e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(9); 1112-1117

Original Research Article

Cranial USG Findings in Late Preterm

Shrikant Giri[1], Pallavi Giri[2], Monika Jaiswal[3], Pratibha Agarwal[4]

[1]Instructor Lead Guide, Department of Paediatrics, Shri Shushu Bhawan, Bilaspur, C.G. India
[2]Instructor Co-guide, Department of Paediatrics, Shri Shushu Bhawan, Bilaspur, C.G. India
[3]Senior Resident, Department of Paediatrics, Shri Shushu Bhawan, Bilaspur, C.G. India
[4]Resident, Department of Paediatrics, Shri Shushu Bhawan, Bilaspur, C.G. India

Received: 21-07-2025 / Revised: 20-08-2025 / Accepted: 21-09-2025
Corresponding Author: Dr. Shrikant Giri
Conflict of interest: Nil

Abstract:

Background: The majority of premature births in developed countries (72% of preterm births) are late preterm infants (LPI), which are defined as babies born between 34+0 and 36+6 weeks gestation. Late preterm infants also account for the notable rise in premature births that has occurred over the last two decades. Neuro-morbidity has been linked to both extrinsic and intrinsic causes, and brain vulnerability has also been shown in late preterm newborns. A link exists between extrinsic vulnerability and the harmful consequences of prenatal morbidities on the brain. Conversely, at particular gestational ages, intrinsic variables are associated with the morphological and molecular immaturity of the developing brain. A universal CUS screening program, however, would place a significant strain on caregivers and increase resource consumption and medical expenses, especially given the size of the LATE preterm infant population. Therefore, the present study was conducted to find out the association between perinatal factors and cranial USG findings in late Preterm neonates.

Aim: To find out association between perinatal risk factors and cranial USG findings in late preterm neonates

Method: This was a hospital based prospective observational study conducted in a level IIIA NICU in Shri Shishu Bhawan Hospital, Bilaspur which is a tertiary care hospital from December 2022 to December 2023. It includes all the Late Preterm neonates >34+0 and <36+6 weeks of gestation admitted in NICU of the institute. To reject the null hypothesis the test of significance required shall be chi square test. The sample size hence calculated by G*Power Software by UCLA university is 88. The collected data were transformed into variables, coded and entered in Microsoft Excel. Data were analyzed and statistically evaluated using SPSS-PC-25 version. Chi-square test and statistical analysis were applied.

Results: The cranial ultrasound findings among study subjects, maximum 48.86% cases had severe abnormalities, 20.45% cases had PHE and 10.23% cases had mild abnormalities and 20.45% had normal CUS findings. The association b/w risk factors and CUS findings among mild abnormalities maximum 44.4% had MSL, had PROM, and 11.1% each had eclampsia and oligohydramnios. Among PHE cases 50% had oligohydramnios, 33.33% had PROM, and 16.7% had MSL. Whereas among severe abnormalities cases maximum 44.19% had oligohydramnios and 25.58% had MSL and 11.63% had PROM. Association b/w risk factors and CUS findings was tested using chi square test and it was statistically significant ($p<0.05$).

Conclusion: The present study acknowledges the role of cranial ultrasonography in early diagnosis of brain damage in high-risk neonates and that helps in the clinical management of neonates at NICU settings. It concludes that near half cases had severe abnormalities, followed by PHE and mild abnormalities.

Keywords: Cranial USG, Preterm, Perinatal Factors, Premature.

Introduction

The majority of premature births in developed countries (72% of preterm births) are late preterm infants (LPI), which are defined as babies born between 34+0 and 36+6 weeks gestation [1]. Late preterm infants also account for the notable rise in premature births that has occurred over the last two decades. It is commonly known that late preterm newborns are more susceptible to disorders that develop in the early neonatal period than are term babies [2].

When compared to term-born controls, the mortality rate increases thrice, and the morbidity rate about doubles for every extra week of gestation that occurs before 38 weeks [3]. There is a higher chance of temperature instability, respiratory distress syndrome (RDS), severe weight loss and dehydration that necessitates intravenous infusion, sepsis, hypoglycemia, and jaundice that requires phototherapy in late preterm infants [4]. Neuro-morbidity has been linked to both extrinsic and

intrinsic causes, and brain vulnerability has also been shown in late preterm newborns [5]. A link exists between extrinsic vulnerability and the harmful consequences of prenatal morbidities on the brain. Conversely, at particular gestational ages, intrinsic variables are associated with the morphological and molecular immaturity of the developing brain [6].

Magnetic Resonance Imaging (MRI) studies have provided evidence of alterations in specific functions like visual performance, as well as morphological maturational processes like myelination, cortical folding, and gradual involution of germinal matrix [7]. The observations cited above point to a highly varied risk of neuromorbidities among the late preterm infant population, with younger kids born at 34 weeks having a higher risk than older late preterm infants born at 36 weeks.

Furthermore, because they can develop arterial/venous stroke, hypoxic-ischemic encephalopathy (HIE), parenchymal injuries following hypoglycemia, and germinal matrix-intraventricular hemorrhage (GMH-IVH) and cystic periventricular leukomalacia (cPVL), they are exposed to a wider spectrum of brain lesions common to both most premature and more mature babies [8]. The majority of these lesions are clinically mild or quiet throughout the newborn period, going undetected until later in childhood. This could explain why late preterm infants have a higher risk of poorer neurobehavioral outcomes than term infants, as has been documented in the literature. Early neurobehavioral intervention programs to enhance long-term results would be made possible by the early identification of late preterm infants with brain abnormalities [9].

Early neurobehavioral intervention programs to enhance long-term results would be made possible by the early identification of late preterm infants with brain abnormalities [10]. A universal CUS screening program, however, would place a significant strain on caregivers and increase resource consumption and medical expenses, especially given the size of the LATE preterm infant population. Therefore, the present study was conducted to find out the association between perinatal factors and cranial USG findings in late Preterm neonates.

Aim: To find out association between perinatal risk factors and cranial USG findings in late preterm neonates

Method and Material

This was a hospital based prospective observational study. The study was conducted in a level IIIA NICU in Shri Shishu Bhawan Hospital, Bilaspur which is a tertiary care hospital from December 2022 to December 2023. It includes all the Late Preterm neonates >34+0 and <36+6 weeks of gestation admitted in NICU of the institute. To reject the null hypothesis the test of significance required was chi square test. The sample size hence calculated by G*Power Software by UCLA university is 88.

Before starting the study, ethical approval was taken from Institutional Ethics Committee of MOU with Apollo Hospital, Bilaspur was taken. All the children meeting the inclusion criteria were enrolled in this study with informed consent of their guardian.

Inclusion and Exclusion Criteria: Late Preterm neonates from >34+0 weeks to <36+6 weeks of gestation who are admitted in NICU of this institute were included on the study. Whereas preterm neonates < 34weeks of gestational age and term neonates >37 weeks of gestational age were excluded from the study.

Methodology: A detailed antenatal history was obtained. Perinatal details were collected, and a detailed clinical examination was done. Routine investigations like metabolic and septic screens were performed. Other relevant investigations like a lumbar puncture in neonatal convulsions and neonatal sepsis and chest X-ray in all respiratory distress cases were done. CUS of the neonates fulfilling the inclusion criteria was performed in NICU. Proper antiseptic precautions were taken while performing the CUS examination because of the poor immune system of neonates, especially those born prematurely.

Technique of examination

- Transcranial grey scale Ultrasound: The anterior fontanel was used as the principal acoustic window, and the scanning procedure included:
- Six standard coronal views: frontal lobes, frontal horns of the lateral ventricles, foramen of Monro and the third ventricle, body of the lateral ventricles, trigone of the lateral ventricle, and occipital lobes.

Statistical analysis: The collected data were transformed into variables, coded and entered in Microsoft Excel. Data were analyzed and statistically evaluated using SPSS-PC-25 version. Chi-square test and statistical analysis were applied. Probability value of $p<0.05$ were considered statistically significant.

Results

Among study subjects, maximum 53.41% were b/w age of 4-7 days, 26.14% were b/w 0-3 days and 20.45% were > 8 days. Among study subjects, 56.82% were male and 43.18% were female. Further, more than half (56.82%) were born through vaginal delivery and 43.18% were born by LSCS.

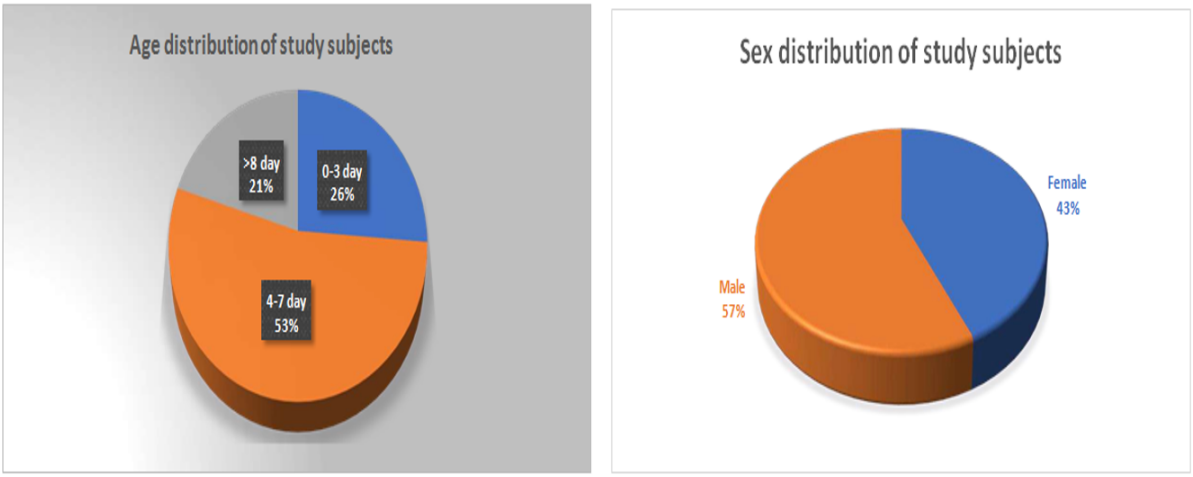

Figure 1: Distribution based on age and sex

Table 1: Chief complaint

Chief complaint	Freq.	Percent
Breathing difficulty	54	61.36
Poor feeding	8	9.09
Delayed cry	6	6.82
MSL	8	9.09
Seizure	10	11.36
Total	88	100

Table 1 shows the chief complaint among study subjects, maximum 61.36% had breathing difficulty, 11.36% had seizure, 9.09% each had poor feeding & MSL and 6.82% had delayed cry.

Table 2: Perinatal risk factors

Perinatal risk factors	Frequency	Percent
MSL	24	27.27
Oligohydramnios	31	35.23
PROM	21	23.86
Eclampsia	12	13.64
Total	88	100

Table 2 shows the risk factors among study subjects, maximum 35.23% had oligohydramnios, 27.27% had MSL, 23.86% had PROM and 13.64% had eclampsia.

Table 3: Study subject factors

Study subject	Sub subjects	Frequency	Percentage
Haemoglobin	Anemia	23	26.1
	Normal	65	73.86
WBC	Low (<5000/µL)	18	20.45
	Normal	62	70.45
	Raised (>5000/µL)	8	9.09
Platelets	Low platelets (1.5 lac/µL)	29	32.95
	Normal	59	67.05
Hematocrit	Abnormal	28	31.82
	Normal	60	68.18
Blood culture	Positive	9	10.33
	No growth	79	89.77
Lumber puncture	Meningitis	13	14.77
	Normal	75	85.23

The table 3 has suggested that the hemoglobin among study subjects 26.14% had anemia. Moreover, among study subjects WBC was low (<5000/µL) in 20.45% study subjects, and rose (>5000/µL) in 9.09% cases. The platelets status among study subjects, platelets was low among 32.95% cases and Hematocrit was abnormal among 31.82% cases. Blood culture was positive among 10.33% cases. Apart from this, according to AIIMS protocol for meningitis, in lumber puncture meningitis was positive among 14.77% cases.

Table 4: CUS findings

CUS findings	Freq.	Percent
Mild abnormalities	9	10.23
Normal	18	20.45
PHE	18	20.45
Severe abnormalities	43	48.86
Total	88	100

Table 4 shows the cranial ultrasound findings among study subjects, maximum 48.86% cases had severe abnormalities, 20.45% cases had PHE, and 10.23% cases had mild abnormalities and 20.45% had normal CUS findings.

Table 5: Risk factors

Risk factors	CUS FINDINGS				Total	P value
	Mild abnormalities	Normal	PHE	Severe abnormalities		
MSL	4	6	3	11	24	0.039
	44.44%	33.33%	16.67%	25.58%	27.27%	
Oligohydramnios	1	2	9	19	31	
	11.11%	11.11%	50.00%	44.19%	35.23%	
PROM	3	7	6	5	21	
	33.33%	38.89%	33.33%	11.63%	23.86%	
Eclampsia	1	3	0	8	12	
	11.11%	16.67%	0.00%	18.60%	13.64%	
Total	9	18	18	43	88	
	100%	100%	100%	100%	100%	

Table 5 shows the association b/w risk factors and CUS findings. Among mild abnormalities maximum 44.4% had MSL, had PROM, and 11.1% each had eclampsia and oligohydramnios. Among PHE cases 50% had oligohydramnios, 33.33% had PROM, and 16.7% had MSL. Whereas among severe abnormalities cases maximum 44.19% had oligohydramnios and 25.58% had MSL and 11.63% had PROM. Association b/w risk factors and CUS findings was tested using chi square test and it was statistically significant ($p<0.05$).

Discussion

The present study was conducted with the purpose to find out association between perinatal risk factors and cranial USG findings in late preterm neonates. In present study age distribution of study subjects shows that more than half of the neonates were b/w age of 4-7 days, followed by one fourth were b/w age of 0-3 days and rest were> 8 days. Whereas sex wise distribution shows that majority more than half were males and rest females.

Similar study done by Pathak et al., (2021) [11] on the cranial ultrasound in moderate and late preterm neonates. Out of 100 neonates, 47 (47%) were males and 53 (53%) females. The age of neonates was 4 days. Helderman et al., (2022) [12] did a study on association of Abnormal Findings on Neonatal Cranial Ultrasound with Neurobehavior at Neonatal Intensive Care Unit Discharge in Infants Born Before 30 Weeks' Gestation. More than half of the infants were male 55.7% and rest 44.3% were female.

In present study among study subjects more than half were born through vaginal delivery and forty three percent were born by LSCS. Fumagalli et al., (2015) [13] study the cranial ultrasound findings in late preterm infants and correlation with perinatal risk factors. They reported that among neonates most of them were normal vaginal birth. Similar study done by Pathak et al (2021) [11] on the cranial ultrasound in moderate and late preterm neonates. Out of 100 neonates, 41 were delivered by caesarean section whereas 59 had spontaneous vaginal delivery.

In present study the chief complaint among study subjects was maximum sixty one percent had breathing difficulty, eleven percent had seizure, nine percent each had poor feeding & MSL and seven

percent had delayed cry. Kinikar et al., (2018) [14] study of cranial ultrasound its correlation with perinatal risk factors and its outcome in preterm neonates admitted to Neonatal intensive care unit. Out of 100 preterms, neonatal comorbidities associated with abnormal USG were RDS (25.53%), neonatal sepsis (21.27%), birth asphyxia (17.02%), neonatal seizures (8.51%), NEC (6.38%) and others (21.27%). Similar study done by Pathak et al., (2021) [11] on the cranial ultrasound in moderate and late preterm neonates. Out of 100 neonates, seventy-five neonates had some or other form of co-morbidities. The commonest issues noticed were hyperbilirubinemia (52%), followed by sepsis (23%) and respiratory distress syndrome (RDS) (17%).

In present study among study subjects' distribution of perinatal risk factors among study subjects, maximum thirty five percent had oligohydramnios, twenty seven percent had MSL, twenty four percent had PROM and fourteen percent had eclampsia. Kinikar et al., (2018) [14] study of cranial ultrasound its correlation with perinatal risk factors and its outcome in preterm neonates admitted to Neonatal intensive care unit. Maternal risk factors present in neonates with abnormal CUS were PIH (53.1%), PROM (25.5%), APH (8.5%) and others (12.7%). However, there was no significant association. Sherwani et al., (2023) [15] study the assessment of role of cranial ultrasound (CUS) in the evaluation of high-risk preterm and term neonates. Out of the 200 neonates, maximum thirty six percent had LBW, twenty six percent had MSL, twelve percent had oligohydramnios, Seventeen percent had PROM and nine percent had eclampsia.

In present study assessment of hemoglobin status in study subjects shows that around one fourth were anemics. WBC counts shows that twenty percent had low counts and nine percent had raised counts. Platelets status among study subject's shows that it was low among thirty three percent cases and Hematocrit was abnormal among thirty-two cases. In present study among study subjects blood culture was positive among ten percent cases and according to AIIMS protocol for meningitis, in lumber puncture meningitis was positive among fifteen percent cases.

Fumagalli M et al (2015) [13] study the cranial ultrasound findings in late preterm infants and correlation with perinatal risk factors. They reported that among neonate's study subjects shows that twenty-nine were anemics. WBC counts shows that thirty six percent had raised counts. Platelets status among study subjects shows that it was low among twenty six percent cases and Hematocrit was abnormal among nineteen percent cases. Similar study done by Pathak et al., (2021) [11] on the cranial ultrasound in moderate and late preterm neonates. Out of 100 neonates, WBC counts shows that twenty seven percent had raised counts. Platelets status among study subjects it was low among thirty one percent cases.

In present study cranial ultrasound findings among study subjects shows that maximum around half cases had severe abnormalities, one fifth cases had PHE and ten percent cases had mild abnormalities and rest had normal CUS findings. A similar study done by Fumagalli et al., (2015) [13] on cranial ultrasound findings in late preterm infants and correlation with perinatal risk factors. Periventricular hyperechogenicity and severe abnormalities were observed in, respectively, 19.6 % and 1 % of late preterm at birth. Kinikar et al (2018) [14] did a similar study of cranial ultrasound its correlation with perinatal risk factors and its outcome in preterm neonates admitted to Neonatal intensive care unit. Out of 100 pre-terms, 53% had normal CUS findings while 47% had abnormal findings.

In present study association b/w risk factors and CUS findings shows that among mild abnormalities maximum forty four percent thirty three percent had PROM, seventeen percent had MSL. Whereas among severe abnormalities cases maximum forty four percent had prematurity, twenty six percent had oligohydramnios and nineteen percent had eclampsia and the association was statistically significant ($p<0.01$). Kinikar et al (2018) [14] did a similar study of cranial ultrasound its correlation with perinatal risk factors and its outcome in preterm neonates admitted to Neonatal intensive care unit. Out of 100 pre-terms, Neonatal comorbidities associated with abnormal USG were RDS (25.53%), neonatal sepsis (21.27%), birth asphyxia (17.02%), neonatal seizures (8.51%), NEC (6.38%) and others (21.27%). (Table 4) There was significant association between abnormal CUS and RDS ($p=0.014$), birth asphyxia ($p=0.008$).

Conclusion

The present study acknowledges the role of cranial ultrasonography in early diagnosis of brain damage in high-risk neonates and that helps in the clinical management of neonates at NICU settings. It concludes that near half cases had severe abnormalities, followed by PHE and mild abnormalities.

Severe abnormalities include:

- Germinal matrix hemorrhage
- IVH
- cPVL
- Venous/ arterial stroke
- Malformations
- Severe hypoxic ischemia

PHE (the parenchymal echogenicity in the periventricular area defined as periventricular

hyperechogenicity (PHE) when isoechogenic/h yperechogenic to the choroid plexus.

Mild abnormalities include

- Asymmetric lateral ventricles
- Mild dilatation of occipital horns (thalamo-occipital distance <95 percentiles)
- Cysts of chorioid plexus, frontal temporal and caudothalamic pseudocysts
- Lenticulostriate vasculopathy
- Infections

References

1. Shapiro-Mendoza CK, Lackritz EM. Epidemiology of late and moderate preterm birth. Semin Fetal Neonatal Med. 2012; 17(3):120–5. doi: 10.1016/j.siny.2012.01.007.
2. Wang ML, Dorer DJ, Fleming MP, Catlin EA. Clinical outcomes of near-term infants. Pediatrics. 2004;114(2):372–6. doi: 10.1542/peds.114.2.372.
3. Kinney HC. The near-term (late preterm) human brain and risk for periventricular leukomalacia: a review. Semin Perinatol. 2006;30(2):81–8. doi: 10.1053/j.semperi.2006.02.006.
4. Sannia A, Natalizia AR, Parodi A, Malova M, Fumagalli M, Rossi A, et al. Different gestational ages and changing vulnerability of the premature brain. J Matern Fetal Neonatal Med. 2013; doi:10.3109/14767058.2013.796166.
5. Childs AM, Ramenghi LA, Evans DJ, Ridgeway J, Saysell M, Martinez D, et al. MR features of developing periventricular white matter in preterm infants: evidence of glial cell migration. AJNR. 1998;19(5):971–6.
6. Judaš M, Sedmak G, Kostović I. The significance of the subplate for evolution and developmental plasticity of the human brain. Front Hum Neurosci. 2013;2(7):423.
7. Bassi L, Ricci D, Volzone A, Allsop JM, Srinivasan L, Pai A, et al. Probabilistic diffusion tractography of the optic radiations and visual function in preterm infants at term equivalent age. Brain. 2008;31(Pt 2):573–82. doi: 10.1093/brain/awm327.
8. Groppo M, Ricci D, Bassi L, Merchant N, Doria V, Arichi T, et al. Development of the optic radiations and visual function after premature birth. Cortex. 2014;56:30–7. doi: 10.1016/j.cortex.2012.02.008.
9. Benders MJ, Groenendaal F, De Vries LS. Preterm arterial ischemic stroke. Semin Fetal Neonatal Med. 2009;14(5):272–7. doi: 10.1016/j.siny.2009.07.002.
10. Logitharajah P, Rutherford MA, Cowan FM. Hypoxic-ischemic encephalopathy in preterm infants: antecedent factors, brain imaging, and outcome. Pediatr Res. 2009;66(2):222–9. doi: 10.1203/PDR.0b013e3181a9ef34.
11. Pathak OK, Singh YR, Mugurkar R, Suryawanshi R.. Cranial Ultrasound in Moderate and Late Preterm Neonates: A Prospective Observational Study. J Nepal Paediatr Soc. 2021;41(1):42-7.
12. Helderman J, O'Shea TM, Dansereau L, et al. Association of Abnormal Findings on Neonatal Cranial Ultrasound With Neurobehavior at Neonatal Intensive Care Unit Discharge in Infants Born Before 30 Weeks' Gestation. JAMA Netw Open. 2022;5(4):e226561. doi:10.1001/jamanetworkopen.2022.6561
13. Fumagalli M, Ramenghi LA, De Carli A, Bassi L, Farè P, Dessimone F, Pisoni S, Sirgiovanni I, Groppo M, Ometto A, Consonni D, Triulzi F, Mosca F. Cranial ultrasound findings in late preterm infants and correlation with perinatal risk factors. Ital J Pediatr. 2015 Sep 24;41:65. doi: 10.1186/s13052-015-0172-0.
14. Utkarsha Kinikar, & Sara Dhanawade. (2018). Study of cranial ultrasound its correlation with perinatal risk factors and its outcome in preterm neonates admitted to Neonatal intensive care unit. Pediatric Review: International Journal of Pediatric Research, 5(4), 169-174. https://doi.org/10.17511/ijpr.2018.i04.03
15. Sherwani, A.S., Parry, A.H., Bhat, M.H. et al. Assessment of role of cranial ultrasound (CUS) in the evaluation of high-risk preterm and term neonates. Egypt Pediatric Association Gaz 71, 7 (2023). https://doi.org/10.1186/s43054-023-00158-x