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Original Article

Role of Transfontanelle Neurosonography in the Imaging Evaluation of Meningitis in Neonates and Infants

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Abstract

Introduction: Acute bacterial meningitis still remains as one of the major causes of infant morbidity and mortality even with the recent advances of antibiotics and supportive treatment. The early diagnosis and appropriate medical and surgical interventions of the complication can reduce the morbidity and mortality to a considerable extent. The use of transfontanelle ultrasound to examine these infants has been rapidly increased being relatively simple, easy to perform, and safer, makes it an ideal method for the early detection of signs of meningitis, its complication, and follow-up of the patients. Study aimed to establish role of ultrasonography in evaluation of meningitis and its complication in neonates and infants.

Materials and Methods: A total of 40 patients who were suspected clinically or pathologically for meningitis were evaluated by transfontanelle ultrasound on Mindray DC 30 machine with linear probe (7 MHz–12 MHz) and curvilinear probe (3 MHz–5 MHz).

Results: A study was performed on 40 patients (newborn to 1 year old) of suspected meningitis. Transfontanelle ultrasonography was obtained out of which 12 patients were normal. The spectrum of sonographic abnormalities includes echogenic sulci (52.5%) and cerebritis (32.5%), ventriculomegaly (55%), ventriculitis (27.5%), subdural effusion (7.5%), epidural effusion (2.5%), encephalomalacia (5%), and cerebral abscess (7.5%) in patients.

Conclusion: Transfontanelle ultrasound in neonates/infants is a rapid, real-time, safe, and effective method for initial diagnosis, to identify complications, planning the treatment of meningitis and its follow-up even when the signs and symptoms are non-specific. It gives us information not only in early as well as late changes seen in meningitis.

Key words: Brain, Meningitis, Neonates, Transfontanelle, Ultrasonography

INTRODUCTION

Acute bacterial meningitis still remains as one of the major causes of infant morbidity and mortality even with the recent advances of antibiotics and supportive treatment. The early diagnosis and appropriate medical and surgical interventions of the complication can reduce the morbidity and mortality to a considerable extent.[1]

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The use of transfontanelle ultrasound to examine these infants has been rapidly increased. Transfontanelle scan being relatively simple, easy to perform, and safer, makes it an ideal method for the early detection of signs of meningitis, its complication, and follow-up of the patients.

Using the color Doppler ultrasound, one can also differentiate benign enlargement of subarachnoid space from subdural effusion.[2] Transfontanelle ultrasound is also extremely beneficial in evaluating interventricular contents, and debris and septations.[3]

The objectives of the study were early diagnosis of meningitis by transfontanelle ultrasound, early detection of its complications, and early therapeutic interventions and to establish the relationship between imaging findings and underlying pathological changes.

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MATERIALS AND METHODS

The study was performed in the Department of Radiodiagnosis, NSCB Medical College, Jabalpur, Madhya Pradesh. It is a hospital-based descriptive and observational study. Only the patients who were willing to take part in the study were included, the patients who were suspected clinically or pathologically for meningitis.

A total of 40 patients were included in the study from the age group ranging from day 0 to 180. Transfontanelle ultrasound was performed on Mindray DC 30 machine. Patients were examined on both high-frequency 7 MHz–12 MHz and low-frequency probe 3 MHz–5 MHz; coronal, axial, and sagittal images were taken, under aseptic precautions to reduce any chances of infection to the neonates/infants.

Brain parenchyma, ventricular system, brainstem, cerebellar hemisphere, outline/content of ventricle, cerebrospinal fluid (CSF), and extra-axial spaces were examined carefully. The patients were evaluated for the presence of echogenic/widening of sulci, signs of ventriculitis, parenchymal echogenicity, any extra-axial fluid collection, and for any evidences of abscess, infarcts, and encephalomalacia.[4,5]

RESULTS

Amongst 28 cases which had spectrum of findings on transfontanelle scan; sulcal widening and echogenicity was seen in 21 of the cases, ventriculomegaly in 22, signs of ventriculitis in 11, focal cerebritis in 13, subdural/epidural effusion in 4, abscess was found in 3 cases and encephalomalacia in 2 of the cases [Table 1].

Out of these 28 patients, 15 cases underwent sequential follow-up scans few had contrast-enhanced computed tomography/magnetic resonance imaging to rule out further complications. Fifteen cases which underwent transfontanelle scan were performed on the seventh and the 14th or on discharge day whichever was earlier and the findings were then compared.

Out of these, there was a significant decrease in the findings with sulcal echogenicity with prompt use of antibiotics and supportive therapy, however, the case with the abscess showed deterioration.

DISCUSSION

Meningitis is a common cause of morbidity and mortality in the pediatrics age group. An early identification of macroscopic pathological changes is important for timely diagnosis and treatment.

Our study consisted of 40 infants of age group ranging from 0 to 180 days with mean age of 24 days. Maximum cases were seen of age group of 0–1 month which is 37.5%, male preponderance was seen in our study and these were also found in the studies done by Soni *et al.*[6]

We did evaluate 40 patients with suspected/clinical CSF positively diagnosed cases out of which normal sonogram was seen in 12 of the cases, which is 30% of total. Similar pattern was seen under the study [Table 2].[6-9]

In early stages, first, there are widening and increased echogenicity of sulci due to intense inflammatory exudates accumulating in the fissures and sulci. In our study, it was observed in 52.5% of the patients, whereas Hans *et al.*[8] reported 82% of cases, Soni *et al.*[6] in 63% of the cases, Baruah *et al.*[7] in 60%, and Mahajan *et al.*[10] in 62% of the total cases. All the mentioned studies found that echogenic sulci as the earliest findings in case of meningitis [comparison Table 3 and Figure 1].

An abnormal parenchymal echogenicity; focal or diffuse represents cerebritis or infarction, which is common in complicated meningitis and carry poor prognosis. In our study, focal cerebritis was found in 32.5% of the cases our study is consistent with Soni *et al.*[6] which reported it in 29.5%, Chaudhary *et al.*[11] in 65%, and Patel *et al.*[9] in 30.7% of patients.

Ventriculomegaly can be an early or late finding on transfontanelle scan. An early ventriculomegaly represents

Table 1: Sonographic spectrum in cases of meningitis (*n*=40)

Findings	Number (*n*)	Percentage
Echogenic sulci	21	52.5
Focal cerebritis	13	32.5
Ventriculomegaly	22	55
Ventriculitis	11	27.5
Subdural effusion	3	7.5
Epidural effusion	1	2.5
Abscess	3	7.5
Hemorrhagic inflammation	2	5
Encephalomalacia	2	5

Table 2: Radiological findings according to gender distribution

Diagnosis	Male	Female	Total
Normal study	7	5	12
Abnormal findings	15	13	28
Total	22	18	40

Table 3: Comparison with various previous studies

Findings	Our study (%)	Soni *et al.* (%)	Baruah *et al.* (%)	Han *et al.* (%)	Patel *et al.* (%)
Normal findings	30	35.4	40	38.4	19.2
Echogenic sulci	52.5	63	60	39.7	53.8
Focal cerebritis	32.5	29.5	–	11.5	30.7
Ventriculomegaly	55	59	28.6	14	46
Ventriculitis	27.5	35	1.4	6	23
Subdural effusion	7.5	2.2	–	33.3	7.6
Epidural effusion	2.5	2.2	–	33.3	3.8
Abscess	7.5	2.2	–	1.2	7.6
Hemorrhagic infarcts	5	–	–	–	3.8
Encephalomalacia	5	2.2	–	–	3.8

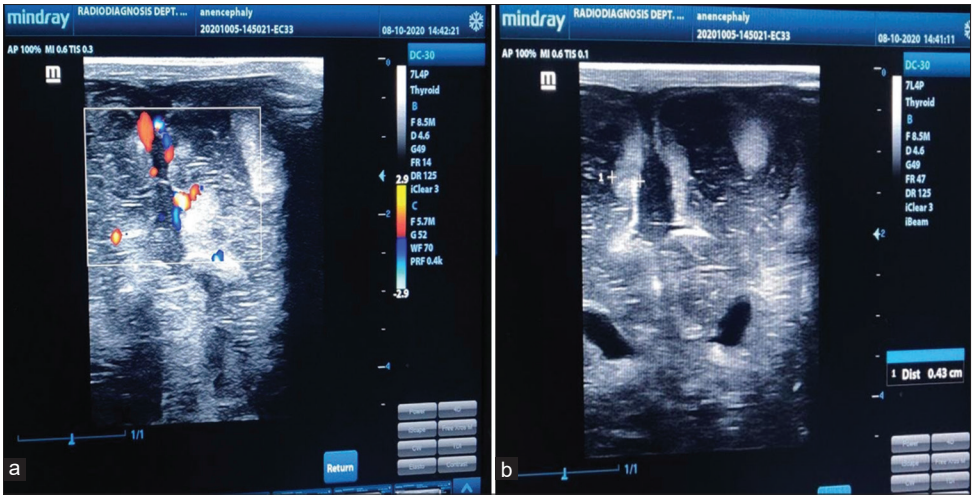

Figure 1: Transfontanelle ultrasound in an infant shows (a, b) thickened and echogenic bilateral frontal sulci with increased vascularity on color Doppler

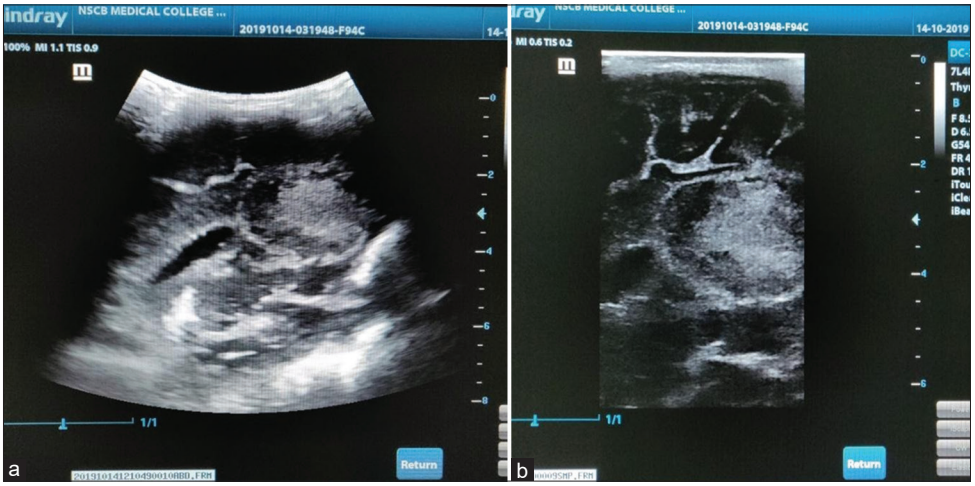

Figure 2: Transfontanelle ultrasound in an infant shows (a, b) a well-defined round to oval lesion with smooth margin and heterogeneously hypo-hyperechoic content within suggestive of cerebral abscess

non-obstructive normal pressure hydrocephalus and is usually reversible.[12] However, late is generally due to obstruction secondary to accumulation of purulent exudates or secondary to chronic inflammatory changes. In our study, it was found in 55% of the cases. Baruah *et al.*[7] found the same in 28.6% of patients, Soni *et al.*[6] in 59% of the cases, and Patel *et al.*[9] in 46% of patients.

Ventriculitis arises from the ependymal linings or from the choroid plexus. On ultrasound, there is echogenic

ependyma with irregular hyperechoic choroid plexus, exudates, and septations.[13-15] In the present study, it was seen in 27.5% of the patients which was consistent with the studies such as Soni *et al*.[6] 33%, Mahajan *et al*.[10] 21%, and Patel *et al*.[9] in 23% of the cases.

Abscess is identified as well-defined, thick hyper echoic rim with hyperechoic content and may be seen as the complications of meningitis.[16,17] In our study, it was reported in 3 cases (7.5%) which was consistent with other studies done by Soni *et al*. 2.2% and Patel *et al*. 7.6%.[6,9]

Subdural and extradural effusion and subdural empyema were reported as complications of meningitis [Figure 2].[18-20]

CONCLUSION

Transfontanelle ultrasound in neonates/infants is a rapid, real-time, safe and effective method for initial diagnosis, to identify complications, planning the treatment of meningitis and its follow-up even when the signs and symptoms are non-specific. It gives us information not only in early as well as late changes seen in meningitis.

Therefore, the role of transfontanelle Neurosonography in providing accurate imaging and pathological information can help in planning its timely medical or surgical interventions and prognosis of the patients.

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