



EVALUATION OF HIGH-RISK TERM AND PRETERM NEONATES BY TRANSCRANIAL ULTRASOUND

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ABSTRACT

Background: High-risk term and preterm neonates are susceptible to intracranial abnormalities that contribute significantly to neonatal morbidity and mortality. Transcranial ultrasonography is a safe, bedside, radiation-free, and cost-effective imaging modality for early detection of neonatal brain lesions and timely clinical management. **Objectives:** To evaluate transcranial ultrasonographic findings in high-risk term and preterm neonates and determine the association between neonatal and maternal risk factors with abnormal neurosonographic findings. **Methodology:** A prospective observational study was conducted on 100 high-risk term and preterm neonates admitted to a tertiary care hospital. Clinical details, maternal risk factors, and transcranial ultrasonography findings were recorded. Statistical analysis was performed using Chi-square and Fisher's exact tests, considering $p < 0.05$ statistically significant. **Results:** Among 100 neonates, 55% were preterm, 66% were males, and 46% had low birth weight. Maternal risk factors were present in 65%, with premature rupture of membranes being the most frequent. Respiratory distress (59%) was the predominant presenting symptom, while respiratory distress syndrome (42%) was the commonest clinical diagnosis. Transcranial ultrasonography demonstrated normal findings in 71% of neonates and abnormalities in 29%. The most frequent abnormalities included subependymal cysts (11%), Grade II germinal matrix hemorrhage (5%), hydrocephalus (5%), Grade I germinal matrix hemorrhage (4%), subarachnoid hemorrhage (2%), scalp hematoma (2%), and caput succedaneum (2%). Abnormal neurosonographic findings showed significant associations with prematurity ($p = 0.021$), primigravida status ($p = 0.037$), lower segment caesarean section delivery ($p = 0.030$), low birth weight ($p = 0.039$), and maternal risk factors ($p = 0.009$), whereas age and gender were not significantly associated. **Conclusion:** Transcranial ultrasonography effectively detects clinically significant intracranial abnormalities in high-risk neonates. Routine neurosonographic screening, particularly in preterm, low-birth-weight infants and those with maternal risk factors, facilitates early diagnosis, appropriate intervention, and improved neonatal neurological outcomes.

KEYWORDS : High-risk neonates, Transcranial ultrasonography, Prematurity, Germinal matrix hemorrhage, Neurosonography.

INTRODUCTION:

Neonatal neuroimaging is a critical diagnostic tool in modern neonatology, playing a pivotal role in the early detection and management of various brain injuries in newborns⁽¹⁾. The neonatal brain is particularly vulnerable to injuries due to factors such as prematurity, birth asphyxia, infections, and metabolic disturbances⁽²⁾. Early neuroimaging enables clinicians to identify life-threatening conditions like hypoxic-ischemic encephalopathy (HIE), intraventricular hemorrhage (IVH), and periventricular leukomalacia (PVL) promptly, allowing for timely interventions that can significantly improve outcomes⁽³⁾.

Among the various neuroimaging modalities available, cranial ultrasonography (USG) stands out as the most widely used technique in neonatal intensive care units (NICUs) due to its numerous practical advantages⁽⁴⁾. Being portable, radiation-free, and cost-effective, cranial USG is ideally suited for bedside use and serial monitoring of conditions like IVH and hydrocephalus⁽⁵⁾. MRI offers superior soft tissue contrast and the ability to detect subtle white matter injuries through advanced sequences like diffusion-weighted imaging (DWI) and susceptibility-weighted imaging (SWI)⁽⁶⁾. Computed tomography (CT) occupies a more limited but still important role in neonatal neuroimaging, primarily in emergency situations where rapid assessment of traumatic injuries or acute hemorrhage is required.

In the context of Indian neonatal care, cranial ultrasonography has emerged as the workhorse of neuroimaging due to its widespread availability and affordability, particularly in resource-limited settings. Its role in screening for common neonatal brain pathologies like IVH (classified using the Papile grading system) and PVL cannot

be overstated, and it remains the primary imaging modality for routine surveillance of high-risk neonates in most NICUs across the country⁽⁷⁾. Recent advances in technology, particularly the development of artificial intelligence-assisted image interpretation, hold promise for addressing some of these challenges by reducing operator dependency and improving diagnostic accuracy⁽⁸⁾.

As our understanding of neonatal brain injury continues to grow, so too must our imaging strategies evolve to ensure that all neonates, regardless of their geographic or socioeconomic circumstances, have access to timely and accurate neuroimaging when they need it most. The present study was conducted to evaluate the imaging findings in transcranial ultrasonography of preterm and high-risk term neonates.

MATERIAL AND METHODS:

The present prospective observational study was conducted at the Dept. of Radiology, Chhatrapati Pramila Rajee Hospital, Kolhapur. A total of 100 preterm neonates born before 34 weeks of gestation or high-risk late preterm (≥ 34 –36 weeks) neonates were included in the study. Term neonates whose parents willing to give consent, were excluded. Detailed data regarding sociodemographic variables such as age, gender etc. along with antenatal history was obtained. Perinatal details were collected, and a detailed clinical examination was done. Routine investigations like metabolic and septic screens were performed.

Neonatal sepsis was defined as the presence of two positive bacterial cultures with a positive c-reactive protein. Transcranial USG of the neonates was performed in NICU. The neonates were divided into two groups based on gestation age (< 32 weeks and > 32 weeks) and on the basis of

birth weight (<2000 g and >2000 g). The frequency of abnormal and normal transcranial USG findings was compared between the two groups to calculate statistical association. Similarly, abnormal and normal transcranial USG findings was compared between the neonates with an Apgar score of 7 or above and <7.

Transcranial USG was performed with Philips EPIQ Elite ultrasound machine with high frequency (7–11 MHz) linear probe and low frequency (3–5 MHz) curvilinear probe. Proper depth of view was adjusted to ensure that no pathology is missed in the posterior fossa of the brain, and multiple focal zones was used to improve lateral resolution. Image quality was optimized by fine adjustment of available presets. Imaging was performed via the anterior fontanelle in sagittal and coronal planes. Imaging in the sagittal plane was done in the midline and then both right and left parasagittal areas was evaluated with probe angulation of 15 to 30° on either side. In the coronal plane, an examination was done through the frontal horns of lateral ventricles, Sylvian fissure, third ventricle, and occipital horns of lateral ventricles. Additional views were obtained through the posterior and mastoid fontanelle and the thin part of the squamous temporal bone.

Data was analyzed using SPSS 26 version software (IBM SPSS Statistics, Somers NY, USA). MS Excel and MS word were used to obtain various types of graphs such as bar diagram. Chi square test and Fisher Exact tests were used as test of significance for qualitative data. p value of 0.05 was considered as statistically significant after assuming all the rules of statistical tests.

RESULTS:

Table 1. Demographic Variables of the Neonates:

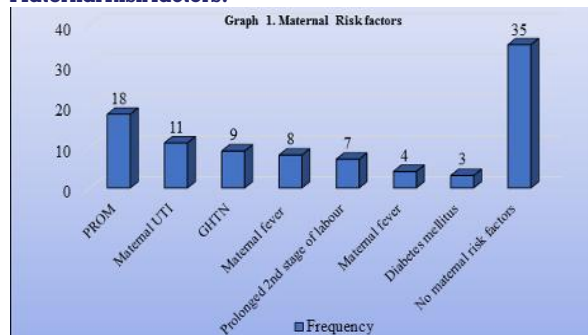
Demographic Variables	Frequency	Percent
Age Group	< 1 day	11
	1 to 5 days	80
	6 to 10 days	7
	> 10 days	2
Gender	Male	66
	Female	34
Preterm Term	Pre-term	55
	Full-term	45
Parity of mothers	Multi-gravida	67
	Primi	33
Mode of delivery	LSCS*	63
	Vaginal Delivery	37
Birth Weight	Low Birth Weight	46
	Normal Birth Weight	54
Total	100	100.0

* Lower Segment Caesarean Section

Out of 100 high-risk neonates evaluated, the majority were between 1 to 5 days of age (80%), followed by neonates aged less than 1 day (11%), 6 to 10 days (7%), and more than 10 days (2%). Most high-risk neonates underwent transcranial ultrasonography within the first five days of life. Among the study population, 66% were males and 34% were females. More than half of the neonates (55%) were preterm. Sixty-seven percent of neonates were born to multi-gravida mothers, while 33% were born to primi-gravida mothers. Most neonates in the study were born to multi-gravida mothers.

Regarding mode of delivery, 63% of neonates were delivered by lower segment caesarean section (LSCS), whereas 37% were delivered vaginally. Caesarean section was the predominant mode of delivery among high-risk neonates. Low birth weight was observed in 46% of neonates, while 54% had normal birth weight. Nearly half of the high-risk neonates were low birth weight.

Maternal Risk factors:



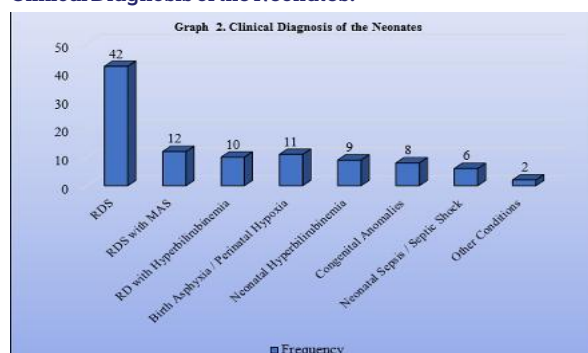
Maternal risk factors were present in 65% of cases, whereas 35% had no identifiable maternal risk factors. Among the risk factors, premature rupture of membranes accounted for 18%, maternal urinary tract infection for 12%, gestational hypertension for 10%, maternal fever for 8% and an additional 4%, prolonged second stage of labour for 8%, and diabetes mellitus for 4%.

Table 2. Presenting Symptoms of the Neonates:

Presenting Symptom	Frequency	Percentage (%)
Respiratory distress	59	59.0
Did not cry after Birth	13	13.0
Icterus	9	9.0
Fever	6	6.0
Hypotonia	2	2.0
Dysmorphic facies / Down facies	2	2.0
Low Apgar (≤ 5 at 1 min)	2	2.0
No Breathing after birth (Resuscitated)	2	2.0
No symptoms	12	12.0

Respiratory distress was the most common presenting symptom, observed in 59% of neonates. This was followed by failure to cry after birth in 13%, icterus in 9%, fever in 6%, hypotonia in 2%, dysmorphic facies suggestive of Down syndrome in 2%, low Apgar score (≤ 5 at 1 minute) in 2%, absence of breathing after birth requiring resuscitation in 2%, and no symptoms in 12% of cases. Respiratory distress was the predominant clinical presentation in high-risk neonates.

Clinical Diagnosis of the Neonates:



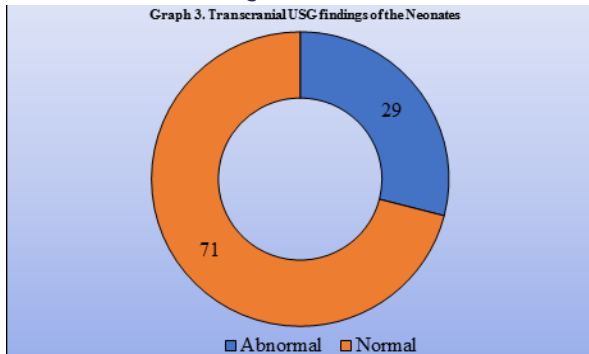
The most common final diagnosis was respiratory distress syndrome, accounting for 42% of cases. Respiratory distress associated with meconium aspiration syndrome was seen in 12%, and respiratory distress with hyperbilirubinemia in 10%. Birth asphyxia or perinatal hypoxia was diagnosed in 11% of neonates.

Neonatal hyperbilirubinemia alone accounted for 9%, congenital anomalies (Down syndrome, congenital rubella, congenital cataract, Multicystic dysplastic Kidney, ASD, PDA, Pelvi-caliectasis) for 8%, neonatal sepsis or septic shock for 6%, and other conditions (Torticollis with plagiocephaly, isolated AGA term neonate) for 2%. Respiratory disorders constituted the major spectrum of diagnoses among high-risk neonates.

Table 3: Imaging Findings of Transcranial Ultrasonography:

Imaging Findings	Frequency	Percent
Subependymal Cysts	11	11
Grade-I Germinal Matrix Haemorrhage	4	4
Grade-II Germinal Matrix Haemorrhage	5	5
Hydrocephalus	5	5
Sub-arachnoid Hemorrhage	2	2
Scalp Hematoma	2	2
Caput Succedaneum	2	2
Normal Imaging Findings	71	71
Total	100	100

Transcranial ultrasonography revealed normal findings in 71% of neonates, whereas 29% showed abnormal findings. Among abnormal findings, subependymal cysts were seen in 11%, Grade I germinal matrix hemorrhage in 4%, Grade II germinal matrix hemorrhage in 5%, hydrocephalus in 5%, subarachnoid hemorrhage in 2%, scalp hematoma in 2%, and caput succedaneum in 2%.

Transcranial USG findings of the Neonates:

Out of 100 high-risk neonates evaluated, the majority (71%) were having normal Transcranial USG findings and 29% neonates were found to have abnormal Transcranial USG findings.

Table 4. Association between Neonatal Factors and Transcranial USG findings:

Neonatal Factors		Transcranial USG		Total	P value
		Abnormal	Normal		
Age Groups	< 1 day	3 (27.3%)	8 (72.7%)	11 (11.0%)	0.832
	1 to 5 day	24 (30.0%)	56 (70.0%)	80 (80.0%)	
	6 to 10 day	2 (28.6%)	5 (71.4%)	7 (7.0%)	
	> 10 day	0 (0.0%)	2 (100.0%)	2 (2.0%)	
Gender	Male	16 (24.2%)	50 (75.8%)	66 (66.0%)	0.110
	Female	13 (38.2%)	21 (61.8%)	34 (34.0%)	
Preterm / Term	Pre-term	21 (38.2%)	34 (61.8%)	55 (55.0%)	0.021
	Full-term	8 (17.8%)	37 (82.2%)	45 (45.0%)	
Gravida status	Primi	14 (42.4%)	19 (57.6%)	33 (100.0%)	0.037
	Multi-gravida	15 (22.4%)	52 (77.6%)	67 (100.0%)	
Mode of delivery	LSCS	23 (36.5%)	40 (63.5%)	63 (63.0%)	0.030
	Vaginal	6 (16.2%)	31 (83.8%)	37 (37.0%)	
Birth Weight	LBW	18 (39.1%)	28 (60.9%)	46 (46.0%)	0.039
	Normal	11 (20.4%)	43 (79.6%)	54 (54.0%)	
Maternal Risk Factors	Yes	25 (38.5%)	40 (61.5%)	65 (65.0%)	0.009
	No	4 (11.4%)	31 (88.6%)	35 (35.0%)	
Total		29 (29.0%)	71 (71.0%)	100 (100.0%)	

Abnormal USG findings were observed in 27.3% of neonates aged less than 1 day, 30.0% in those aged 1–5 days, 28.6% in 6–10 days, and none in neonates older than 10 days. The association between age and USG findings was not statistically significant ($p = 0.832$). Abnormal USG findings were seen in 24.2% of males and 38.2% of females. However, this association was not statistically significant ($p = 0.110$). Among preterm neonates, 38.2% had abnormal USG findings

compared to 17.8% of full-term neonates. This difference was statistically significant ($p = 0.021$). Abnormal findings were present in 42.4% of neonates born to primi mothers compared to 22.4% of those born to multi-gravida mothers. This association was statistically significant ($p = 0.037$).

Abnormal USG findings were observed in 36.5% of neonates delivered by LSCS and 16.2% of those delivered vaginally. The association was statistically significant ($p = 0.030$). LSCS delivery was significantly associated with a higher incidence of neurosonographic abnormalities. Among low-birth-weight neonates, 39.1% had abnormal USG findings compared to 20.4% among normal birth weight neonates. This association was statistically significant ($p = 0.039$). Abnormal USG findings were observed in 38.5% of neonates with maternal risk factors compared to 11.4% of those without risk factors. This association was highly statistically significant ($p = 0.009$).

DISCUSSION:

Age distribution of neonates:

In the present study, the majority of high-risk neonates undergoing transcranial ultrasound were between 1 and 5 days of age (80%), followed by those less than 1 day (11%), 6–10 days (7%) and more than 10 days (2%). Sherwani R et al. (2017)⁽⁹⁾ evaluated 200 high-risk preterm and term neonates and reported that 77% had their first cranial ultrasound within the first 24 hours of life and the remaining 23% after 24 hours, again highlighting a strong emphasis on early imaging in contemporary NICU practice. Abdelmotaleb GS et al., (2021)⁽¹⁰⁾ in 60 high-risk full-term neonates, also performed cranial ultrasound soon after admission, although they did not quantify exact timing, indicating a similar tendency to image early in term high-risk infants.

Gender distribution of the Neonates:

Male neonates constituted 66% of our high-risk cohort, suggesting a clear male preponderance. Sherwani R et al. (2017)⁽⁹⁾ reported a very similar gender distribution, with 65% males and 35% females among 200 high-risk neonates. Abdelmotaleb GS et al., (2021)⁽¹⁰⁾ also observed that 65% of their high-risk full-term neonates were male and 35% female. Likewise, Vachhani A et al. (2023)⁽¹¹⁾ found a male:female ratio of 2.08:1 (67.5% males and 32.5% females) in their cohort of 40 neurologically symptomatic neonates.

Preterm and term status of Neonates:

In the present study, 55% of neonates were preterm and 45% were full-term, indicating that slightly more than half of the high-risk admissions were born before term. Sherwani R et al. (2017)⁽⁹⁾ reported that among 200 high-risk neonates, 24 (12%) were less than 32 weeks, 24 (12%) were between 33 and 36 weeks, and 52 (26%) were term neonates, so that preterm infants collectively accounted for approximately 48%. Vachhani A et al. (2023)⁽¹¹⁾ found that 5% of neonates were ≤ 28 weeks, 47.5% were 28–36 weeks and 47.5% ≥ 37 weeks, giving an almost equal distribution of preterm and term infants.

Parity of mothers of Neonates:

In our cohort, 67% of neonates were born to multigravida mothers and 33% to primigravida mothers. Vachhani A et al. (2023)⁽¹¹⁾ reported an equal distribution, with 50% primipara and 50% multipara mothers, and did not find a significant association between parity and ultrasound abnormalities. Sherwani R et al. (2017)⁽⁹⁾ also evaluated various perinatal risk factors and found that adverse perinatal conditions (including pregnancy-induced hypertension and antepartum hemorrhage) were significantly associated with abnormal cranial ultrasound, but parity per se was not highlighted as an independent determinant.

Mode of delivery of the Mothers:

Caesarean section was the predominant mode of delivery in our study, accounting for 63% of cases, while 37% were

vaginal deliveries. Sherwani R et al. (2017)⁽⁹⁾ reported a more balanced distribution, with 49% of neonates born by normal vaginal delivery and 51% by lower segment caesarean section; 40.8% of vaginally delivered infants and 35.3% of caesarean-delivered infants had abnormal cranial ultrasound, and the difference was not statistically significant. Abdelmotaleb GS et al., (2021)⁽¹⁰⁾ observed that 71.7% of high-risk term neonates were delivered by caesarean section and 28.3% by normal vaginal delivery, with both cases of abnormal ultrasound occurring after vaginal delivery.

Birth weight of the Neonates:

Low birth weight was present in 46% of our neonates, while 54% had normal birth weight. Sherwani R et al. (2017)⁽⁹⁾ reported a mean birth weight of 2406 ± 900 g, with 76% of their high-risk cohort weighing less than 2000 g and 24% ≥ 2000 g. They demonstrated that 68.9% of low-birth-weight neonates had abnormal cranial ultrasound compared to 31.6% of those ≥ 2000 g, and there was a statistically significant association between birth weight < 2000 g and abnormal findings. Vachhani A et al. (2023)⁽¹¹⁾ observed a mean birth weight of 2.11 ± 0.60 kg; 42.5% of neonates weighed ≤ 2.0 kg and 57.5% weighed more than 2.0 kg, with grade III germinal matrix hemorrhage occurring in 100% of babies < 1 kg and periventricular leukomalacia grade I being most common (33.3%) in those 1.5–2 kg.

Maternal risk factors:

Maternal risk factors were identified in 65% of our cases, with premature rupture of membranes in 18%, urinary tract infection in 12%, gestational hypertension in 10%, maternal fever in 8%, prolonged second stage of labour in 8% and diabetes mellitus in 4%, while 35% had no documented maternal risk factors. Sherwani R et al. (2017)⁽⁹⁾ reported that neonates with at least one adverse perinatal factor had an abnormal cranial ultrasound in 48.8% of cases compared with 29% in those without such factors ($p=0.0053$), and that pregnancy-induced hypertension, PROM and gestational diabetes mellitus were significantly associated with abnormal neurosonography. Abdelmotaleb GS et al., (2021)⁽¹⁰⁾ noted that 13.3% of mothers had PROM and 5.2% had intrapartum fever; however, they did not find a significant difference in PROM or obstructed labour between normal and abnormal ultrasound groups, probably because only two infants (3.3%) had abnormal scans.

Presenting Symptoms of the Neonates:

Respiratory distress was the most frequent presenting symptom in our study, seen in 59% of neonates, followed by failure to cry after birth in 13%, icterus in 9%, fever in 6%, hypotonia in 2% and dysmorphic facies in 2%, while 12% were asymptomatic at presentation. Sherwani R et al. (2017)⁽⁹⁾ highlighted birth asphyxia in 48%, preterm status in 48%, neonatal sepsis in 52% and seizures in 42% of their cohort, and reported that abnormal cry, poor activity, poor tone and cyanosis were significantly associated with abnormal cranial ultrasound. Abdelmotaleb GS et al., (2021)⁽¹⁰⁾ found that 60% of term high-risk neonates had clinical signs of sepsis, 50% had respiratory distress, 50% had neurological manifestations, 50% had tachycardia and 28.3% had jaundice.

Final Diagnosis of the Neonates:

In our series, respiratory distress syndrome alone accounted for 42% of final diagnoses, respiratory distress with meconium aspiration for 12%, respiratory distress with hyperbilirubinemia for 10% and neonatal hyperbilirubinemia alone for 9%, indicating that respiratory and jaundice-related conditions were dominant. Sherwani R et al. (2017)⁽⁹⁾ classified high-risk neonates by inclusion criteria and found that preterm status and birth asphyxia each accounted for 96 cases (48%), neonatal sepsis for 52 cases (26%), seizures for 42 cases (21%) and birth trauma for 8 cases (4%), demonstrating that asphyxia and prematurity were the main

diagnostic groups linked with abnormal cranial ultrasound. Abdelmotaleb GS et al., (2021)⁽¹⁰⁾ reported that among 60 term high-risk neonates, the two abnormal scans corresponded to pneumonia with sepsis complicated by cystic leukomalacia and communicating hydrocephalus, and hypoxic-ischemic encephalopathy with Dandy-Walker malformation, whereas the majority of other diagnoses were sepsis, respiratory distress and hyperbilirubinemia with normal scans.

Transcranial USG findings of the neonates:

In the present study, transcranial ultrasonography was abnormal in 29% of high-risk term and preterm neonates, while 71% had normal scans. This proportion of abnormal studies is intermediate between term-only cohorts and very preterm, neurologically selected populations. Sherwani R et al. (2017)⁽⁹⁾ evaluated 200 high-risk preterm and term neonates and reported abnormal cranial ultrasound findings in 38% and normal scans in 62%, with germinal matrix-intraventricular hemorrhage, periventricular leukomalacia and cerebral edema as the dominant lesions. Abdelmotaleb GS et al., (2021)⁽¹⁰⁾ studied 60 high-risk full-term neonates and found abnormalities in only 3.3%, with 96.7% having normal cranial ultrasound, largely because extremely preterm and very-low-birth-weight infants were excluded.

Association between neonatal factors and transcranial USG findings:

We found that abnormal USG findings were present in 27.3% of neonates aged less than 1 day, 30.0% of those aged 1–5 days, 28.6% of those 6–10 days and none of the two neonates older than 10 days, with no statistically significant association between age group and abnormal ultrasound ($p = 0.832$). Sherwani R et al. (2017)⁽⁹⁾ performed the first cranial ultrasound within 24 hours of life in 77% of neonates and after 24 hours in 23%, and they observed abnormal findings in 42.8% of those scanned in the first 24 hours compared with 21.7% in those scanned later, suggesting that early imaging detects a higher proportion of significant lesions. Jha R et al. (2015)⁽¹²⁾, in a preterm-only cohort, performed serial scans on days 1, 3, 7 and 14 and showed that most germinal matrix-intraventricular hemorrhages appeared within the first 3 days and evolved on follow-up, although they did not find a strong difference in overall abnormality rates by exact day of life.

In our study, abnormal ultrasound findings were observed in 24.2% of male neonates and 38.2% of female neonates, but this difference did not reach statistical significance ($p = 0.110$), indicating that gender was not significantly associated with transcranial USG abnormalities. Sherwani R et al. (2017)⁽⁹⁾ reported that males represented 78.9% and females 21.1% of neonates with abnormal cranial ultrasound, and overall, 65% of their cohort were male, suggesting a higher burden of brain lesions in boys. In a high-risk preterm series, Jha R et al. (2015)⁽¹²⁾ also found a significantly higher incidence of abnormal cranial ultrasound in males, with 54.8% of male preterm infants showing abnormalities versus 32.4% of females.

Prematurity showed a strong association with abnormal neurosonography in our series, as 38.2% of preterm neonates had abnormal USG findings compared with 17.8% of full-term neonates ($p = 0.021$). Sherwani R et al. (2017)⁽⁹⁾ similarly demonstrated that 54.1% of neonates with gestational age ≤ 32 weeks had abnormal cranial ultrasound compared with 32.8% of those > 32 weeks, and they found this association statistically significant ($p = 0.0081$). In the preterm cohort studied by Jha R et al. (2015)⁽¹²⁾, the overall incidence of cranial ultrasound abnormalities was 25.4%, and these lesions were significantly concentrated in infants of lower gestational age, with periventricular hyperechogenicity in 10.6%, germinal matrix-intraventricular hemorrhage in 8% and periventricular leukomalacia in 4%, all more common below 32 weeks.

We found that 42.4% of neonates born to primigravida mothers

had abnormal transcranial USG findings compared with 22.4% of those born to multigravida mothers, and this association was statistically significant ($p = 0.037$). Vachhani A et al. (2023)⁽¹¹⁾ observed that 25% of neonates born to primiparous mothers and 20% born to multiparous mothers had normal scans, implying that 75% and 80% respectively had abnormalities, but they did not find parity to be a statistically significant predictor of ultrasound lesions. In the high-risk preterm study by Jha R et al. (2015)⁽¹²⁾, multiple pregnancy and parity did not show a significant correlation with cranial ultrasound abnormalities, whereas perinatal risk factors such as birth asphyxia and PROM were more strongly associated.

Mode of delivery was significantly associated with neurosonographic abnormalities in our study: 36.5% of neonates delivered by lower segment caesarean section had abnormal scans, compared with 16.2% delivered vaginally ($p = 0.030$). Sherwani R et al. (2017)⁽⁹⁾ reported abnormal cranial ultrasound in 40.8% of neonates born via normal vaginal delivery and 35.3% of those born by caesarean section, with no significant difference between modes. Abdelmotalieb GS et al., (2021)⁽¹⁰⁾ found that 71.7% of high-risk term neonates were delivered by caesarean section and 28.3% by normal vaginal delivery, yet both cases with abnormal ultrasound were vaginally delivered, suggesting that in their series caesarean section was not associated with increased intracranial pathology.

Low birth weight was significantly associated with abnormal ultrasound in our series, with 39.1% of low-birth-weight neonates showing abnormalities compared with 20.4% of normal birth weight neonates ($p = 0.039$). Sherwani R et al. (2017)⁽⁹⁾ demonstrated that 68.9% of neonates with birth weight <2000 g had abnormal cranial ultrasound versus 31.6% of those ≥ 2000 g, and they reported a strong association between birth weight <2000 g and abnormal findings. Vachhani A et al. (2023)⁽¹¹⁾ found that periventricular leukomalacia grade I was most frequent (33.3%) among neonates with birth weight 1.5–2.0 kg, while grade III germinal matrix hemorrhage occurred in 100% of those weighing <1 kg, highlighting a dose-response relationship between decreasing birth weight and severity of lesions.

Maternal risk factors were present in 65% of our cohort, and abnormal transcranial ultrasound findings were markedly more common among neonates with maternal risk factors (38.5%) than in those without (11.4%), a highly significant association ($p = 0.009$). Sherwani R et al. (2017)⁽⁹⁾ reported that 48.8% of neonates with at least one adverse perinatal risk factor had abnormal cranial ultrasound compared with 29% of those without such factors, and they identified pregnancy-induced hypertension, PROM and gestational diabetes mellitus as significantly associated with abnormal neurosonography. In the high-risk preterm series by Jha R et al. (2015)⁽¹¹⁾, birth asphyxia and PROM showed statistically significant correlations with ultrasound abnormalities, whereas maternal PIH and multiple pregnancy showed weaker associations. Abdelmotalieb GS et al., (2021)⁽¹⁰⁾ described PROM in 13.3% of mothers and maternal fever in 5.2% but did not find significant differences in these factors between neonates with abnormal and normal scans, likely due to the small number of abnormal cases.

CONCLUSION:

The most common abnormalities detected are subependymal cysts, germinal matrix hemorrhage, and hydrocephalus, highlighting the utility of transcranial USG as a safe, bedside, non-invasive, and cost-effective screening tool for neonatal brain assessment. Prematurity, low birth weight, maternal risk factors, LSCS delivery, and primi-gravida status are significantly associated with a higher incidence of neurosonographic abnormalities. In contrast, age at presentation and gender do not show significant associations.

The findings indicate that transcranial ultrasonography effectively correlates with important clinical presentations and identifies neonates at increased risk of neurological injury. Routine transcranial ultrasonography should be incorporated into the evaluation of all high-risk neonates, especially preterm and low-birth-weight infants.

REFERENCES:

1. Sarkar S, Bhagat I, Dechert R, Schumacher RE. Severe intraventricular hemorrhage in preterm infants: comparison of risk factors. *Indian J Pediatr.* 2019;86(5):432-438.
2. Baillabh P. Intraventricular hemorrhage in premature infants. *Semin Fetal Neonatal Med.* 2020;25(4):101114.
3. Krishnamurthy U, Yadav RK, Sood BG. Neuroimaging in neonatal hypoxic-ischemic encephalopathy. *Indian J Radiol Imaging.* 2021;31(1):31-42.
4. Malhotra A, Agarwal R. Advanced MRI techniques in neonatal brain imaging. *Indian Pediatr.* 2020;57(8):723-730.
5. Sharma D, Farahbakhsh N. Role of MRI in neonatal encephalopathy. *J Clin Neonatol.* 2019;8(3):145-152.
6. Dutta S, Narang A. Ultrasonography for preterm brain assessment. *Indian Pediatr.* 2019;56(7):567-573.
7. Verma A, Sharma P. Radiation risks in neonatal CT. *Indian J Radiol.* 2020;30(2):210-215.
8. Patel J, Mondkar J. CT scan in neonatal brain injury. *Indian J Neonatal Med.* 2021;12(1):12-18.
9. Sherwani AS, Parry AH, Bhat MH, Gojwari TA, Charoo BA, Choh NA. Assessment of role of cranial ultrasound (CUS) in the evaluation of high-risk preterm and term neonates. *Egyptian Pediatric Association Gazette.* 2023 Feb 13;71(1):7.
10. Abdelmotalieb GS, Soliman AM, Abed NT. Role of cranial ultrasound in high-risk full-term neonates. *The Egyptian Journal of Hospital Medicine.* 2021 Jan 1;82(4):714-8.
11. Vachhani A, Tarafdar D, Trivedi A, Gill S. Evaluation of intracranial abnormalities by transcranial ultrasound in neonates: an observational study. *Int J Anat Radiol Surg.* 2023;12(4):RO05 RO12.
12. Jha R, Singh A, Jha R (2017) Cranial ultrasound in high risk preterm. *New Indian J Pediatrics* 6(1):26-32.