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Screening of Pre-Term Babies through Neurosonography

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Abstract

Brain maturation, the existence of structural brain abnormalities or brain damage, the timing of cerebral injury, and the neurological prognosis of the newborn are all things that may be determined with the use of NSG. It is crucial in determining whether or not to discontinue intense therapy in critically sick newborns and neonates with brain abnormalities who are expected to survive despite their damage. It may aid in optimizing care for the newborn and providing postnatal support for the newborn's family. Premature birth affects around 10% of all births; among these infants, more than 10% will suffer brain damage that cause severe developmental delays or disabilities such cerebral palsy, seizures, mental retardation, and learning problems. As a result, the purpose of the current research is to screen all of these children at risk of neurological difficulties, find structural abnormality, forecast neuro developmental outcome, advise the parents accordingly, and urge the family to conduct early intervention.

1. Introduction

Since its introduction in the late 1970s, neurosonography(NSG) has become a crucial diagnostic technique in contemporary neonatology. Unlike MRI and CT scans, NSG does not use ionizing radiation, does not need sedation, is non-invasive, and may be performed right at the patient's bedside. In newborns and neonates, the suture lines and the fontanel are open, providing auditory windows into the brain.

This method is beneficial for hemodynamically unstable newborns, since imaging may be performed without having to transfer the infant to the radiology department for Surgery. It's possible to start doing it just after you're born. Therapy is non-invasive and may be done as frequently as needed, allowing for the viewing of brain maturation, the development of brain lesions, and the assessment of the timeline of brain damage.

Preterm and full-term newborns both benefit from its ability to identify calcification, cerebral infections, and severe structural brain defects. With these benefits, NSG should be considered a top choice for newborn brain imaging.

2. Objectives

1. To study lesions like germinal matrix hemorrhage, intraventricular hemorrhage, periventricular leucomalacia, ventriculomegaly and others in preterm neonates by using NSG.

2. To evaluate the possible use in determining prognosis and outcome at the end of the study

3. Review of Literature

The cerebral cortex is the brain's outermost layer and is made up of a dense network of neurons. It's the brain's gray matter. The cerebral cortex, which is located directly underneath the meninges, is further subdivided into the frontal, temporal, parietal, and occipital lobes. The gyri are prominent protrusions of brain tissue, and the sulci are deep crevices that alternate with them. The enfolding of the brain is a result of the exponential increase in brain size that has occurred throughout evolutionary history. The birth process required narrow cranial vaults, thus huge brains folded in different ways to fit in these spaces. The cerebral cortex has critical regions for sensing, moving, and connecting. The main somatosensory cortex is located in the postcentral gyrus of the parietal lobe, and it receives information from the thalamus.

4. Structure and Function

a) Frontal Lobe: The frontal lobe is the largest lobe of the brain, lying in front of the central sulcus. Both anatomically and functionally, it divides into different significant areas. The dorsolateral frontal lobe is divided into three major areas which includes the:

i) Prefrontal cortex
ii) The premotor cortex,
iii) Primary motor cortex

The frontal lobes are critical for more difficult decisions and interactions that are essential for human behavior. Thus, damage to this area may result in disinhibition and deficits in concentration, orientation, and judgment. A frontal lobe lesion may also result in regression or a re-emergence of primitive reflexes. The frontal eye fields are the central saccadic eye movement control area, damage to this area may cause eye deviation towards the side of the lesion. However, in patients experiencing a seizure arising from the frontal eye fields will result in the eyes to look away from the lesion.

b) Temporal Lobe: The temporal lobe processes sensory input into derived meanings for the appropriate retention of emotions, visual memory, and language comprehension. It contains the primary auditory cortex which is involved in processing sound. Wernicke's area is located in the superior temporal gyrus of the dominant hemisphere and manages the comprehension of language.

c) Parietal Lobe: The parietal lobe is responsible for perception, sensation, and integrating sensory input with the visual system. It houses the primary somatosensory cortex, which is located in the postcentral gyrus, posterior to the central sulcus. It is responsible for receiving contralateral sensory information.

d) Occipital Lobe: The occipital lobe is the center for the processing of visual input in humans. The primary visual cortex is located in Brodmann Area 17, on the medial side of the occipital lobe within the calcarine sulcus.

5. Role of Cranial Ultrasound

Survival rates for the so-called "High Risk Neonate" have risen dramatically with the development of cutting-edge neonatal intensive care, making it imperative to screen for neurological abnormalities at an earlier age. The use of cranial ultrasonography (CUS) to see both normal and abnormal changes in the infant brain has made it an indispensable diagnostic tool in contemporary neonatology. During neonatal development, numerous sutures and fontanels remain open, allowing for acoustic "windows" into the brain.

It fits the criteria for point-of-care testing since it can be done quickly and simply at the bedside using a portable ultrasound equipment, which is especially useful in the NICU (POCT). It is inexpensive, does not expose newborns to radiation, and has a proven track record of safety. For the purposes of this definition, a high-risk neonate is defined as any newborn with an increased risk of morbidity or death owing to fetal, maternal, or placental abnormalities or an otherwise impaired pregnancy, particularly during the first 28 days of life. CUS is useful for determining the neurological outlook of babies at risk.

Premature newborns are often evaluated with serial cranial ultrasounds at the outset of their hospital stays, with follow-ups performed later on. Neurodevelopmental assessments are performed to record the existence of cerebral bleeding, direct the selection of medications that may increase the risk of further hemorrhage, and advise families on potential consequences. CUS is particularly useful for determining whether or not to discontinue intensive care in critically sick newborns with congenital or acquired brain abnormalities, such as those seen in babies with HIE1.

Both the ultrasound machine and the examiner's level of experience contribute to the diagnostic accuracy of CUS imaging. When carried out correctly, it is a reliable method of detecting frequent complications in newborns. CUS may be started as soon as feasible after delivery, making it ideal for screening, and it can be repeated as frequently as possible without negative side effects, making it useful for keeping tabs on infants with neurological disorders.

6. Cranial USG Technique

Before to the operation, you must take some precautions. The majority of the evaluation is done right next to the incubator where the newborn is now resting. The cranial incubator hole is the optimal examination site. The baby should not be moved, and the incubator's temperature should not be altered, for safety reasons. Particularly with a preterm baby in severe condition, pressure on the anterior fontanelle should be avoided. Neonatology intensive care unit (NICU) procedures need strict adherence to aseptic practices at all times.

A elevated phased array transducer (5-8 MHz) packed into a compact probe yields the best performance. With a probe frequency of 7.5 MHz, high-resolution pictures may be acquired even in premature newborns. When the anterior fontanelle is tiny, it might be challenging to get the best picture. Small-footprint, wide-insonation-angle (up to 140 degrees) phased array transducers aid in obtaining diagnostic-grade imaging.

7. Material and Methods

Type of Study: Prospective observational study

Place of Study: Department of Pediatrics, KIMS Karad DURATION OF STUDY: 18 months

Method of Data Collection:

a) All preterm infants below 32 weeks will be subjected for study.

b) All patients included in the study will undergo neurosonography using standard ultrasonography machine SEIMENS ACUSON JUNIPER.

c) Ethical clearance was obtained for the study from the Ethical committee, KIMS

d) Informed written consent was obtained from the parent or the guardian of the child before enrolling the child in the study.

e) History taking with particular emphasis on:

    i) *Prenatal History:* Maternal parity and illnesses, Drug intake and any complication during pregnancy.

    ii) *Natal History:* Mode of delivery and any complications during delivery.

iii) *Post natal History :* Gestational age, weight diagnosis on admission

f) Clinical examination with particular emphasis on

- Birth weight and gender of the newborn.
- Assessment of gestational age of neonate using the criteria of the new Ballard score system.

g) Neurosonography was performed within 7 days of birth followed by a follow up scan at the end of one month.

Inclusion Criteria

a) All pre term born prior to 32 weeks of gestation.

b) All preterm who weigh less than 1500 gm at birth.

ExclusionCriteria

All cases suspected to have congenital malformations, severe infections and failed resuscitation.

Results and Discussion

Gender wise distribution

In this study we assessed the study subjects according to their gender. We observed that majority of the study subjects were males (54%), followed by 46% female subjects.

The male: female ratio observed in the present study was 1:0.85.

Table-1: Distribution of subjects according to Gender

Gender	Number of subjects	Percentage
Male	54	54
Female	46	46
Total	100	100
M:F ratio	1:0.85	

Agedistribution

We observed that majority of the subjects belonged to the gestational age of 30 weeks (34%), followed by 31 weeks ofgestation among 27% subjects, 32 weeks among 17%, 29 weeks among 15%study subjects.

The mean gestational age among the study subjectswasobservedtobe30.32±1.13weeks.

Table2: Distribution of study according to gestational age

Gestational Age	Numberofsubjects	Percentage
28weeks	7	7
29weeks	15	15
30weeks	34	34
31weeks	27	27
32weeks	17	17
Total	100	100
Meangestationalage	30.32±1.13 weeks	

Mode of Delivery

In this study, we assessed the various modes of delivery among the present study subjects. We observed that LSCS was the preferred mode of delivery among 76% study subjects, followed by normal vaginal delivery conducted among 24% subjects.

Table-3: Distribution of subjects according to mode of delivery

Mode of delivery	Number of subjects	Percentage
Vaginal	24	24
LS CS	76	76
Total	100	100

Birth Weight

In the present study, we assessed the birth weight of the study subjects. We observed that the majority of the study subjects had the weight between the range of 125. to 1500 gm (49%), followed by 37% subjects had birth weight between 1000 to 1250 gm. 14% study subjects had birth weight between 750 to 1000 gm. The mean birth weight observed among current study subjects was 1202.2 ± 169.19 gm.

Table 4: Distribution of subjects according to

birth weight

Birth weight	Number of subjects	Percentage
750-1000 gm	14	14
1000 - 1250 gm	37	37
1250 - 1500 gm	49	49
Total	100	100
Mean birth weight	1202.2 ± 169.19 gm	

8. Clinical Presentation

In the present study we assessed the clinical presentation of the study subjects. we observed that Seizures were noted among 41% subjects, Lethargy among 38% subjects, absent suckling among 31%, Flaccidity among 10%, Irritable / excessive cry among 29%, Sudden onset pallor among 12%, Hypotonia among 32% subjects, and Bulging anterior fontanelle was seen among 5% study subjects.

Table 6: Distribution of subjects according to clinical presentations

Clinical Presentation	Number of subjects	Percentage
Seizures	41	41
Lethargy	38	38
Absent suckling	31	31
Flaccidity	10	10
Irritable / excessive cry	29	29
Sudden onset pallor	12	12
Hypotonia	32	32
Bulging anterior fontanelle	5	5

NSG findings

NSG examination of the study subjects. We observed that 41% subjects presented with germinal matrix hemorrhage, among them overall 15% had grade I GMH, 14% had grade II GMH, 8% had grade III GMH and 4% had grade IV GMH. Among 9% study subjects intraventricular haemorrhage was noted, while among 10% subjects Periventricular leucomalacia was observed. Ventriculomegaly was seen among 2% subjects, cerebral edema observed among 2% subjects, Cysts were observed among 3%, Corpus Callosum Agenesis among 2% and Dandy-Walker syndrome was seen among 1% study subjects.

Table 7: Distribution of subjects according to NSG findings

NSG Finding		Number of subjects	Percentage
Normal		30	30
GMH	**Grade I**	15	15
	Grade II	14	14
	Grade III	8	8
	Grade IV	4	4
IVH (intraventricular haemorrhage)		9	9
PVL (Periventricular leucomalacia)		10	10
Ventriculomegaly		2	2
Cerebral edema		2	2
Cysts		3	3
Corpus Callosum Agenesis		2	2
Dandy-Walker syndrome		1	1

Outcomes

In this study we assessed the outcomes among the study subjects after 1 month showed observed that 75% study subjects were cured and discharged, 4% subjects were discharged against medical advice. 6% mortality was observed in the current study. 1 case of newly diagnosed cystic PVL was diagnosed.

Table 8: Distribution of subjects according to outcomes (The end of 1 month)

Outcome	Number of subjects	Percentage
Resolved	75	75
Persisted	14	14
Death	6	6
DAMA	4	4
New diagnosed	1	1
Total	100	100

USG findings

In this study, we conducted USG examination of the study subjects. We observed that 41% subjects presented with germinal matrix hemorrhage, among them overall 15% had grade I GMH, 14% had grade II GMH, 8% had grade III GMH and 4% had grade IV GMH.

Among 9% study subjects intraventricular haemorrhage was noted, while among 10% subjects Periventricular leucomalacia was observed. Ventriculomegaly was seen among 2% subjects, cerebral edema observed among 2% subjects, Cysts were observed among 3%, Corpus Callosum Agenesis among 2% and Dandy-Walker syndrome was seen among 1% study subjects.

9. Summary and Conclusions

The clinical presentation of the participants was evaluated in this research. For 41% of the study population, we recorded seizures; for 38%, we recorded lethargy; for 30%, we recorded a lack of suckling; for 10%, we recorded flaccidity; for 29%, we recorded irritability or excessive crying; for 12%, we recorded a sudden onset of pallor; for 32%, we recorded hypotonia; and for 5%, we recorded a bulging anterior fontanelle.

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In the present study, we compared USG findings with outcomes on follow up examination after 1 month. We observed that lesions were persisted among GMH grade III (3 cases), IV (1 case), IVH (2 cases), PVL (3 cases), ventriculomegaly (1 case), cerebral edema (1 case), corpus callosum agenesis (2 cases), DWS (1 case). Mortality was observed among GMH III (1 death), GMH IV (2 deaths), IVH (1 death), PVL (1 death), and cyst (1 death). Among majority of the subjects lesions were resolved.

This research shows that cranial ultrasonography is a useful diagnostic tool for monitoring high-risk infants in the NICU. The importance of this modality's usage as a screening tool for premature and asphyxiated newborns is also highlighted. In the neonatal intensive care unit (NICU), CUS is an essential investigative tool for documenting the morphology of brain injury. We observed that 75% study subjects were cured and discharged, 4% subjects were discharged against medical advice. 6% mortality was observed in the current study.

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