

Role of Transcranial Ultrasound in Evaluation of Complicated Meningitis in Neonates and Infants

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Abstract: ***Purpose:** To determine the role of transcranial ultrasound (including Doppler evaluation) in assessment of intracranial pathologies in cases of bacterial meningitis. **Material and Methods:** This prospective study included 40 patients with proven meningitis with clinical suspicion of complications age <12 months (including neonates). All cases were evaluated in department of pediatrics followed by transcranial ultrasound using patent anterior, posterior and mastoid fontanelle. The patients were further evaluated with CT/ MRI in case of clinical deterioration. **Results:** A spectrum of sonographic abnormalities was observed including Echogenic sulci (35%), Ventriculomegaly (30%), Ventriculitis (2.5%), Periventricular Echo (25%), Extraaxial fluid collection (2.5%), Cerebral edema (27.5%), Hydrocephalus (5%), Increased Cerebral Blood flow Velocity in Intracranial Arteries. **Conclusion:** The clinical symptoms of the patients along with Transcranial USG is most important in arriving at diagnosis. USG is an effective, cheaper, non-invasive, portable, easy to repeat and fairly accurate method for evaluating intracranial changes in meningitis. On the basis of sonographic findings adequate medical treatment can be monitored and surgical intervention can be planned. **Keywords -** Transcranial ultrasound, Meningitis, Periventricular, Echogenic, Intracranial.*

1. Introduction

- 1) Pyogenic meningitis is a life threatening CNS infectious disease affecting the meninges, with an elevated mortality and disability rates.^[1]
- 2) Bacteria may arise at CNS as a result of
 - Direct implantation.
 - Contagious spread from a local septic process (e.g. Sinusitis).
 - An infected foreign body (e.g. A shunting catheter)
 - By Hematogenous spread.
- 3) Cranial Sonography is usually the first imaging modality used in the evaluation of critically ill infants with suspected meningitis.[2],[3]
- 4) Thus familiarity with the pathophysiology and sonographic appearance of meningitis is important for the radiologist and neonatologist.
- 5) Sonography can play an important role in detection of post-infectious hydrocephalus and other sequelae.

2. Aims & Objectives

To determine the role of Transcranial Ultrasound (including Doppler evaluation) in assessment of intracranial pathologies in cases of bacterial meningitis in neonates.

3. Materials and Methods

A Prospective study is done with 40 patients with proven meningitis with clinical suspicion of complications. Age group: less than 12 months (including neonates).

All cases were evaluated in department of pediatrics followed by transcranial ultrasound using patent anterior,

posterior and mastoid fontanelle. The patients were further evaluated with CT/ MRI in case of clinical deterioration.

3.1 Equipment

- In premature infants, a 7.5 MHz transducer was used to obtain a higher resolution.
- A 5 MHz transducer was used in infants with larger head.

3.2 Sonographic Technique

- Cranial sonography was done through anterior fontanelle in both coronal and sagittal plane.
- The posterior fossa was evaluated through posterior and mastoid fontanelles.
- Color Doppler imaging was used to evaluate fluid collections.
- If extracerebral collections are expected, they were further evaluated with CT or MRI Brain.

4. Results

A spectrum of sonographic abnormalities was observed including

- Echogenic sulci (35%)
- Ventriculomegaly (30%)
- Cerebral edema (27.5%)
- Periventricular Echo (25%)
- Hydrocephalus (5%)
- Ventriculitis (2.5%)
- Extra-axial fluid collections (2.5%)
- Increased Cerebral Blood flow velocity in Intracranial arteries.

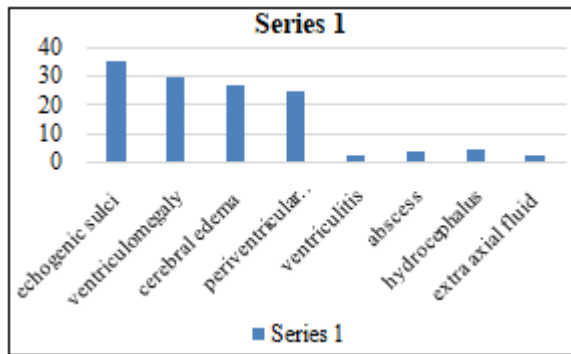


Figure 1: Sonographic abnormalities

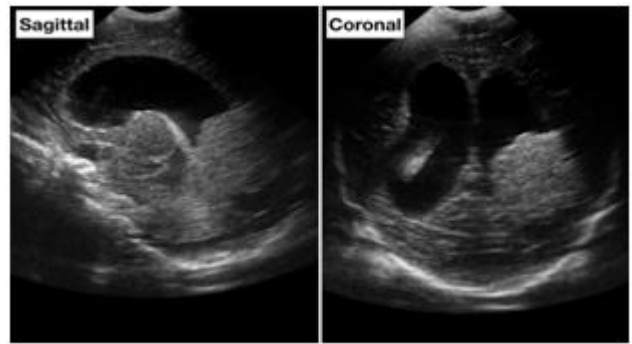


Figure 6: Hydrocephalus on USG



Figure 2: Echogenic Sulci on USG

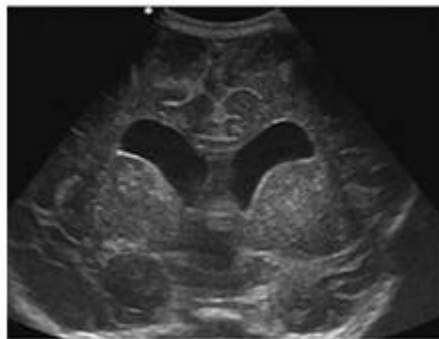


Figure 3: Ventriculomegaly on USG

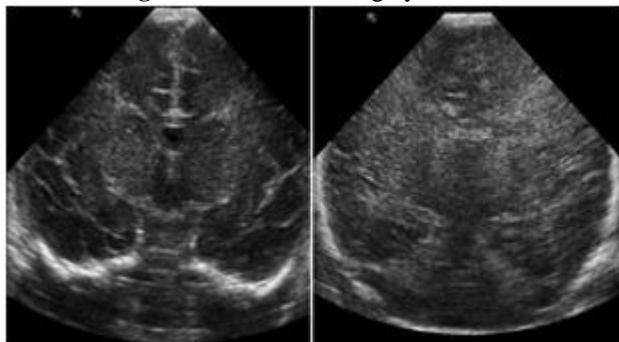


Figure 4: Cerebral Oedema on USG

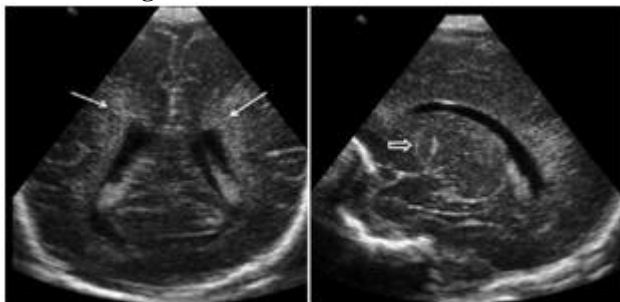


Figure 5: Periventricular Echo on USG

5. Discussion

5.1. Clinical Features

- Fever
- Lethargy
- Seizures
- Signs of raised ICT
- Coma
- Neck rigidity- less common among neonates and infants

5.2. Pathophysiology

- Arachnoiditis leads to vasculitis of small and medium sized intracranial bridging cortical veins leading to vascular occlusion and ischaemic infarcts.
- Inflammatory reaction ensues causing neuronal loss, gliosis and periventricular leucomalacia.



5.3. Diagnosis Based on Imaging Findings

- Non specific with respect to causative organism
- Rule out other associated causes

5.4 USG Findings^[4]

- Echogenic sulci- accumulation of inflammatory exudates
- Ventriculomegaly
- Ventriculitis
- Increased periventricular echogenicity
- Cerebral edema- chinked ventricles, sulcal and gyral effacement.
- Extraaxial fluid collection : subdural hygromas
- Abscess: fairly well defined collection with thick wall
- Infarct: absence of arterial pulsation, absence of gyral pattern, altered parenchymal echogenicity and midline shift.

5.5. CT Findings

- Limited role due to radiation exposure

- Better sensitivity in identification of complications
- May be normal
- Subtle hydrocephalus
- Hyperdensity around basal cisterns (especially in tuberculosis)
- Leptomeningeal enhancement
- Complications of the meningitis

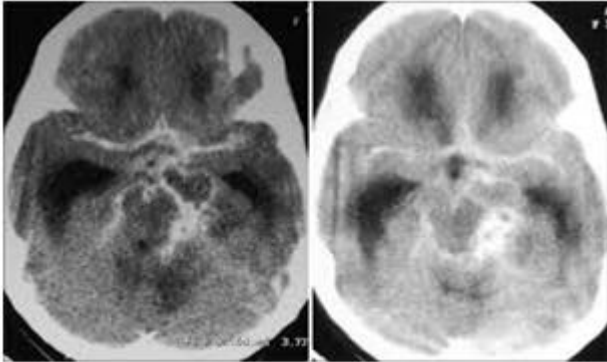
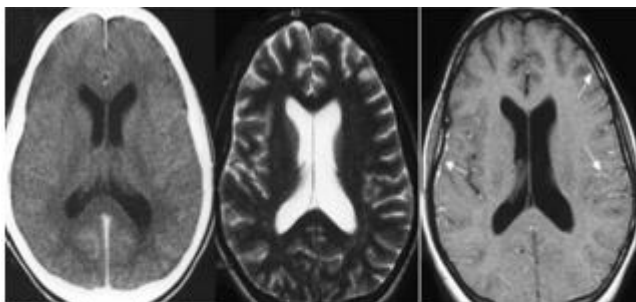


Figure 7: Hyperdensity Around Basal Cisterns on CT Head

5.6. MRI Findings

- Most sensitive modality
- T1 : may be normal, sulci may appear less hypointense than normal
- T1 C+ (Gd) : leptomeningeal enhancement
- FLAIR: demonstrates hyperintense signal in CSF spaces especially in the sulci.
- FLAIR C+ (Gd) : has shown to be more sensitive and specific than T1 C+ (Gd) sequence in spotting leptomeningeal enhancement
- MR angiography: arterial narrowing or occlusion

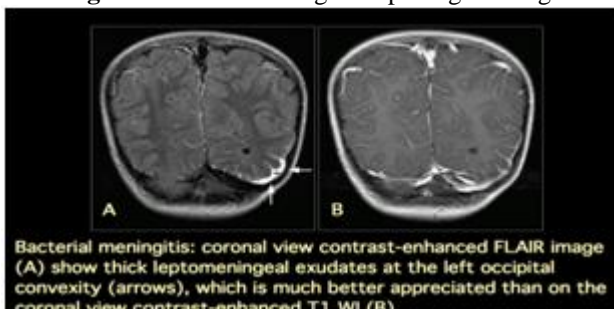


This axial nonenhanced computed tomography scan shows mild ventriculomegaly and sulcal effacement

Acute bacterial meningitis. This axial T2-weighted magnetic resonance image shows only mild ventriculomegaly.

This contrast-enhanced, axial T1-weighted magnetic resonance image shows leptomeningeal enhancement (arrows).

Figure 8: CT/MRI Images Depicting Meningitis



Bacterial meningitis: coronal view contrast-enhanced FLAIR image (A) show thick leptomeningeal exudates at the left occipital convexity (arrows), which is much better appreciated than on the coronal view contrast-enhanced T1 WI (B).

Figure 9: Flair & T1 MRI Images in Meningitis

5.7. Complications of Meningitis^[5]

- Hydrocephalus
- Cerebritis
- Abscess
- Thrombosis
- Infarct
- Vasculitis
- Extra axial fluid collections

6. Conclusion

- Bacterial meningitis is fairly common disease in infancy. The typical features of fever, seizures, refusal to feed, lethargy and irritability with low sugar and high polymorphs along with Transfontanelles real time Ultrasonography is most important in arriving at diagnosis.
- USG is an effective, cheaper, non-invasive, portable, easy to repeat and fairly accurate method for evaluating intracranial changes in uncomplicated as well as complicated meningitis.
- On the basis of sonographic findings adequate medical treatment can be monitored and surgical intervention can be planned.

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Author Profile



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