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Radiological profile of dengue among infants at a tertiary care hospital with special reference to increased resistive index of middle cerebral artery: A cross sectional study

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Abstract:

Background: Ultrasonography is readily available and is non-invasive which gives quick results. It tells about severity of dengue among infants. It is a promising tool. It can help in management and assessing severity of dengue.

Objective: To study radiological profile of dengue among infants with special reference to increased resistive index of middle cerebral artery

Methods: Retrospective study on subjects admitted with infant dengue was done for two years. Data of 98 infants admitted with Dengue were collected from medical records department. Data of infant dengue with congenital heart disease, comorbidities like sepsis and known case primary immunodeficiency were excluded. Radiological findings of ultrasound abdomen & thorax of the subjects were recorded.

Results: The males were slightly more than females. 7-12 months were more affected than younger counterpart. Mean duration of hospital stay was significantly more among those with IgG positive compared to the negative ($p<0.05$). In neurosonogram findings, most common

was increased resistive index of middle cerebral artery in 29.6%. Ultrasound of abdomen, prominent findings were edema of gall-bladder (96.9%), ascites (98.9%), hepatomegaly (91.8%). Those with abnormal neurosonogram, had significantly more duration of hospital stay as well as PICU stay compared with those with normal neurosonogram findings ($p<0.05$).

Conclusion: Increased resistive index of middle cerebral artery was the prominent finding on neurosonogram. Ascites, hepatomegaly and gall-bladder edema were commonly seen ultrasonography-abdomen findings. Abnormal neurosonogram was associated with longer hospital and PICU stay. These findings can be used for early detection of the severe cases for improved outcome.

Key words: ultrasonography, hepatomegaly, splenomegaly, ascites, infants

Introduction:

Dengue is transmitted by Aedes aegypti. It has four serotypes. They cause dengue fever (DF) which is mild and dengue hemorrhagic fever (DHF) or dengue shock syndrome (DSS) which are severe forms of the disease. The disease can occur at any age in both the sexes. It is a public health problem in infants in some countries. [1] In 1970, infant dengue in the form of DHF/DSS was first reported. [2] In case of mothers immune to dengue, DSS/DHF can occur in infants. Dengue among children is an important cause of morbidity and mortality in Asia. Of all the children hospitalized, infant dengue is responsible for 5% of these cases in India. [3]

Prevalence of dengue differs based on the age. Children below the age of one year are at risk of DHF/DSS. The prevalence of DHF among the infants in South Asian countries is 0.5/1000. [4] In India, the prevalence of dengue fever was about 20% in infants during an outbreak. [5]

Severe forms of dengue are common in infants. The infants can present even with convulsions and dysfunction of the liver compared to children and adults. The death rate is also more in them. Their mean platelet count is also very low and white blood cell count and total lymphocyte count high compared to children and adults. Manifestations of hemorrhage are also more in infants. [2, 3, 6]

Diagnosis of dengue is usually serology based diagnosis. It takes time to know the severity of the dengue fever in infants. Ultrasonography is readily available and is a non-invasive method which gives quick results within minutes. It tells us about the severity of the dengue among infants. It is a promising tool. It can help in the management and assessing the severity of the dengue. It can be used to assess the at risk patients in terms of entry in the critical phase of the dengue. Early identification by ultrasonography can help early management of the case and improve the outcome. We can detect the leakage of the capillaries using the USG like pleural effusion, ascites. At the same time, we can assess the enlargement of the liver, spleen and gall bladder wall thickening. [7-9]

Infant dengue is critical because ADE puts infants at risk of DSS due to tranplacentally transferred antibodies in dengue exposed mothers. [10]

With this background, to explore the importance of ultrasonography in infant dengue, we carried out this study with the objective of to study the radiological profile of dengue among infants at a tertiary care hospital with special reference to increased resistive index of middle cerebral artery

Methods:

A retrospective study on the subjects admitted with infant dengue from was done for a period of 2 years at a tertiary children's hospital. The ethical clearance was obtained from institutional ethics committee. Data of 98 infants admitted with Dengue during January 2019 till December 2021 were collected from the medical records department. Data of infant dengue with congenital heart disease, comorbidities like sepsis and known case primary immunodeficiency were excluded. The radiological findings of ultrasound abdomen & thorax and chest X-ray PA view of the subjects were recorded.

Different variables like age in months, sex, duration of hospital stay in hours, duration of pediatric intensive care unit (PICU) in hours, weight, presence of fever at the time of admission and at the time of discharge, serological variables like results of non-structural proteins-1 (NS-1) and IgM and IgG positivity, neurosonogram and ultrasonography findings of all the cases were recorded with full details in the pre designed, pre tested study questionnaire designed for the present study.

Neurosonography and ultrasonography were carried out by the experienced radiologists using the standard operable machines and standard techniques. All patients were scanned using Volusion S8 GE healthcare with convex transducer of 1-5 mHz and linear transducer of 4-12 mHz. Resistive index of .8 or less was taken as normal for MCA. Resistive index was measured with linear transducer using angle of insonation of 30 degrees and about 1.0cm distal to origin of MCA.

An attempt was made to study the association between the serology findings with the mean duration of hospital stay and mean duration of the PICU stay. Similarly, an association was studied between the neurosonogram findings as normal and abnormal with the mean duration of the hospital stay and with the mean duration of the PICU stay.

Statistical analysis:

The data was entered in the Microsoft Excel worksheet and analyzed using proportions. Students t test was applied to study the significant differences between the mean values of the groups. P value less than 0.05 was taken as statistically significant.

Results:

Table 1: Age and sex wise distribution of study subjects

Age (months)	Sex				Total	
	Male		Female			
	Number	%	Number	%	Number	%
2-6	20	52.6	18	47.4	38	38.8
7-12	31	51.6	29	48.4	60	61.2
Total	51	52.1	47	47.9	98	100

Table 1 shows age and sex wise distribution of study subjects. The affected proportion of males and females were not very different even though the number of males was slightly more than that of females. Age group of 7-12 months was more affected that their younger counterpart.

Table 2: Distribution of study subjects as per clinical profile

Variable	Number	%	Mean±SD
Hospital stay (hours)	98	100	159±51.9
PICU stay (hours)	98	100	109.9±53.43
Weight (kg)	98	100	7.8±1.6
Fever	98	100	--
Afebrile at admission	56	59.2	--
Afebrile at discharge	97	98.9	--

Table 2 shows distribution of study subjects as per clinical profile. The mean duration of hospital stay was 159 hours and that of PICU stay was 109.9 hours. Mean weight was 7.8 kg. All infants had fever some or the other days of admission. 59.2% were afebrile at the time of admission which increased to 98.9% at the time of discharge.

Table 3: Distribution of study subjects as per positivity profile

Variable	Number	%	Mean±SD
NS1 positive	98	100	--
IgM positive	98	100	--
IgM titer	98	100	3.2±1.3
IgG positive	17	17.7	--

Table 3 shows distribution of study subjects as per positivity profile. All were NS-1, IgM positive. Whereas only 17.7% were positive for IgG. The mean value of the IgM titer was 3.2 which was slightly above the normal

Table 4: Association between IgG positivity and Hospital and PICU stay

Variable	IgG positive (N=17)	IgG negative (N=81)	T value	P value
Hospital stay	184±52.2	154±51.9	**2.156**	**0.033**
PICU stay	132.7±52.7	105.1±53.4	1.958	0.062

Table 4 shows association between IgG positivity and Hospital and PICU stay. The mean duration of hospital stay was significantly more among those with IgG positive compared to the negative ($p<0.05$). But the PICU stay in hours was statistically not significant different for IgG positive or negative ($p>0.05$).

Table 5: Radiological profile of dengue among infants

Radiology findings		Number	%
Neurosonogram	Normal	63	64.4
	Echogenic thalami and basal ganglia	01	1
	increased internal carotid artery velocity	01	1
	Increased resistive index of middle cerebral artery	29	29.6
	Intra-ventricular bleed	02	2
	Prominent lateral ventricles	02	2

Ultra-sound abdomen	Gall bladder edema present (> 3 mm)	95	96.9
	Peri gall bladder collection	32	32.7
	Ascites	97	98.9
	Hepatomegaly	90	91.8
	Splenomegaly	68	69.4
	Increased echotexture of liver	09	9.2
	Increased echotexture of kidney	07	7.1
	Peri-hepatic collection	14	14.3
	Peri-nephric collection	26	26.5
	Unilateral pleural effusion	34	34.7
	Bilateral pleural effusion	62	63.3
	Mild effusion	49	50
	Moderate effusion	48	48.9
	Basal consolidation of lungs	27	27.6

Table 5 shows radiological profile of dengue among infants. In the neurosonogram findings, the most common finding was Increased resistive index of middle cerebral artery in 29.6% of the cases. It was found to be normal in 64.4% of the cases. In the ultrasound of the abdomen, the prominent findings were edema of the gall bladder (96.9%), ascites (98.9%), hepatomegaly (91.8%).

Table 6: Association between neurosonogram findings and duration of hospital and PICU stay

Variable	Normal neurosonogram (N=63)	Abnormal neurosonogram (N=35)	T value	P value
Hospital stay	150±51.9	179±52.5	2.631	**0.0096**
PICU stay	97.04±53.4	135.6±52.6	3.458	**0.0009**

Table 6 shows association between neurosonogram findings and duration of hospital and PICU stay. Those with abnormal neurosonogram, had significantly more duration of hospital stay as well as more duration of the PICU stay compared with those with normal neurosonogram findings ($p<0.05$).

Discussion:

The affected proportion of males and females were not very different even though the number of males was slightly more than that of females. Age group of 7-12 months was more affected that their younger counterpart. The mean duration of hospital stay was 159 hours and that of PICU stay was 109.9 hours. Mean weight was 7.8 kg. All infants had fever some or the other days of admission. 59.2% were afebrile at the time of admission which increased to 98.9% at the time of discharge. All were NS-1, IgM positive. Whereas only 17.7% were positive for IgG. The mean value of the IgM titer was 3.2 which was slightly above the normal. The mean duration of hospital stay was significantly more among those with IgG positive compared to the negative ($p<0.05$). But the PICU stay in hours was statistically not significant different for IgG positive or negative ($p>0.05$). In the neurosonogram findings, the

most common finding was Increased resistive index of middle cerebral artery in 29.6% of the cases. It was found to be normal in 64.4% of the cases. In the ultrasound of the abdomen, the prominent findings were edema of the gall bladder (96.9%), ascites (98.9%), hepatomegaly (91.8%). Those with abnormal neurosonogram, had significantly more duration of hospital stay as well as more duration of the PICU stay compared with those with normal neurosonogram findings ($p<0.05$).

Parmar J et al [11] studied 160 cases of suspected dengue and did the ultrasound examination. They compared the serology results with the radiological reports. 41.2% of the cases had thickening of the gall bladder which is low compared to the present study where we found it as 96.9%. they found that the sensitivity and specificity of the ultrasound compared to the serology was low.

Colbert JA et al [12] observed that the using ultrasound measurement of the gall bladder wall thickening was significantly associated with severity of the dengue in pediatric patients. It was also found to be correlated with the thrombocytopenia and raised hematocrit. Thus, the authors concluded that gall bladder wall thickening can be used as a prognostic indicator for the severity of the dengue in pediatric patients.

Wu KL et al [13] studied 86 suspected dengue patients and carried out abdominal sonography. Serology confirmed presence of dengue in all cases. Gall bladder thickening was seen in 59% of the cases, whereas we found that the gall bladder thickening was present in 96.9% of the cases. They reported presence of ascites in 37% of the cases compared to 98.9% in the present study. They found that splenomegaly was present in 34% of the cases compared to 69.4% of the cases in the present study. They noted that pleural effusion was present in 32% of the cases compared to 63.3% of the cases of the present study. They concluded that abdominal sonography can be used as a first line imaging modality in suspected dengue cases.

Chacko B et al [14] carried out a prospective study among pediatric cases of dengue. They observed that along with different factors, ultra-sonographic evidence of effusion was able to predict the dengue shock syndrome. We also found that 63.3% of the cases had bilateral pleural effusion.

Pramulio HS et al [15] carried out USG of 29 children of age 2-13 years having dengue. They observed that the ascites was common in dengue among the children. We also found that ascites was present in 98.9% of the cases.

Venkata Sai PM et al [16] performed a study to know if ultrasound is useful in the diagnosis of dengue. They included 128 children of age 2-9 years who were suspected cases of dengue. They excluded 40 cases as they were found to be negative by serology. Among the remainder, 32 were screened using the ultrasound on second and third day and again repeated on fifth to seventh day of fever. In 56 cases, USG was done only on fifth to seventh day of fever. Among first group of 32 children, gall bladder thickening was seen in all cases. We also found that the gall bladder thickening was present in 96.9% of the cases which is comparable with this study. Among them, only 21% were found to have hepatomegaly whereas it was 91.8% in the present study. In their study, splenomegaly was seen in only 6.3% of the cases compared to 69.4% in the present study. But in their study the proportion with ascites increased on fifth to seventh day of fever to 53%. These differences in two studies is because of difference in the age groups. We studied infant dengue while this study

was about the children in the age group of 2-9 years. This means that infants suffer more severe form of dengue compared to older children.

Motal M et al [17] studied case records of 169 patients with suspected dengue. They reviewed the ten parameters of the ultrasonography. This study was done among the adults. Ascites was most commonly seen in 74.6% of the cases compared to 98.9% of the cases in the present study. The gall bladder wall edema was seen in 72% of the cases compared to 96.9% in the present study. Hepatomegaly was seen in 46.2% of the cases compared to 91.8% of the cases in the present study. Splenomegaly was seen in 39.1% of the cases compared to 69.4% of the cases. Right side pleural effusion was seen in 28.4% of the cases compared to 34.7% of the cases in the present study. Bilateral pleural effusion was seen in 11.2% of the cases compared to 63.3% of the cases. All these comparison of findings between studies one with infant dengue and one with adult dengue suggest that the severity of the organ involvement in more in infants compared to adults.

Conclusion:

Increased resistive index of middle cerebral artery was the prominent finding on neurosonogram. Ascites, hepatomegaly and gall-bladder edema were commonly seen ultrasonography-abdomen findings. Abnormal neurosonogram was associated with longer hospital and PICU stay. These findings can be used for early detection of the severe cases for improved outcome.

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Legends to the figures

Figure 1: gall bladder wall edema

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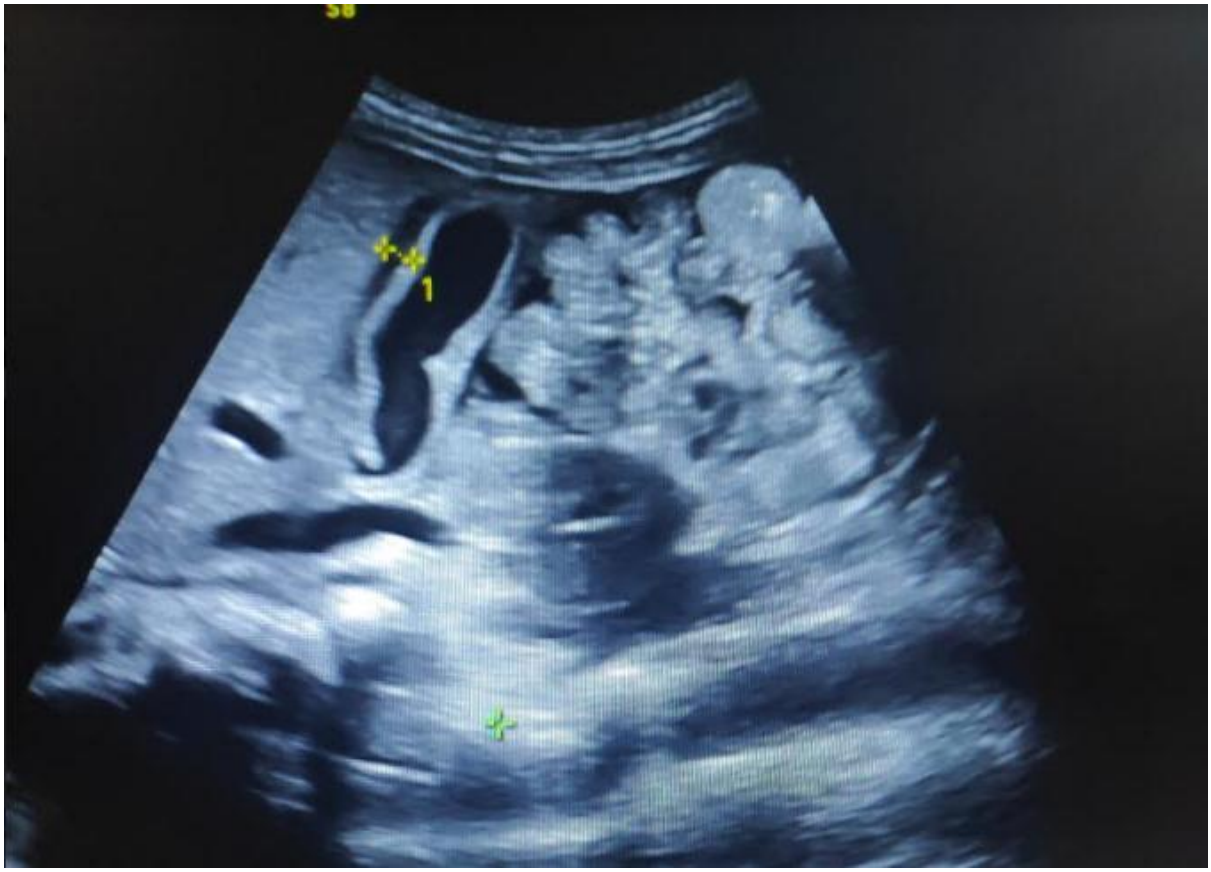

Figure 2: Perinephric fluid collection, pleural effusion

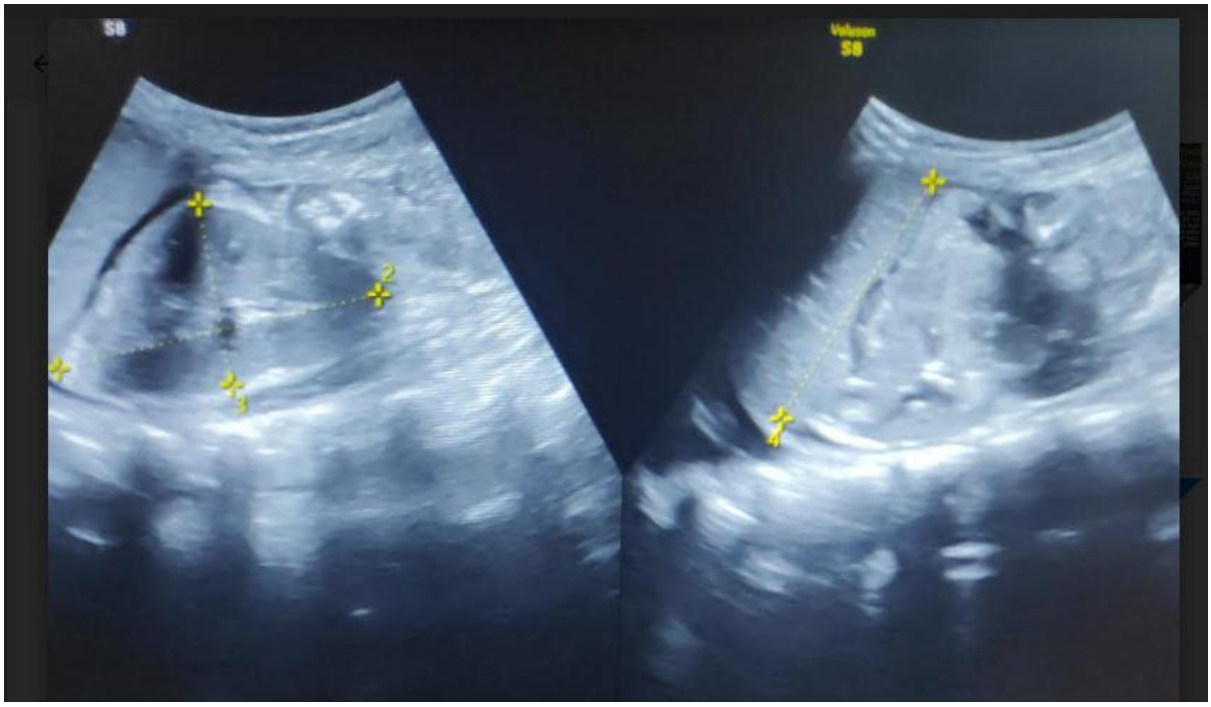

Figure 3: Ascites

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Figure 4: Increased resistive index in middle cerebral artery

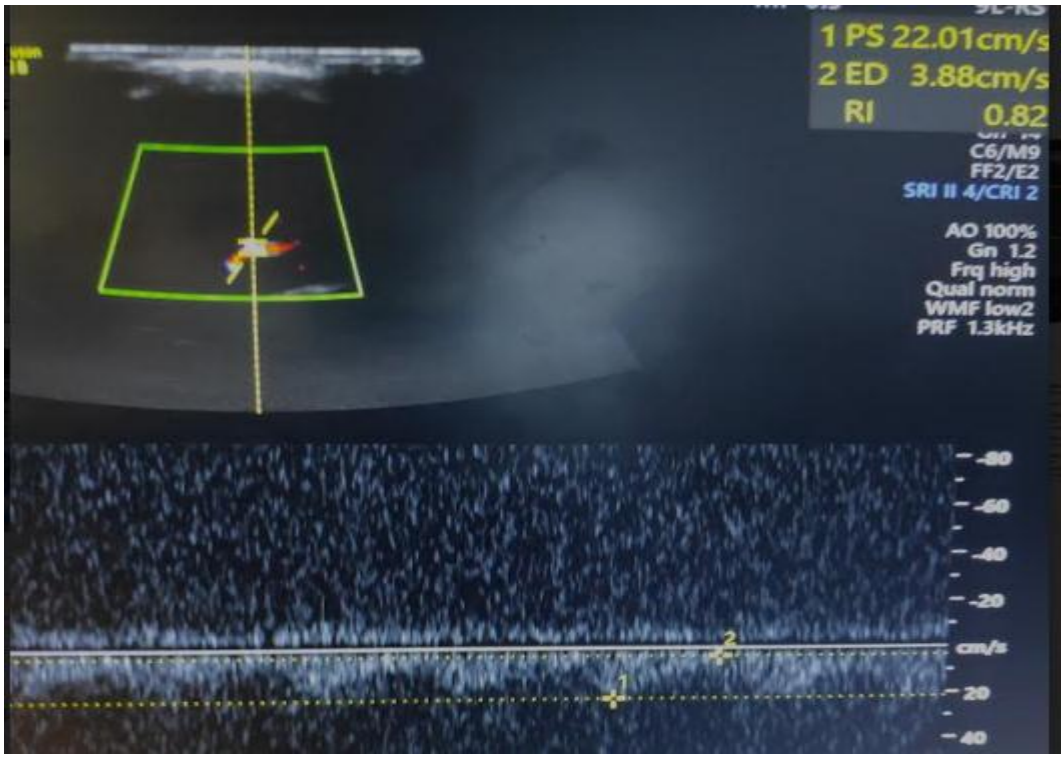

Figure 5: Acute necrotising encephalitis

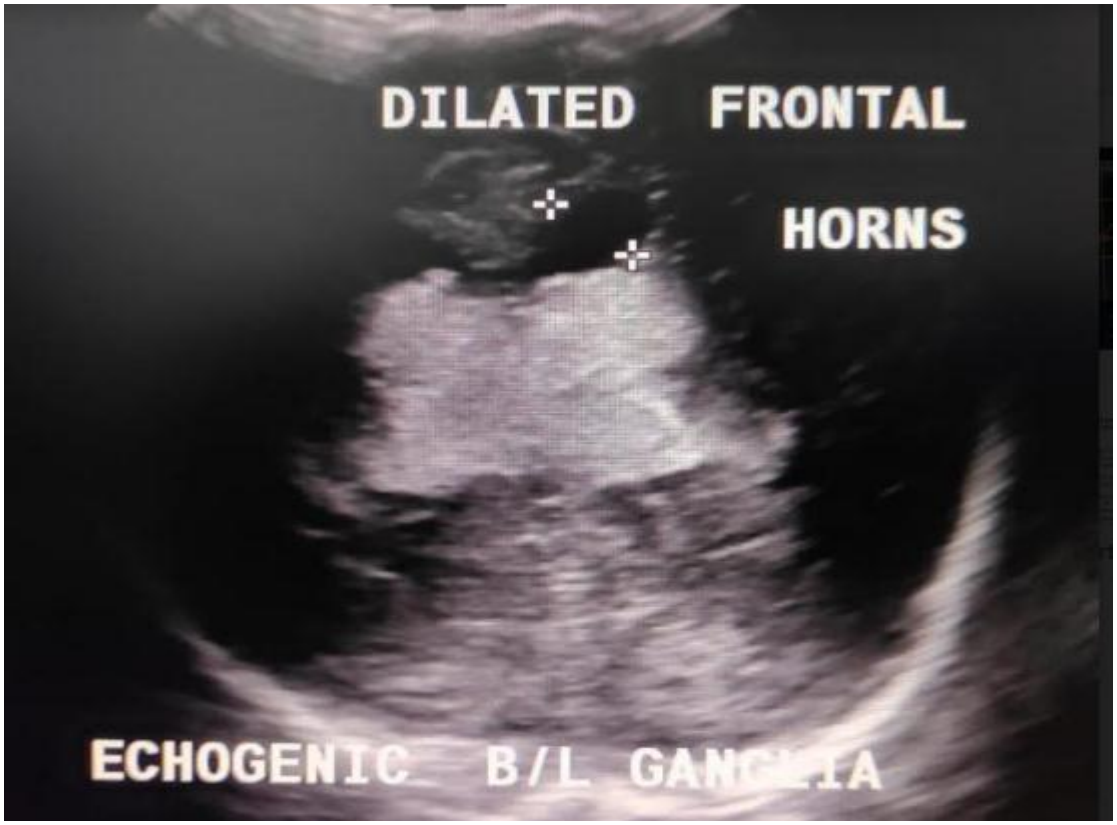

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Figure 6: Acute necrotising encephalitis