A prospective study of correlation of gestational age, birth weight and perinatal risk factors with various cranial ultra sound findings in high risk neonates

Niranjan Nagaraj[1,*], Pramod Kumar Berwal[2], Shyama Choudhary[3]

[1,3]Senior Resident, [2]Professor& Head, Dept. of Pediatrics, Sardar Patel Medical College Bikaner, Rajasthan

***Corresponding Author:**
Niranjan Nagaraj
Senior Resident, Dept. of Pediatrics, Sardar Patel Medical College Bikaner, Rajasthan
Email: getniranjan806@gmail.com

Abstract

Background: CUS plays an important role in assessing neurological prognosis of these high risk infants. This study was conducted to assess the correlation of gestational age, birth weight and perinatal factors with various cranial ultra sound findings in high risk neonates.

Methods: A clinical study was conducted at Sardar Patel Medical College, Bikaner. 200 high risk neonates were enrolled for the study. Cranial ultrasound was done and findings were studied. Detailed antenatal and perinatal history was recorded and clinical examination and baseline investigations was done. Perinatal details were recorded and clinical examination with appropriate investigations was done. CUS was done and morphology of various findings was studied and recorded.

Results: On cranial ultrasound, 76 of neonates had abnormal findings. Correlation of gestational age with cranial ultrasound findings was statistically significant (P=0.010). Correlation of birth weight of high risk neonates with abnormal cranial ultrasound findings was statically not significant (P=0.9160). In the correlation of perinatal risk factors with abnormal cranial ultrasound findings, there was no significant correlation with PIH, APH, PROM, multiple births and birth trauma (P=0.620).

Conclusion: It is cheap, non-invasive, non-ionizing radiation, repeatable and easily available in bed sides. Cranial ultra sound helpful for the early diagnosis and therapeutic approach for sick neonates.

Keywords: Cranial ultra sound, Gestational age, perinatal factors, Birth weight, Bikaner

Introduction

CUS plays an important role in assessing neurological prognosis of these high risk infants. Most newborn intensive care unit centers perform serial cranial ultrasound evaluations early in the course of hospitalization for premature infants and often, a follow-up examination is done at a later age. These evaluations are done to document the presence of intracranial hemorrhage, to guide choice of therapies that may exacerbate risk of further hemorrhage, and to counsel families about neurodevelopment outcomes.[(1)]

The newborn is an (understandably) uncooperative patient, incapable of following directions such as "hold your breath" or "remain still." Thus, cross-sectional modalities such as CT or MRI that require cooperation for optimal image quality are difficult to apply. Even low-dose ionizing radiation is potentially harmful for neonates, particularly when serial exams are required. Appropriate timing of CUS and accurate assessment of the site and extent of lesions is crucial for accurate prediction of neurodevelopment outcome. Several studies have suggested that only in 40–50% of preterm infants with cerebral palsy (CP), lesions are detected on CUS.[(2)]

Meningitis and brain infections can have a very rapid, fulminant course and should therefore be intensively monitored by repetitive CUS. Minor cranial ultrasound abnormalities, such as mild ventricular enlargement, choroid plexus cysts, and sub ependymal cysts, have been identified in 3% to 5% of the newborn population.

Material and Methods

This is prospective observational study was conducted in the Department of pediatrics, Sardar Patel Medical College, Pediatric PBM Hospital, Bikaner (Rajasthan) from September 2014 to September 2015. 200 hundred high risk neonates admitted to neonatal intensive care unit were selected as per the inclusion criteria. This study includes High risk neonates with any of the following: Neonatal convulsions, Birth asphyxia & HIE, Respiratory distress, Neonatal sepsis, Preterm neonates, Neonates born out of traumatic/instrumental labour, metabolic disturbances with convulsions, congenital malformation of CNS & neural tube defects and excludes Babies > 28 days. Informed consent was taken from the patient attenders for enrollment of the neonate in the study. Assessment of factors placing the neonate in a high risk category was done taking detailed maternal history reviewing antenatal records. Perinatal history and vital signs was recorded. Complete neurological examination was done during baby's stay in NICU. Gestational age was assessed as per modified Ballard's scoring method for all preterm neonates. Evaluation with baseline routine investigations [septic and metabolic work up] and lumbar puncture in case of neonatal convulsions and neonatal sepsis, chest X-ray in all respiratory distress cases was done. Cranial ultrasound of the high risk

neonate fulfilling the inclusion criteria was performed. Morphology of cranial ultrasound findings was studied and recorded and clinical correlation with various findings on cranial ultrasound was done. Statistical analysis was done by using SPSS software methods.

Instrumentation

The sonograms were performed on a Voluson 630 pro GE machine using a multifrequency high density volume -TV/TR probe. The images were obtained through the anterior fontanel and additional sections through the thin part of squamous temporal bone so as give images in axial plane comparable to CT & MRI images. Image quality was maximized by fine adjusting the preset already available for transcranial scans. The images were recorded on the hard disc of the ultrasound machine in a digital format for purpose of review. Only still gray scale images were recorded. Software for post processing the images was available. All ultrasounds were performed by a single radiologist to avoid inter-observer variation and the images were reviewed by the same radiologist later without clinical information to check for the intra-observer variation. The scan was performed in the ultrasound suite after taking care to keep the baby warm. Strict aseptic precautions were taken. The probe was covered by a probe cover. After applying the coupling gel the imaging was carried out in sagittal, modified sagittal, coronal, modified coronal planes. In addition in our study we included scanning in the axial plane through the thin part of squamous temporal bone from right and left sides. Though the examination was dynamic real time we recorded images in fixed planes through fixed anatomical land marks and with additional images through the pathology. Sagittal section: Plane (a) Midline, (b) & (c) 15, 30 degree parasagittal angulation on left and right sides. Coronal plane (a) through the frontal horns, (b) through the sylvian fissure, (c) through the 3rd ventricle, (d) through the posterior fossa, (e) through the occipital horn. An additional image of the germinal matrix with a zoom factor of 1.7 was recorded both in coronal and sagittal planes. Axial plane views were recorded through the right and left temporal fontanel at the level of thalamus and caudothalamic grooves.

Results

On cranial ultrasound, 76 of neonates had abnormal findings. 24 of these had evidence of intracranial bleed, 26 periventricular echogenecity, 14 had ventriculomegaly, 4 had cerebral edema and 2 had leukomalacia, 6 neonates had findings suggestive of simple cyst in middle cranial fossa, agenesis of carpus callosum, choroid plexus cyst.

Correlation of gestational age with cranial ultrasound findings was statistically significant (P=0.010). Of these, 34 preterm were less than 32 weeks, 90 preterm were between 33 and 36 weeks and rest 76 were term neonates. Correlation of birth weight of high risk neonates with abnormal cranial ultrasound findings revealed that 56 low birth weight neonates and 20 normal birth weight neonates had abnormal CUS. Correlation of birth weight of high risk neonates with abnormal cranial ultrasound findings was statically not significant (P=0.9160).

Of the 76 high risk neonates having abnormal CUS findings, 16 of neonates were born to mothers with PIH. 6 neonates born with PROM, 2 born out of multiple pregnancies and 4 had birth trauma. In the correlation of perinatal risk factors with abnormal cranial ultrasound findings, there was no significant correlation with PIH, APH, PROM, multiple births and birth trauma (P=0.620).

Discussion

This study was conducted at Sardar Patel Medical College, Pediatric PBM Hospital, and Bikaner**.** The duration of study was from September 2014 to September 2015.One hundred high risk neonates admitted to neonatal intensive care unit were selected as per the inclusion criteria on non-randomized purposive sampling basis and were subjected to neurosonography on selected days.

On cranial ultrasound, 76 of neonates had abnormal findings. 24 of these had evidence of intracranial bleed Elia FM et al[(4)], concluded that CUS accurately predicts the presence of GMH, intraventricular and parenchymal haemorrhage. Badrawy N et al showed in their study that 37% preterms had abnormal CUS findings.[(5)] Correlation of gestational age with cranial ultrasound findings was statistically significant (P=0.010). Of these, 34 preterm were less than 32 weeks, 90 preterm were between 33 and 36 weeks and rest 76 were term neonates.

Perlman JM et al in their study found out that up to 50% of neonates weighing less than 1500 g exhibited some abnormality on the initial CUS.[(6)] Severe IVH was observed in approximately 11% of the neonates weighing less than 1000 g and in 5% of those between 1000- and 1250-g BW. Cystic PVL was noted in 5% of the neonates weighing less than 1000-g and in approximately 1% of those between 1250 and 1500 g. In this study Correlation of birth weight of high risk neonates with abnormal cranial ultrasound findings revealed that 56 low birth weight neonates and 20 normal birth weight neonates had abnormal CUS. Correlation of birth weight of high risk neonates with abnormal cranial ultrasound findings was statically not significant (P=0.9160).

Vermeulen GM et al reported cranial ultrasound abnormalities in 13% of preterm neonates some of which had perinatal risk of PROM and proved early onset neonatal infectious disease is an independent risk factor for cranial ultrasound abnormalities.[(7)] In our study Correlation of birth weight of high risk neonates with

abnormal cranial ultrasound findings revealed that 56 low birth weight neonates and 20 normal birth weight neonates had abnormal CUS. Correlation of birth weight of high risk neonates with abnormal cranial ultrasound findings was statically not significant (P=0.9160).

Table 1: Correlation of Perinatal risk Factors with Cranial Ultrasound findings in high risk neonates

	Cranial ultrasound		
Perinatal risk factors	**Normal (n=124)**	**Abnormal (n=76)**	**Significance**
PIH	26 (20.9%)	16 (21.1%)	P=0.620 χ^2=2.614 df=3
PROM	24 (19.4%)	6 (7.9%)	
MP	10(8.1%)	2 (2.6%)	
Birth trauma	4 (3.2%)	4 (5.3%)	

Table 2: Correlation of Birth Weight (GM) with Cranial Ultrasound Findings

	Cranial ultrasound		significance
Birth weight (gm)			
	Normal (n=124)	**Abnormal (n=76)**	
<1499	60 (48.4%)	30 (39.5%)	P=0.916 χ^2=0.960 df=1
1500 – 1999	16 (12.9%)	10 (13.1%)	
2000 -2499	20 (16.1%)	16 (21.1%)	
2500 – 2999	18 (14.5%)	14 (18.4%)	
>3000	10 (8.7%)	6 (7.9%)	

Table 3: Correlation of gestation age of neonates with cranial Ultrasound findings

	Cranial ultrasound		
Gestational age (weeks)	**Normal**	**Abnormal**	**Significance**
	(n=124)	**(n=76)**	**χ^2=9.299 p=0.010**
28-32	14 (11.2%)	20 (26.3%)	
32-36	70 (56.4%)	20 (26.3%)	
37-40	40 (32.3%)	36 (47.4%)	

Conclusion

Cranial ultra sound is the best method for evaluation of brain abnormalities. It is cheap, non-invasive, non-ionizing radiation, repeatable and easily available in bed sides. Cranial ultra sound helpful for the early diagnosis and therapeutic approach for sick neonates. Cranial ultra sound helpful for neurodevelopemental assessment.

Bibliography

1. De Vries LS, Groenendaal F. Neuroimaging in the preterm infant. Ment Retard Dev Disabil Res Rev 2002;8:273–280.
2. Lara M. Leijser Linda S. de Vries Frances M. Cowan using cerebral ultrasound effectively in the newborn infant. Early Human Development 2006;82(12):827-835.
3. Marylou Behnke, Fonda Davis Eyler, Cynthia Wilson Garvan, Mark J. Tenholder, et al. Cranial ultrasound abnormalities identified at birth: their relationship to perinatal risk and neurobehavioral outcome. Pediatrics 1999;103:1-6.
4. Elia F, Maalouf G, Philip JD, Serena JC, Marry AR. Comparison of findings on cranial Ultrasound and MRI in preterm infants. Paediatrics 2001;107:719-27.
5. Nadia Badrawy, Amira Edrees, Dahlia El Sebaie and Mohamed El Ghawas. Cranial ultrasonographic screening of the preterm newborn. Alexandria J Pediatr 2005 Jul;19(2):347-356.
6. Perlman JM, Volpe JJ. Intraventricular hemorrhage in extremely small premature infants. AJDC. 1986;140:122-124.
7. Vermeulen GM, Bruinse HW, Gerards LJ, de Vries LS. Perinatal risk factors for cranial ultrasound abnormalities in neonates born after spontaneous labour before 34 weeks. Eur J Obstetrics Gynecology Reprod Biol 2001 Feb;94(2):290-295.