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Role of Sonography of Brain through Anterior Fontanelle in Neonate

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ABSTRACT

Objectives:- The objective of this study was to evaluate the role of sonography in newborn and neonate brain through anterior fontanelle to identify brain pathology noninvasively and rapidly at bed side level.

Materials and methods: - Neonatal cranial ultrasonography (US) has traditionally relied on the anterior fontanelle as the primary acoustic window. We generally use phased-array, multiple-foci 5.0- or 7.0-MHz sector transducers (Esaote My Lab 40, My lab 60, Samsung AVXGE30). The proximity to the brainstem and posterior fossa afforded by the alternate windows (i.e., the posterior and mastoid fontanelles) allows the use of higher-frequency probes in these areas, thereby increasing resolution. The anterior fontanelle, located at the junction of the coronal and sagittal sutures, is the largest fontanelle. Although anterior fontanelle imaging can be performed with the neonate in any position, imaging through the posterior and mastoid fontanelles is facilitated by placing the infant in the lateral decubitus position.

Results:- B-mode sonography had sensitivity of 82.5%, specificity of 63.6%, though MRI and CT imaging remains the investigation of choice but for early bedside evaluation for brain imaging in neonates, trans fontanelle ultrasonography is the choice to investigate.

Conclusions: Neonatal intracranial sonography performed through the anterior fontanelle and with use of the posterior fontanelle and through the mastoid fontanelle-can significantly augment the diagnostic power of neurologic sonography in detecting brain abnormality findings like small intraventricular haemorrhages, subarachnoid haemorrhage, and hydrocephalus, choroidal cyst and in depicting structural abnormalities of the brainstem and cerebellum.

Key Words: Neonates, anterior fontanelle, Posterior and mastoid fontanelle, Sonography.

INTRODUCTION

The most important period for a child that has deepest impact on his life expectancy is the neonatal period to first year of life. Infant and neonatal mortality and morbidity rate is thus the most important indicator of health status of a community. Infections (36%), preterm birth (28%) and birth asphyxia (23%) account for 87% of neonatal deaths in community. [1,2] There is some variation between different epidemiology. The common causes of neonatal deaths in India include infections, birth asphyxia, and prematurity which contribute to 32.8%, 22.3%, and 16.8% of the total neonatal deaths, respectively. [3,4]

Dewbury et al in 1980 first reported the use of anterior fontanelle as a bone free window through which brain can be imagined. Since then this technique has become widely accepted and is regarded as a primary imaging method for the neonatal brain. [5]

Complications of premature birth include bleeding in the brain parenchyma and/or in the ventricles (IVH). Most cases of IVH can be detected by cranial ultrasound in first week after delivery. IVH may cause gross motor delays to cerebral palsy or mental retardation. [6]

There are many other congenital abnormalities affecting the brain parenchyma such as neural tube closure, diverticulation, cleavage, sulcation, neuronal migration and posterior fossa developmental defects.

Though there are many advantages in computed tomography (CT) and magnetic resonance imaging (MRI) for evaluation of brain pathology and structure abnormality, ultrasound (US) is still the most commonly used modality for examining the newborn brain. [7] Ultrasound is the modality which able to evaluate the brain at the bedside, which can be vitally important in the case of the critically ill neonate.

CT requires sedation and will produce ionizing radiation, while MRI requires sedation, mobilization of patient to machine, having the hypothermic environment and prolonged time for imaging. Most important is ultrasound does not produce any radiation. However, ultrasound is operator-dependent which requires good hand for proper examination. [8]

Cranial ultrasound produces image of brain and ventricles by reflecting sound wave, investigation is most commonly done on neonates to evaluate complication of premature birth. The most common abnormalities found by imaging are hydrocephalus, intracranial/germinal matrix haemorrhage and/or related hypoxic-ischemic damage, same way we can exclude the possibility for the same. We can have images if there is tumour or space occupying lesion but there will be limited evaluation for that though it can give provisional diagnostic view. [9]

Non-invasive real time sonography has key role in the initial evaluation and monitoring of ventricular dilatation in the newborns. [10-13] Ventricular size, intracranial/germinal matrix haemorrhage, abnormalities of ventricular system and cystic lesion are well recognized by usual sonographic criteria. [14,15] Mastoid fontanelle imaging is particularly useful evaluating in temporal horn of ventricles and choroid plexus detecting haemorrhage involving the brainstem, cerebellum and subarachnoid cisterns. It plays role in the diagnosis of inflammatory processes too. [16-18]

MATERIALS AND METHODS

147 neonates were included in the study among which 41 were full term and 79 were preterm who were admitted in the Neonatal care unit in Shree M.P. Shah government medical college, Jamnagar, during period of June-2018 to December-2019.Informed consent was taken from the parents before the commencement of the study. After taking the ethical approval from the college, all the preterm neonates and term neonate who presented with clinical features suggestive of CNS involvement cases were assessed. All 147 neonates were examined within 24 hours from admission for cranial ultrasound irrespective of the clinical status and term presenting with CNS or other symptoms were included in the study and we have gathered information. The examination was done by multiple-foci 5.0- or 7.0-MHz sector transducers (Esaote My Lab 40, My lab 60, Samsung AVXGE30 machine. Anterior and posterior fontanelle and mastoid window were used as windows for ultrasound scanning. Coronal and sagittal scans were obtained using multiple angulated views. Size and shape of ventricles, presence or absence of intraventricular echogonic area, periventricular area with echogenicity, any midline shift, choroid plexus, any abnormal hyper or hypoechoic area or lesion and other visualised and accessible anatomical structure has been evaluated.

Inclusion criteria

- Bulging in fontanelle.
- Seizure or hypotonia in newborn.
- Suspicious of developmental delay.
- Follow of antenatal sonography findings.
- Traumatic delivery.

OBSERVATIONS AND RESULTS

In study 147 cases were included out of them 79 were preterm [Table 1].68 cases were full term neonates.

Table 1: Major causes for admission in neonatal care unit.

No.	Cause of admission	No of patients.
1	Preterm	79(53.74%)
2	Overweight	11 (7.48%)
3	Convulsion	31 (21.08%)
4	Hypotonia	40 (27.21%)
5	Neonatal Jaundice	31 (21.08)
6	Birth asphyxia.	24 (51.06%)

All above mentioned are major causes for admission in neonatal care unit from there reference for bedside ultrasonography been sent.

Table 2: Indicative symptoms for brain parenchymal ultrasonography.

No.	Symptoms at time of examination	No of patients.
1	Convulsion.	31 (21.08%)
2	Bulging of fontanelle.	34 (23.12%)
3	Hypotonia.	40 (27.21%)
4	Not feeding well.	17 (11.56%)
5	Abnormal reflexes.	11 (7.48%)
6	Delayed milestones.	14 (9.52%)
7	Respiratory distress.	21 (14.28%)

These are the symptoms which can be related with CNS. Ultrasonography was done to newborn/neonate who one or more above mentioned symptoms. Even asymptomatic newborn with low birth weight (<1500 gm) also been examined.

Table 3: Ultrasound findings in all symptomatic neonates.

No.	Ultrasound findings	No of patients.
1	Hydrocephalus	21 (14.28%)
2	Intraparenchymal haemorrhage.	7 (4.76%)
3	Intraventricular/ germinal matrix haemorrhage.	12 (8.16%)
4	Choroidal cyst	3 (2.04%)
5	Benign enlargement of subarachnoid space	15 (10.20 %)
6	Other findings	14 (9.52%)
7	No abnormality found	49 (33.33%)

In neonates, prematurity with hypotonia (50.63%) were the predominant symptoms for neonatal admission and evaluation for cranial ultrasonography while the other symptoms were refusal of feed and bulging fontanelle (23.1%), convulsions (39.24%) [Table 2].In full term neonates, bulging fontanelle, feeding refusal and convulsion were remained main symptoms.

B-mode sonography had sensitivity of 87.5%, specificity of 63.6% [Table3], though MRI and CT imaging remains the investigation of choice but for early bedside evaluation for brain imaging in neonates, trans fontanelle ultrasonography is the choice to investigate.

Sonography findings:

Figure 1: Trans anterior fontanelle sonography shows dilatation of both frontal lobes

Figure 2: Sonography shows benign enlargement of subarachnoid space.

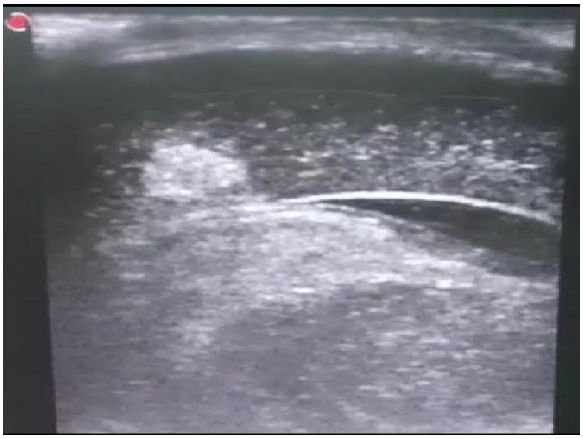

Figure 3: Sonography thorough mastoid approach shows hyperechoic foci involving parenchyma suggestive of intraparenchymal haemorrhage.

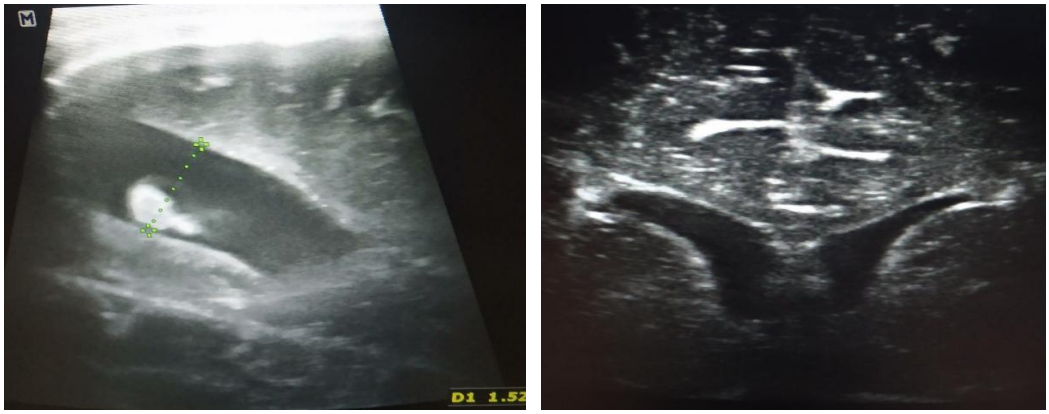

Figure 4: Through trans anterior fontanelle shows normal frontal horns; however at mastoid fontanelle approach shows focal dilatation of body of ventricles.

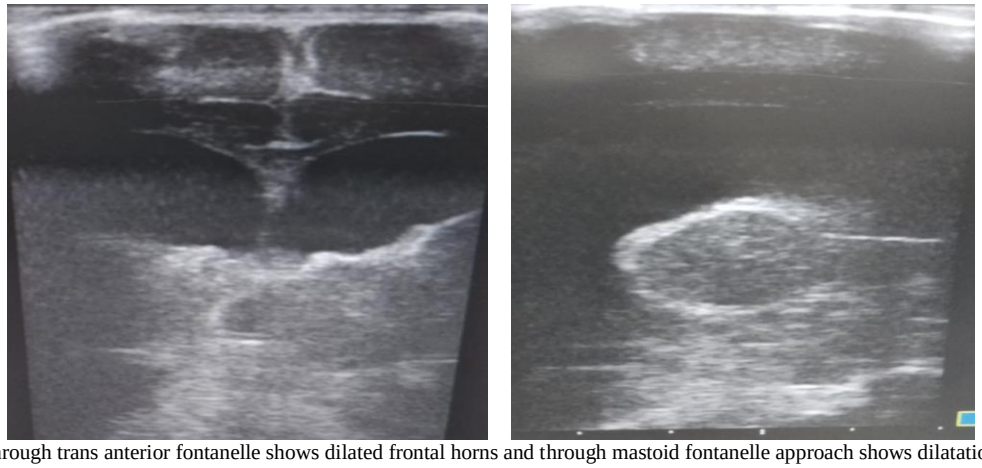

Figure 5: Through trans anterior fontanelle shows dilated frontal horns and through mastoid fontanelle approach shows dilatation of body of ventricle along with hyperechoic material completely filling it suggestive of intraventricular haemorrhage.

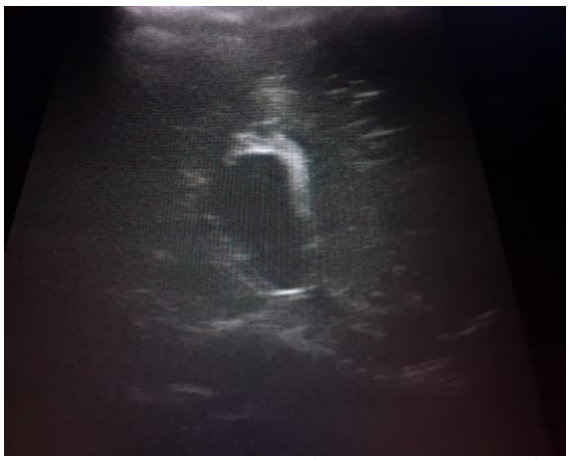

Figure6: Through trans anterior fontanelle shows well defined cystic lesion within choroid, suggestive of choroidal cyst.

DISCUSSION

The use of real-time sonography in the diagnosis for intracranial/germinal matrix haemorrhage and brain structure abnormality is an accurate procedure. Particularly in premature neonates in whom bleeding is not uncommon [Figure 3].

Every newborn, more importantly underweight (less than 1500 gm) should be examined sonographically irrespective of whether symptomatic or not and then followup is advised if further clinically indicated. If the child is symptomatic and suspicious of intracranial haemorrhage and the sonogram is negative, CT to be done when the neonate is stable. In the full-term neonates, the bleeding is often subarachnoid. So, in symptomatic full-term neonate, if sonography does not show intracranial pathology, immediate CT/MRI imaging is preferred. The use of real-time sonography to detect solid lesions is not very accurate at present, because small parenchymal changes are difficult to visualize, though big lesion can be identified.

CONCLUSIONS

Neonatal intracranial sonography performed through the anterior fontanelle and with use of the posterior fontanelle and through the mastoid fontanelle [Figure 4]-

can significantly augment the diagnostic power of neurologic sonography in detecting brain abnormality findings like small intraventricular haemorrhages, subarachnoid haemorrhage, and hydrocephalus, choroidal cyst and in depicting structural abnormalities of the brainstem and cerebellum. For preterm neonates bedside transfontanelle sonography is key investigation to evaluation brain parenchymal and structural abnormality.

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Conflict of Interest: None

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