PROFILE OF CHEST AND ABDOMEN ULTRASOUND ON PATIENTS WITH DENGUE VIRUS INFECTION IN DR. SOETOMO HOSPITAL SURABAYA BETWEEN FEBRUARY-APRIL 2012

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ABSTRAK

Penelitian ini dilakukan untuk mengetahui profil ultrasonografi toraks dan abdomen pada penderita infeksi virus dengue di RSUD dr. Soetomo. Penelitian ini adalah penelitian deskriptif cross-sectional dengan consecutive sampling. Dari bulan Februari hingga April 2012. Sampel teridiri dari 33 pasien anak dan 25 pasien dewasa terdiagnosis sebagai demam dengue dan demam berdarah dengue menurut kriteria WHO 1997 yang menjalani pemeriksaan ultrasonografi toraks dan abdomen pada hari pertama masuk rumah sakit. Temuan ultrasonografi pada penderita anak antara lain hepatomegali (39,4%), splenomegali (6,1%), penebalan dinding gallblaDFer (51,5%), asites (27,3%), perinephric fluid (15,2%) efusi pleura kanan dan bilateral (15,2% dan 21,2%). Temuan ultrasonografi pada penderita dewasa antara lain hepatomegali (24%), splenomegali (12%), penebalan dinding gallblaDFer (32%), asites (24%), perinephric fluid (12%), efusi pleura kanan dan bilateral (8% dan 12%). Terdapat korelasi signifikan antara jumlah temuan dengan derajat beratnya penyakit pada penderita anak ($p < 0.05$). Beberapa penderita anak secara klinis didiagnosis sebagai demam dengue dan pada ultrasonografi didapatkan temuan-temuan kebocoran plasma. Ultrasonografi menunjukkan adanya hepatomegali, splenomegali, penebalan dinding gallblaDFer, asites, perinephric fluid dan efusi pleura pada penderita dengan infeksi virus dengue. Pemeriksaan ultrasonografi dapat digunakan sebagai alat gambar dalam mengevaluasi penderita dengan infeksi virus dengue sehingga didapatkan penanganan dan pengawasan penderita yang lebih tepat. ***(FMI 2013;49:237-243)***

Kata kunci: ultrasonografi toraks, ultrasonografi abdomen, infeksi virus dengue, demam dengue, demam berdarah dengue

ABSTRACT

*This study was conducted to evaluate the chest and abdominal ultrasonography findings in patients with dengue viral infection in dr. Soetomo General Hospital. This study is a descriptive, cross-sectional study with consecutive sampling. It done from February to April 2012. Samples were 33 pediatric patients and 25 adult patients diagnosed as dengue fever and dengue hemorrhargic fever according to WHO 1997 criteria underwent chest and abdominal ultrasonography on the first day of admission. The sonographic findings in pediatric patients including hepatomegaly (39,4%), splenomegaly (6,1%), thickened gallblaDFer wall (51,5%), ascites (27,3%), perinephric fluid (15,2%) right and bilateral pleural effusion (15,2% and 21,2%). The sonographic findings in adult patients including hepatomegaly (24%), splenomegaly (12%), thickened gallblaDFer wall (32%), ascites (24%), perinephric fluid (12%), right and bilateral pleural effusion (8% and 12%). There is significant correlation between the number of findings and the severity of disease in pediatric patients ($p < 0.05$). Several pediatric patients clinically diagnosed as dengue fever had ultrasonographic findings of plasma leakage. Ultrasonography shows hepatomegaly, splenomegaly, thickened gallblaDFer wall, ascites, perinephric fluid and pleural effusion in patients with dengue viral infection. Ultrasonography examination can be used as imaging modality in evaluating patients with dengue viral infection for better monitoring and treatment.****(FMI 2013;49:237-243)***

Keyword: *chest ultrasonography, abdominal ultrasonography, dengue viral infection, dengue fever, dengue hemorrhargic fever*

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INTRODUCTION

Dengue virus infection (IVD) is an acute viral infection caused by dengue virus serotypes with four types (DEN 1, 2, 3 and 4) are transmitted through mosquito Aedes aegypti and Aedes albopictus. IVD is a Flavivirus infection most of the world, including in tropical countries such as Indonesia, and remains a significant health problem. Data from the Ministry of Health showed that IVD morbidity increased from 0.05 in 1968 to 35.19/100,000 population in 1998 to 58.85/100,000 population in 2008, but the death rate decreased from 41.3% in year 1968 to 0.86% in 2008

IVD may not cause symptoms/asymptomatic, but can also cause a fever that is not typical, dengue fever (DF), dengue hemorrhagic fever (DHF), to dengue shock syndrome. DHF can lead to increased vascular permeability resulting in leakage of plasma with manifestations such as pleural effusion and ascites. In

DHF can occur enlarged abdominal organs such as hepatomegaly, splenomegaly and an enlarged pancreas. Ultrasonography (USG) can detect a variety of conditions with better sensitivity than physical and radiographic examination. Research on ultrasound findings in patients with IVD still slightly in Indonesia. It is hoped this research can help show the ultrasound findings that exist in patients with IVD.

MATERIALS AND METHODS

This research was a quantitative descriptive observational design. Descriptive study did not look for or explain the mutual relations as well as to test the hypothesis. Purpose of this descriptive study was to create a description of the picture in a systematic, factual and accurate information about the findings of thoracic and abdominal ultrasonography in patients with dengue virus infection dr. Soetomo general hospital. The study was conducted with a cross sectional survey method.

Subjects were all patients with a diagnosis of dengue virus infection that met criteria for inclusion in the inpatient tropic men and women (adult patients) as well as the inpatient children in dr. Soetomo general hospital from February 2012 to April 2012. Inclusion criteria were all patients with a diagnosis of dengue virus infection according to WHO 1997 criteria, with no abnormalities or a history of other diseases, such as liver and kidney disorders, blood disorders, autoimmune diseases, heart failure, malignancy, obesity and malnutrition. Thoracic and abdominal ultrasound examination performed on the first patient in the hospital. Sampling was conducted in consecutive sampling during the study period.

RESULTS

In this research, children who met the inclusion criteria were 33 patients, consisting of 13 men (39.4%) and 20 women (60.6%) with age <10 in 27 patients (81.8%) and> 10 years and 6 patients (18.2%). The age range of patients between 1-14 years. The mean patient age 7.06 years.

Table 1. Distribution of Children Patients by Age

Age	Frequency	Percentage
< 10 year	27	81.8
> 10 year	6	18.2
Total	33	100.0

Table 2. Distribution of Children Patients According to Sex

Sex	Frequency	Percentage
Male	13	39.4
Female	20	60.6
Total	33	100.0

Table 3. Distribution of Adult Patients According to Age

Age	Frequency	Percentage
< 20 year	7	28.0
21-30 year	9	36.0
31-40 year	6	24.0
41-50 year	2	8.0
> 50 year	1	4.0
Total	25	100.0

Table 4. Distribution of Adult Patients According to Sex

Sex	Frequency	Percentage
Man	12	48.0
Female	13	52.0
Total	25	100.0

In this research, diagnosis in child patients : DF 14 people (42.4%), DHF grade I 7 (21.2%), Grade II 10 (30.3%), and the degree III 2 (6.1%).

Table 5. Distribution of Children Patient According to Diagnose

Diagnosis	Frequency	Percentage
DF	14	42.4
DHF grade I	7	21.2
DHF grade II	10	30.3
DHF grade III	2	6.1
Total	33	100.0

Table 6. Distribution of Adult Patient According to Diagnose

Diagnosis	Frequency	Percentage
DF	2	8.0
DHF grade I	11	44.0
DHF grade II	12	48.0
Total	25	100.0

Distribution According to USG Result

In the thoracic and abdominal ultrasound examination that found in the child patient: hepatomegaly 13 (39.4%), splenomegaly 2 (6.1%), 17 GB wall thickening (51.5%), ascites 9 (27.3%), fluid about perinephric space (perinephric fluid) 5 (15.2%), pleural effusion

right 5 (15.2%), and bilateral pleural effusion 7 (21.2%). Kidney did not reveal any abnormalities.

Table 7. Distribution of Children Patient According to USG Finding

Finding	Frequency	Percentage
Hepatomegaly	13	39.4
Splenomegaly	2	6.1
GB wall thickening	17	51.5
Ascites	9	27.3
Perinephric fluid	5	15.2
Right pleural effusion	5	15.2
Bilateral pleural effusion	7	21.2

Frequency of hepatomegaly most commonly found in DHF grade III (66.7%) Followed by Grade II (55.5%). Splenomegaly was found only in DHF Grade II. GB wall thickening was found in all Patients with DHF Grade II and III. Ascites was found in all Patients with DHF grades III and as much as 55.5% in the second degree. Frequency perinephric fluid most commonly found in Patients with DHF level III (66.7%) Followed by Grade II (22.2%). Pleural effusions were found is right and bilateral pleural effusion. Right pleural effusion is most commonly found in Patients with DHF level III (33.3%). Bilateral pleural effusions are found most commonly found in Patients with DHF level III (66.7%) Followed by Grade II (44.4%). The number of ultrasound findings were found in people with children: no finding as many as 11 Patients (33.3%), 1 the findings of 8 Patients (24.2%), 2 the findings of 3 Patients (9.1%), 3 findings of 3 Patients (9.1%), 4 the findings of five Patients (15.2%), and 5 findings of 3 Patients (9.1%).

In patients with the most children with DF were no positive findings on ultrasound, a number of 8 patients of 14 patients. In patients with DHF grade I earned the highest first ultrasound findings, ie 3 patients from 7 patients; highest level II ultrasound findings obtained 4, ie 4 patients out of 10 patients, and the Grade II from 2 patients one had 4 and the other findings have 5 positive findings on ultrasound. With the level of Spearman correlation test procedure found a significant correlation between the degree of the disease with ultrasound findings in patients with the number of children ($p < 0.05$).

Table 8. Distribution of ultrasound findings at Each Degree of Disease (Children)

Finding	DF (n = 14)	DHF 1 (n = 7)	DHF 2 (n = 9)	DHF 3 (n = 3)	Total
hepatomegaly	3	3	5	2	13
	21.4%	42.8%	55.5%	66.7%	
splenomegaly	0	0	2	0	2
	.0%	.0%	22.2%	0.%	
GB wall thickening	4	1	9	3	17
	28.5%	14.3%	100.0%	100.0%	
ascites	1	0	5	3	9
	7.14%	.0%	55.5%	100.0%	
Perinephric fluid	1	0	2	2	5
	7.14%	.0%	22.2%	66.7%	
Right pleural effusion	2	1	1	1	5
	14.3%	14.3%	11.1%	33.3%	
Bilateral pleural effusion	1	0	4	2	7
	7.14%	.0%	44.4%	66.7%	

Table 9. Distribution Amount Ultrasound Findings in Children

Number of findings	Frequency	Percentage
0	11	33.3
1	8	24.2
2	3	9.1
3	3	9.1
4	5	15.2
5	3	9.1
Total	33	100.0

Table 10. The degree of illness and number of Ultrasound Findings in Children

	Amount of USG Finding						Total
	0	1	2	3	4	5	
DF	8	4	0	1	0	1	14
	24.2%	12.1%	.0%	3.0%	.0%	3.0%	42.4%
DHF gradeI	3	3	1	0	0	0	7
	9.1%	9.1%	3.0%	.0%	.0%	.0%	21.2%
DHF grade II	0	1	2	2	4	1	10
	.0%	3.0%	6.1%	6.1%	12.1%	3.0%	30.3%
DHF grade III	0	0	0	0	1	1	2
	.0%	.0%	.0%	.0%	3.0%	3.0%	6.1%
Total	11	8	3	3	5	3	33
	33.3%	24.2%	9.1%	9.1%	15.2%	9.1%	100.0%

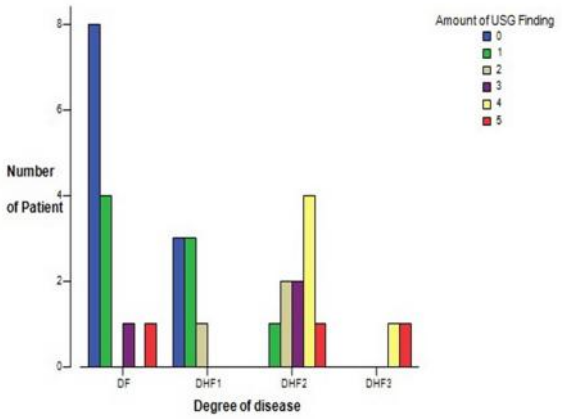


Figure 1. The degree of disease and number of ultrasound findings in Children

In the thoracic and abdominal ultrasound examination adult patients obtained: hepatomegaly 6 (24%), splenomegaly 3 (12%), 8 GB wall thickening (32%), ascites 6 (24%), perinephric fluid 3 (12%), pleural effusion right 2 (8%), and bilateral pleural effusion 2 (12%). In the kidney did not reveal any abnormalities.

Table 11. Distribution of ultrasound findings In Adult

	Frequency	Percentage
Hepatomegaly	6	24.0
Splenomegaly	3	12.0
GB wall thickening	8	32.0
Acites	6	24.0
Perinephric fluid	3	12.0
Efusion of Right Pleura	2	8.0
Efusion of Bilateral Pleura	2	8.0

The frequency of hepatomegaly, splenomegaly, GB wall thickening, ascites, perinephric fluid and bilateral pleural effusion in adults most commonly found in patients with DHF Grade II, respectively 33.3%, 16.7%, 41.7%, 33.3%, 25%, and 16.7%. Right pleural effusion was found only in patients with DHF Grade II. The number of ultrasound findings were found in adult patients: no finding as many as 13 patients (52%), 1 finding two patients (8%), 2 the findings of four patients (16%), 3 findings of 3 patients (12%), and 4 findings of three patients (12%).

Table 12. Distribution of ultrasound findings in Each Degree Diseases (Adult)

Findings	DF (n = 2)	DHF 1 (n = 11)	DHF 2 (n = 12)	Total
Hepatomegaly	0	2	4	6
	.0%	18.2%	33.3%	
Splenomegaly	0	1	2	3
	.0%	9.1%	16.7%	
GB Wall Thickening	0	3	5	8
	.0%	27.3%	41.7%	
Acites	0	2	4	6
	.0%	18.2%	33.3%	
Perinephric fluid	0	0	3	3
	.0%	.0%	25%	
Efusio of Right Pleura	0	0	2	2
	.0%	.0%	16.7%	
Efusion of bilateral pleura	0	1	2	3
	0.%	9.1%	16.7%	

Table 13. Distribution Amount ultrasound findings in Adult

Number of Finding	Frequency	Percentage
0	13	52.0
1	2	8.0
2	4	16.0
3	3	12.0
4	3	12.0
Total	25	100.0

In adult patients with DF total of 2 patients no positive findings on ultrasound. In patients with DHF grade I did not got the most positive findings on ultrasound, namely 7 patients out of 11 patients, and the highest earned degree II not found a positive ultrasound findings, ie 4 patients out of 12 patients, but there were 2 patients with 3 findings, 3 patients with 3 findings and 3 patients with 4 positive findings. In order levels Spearman correlation test found no significant correlation between the degree of disease by the number of ultrasound findings in adult patients ($p > 0.05$).

Table 14. The degree of disease and number of ultrasound findings in the Adult

	Number of USG Finding					Total
	0	1	2	3	4	
DF	2	0	0	0	0	2
	8.0%	.0%	.0%	.0%	.0%	42.4%
DHF grade I	7	1	1	1	1	11
	28.0%	4.0%	4.0%	4.0%	4.0%	44%
DHF grade II	4	1	3	2	2	12
	16.0%	4.0%	12.0%	8.0%	8.0%	48.0%
Total	13	2	4	3	3	33
	52.0%	8.0%	16.0%	12.0%	12.0%	100.0%

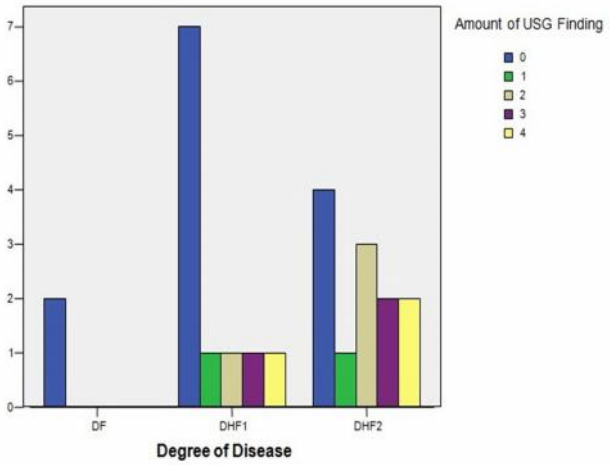


Figure 2. The degree of disease and number of ultrasound findings in the Adult

DISCUSSION

In this research, 33 patients with a range of children 1-14 years of age and consisted of 39.4% men and 60.6% of women and 25 adult patients with an age range 18-54 years and consists of 48% male and 52% female. Various previous studies have variations in gender distribution of patients. Mia et al (2010), do Vabo et al (2004), and Mehdi et al (2012) find more men in their research, while Wu et al (2004) more women. Patients with a diagnosis of most children with fever (57.6%) with the second degree as the highest degree (30.3% of all patients), while the DF as much as 42.6%. Most adult patients diagnosed with dengue fever (92%) with second degree as the highest degree (48% of all patients), while only 2 adult patients diagnosed with DF. Mia et al (2010) with a sample of their research found that 46% of patients diagnosed with dengue fever Grade II while Mehdi et al (2012) found that 86% of people with degrees I.

The findings of thoracic and abdominal ultrasound were obtained in this study were hepatomegaly, splenomegaly, GB wall thickening, ascites, fluid around the perinephric space (perinephric fluid), and pleural effusion (right and bilateral). The frequency of hepatomegaly in patients with the most children found in DHF grade III (66.7%), and in patients with acquired most of the adult dengue Grade II (33.3%). In both groups the frequency of hepatomegaly increasingly less common in milder degrees. Mia et al (2010) gain frequency of hepatomegaly in children and adults at the most heaviest on the degree of illness in their studies (degree IV DHF) and the mild degree of the disease, the lower the frequency of hepatomegaly. Mehdi et al (2012) and Setiawan et al (1998) also reported that the frequency of hepatomegaly in more degrees obtained in a heavier.

Splenomegaly in children was found only in patients with DHF II and the most widely grown frequencies obtained in DHF II. Mia et al (2010) found the frequency of splenomegaly in children and adults most in DHF IV, then at Grade II. Not found splenomegaly in DHF grade III. Mehdi et al (2012) and Yousaf et al (2011) get the most frequency on the degree of splenomegaly heavier than light, while Setiawan et al

(1998) splenomegaly get the same frequency between the degree of heavy and light.

GB wall thickening on ultrasound findings of this study are the most, both in patients with children (51.5%) and adults (32%). The frequency of GB wall thickening in children was found in all patients with DHF grades III and II, and in adult patients found most in DHF Grade II. GB wall thickening was reported to be significantly associated with the severity of the clinical manifestations of dengue virus infection. Wu et al (2004), Mehdi et al (2012), Venkata Sai et al (2005), Yousaf et al (2011), do Vabo et al (2004), Quiroz-Moreno et al (2006), and Srikiatkhachorn et al (2007) on the research, they also get similar results in 0 adult patients and 19 children patients.

Venkata Sai et al (2005) the study concluded that during the plague epidemic of dengue if it is found on ultrasound the GB wall thickening in patients with fever, with or without signs poliserositis, then it should suspect the possibility of a DF/DHF. The frequency of ascites in patients with the most children are found in the third degree fever followed by Grade II, and in adult patients found most in DHF Grade II. In this research, Mia et al (2010) frequency of ascites in children and adults are found most heaviest on the degree of illness in their studies (degree IV) and the mild degree of disease less frequency ascites. Mehdi et al (2012), Setiawan et al (1998), Yousaf et al (2011) and Srikiatkhachorn et al (2007) also reported that the frequency of much more ascites obtained at higher degrees is heavy.

In young patients the frequency of perinephric fluid found at most third degree fever followed by Grade II, and in adult patients only found in DHF Grade II. Mia et al (2010) and Mehdi et al (2012) also get perinephric fluid frequency is greatest in degree rather than light weight. Setiawan et al (1998) obtain these findings only on the degree of the weight and not found in minor degree, and they concluded that the perinephric fluid may be a marker of severity of manifestations of viral infections dengue. In this study, pleural effusion found is right and bilateral pleural effusion. There were no pleural effusion on the left side only. Pleural effusion in children was found in all patients with DHF III degrees and more than half of the second degree. Pleural effusion in adults almost exclusively found in DHF Grade II and the only one found in the degree of I. Yousaf et al (2011), Mia et al (2010), Srikiatkhachorn et al (2007), Mehdi et al (2012) and Setiawan et al (1998) also reported that the frequency of pleural effusion was found in more degree heavier.

In young patients at the more severe degrees of the findings during an ultrasound that looks more and more. In young patients with dengue fever most found no abnormalities on ultrasound of her, up to 4-5 findings in patients with dengue fever degree III. Similarly, in adult patients in which the degree more severe visible amount of ultrasound findings are more and more. In all patients with DF is not found abnormalities in the ultrasound and it looks more and more findings in patients with more severe degrees of illness. In this study on child patients obtained a statistically significant correlation between the number of findings with the degree of the disease, which means the more severe degree of disease ultrasound findings were obtained. However, in adult patients found no statistically significant correlation ($p = 0.056$) between the number of findings with the degree of disease. This is very likely due to the sample size in a smaller adult patients ($n = 25$) compared to samples in patients with children ($n = 33$).

In young patients are patients who are diagnosed DF, but the ultrasound found signs of plasma leakage. There were 2 patients had a right pleural effusion, and there is 1 people found bilateral pleural effusion, ascites and perinephric fluid. These findings can be difficult to detect on clinical examination. Balasubramanian et al (2006) in a study comparing ultrasound with clinical examination, laboratory and radiographic in detecting the leakage of plasma, found that ultrasound had a sensitivity and negative predictive value in detecting leaks highest this plasma. Mia et al (2010) also found in their study that there was no pleural effusion and ascites were detected on clinical examination, but was found on ultrasound. This shows the importance of a thorough evaluation of ultrasound in patients with dengue virus infection so that it can support the treatment and monitoring of patients with more precise.

CONCLUSION

The number of children in the study sample was 33 people ranging in age from 1-14 years and consisted of 13 men (39.4%) and 20 women (60.6%) and 25 adult patients with an age range 18-54 years and consists 12 men (48%) and 13 women (52%). In patients with a clinical diagnosis of DF children found 14 people (42.4%), DHF grade I 7 (21.2%), Grade II 10 (30.3%), and the degree III 2 (6.1%). In adult patients, the diagnosis of DF obtained 2 people (8%), DHF grade I 11 (44%) and Grade II 12 (48%).

In the thoracic and abdominal ultrasound examination obtained hepatomegaly child patients 13 (39.4%), splenomegaly 2 (6.1%) patients, GB wall thickening 17 (51.5%) patients, acites 9 (27.3%) patients, perinephric

fluid 5 (15.2%) patients, pleural effusion right 5 (15.2%) patients, and bilateral pleural effusion 7 (21.2%) patients. In adult patients obtained hepatomegaly 6 (24%) patients, splenomegaly 3 (12%) patients, GB wall thickening 8 (32%) patients, ascites 6 (24%) patients, perinephric fluid 3 (12%) patients, right pleural effusion 2 (8%) patients, and bilateral pleural effusion 2 (12%) patients.

The number of ultrasound findings were found in children patients: no finding as many as 11 patients (33.3%), 1 the findings of 8 patients (24.2%), 2 the findings of 3 patients (9.1%), 3 findings of 3 patients (9,1%), 4 the findings of five patients (15.2%), and 5 findings of 3 patients (9.1%). The number of ultrasound findings were found in adult patients: no finding as many as 13 patients (52%), 1 the findings of two patients (8%), 2 the findings of four patients (16%), 3 findings of 3 patients (12%), and 4 findings 3 patients (12%). There is a significant correlation between the degree of disease by the number of ultrasound findings in children patients, while in adult patients not found. Children patients who are diagnosed on ultrasound DF and right pleural effusion (2 people), and there is 1 person found bilateral pleural effusion, ascites and perinephric fluid.

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REFERENCES

Balasubramanian S, Janakiraman L, Kumar SS, Muralinath S, Shivbalan S (2006). A reappraisal of the criteria to diagnose plasma leakage in dengue hemorrhagic fever. Indian Pediatr 43, 334-339

do Vabo KA, Neto GT, dos Santos AASMD, do Vabo TP, Santos MLdO, Marchiori E (2004). Abdominal ultrasound findings in patients with dengue fever. Radiol Bras 37, 159-162

Mehdi SA, Mahais AH, Bhukhari H, Aslam S (2012). Gray scale trans-abdomino-thoracic ultrasonography in evaluation of dengue hemorrhagic fever. APMC 6, 32-36

Mia MW, Nurullah AM, Hossain A, Haque MM (2010). Clinical and sonographic evaluation of dengue fever in Bangladesh: a study of 100 cases. Dinajpur Med Col J 3, 29-34

Quiroz-Moreno R, Méndez GF, Ovando-Rivera KM (2006). Clinical utility of ultrasound in the identification of dengue hemorrhagic fever. Rev Med Inst Mex Seguro Soc 44, 243-248

Setiawan MW, Samsi TK, Wulur H, Sugianto D, Pool TN (1998). Dengue haemorrhagic fever: ultrasound as an aid to predict the severity of the disease. Pediatr Radiol 28, 1-4

Srikiatkhachorn A, Krautrachue A, Ratanaprakarn W, Wongtapradit L, Nithipanya N, Kalayanarooj S, Nisalak A, Thomas SJ, Gibbons RV, Mammen MP Jr, Libraty DH, Ennis FA, Rothman AL, Green S (2007). Natural history of plasma leakage in dengue hemorrhagic fever: a serial ultrasonographic study. Pediatr Infect Dis J 26, 283-290

Venkata Sai PM, Dev B, Krishnan R (2005). Role of ultrasound in dengue fever. Br J Radiol 78, 416-418

Wu KL, Changchien CS, Kuo CH, Chiu KW, Lu SN, Kuo CM, Chiu YC, Chou YP, Chuah SK (2004). Early abdominal sonographic findings in patients with dengue fever. J Clin Ultrasound 32, 386-388

Yousaf KR, Atiq S, Sheik QS, Nisar MS, Mansoor Z, Khalid S (2011). Sonographic features of polyserositis as an adjunct to clinicopathological parameter in diagnosing and predicting the severity of dengue fever. Pak J Med Health Sci 5, 184-189