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Original Research Article

ROLE OF NEUROIMAGING IN PRETERM INFANTS TO PREDICT NEUROLOGICAL OUTCOMES

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Abstract

Background: Preterm neonates are defined as being born at less than 37 completed weeks of gestation. Preterm neonates have an increased risk of birth Asphyxia, Respiratory distress syndrome, Temperature instability, Hypoglycemia, and Sepsis. The premature neonate is also vulnerable to both hemorrhagic and ischemic brain injuries, because of limited cerebral auto-regulation. Germinal matrix hemorrhage, Intraventricular hemorrhage, and white matter injury mainly cystic periventricular leukomalacia are responsible for mortality and morbidity. To assess the importance of neuroimaging as an investigatory modality for intracranial complications in preterm neonates. To study neuroimaging findings in preterm neonates. To identify early intracranial complications in all preterm infants < 34 weeks of gestation by neuroimaging. To identify early intracranial complications in high-risk preterm of >34 weeks of gestation by neuroimaging. To evaluate the association of neuroimaging findings with the gestational age of neonates. **Materials and Methods:** Including Preterm neonates with < 34 weeks of gestation and also included preterm with >34 weeks of gestation with the following risk factors, e.g., neonatal seizure, clinical suspicion of intracranial hemorrhage (bulging anterior fontanelle, splayed sutures, lethargic, poor feeding, etc.), rapid enlargement of the head, and unexplained congestive cardiac failure. Admitted to NICU and underwent Neurosonography between January 2021 to August 2022. **Result:** Neuroimaging was done in preterm infants selected for a routine examination; out of them, USG craniums were done in 55 preterm infants, and CT scans were done in one preterm infant. MRI brain was done in one baby at term equivalent age. Out of 56 preterm neonates included in this study, only 16.07% had abnormal neuroimaging findings and 83.93% had normal neuroimaging findings Out of all preterm infants with abnormal neuroimaging, the cyst was found in maximum babies (44.44%) followed by periventricular leukomalacia (33.33%) followed by an intracranial bleed (22.22%). **Conclusion:** There was a significant association between abnormal Neuroimaging and gestational age and birth weight. The most common abnormality was cyst followed by PVL and ICH. Early Neurosonography could help in prognosticating immediate outcomes and early intervention.

INTRODUCTION

Preterm is defined as childbirth < 37 completed weeks of gestation. Prematurity increases the risk of birth asphyxia, respiratory distress syndrome, temperature instability, hypoglycemia, and sepsis.[1]
A premature neonate is vulnerable to both hemorrhagic and ischemic brain injuries. This is due to vascular, cellular, and anatomical features of the developing brain and physiological instability because of limited cerebral autoregulation.[2]

In preterm neonates, Germinal matrix hemorrhage (GMH) / Intraventricular hemorrhage (IVH) and white matter injury particularly cystic periventricular leukomalacia (cPVC) are major USG cranial findings.[3]
Both are related to neurodevelopmental abnormalities, like cerebral palsy and motor developmental delay, and also cognitive, language, and behavioural disorders, like attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD).[4] These may affect children and their families.[5] Earlier identification and proper

interventions are needed for the infants to have a better quality of life.[6]

The American Academy and the Practise Committee of Child Neurology advised routine screening by neuro sonogram for all neonates born before 30 weeks of gestation. They also advised performing the first screening ultrasonography 7 to 14 days after delivery and repeating it at the near-term equivalent age.[7]

Early identification of brain abnormalities by using cranial ultrasound would allow early interventions to improve long-term outcomes.[8]

The aim of the study was to assess the importance of neuroimaging as an investigatory modality for intracranial complications in preterm neonates admitted in NICU of Katihar medical college, Katihar. Primary objective was to study neuroimaging findings in preterm neonates. And secondary objectives were:

a. To identify early intracranial complications in all preterm infants < 34 weeks of gestation by neuroimaging.
b. To identify early intracranial complications in high-risk preterm of >34 weeks of gestation by neuroimaging.
c. To evaluate the association of neuroimaging findings with the gestational age of neonates.

MATERIALS AND METHODS

The prospective observational study was conducted from January 2021 to August 2022 on 56 preterm infants in the Neonatal intensive care unit, Department of Paediatrics, in association with the Department of Radiodiagnosis, Katihar Medical College, Katihar. The study was approved by the Ethical committee of our institute and written informed consent was obtained from parents of all preterm infants. The inclusion criteria were Including Preterm neonates with <34 weeks of gestation and also included preterm with >34 weeks of gestation with the following risk factors, e.g., neonatal seizure, clinical suspicion of intracranial hemorrhage (bulging fontanels, splayed sutures, lethargic, poor feeding, etc.), rapid enlargement of the head, and unexplained congestive cardiac failure. Exclusion Criteria included Preterm neonates born with an instrumental or traumatic labour, congenital malformation, and born with perinatal asphyxia. For all Preterm Neonates included in the study, Birth weight was measured with an electronic weighing scale, And Gestational age will be calculated by using Last Menstrual Period (LMP), First Trimester USG Report and New Ballard Scoring System.

All Neonates included in this study underwent Routine Cranial Ultrasonography within 7 days of life and follow-up for 2nd Neurosonography repeated at Term Equivalent Age (36-40 weeks) or before hospital discharge.

Clinical examination of preterm infants, mother's history, looking into perinatal and antenatal records. Other neuroimaging modalities, e.g., CT and MRI, may be done as clinically indicated in preterm neonates. The neuro sonogram was viewed and examined by a specialist radiologist, and clinical reports were reported.

Statistical Analysis

The data were analyzed by SPSS 20 and interpreted as frequencies, percentages, P-value, and chi-square.

RESULTS

Neuroimaging was done in preterm infants selected for a routine examination. Out of 56 preterm neonates included in the study, only 16.07% had abnormal neuroimaging findings and 83.93% had normal neuroimaging findings.

Table 1: Sex distribution (n=56)

Sex	Number of infants	Percentage (%)
Male	37	66.07
Female	19	33.92
Total	56	100.0

In our study, out of 56 enrolled preterm infants, 66.07% were male and 33.92% were female.

Table 2: Incidence of abnormal neuroimaging based on gender

Gender	Normal Neuroimaging	Abnormal Neuroimaging	P Value
Male	37	6	0.97
Female	19	3	

No significant relationship was found between abnormal neuroimaging and gender distribution. Out of the total enrolled babies, 10.71% were male and 5.36% were female with abnormal neuroimaging.

Table 3: Mode of delivery in enrolled infants

Mode of Delivery	Number	Percentage
VD	44	78.58
LSCS	12	21.42

Out of the total enrolled babies, 44 (78.68%) were born via vaginal delivery, and 12 (21.42%) were born via cesarean section. Out of the total enrolled babies, 78.58% were single births and 21.42% were twin births.

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Table 4: Birth weight of infants

Birth weight(kg)	Number of Infants	Percentage (%)
<1	2	3.6
1-1.5	20	35.71
1.5-2.0	24	42.86
>2.0	10	17.86

Among total enrolled preterm infants, the maximum number of 42.86% is between birth weights of 1.5 and 2 kg, and < 1 kg were 3.6%; 35.71% were born between 1kg and 1.5 kg, and 17.86% were between >2 kg.

Table 5: Correlation between birth weight and number of infants with Neuroimaging findings

Birth weight(kg)	Normal Neuroimaging	Abnormal neuroimaging	P-Value
<1	1	1	0.036
1-1.5	17	3	
1.5-2.0	23	1	
>2.0	6	4	

In our study, a higher incidence of abnormal neuroimaging was found in babies with birth weights >2kg (44.44%), which is the inverse of the results of many studies which show, less the birth weight and more the neuroimaging abnormalities.

Table 6: Number of preterm infants with abnormal neuroimaging findings

Abnormal Finding	Frequency(n=9)	Percentage (%)
IVH	2	22.22
PHE	0	0
PVL	3	33.33
Parenchymal bleed	0	0
Cyst	4	44.44

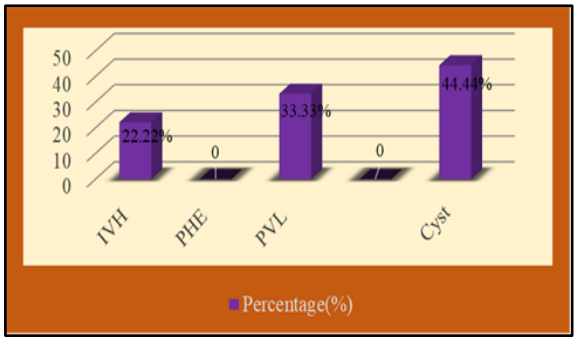

Figure 8: The number of preterm infants with abnormal neuroimaging findings

Out of all preterm infants with abnormal neuroimaging, cyst was found in maximum babies (44.44%) followed by periventricular leukomalacia (33.33%) followed by an intracranial bleed (22.22%).

DISCUSSION

Among the various neuroimaging modalities, Cranial USG is used in preterm neonates as a screening tool. It is used both prognostically and diagnostically. Sex distribution in our study was found to be 66.03% male and 33.97%. In a study by Jha R et al. a significant association was found between the male gender and abnormal neuroimaging findings.[12] In our study, out of the total babies, 16.07% had abnormal findings, comparable to a study done earlier they reported 24%, 10.8%,13.3%, 16.1%, 25.4%, 29%; 47%.[8-14] The incidence of cysts in our study is 7.1% out of the total neuroimaging were done in selected preterm. This result is comparable with other studies showing 8.51%, 4%, and 1%.[13-15]

The incidence of PVL in our study was 5.4%, which is similar to 5%, 2%, 1.6%, and 0.9%.[16,13,11,17] Sepsis and a lack of antenatal steroids were common risk factors in all three cases of PVL. Among the three cases of PVL; PROM, NEC, and very low birth weight were associated with one case each.

The incidence of IVH in our study is 3.57%. In both cases of IVH, the babies were VLBW and their sepsis screens were positive. Other study reported 7.8%, 10%, 11.2%, 8%, 6%, 40.42%, 26.7%.[9-14,17]

As compared to all studies, our study shows similar risk factors for IVH. Both cases of IVH were delivered vaginally, as VLBW, one baby developed shock and another one had RDS. Sepsis was the common risk factor in both cases. The smaller number of IVH cases may be attributed to differences in methodology. Use of the delayed cord clamping technique in inborn babies, proper resuscitation to avoid increasing cerebral venous pressure, gentle suctioning, early detection of the metabolic problem by doing ABG, using an infusion pump to prevent volume expansion, proper maintaining of the head position, monitoring blood sugar and electrolytes, and proper uses of ventilation may have prevented IVH. It may also be due to the small sample size and single-centric study. In two cases of IVH, one baby with Grade-I intraventricular bleeding was found to be improved in the second neuroimaging (MRI) done before discharge. Another baby with grade II intraventricular bleeding developed seizures and required anticonvulsant therapy. Out of all the study cases, one preterm was diagnosed with patent ductus arteriosus (PDA). An early diagnosis was made by the clinical examination and later confirmed by echocardiography. With prompt medical

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management, complications of PDA were prevented and cured without the need for surgical intervention. No cranial abnormalities were found in neuroimaging.

CONCLUSION

Our study shows that neurological complications have got no significant association with gender. An increased incidence of abnormal neuroimaging was not associated with decreased birth weight. There was no association of IUGR with abnormal neuroimaging. Many of the studies found a higher incidence of abnormal neuroimaging with decreasing birth weight. We found a higher incidence of abnormal neuroimaging in babies with birth weights >2kg (44.44%).

A mixed incidence of IVH was found in different studies conducted in India and other countries. Many studies show IVH in less than 10% while other studies showed incidence in more than 10% of pre-term babies. Our study shows the incidence of IVH in less than 10% of pre-term babies. Most of the previous studies reported IVH as the primary finding while in our study, the incidence of PVL is greater than IVH (5.36% v/s.3.57%). The reason could be the advancement of NICU by the change in time with the use of more well-trained staff, sophisticated precise instruments, and improved protocols and handling.

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