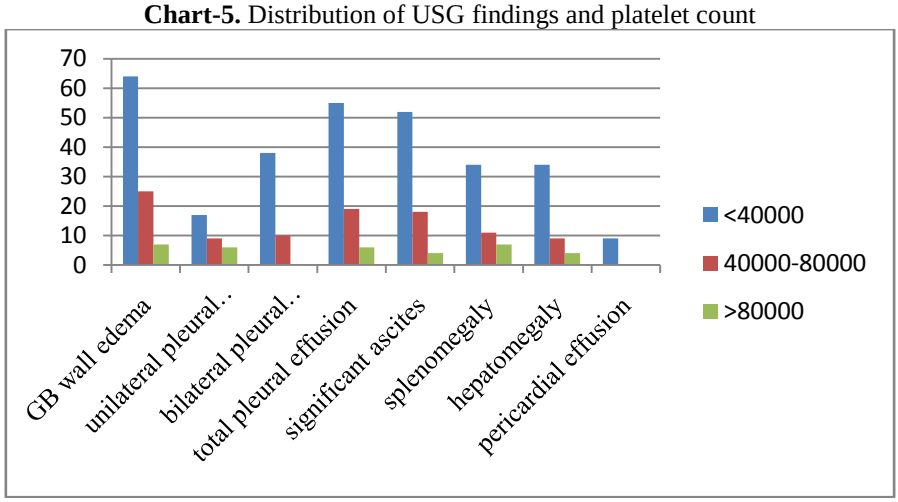
Chart-4. Comparision of USG findings in relation to day of performance of ultrasonography



3.4. Correlation of ultrasound findings with platelet count

A total of 150 patients were divided into three groups based on the platelet count. Group I comprised of 73 patients with platelet count less than 40000, group II includes 46 patients with platelet count 40000-80000 and group III includes 31 patients with platelet count more than 80000. Gall bladder wall thickening was observed in most of the patients of the group I being present in 64 patients (87.6%). Pleural effusion was also seen more commonly in this group. Unilateral pleural effusion was seen in 17 patients (23.2%) and bilateral pleural effusion was seen in 38 patients (52%) . Ascites was seen in 52 (71.2 %) of group I patients. GB wall edema was most commonly seen in group I compared to group II and least common in group III. Gall bladder wall edema was significantly (odds ratio – 10.1) more commonly seen in patients with lower platelet counts. There was significant statistical relationship of observing ascites(odds ratio 9.6), pleural effusion(odds ratio 6.8) and hepatomegaly(odds ratio 3.8) in patients with platelet count of less than 40000. Pericardial effusion was seen in 9 patients and all of them had platelet count less than 20000. Among 7 patients with platelet count of more than 120000, all of them had normal ultrasonographic study of abdomen.

Chart-5. Distribution of USG findings and platelet count

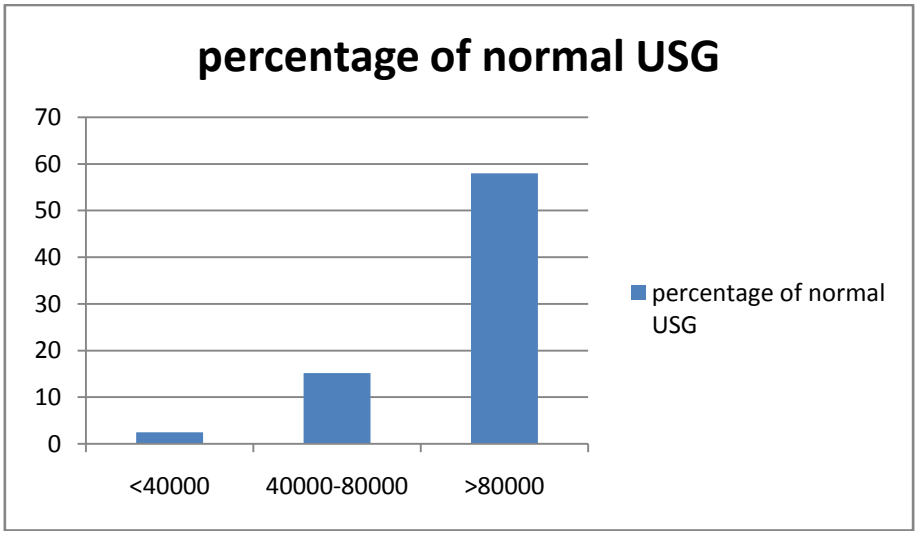


3.5. Ultrasonographic findings in seronegative patients

A total of 210 patients, who were clinically suspected to have dengue fever, were referred for ultrasonography. Upon follow up it was found that 150 patients were seropositive and 60 were seronegative. Among those 60 seronegative patients, 56 patients had normal study of the abdomen and pelvis. Two cases on follow up were found to have nephrotic syndrome and they had ascites and bilateral pleural effusion. One case had decompensated liver disease which had gall bladder edema, splenomegaly, right pleural effusion and ascites. Another, one case had chronic renal failure which had ascites and bilateral pleural effusion.

3.6. Correlation of normal USG study with platelet count

Among the total of 150 patients studied, 27 patients had normal ultrasonography of abdomen. The patients belonging to group III, i.e. with platelet count above 80000, 18 patients (58%) had normal USG study of which, USG was done beyond the fifth day in 14 patients. In the group II patients, 7(15.2%) patients had normal USG study and USG was performed beyond the fifth day of fever in all these 7 cases. Among those patients belonging to group I with platelet count of less than 40000, 2(2.5%) patients had normal USG study of abdomen and in both these patients USG was performed in the seventh day from the onset of fever.



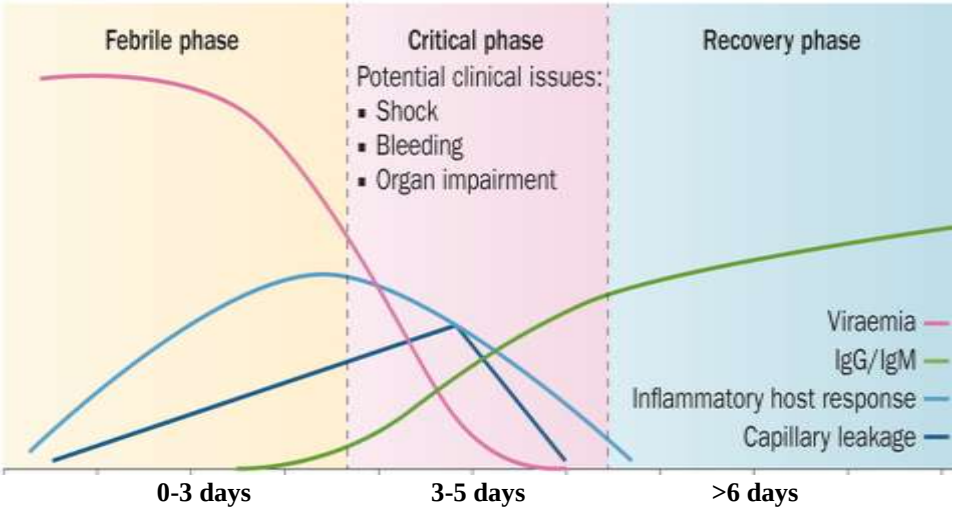
Discussion

Dengue fever constitutes one of the most common arthropod borne viral febrile illness, being endemic in tropical and subtropical countries with outbreaks occurring during monsoon [6] due to increased breeding of mosquito. Classical dengue fever manifests clinically as sudden onset of high grade fever with chills, rigor, intense retro orbital pain, headache, muscle joint pain and hence also known as break-bone fever. The severe form of dengue includes the dengue shock syndrome and dengue haemorrhagic fever [2]. These severe forms of dengue occur when infection with more than one serotype of virus occurs. The first infection probably sensitises the person and the second serotype induces the immunological response [7]. Increased capillary permeability is the key factor behind the pathogenesis of dengue, which manifests as GB wall edema, ascites and pleural effusion [8].

Serology remains the main diagnostic test of dengue fever. But haemagglutionation inhibition antibody appears at detectable levels by around day 5-6 of febrile illness and hence it would take about 7 days to confirm the diagnosis. Ultrasound has several advantages, being a non invasive, safe, cost effective imaging modality, which is readily available and does not utilise ionising radiation. The increased capillary permeability of dengue fever leading to GB wall edema, ascites, pleural pericardial effusions, organomegaly could be readily picked up by ultrasonography. The main aim of our study is to make an earlier diagnosis of dengue fever with the help of ultrasonography even before the serological reports arrive, which would help in better management, thus reducing the mortality.

The course of dengue fever can be divided into three phases; febrile phase, critical phase, recovery phase. In febrile phase, there is rise in temperature associated with myalgia, vomiting, epigastric discomfort and headache. This phase lasts for up to about three days. In the critical phase (third to fifth day), there is a significant increase in capillary permeability which leads to thrombocytopenia and fall in haematocrit. This increase in capillary permeability leads to the occurrence of GB wall edema, pleural effusion and ascites. Hence, it is during the critical phase ultrasonography demonstrates GB wall edema, ascites and pleural effusions. The recovery phase (beyond the sixth day) is characterised by the gradual resorption of the fluid in extra vascular compartment. The general well being of the patient improves, the hemodynamic status of the patient stabilises and the platelet count rises towards normal.

Chart-6. Course of dengue febrile illness

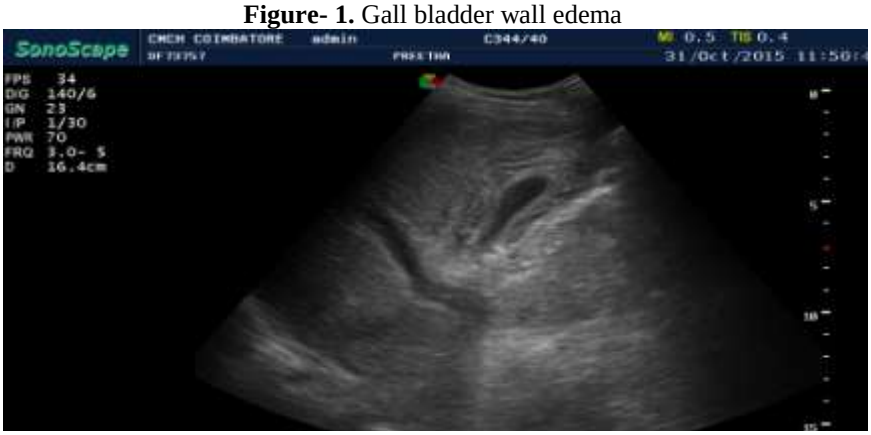


4.1 GB wall edema:

GB wall thickness is obtained on the anterior sub hepatic wall in order to avoid artefacts produced by the adjacent intestinal gas and thickness of more than 3 mm in a distended GB is considered as thickened GB wall[8]. Dengue presents with striated pattern of GB wall thickening as a result of increased fluid accumulation between GB wall layers that produces striations [9].

GB wall thickening was significantly associated with lower platelet counts as proved in our study. GB wall edema is also seen to significantly occur during the third to fifth day of fever, which proves that GB wall edema is seen to occur during the critical phase of illness[10]. But, the GB wall edema resolves faster, hence there is greater chance of picking up GB wall edema when USG is performed earlier than 5 days as proved in our study. But the main limitation of GB wall edema is its lack of specificity as it is seen in other condition like decompensated liver disease, hypoalbuminemia, acute cholecystitis and viral hepatitis.

Figure- 1. Gall bladder wall edema



4.2. Pleural and pericardial effusions and ascites

Polyserositis and increased capillary permeability are the main features of dengue haemorrhagic fever, with leakage of plasma from the intravascular space resulting in pleural, pericardial effusions and ascites especially seen during the critical phase of illness.

Pleural effusion was the most frequent finding and they could be unilateral or bilateral. Chest X-ray has lower sensitivity in picking up effusion than USG (sensitivity -93%, specificity -96 %). Pleural effusion was significantly more commonly seen in patients with low platelet count and when USG is performed within 5 days of fever onset. The onset of pleural effusion occurs soon after defervescence, usually beyond the third day[11].Bilateral and unilateral pleural effusion were commonly seen in patients with platelet count of less than 40000. In patients with platelet count of more than 80000, none of them had bilateral pleural effusion .

Figure-2. Pleural effusion

Ascites was more commonly seen in patients with low platelet and was more commonly seen during third to fifth day of illness. Hence, similar to pleural effusion, ascites also had a significant statistical correlation with low platelet count and occurring during the critical capillary leak phase of dengue.

Figure-3. Ascites

Pericardial effusion is seen in 9 patients in our study. All the 9 patients were paediatric cases and had very low platelet count of less than 20000. Hence, in our study it was demonstrated that the detection of pericardial effusion points to severe disease. Similarly perirenal, hepatic sub capsular fluid collections were observed in 22 cases all had platelet count less than 20000. Hence, the presence of pericardial, perirenal, hepatic subcapsular fluid points to severe disease.

Hepatomegaly was observed in 34 patients with platelet count less than 40000 and in 9 patients with platelet count between 40000-80000. Splenomegaly was seen in 34 patients with platelet count of less than 40000 and in 11 patients with platelet count (40000 – 80000). But statistically both hepatomegaly and splenomegaly did not prove to be significant in the correlation with platelet count.

There were 7 patients who had platelet court more than 120000 all of them had normal study of USG abdomen.

4.3. Comparision with previous studies

Venkata Sai et al.[10] had studied 88 children belonging to the age group of two-nine years, who were serologically positive for dengue. In their study it was demonstrated that gallbladder wall thickening was seen in 100% of the patients when ultrasonography was performed between the second and seventh day of fever onset. This was followed by pleural effusion. Hence, the authors had concluded that during the epidemic, gallbladder wall edema, with or without other signs of polyserositis, like ascites or pleural effusion, should strongly suggest the possibility of dengue. In our study, GB wall edema was seen in 85.4% of the patients in whom USG was performed before fifth day. This was followed by pleural effusion and significant ascites. Thus, our study correlated with the study done by VenkataSai et al. That GB wall edema was the most commonly seen when USG was performed before the fifth day. Thus, the presence of GB wall edema in a febrile patient should suggest the increased likelihood of dengue fever.

In the study conducted byV. R. Santhosh et al.[12] 96 sero-positive dengue patients were examined with ultrasonography. It was found that 64 (66.7%) patients had GB wall thickening, 62 (64.5%) patients had ascites, 48 (50%) patients showed pleural effusion, 17 (17.7%) patients showed hepatomegaly, 16 (16.7%) patients had splenomegaly and in 17 (17.7%) patients ultrasound findings were normal. The most common combination of findings were GB wall edema, ascites and pleural effusion which was seen in all age groups. GB wall edema was seen in 97.8% of patients whose platelet count was less than 40,000 followed by ascites (86.9%) and pleural effusion (58.6%). No abnormal sonographic finding was seen in patients whose platelet counts were more than 150,000.Our study correlated well with this study as it was observed that GB wall thickening was observed in most of the patients of the group I being present in 64 patients (87.6%), right pleural effusion seen in 56 patients (76.17 %), left pleural effusion in 41 patients (56.2 %) and bilateral pleural effusion was seen in 34 patients (43.8%). Ascites was seen in 52 patients (71.2 %). GB wall edema was most commonly seen in group I compared to group II and III. Seven patients with platelet count of more than 1,20,000 had normal sonographic study of the abdomen. Hence, our study also proved that degree of thrombocytopenia showed a significant direct correlation to the ultrasound findings.

Sudhir Sachar et al,[13] had done a study on 20 patients with dengue fever, which was confirmed with platelet count and serologic tests. USG features included thickened GB wall in all(100%) patients, ascites was seen in 15 patients (75%), splenomegaly was present in 8 patients (40%), and pleural effusion in 14 patients (70%). The pleural effusion seen was either bilateral or unilateral, but never seen alone on the left side. In our study done on 150 patients,96 patients (64%) had gall bladder wall edema, 80 patients (53.3%) had left pleural effusion, 81 patients (54%) had right pleural effusion, 46 patients (30.6%) had bilateral pleural effusion, 74(49.3%) patients had significant ascites, 52 patients (34.7%) had splenomegaly. As opposed to this study done by Sudhir Sachar et al. our study showed 34 patients having unilateral left-sided pleural effusion. Thus, it was proved in our study that unilateral left-sided pleural effusion can also be seen in dengue fever patients.

IV. Conclusion

Ultrasonographic features that include GB wall edema, pleural effusion (unilateral and bilateral), ascites, should strongly favor diagnosis of dengue fever in a patient who presents with fever and thrombocytopenia, especially during an epidemic. It helps in making the diagnosis of dengue fever in patients awaiting their serological reports. Hence, ultrasound being a simple bed side tool would effectively predict whether the acute febrile illness could be dengue fever. In our study, the severity of disease was predicted with the help of ultrasound. The degree of thrombocytopenia showed a significant statistical correlation to the ultrasound features of dengue fever especially GB wall edema, ascites and pleural effusion. Thus ultrasonography is a simple and valuable tool in diagnosing and predicting severity of dengue fever.

References

[1]. K.PARK.2011."Textbook of preventive and social medicine"21 edition.Social preventive medicine;224-225
[2]. Monograph on Dengue/Dengue Haemorrhagic fever, Compiled by Prasert Thongchroen, Regional Publication, WHO (1983); SEARO No. 22
[3]. Setiawan MW, Samsi TK, Wulur H, et al. Dengue haemorrhagic fever: ultrasound as an aid to predict the severity of the disease. PediatrRadiol. 1998;28:1-4.
[4]. Nelson ER. Hemorrhagic fever in children :report of 69 cases.JPaediatric 1960 ;56;101-8
[5]. Shlaer WJ , Leopold JR, Scheible FW .sonography of thickened gall bladder wall : a non specificfinding.AJR Am J Roentgenol 1981 ;136:337-9
[6]. Ukey P, Bondade S, Paunipagar P, Powar R, Akulwar S. Study of seroprevalence of dengue Fever in central India. Indian J Community Med. 2010;35:517–9.
[7]. Vabo KA, Torres Neto G, Santos AASMD, et al. Achados ultra-sonográficosabdominaisempacientes com dengue. Radiol Bras. 2004;37:159-62.
[8]. HB, DiPietro M, Barber FE, et al. Sonography of thickened gallbladder wall: causes in children. AJR Am J Roentengol. 1983;141:57-60.
[9]. Teefey SA, Baron RL, Bigler SA. Sonography of the gallbladder: significance of striated (layered) thickening of the gallbladder wall. AJR Am J Roentgenol. 1991;156:945-7.
[10]. VenkataSai PM, Dev B, Krishnan R. Role of ultrasound in dengue fever. Br J Radiol. 2005;78: 416-8
[11]. Balasubramanian S, Janakiraman L, Kumar SS, et al. A reappraisal of the criteria to diagnose plasma leakage in dengue hemorrhagic fever. Indian Pediatr. 2006;43:334-9.
[12]. V. R. Santhosh et al.Sonography in diagnosis and assessment of dengue fever.J Clin Imaging Sci. 2014; 4: 14.
[13]. SudhirSachar, Sunder Goyal, SaurabhSacha. Role of Ultrasonography ("Honeycomb Sign") in Early Detection of Dengue Hemorrhagic Fever.archClinExp Surg. 2013; 2(1): 38-42