

## Original Research :

# Cranial Ultrasound in High Risk Preterm

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### Abstract:

**Objectives:** To assess the importance of cranial Ultrasound as an investigational tool for high risk preterm and to find out morphology and location of various cerebral lesions and correlate clinically.

**Method:** An observational correlation clinical study conducted at Patna Medical College and Hospital, Patna for a period of 2 years, involving 75 high risk preterm (less than 34 weeks of gestational age) admitted to NICU who were subjected to neurosonography. Perinatal details were recorded and clinical examination with appropriate investigations was done. Clinical correlation with CUS findings and follow up was done.

**Results:** Incidence of CUS abnormalities in the present study was 25.4%. Abnormal Cranial USG findings were periventricular hyperechogenicity (10.6%), intracranial haemorrhage (8%), periventricular leucomalacia (4%) and cerebral edema (2.4%). Incidence of abnormal Cranial USG was significantly higher in males compared to females. Abnormal cranial USG was also significantly related to gestational age and birth weight. Among perinatal risk factors, correlation of abnormal Cranial USG with APH and Birth Asphyxia was statistically significant. Among clinical examination, statistically significant relation between abnormal activity and abnormal tone ultrasound abnormalities. Positive CRP has significant relation with CUS abnormalities.

### Conclusion:

Cranial Ultrasound is an ideal tool for primary screening of the cerebral pathologies in premature sick newborn.

**Keywords:** *Fetal brain, cerebral circulatory autoregulation, Cranial USG, periventricular hyperechogenicity, intracranial hemorrhage, periventricular leucomalacia, birth asphyxia, APH*

### Introduction:

Heading towards the goal "EVERY NEWBORN", by 2030, Neonatal Care in India is advancing at an impressive phase at the level of Community as well as in tertiary care units. Cranial Ultrasonography is an ideal tool for primary screening of neonatal brain as it is almost ubiquitously available, safe and radiation free, and can be initiated immediately after birth. It can be performed safely at bedside, so a suitable modality for even unstable new-borns. It can be repeated as often as possible without any adverse effects and hence, helps in proper follow up of babies with neurological problems. It is relatively sensitive and highly specific means of predicting the presence or absence of later neurodevelopmental abnormalities in preterm infants.

Fetal brain is vulnerable to both haemorrhagic and ischaemic injuries during late second and third trimesters due to vascular, cellular, and anatomical features of the developing brain and physiological instability due to limited cerebral circulatory autoregulation. Preterm infants,

especially those younger than 32 weeks gestation are prone to both Germinal Matrix haemorrhage/ Intraventricular Haemorrhage and ischemic white matter injuries 2, therefore, routine cranial ultrasound is most valuable for this group. Hence, this study was undertaken to assess the importance of cranial ultrasound as an investigational tool for high risk preterms and to find out the morphology and location of various cerebral lesions and its clinical correlation.

### Materials and Methods:

This was an observational correlation clinical study conducted at Neonatal Intensive Care Unit, Department of Paediatrics, Patna Medical College and Hospital, Patna from October, 2013 to October 2015. 75 neonates admitted to NICU were selected as per the inclusion criteria on non randomized sampling and were subjected to neurosonography within 3 days, at 7th day, at 14th day and at 28th day of life. Informed consent was obtained from the parents/guardians regarding inclusion of the neonate in the study. Descriptive statistical analysis was carried out. Significance was assessed at 5% level of significance. Chi square and Fisher exact test was used to find the significance of study parameters on categorical scale between 2 or more groups. Statistical software namely, Epi info and SPSS were used for the analysis of data.

The following Parameters were assessed viz. Gender distribution, Gestational Age of the preterm/ birth weight alongwith Maternal Risk Factors like PIH, APH, PROM, Multiple Pregnancy. Perinatal Risk Factors like Birth Asphyxia, Neonatal Sepsis, Neonatal Seizure were also studied. Clinical Examination of the Preterm was done for Abnormal Cry, Poor Activity, Abnormal Tone, Pallor, Icterus, Cyanosis, Tachycardia (HR>160/min), Tachypnea (RR >60/min), Abnormal CRT, Presence of CHD,

Abnormal RS. Investigations like, Hemoglobin (<13 gm/dl), Total Count (<5000 or >30 000 cells/cumm), Positive CRP, Positive C/S, Abnormal CSF Analysis, Cranial USG, its abnormalities were assessed. Follow up was in form of Clinical Outcome (Death or Discharged)

### Observation:

In the present study, 75 preterms were enrolled. Incidence of Cranial Ultrasound abnormalities in high risk neonates was 25.4%. There were 62.6% males and 37.4% females. Incidence of abnormal cranial USG findings was significantly higher in males. 45.4% of the preterms were less than 30 weeks gestation and weighed less than 1200gms. Relation of gestational age and body weight with abnormalities in cranial USG were significant. Out of the total 19 Abnormal cranial USG findings, 8 had periventricular hyperechogenicity, 6 had intracerebral/ intraventricular haemorrhage, 3 had periventricular leucomalacia and cerebral edema was present in 2 cases. Among the maternal risk factors, statistically significant relation was found between APH and Cranial USG abnormalities, moderately significant relation between PROM and abnormal CUS findings and no statistical relation between abnormal CUS and multiple pregnancy and PIH. Among perinatal risk factors, significant relation between Cranial USG abnormalities and birth asphyxia but no relation between neonatal sepsis and neonatal seizures with ultrasound abnormalities could be established. Poor activity and abnormal tone showed moderately significant relation with abnormal cranial USG findings. Significant correlation of positive CRP with abnormalities of cranial USG was found. Out of 21.4% neonates who expired in the present study, 45.4% had neurosonogram abnormalities and significant relation between preterms who expired and cranial abnormalities as detected by neurosonogram was established.

**1. Incidence of Abnormal Cus Based on Gender**

GENDER	CRANIAL USG		SIGNIFICANCE
	NORMAL (n= 56)	ABNORMAL (n=19)	
MALE	30	17	<b>0.005</b>
FEMALE	26	02	

**2. Association Of Gestational Age And Weight With Cranial Usg Findings**

GESTATIONAL AGE & WEIGHT	CRANIAL USG		SIGNIFICANCE
	NORMAL (n=56)	ABNORMAL (n=19)	
< 30 WEEKS (<1.2 KG)	21(37.5%)	13(68.4%)	<b>0.019</b>
>30 WEEKS (>1.2 KG)	35(62.5%)	06(31.6%)	

**3. Incidence Of Different Cus Abnormalities In High Risk Preterms**

CRANIAL USG	NO. OF PRETERMS	PERCENTAGE
NORMAL	56	74.6%
ABNORMAL	19	25.3%
● PVHE	08	10.6%
● ICH	06	8%
● PVL	03	4%
● CEREBRAL EDEMA	02	2.6%

**4. Association Of Maternal Risk Factors With Cranial Ultrasound Findings**

MATERNAL RISK FACTORS	CRANIAL USG		SIGNIFICANCE
	NORMAL	ABNORMAL	
PIH	14	06	0.29
APH	14	10	0.017
PROM	21	02	0.04
MULTIPLE PREGNANCY	07	01	0.6

**5. Association Of Perinatal Risk Factors With Cranial Ultrasound Findings**

PERINATAL RISK FACTORS	CRANIAL USG		SIGNIFICANCE
	NORMAL	ABNORMAL	
BIRTH ASPHYXIA	14	10	0.017
NEONATAL SEPSIS	29	09	0.15
NEONATAL SEIZURES	15	03	0.23

**6. Incidence Of Abnormal Clinical Examination In High Risk Preterms With Abnormal cranial USG Findings And Their Association**

CLINICAL EXAMINATION	CRANIAL USG		SIGNIFICANCE
	NORMAL	ABNORMAL	
ABNORMAL CRY	08	06	0.06
POOR ACTIVITY	09	07	0.03
ABNORMAL TONE	03	04	0.03
PALLOR	01	02	0.08
ICTERUS	14	03	0.21
CYANOSIS	14	09	0.04
TACHYCARDIA(>160/MIN)	02	01	0.37
TACHYPNEA(>60/MIN)	56	19	1.0
ABNORMAL CRT	04	02	0.3
PRESENCE OF CHD	14	06	0.29
ABNORMAL RS	27	08	0.32

**7. Incidence Of Abnormal Investigations With Abnormal Cranial USG Findings And Their Association**

INVESTIGATION	CRANIAL ULTRASOUND		SIGNIFICANCE
	NORMAL	ABNORMAL	
HEMOGLOBIN (<13g/DL)	04	02	0.32
TLC (<5000 OR >300000)	02	00	0.27
POSITIVE CRP	20	02	0.01
POSITIVE C/S	01	02	0.08
ABNORMAL CSF ANALYSIS	03	01	0.48

**8. Association Of Clinical Outcome With Cranial USG Abnormalities**

CLINICAL OUTCOME	CRANIAL	USG	SIGNIFICANCE
	NORMAL	ABNORM-AL	
DISCHARGE	51	08	0.001
DEATH	05	11	

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**Discussion:**

Daneman A, Epelman M et al<sup>3</sup> (2006) proved that CUS remains an extremely useful modality for evaluation of the neonatal brain. De Vries and Cowan et al<sup>4</sup> (2007) have suggested that head ultrasound and MRI are complementary modalities, with ultrasound as an especially useful tool in the early days, when the infant is unstable for transport and ultrasound findings may be sufficient for major clinical decisions. Present study aims at proving the same.

Incidence of CUS abnormalities in high risk preterms is 25.4% in the present study. Badrawy N, Edrees A, and Mohamed El Ghawas et al<sup>5</sup> (2005) showed in their study that 37% preterms had abnormal CUS findings. There is significant association between male gender and Cranial USG abnormalities with p value 0.005 in the present study. Janet L. Peacock et al in 2012, in their study showed that male sex was significantly associated with higher birth weight, oxygen dependency, death and major cranial ultrasound abnormalities (20% in males vs. 12% in females). Differences remained significant after adjusting for birth weight and gestational age. In the present study, the relation of gestational age with cranial sonography abnormalities is significant.

The EPIPHAGE Cohort Study<sup>6</sup> done to predict Cerebral Palsy among very preterm Children in relation to gestational age and neonatal cranial ultrasound abnormalities had 7.1% neonates of gestational age 24-26 weeks, 16.5% neonates of 27-28 weeks, 24.9% neonates between 29-30 weeks and 51.5% neonates between 31-32 weeks of gestation. In the present study, on CUS, 25.4% of neonates had abnormal findings. 8% of these had evidence of intracranial bleed, 10.6% has periventricular hyperechogenicity, 4% has periventricular leucomalacia, 2.6% had cerebral edema. Mercuri, Lilly Dubowitz et al<sup>7</sup> (1998) reported ischemic lesions, such as periventricular and thalamic densities were the most common finding (8%), followed by intracranial haemorrhagic lesions (6%) on CUS. Chowdhury V,

Gulati P et al<sup>8</sup> (1992) in their study on 50 preterm neonates of which 58% were males and 42% females, detected intracranial pathology in 12% of preterms and 6% of these had intracranial haemorrhage. In our study, 8.6% of neonates which had abnormal findings on CUS had PROM. Also, there was significant correlation with APH with abnormal cranial ultrasound findings with 41.6% of neonates born to mothers with PIH having CUS findings. 8.6% neonates with PROM, 1.25% with multiple pregnancies had abnormal CUS findings.

Nelson and Grether et al<sup>9</sup>, (1995) Schendel et al, (1996) Michael O'Shea T et al<sup>10</sup> (1998) studied prenatal factors like preeclampsia related to cranial ultrasound findings, neurodevelopmental outcome and incidence of cerebral palsy. Badrawy N et al (1988) reported that PROM and preeclampsia influenced the presence of CUS abnormalities and risk of developing periventricular intraventricular haemorrhage (PIVH). The association between birth asphyxia and cranial USG abnormalities is significant in the present study. Alan Daneman et al 2006 concluded that perinatal asphyxia is significantly associated with cranial USG abnormalities in term neonates.

In our study, moderately significant relation exists between abnormal Cranial USG and clinical features like poor activity and abnormal tone.

Miznahi et al<sup>11</sup>, (1994) stated that in the presence of IVH there are often pallor, periods of apnea, cyanosis failure to suck well, high pitched cry, muscle twitching and convulsions.

Badrawy N et al (1988) reported that the neurological manifestations which had significant association with SE-IVH in were poor neonatal reflexes, seizures and apnea. In the study, of the 25.4%, neonates which had abnormal CUS, 10.5% had positive CRP which was statistically significant relation. In the present study, of the 25.4% neonates having abnormal CUS, 42.1% were discharged and 57.8% died. Badrawy N et al (1988) reported that 40% of neonates in their study did clinically well with total mortality of 30%.

**Conclusion:**

The concept of 'survival' of the newborn has predictably given way to the importance of 'intact survival' of the high risk infant, prompting initiation of strategies to identify neurological sub-normality at the earliest. This study highlights the convenience and diagnostic efficiency of cranial ultrasound in high risk neonates in NICU.

It also emphasizes its use as a screening modality for preterm neonates influencing their neurodevelopmental outcome. High efficacy of CUS in detecting presence of brain damage and its evolution on regular follow up guides clinical decisions and prognosis. This is particularly important in the anticipation of potential preventive, protective, and rehabilitative strategies for the management of critically ill newborn infants.

Study concludes CUS is critical as an investigatory modality in NICU and effectively documents morphology of brain damage.

**Conflict Of Interest:** None

**Funding for the Study:** None

**Contributions of authors:**

**Ruchi Jha:** Original research and Review,

**Alka Singh:** Conception of the topic, Guidance, assistance and enrichment,

**Richa Jha:** Selection of high risk pregnancies, their follow up till delivery and maternal risk factors

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