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# A Comparative Study Between Mri And Transcranial Usg In Etiological Diagnosis Of Neonatal Seizure

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**ABSTRACT**

**Background:** Neonatal seizures are critical neurological emergencies and often signal underlying central nervous system abnormalities. Prompt identification of the etiology is vital for prognosis and treatment. While Magnetic Resonance Imaging (MRI) is the gold standard for neonatal neuroimaging, Transcranial Ultrasonography (TUS) is widely used due to its bedside availability and cost-effectiveness. This study aims to compare MRI and TUS in diagnosing the etiology of neonatal seizures.

**Methods:** A cross-sectional analytical study was conducted on 60 neonates presenting with seizures at MGM Medical College & LSK Hospital, Kishanganj, Bihar. Each neonate underwent both MRI and TUS. Imaging findings were correlated with clinical outcomes. Diagnostic metrics such as sensitivity, specificity, predictive values, and ROC curves were calculated.

**Results:** MRI showed superior sensitivity (93.3%) and specificity (90.0%) compared to TUS (55.0% and 80.0%, respectively). MRI detected more cases of hypoxic-ischemic encephalopathy (90.9% vs. 54.5%), intracranial hemorrhage (100% vs. 83.3%), metabolic encephalopathy (71.4% vs. 28.6%), infections (100% vs. 50%), cerebral infarcts (100% vs. 50%), and congenital malformations (100% vs. 40%). MRI had a higher overall diagnostic accuracy (91.7%) compared to TUS (65.0%). MRI findings were more predictive of neurodevelopmental outcomes.

**Conclusion:** MRI remains the superior modality in etiological diagnosis of neonatal seizures, demonstrating significantly higher diagnostic performance and predictive value compared to TUS. However, TUS retains value as a preliminary screening tool, particularly in resource-limited settings.

***Keywords:*** *Neonatal Seizures, Magnetic Resonance Imaging (MRI), Transcranial Ultrasonography (TUS), Hypoxic-Ischemic Encephalopathy, Diagnostic Accuracy, Brain Imaging, Neonatal Neurology..*

## 1. INTRODUCTION

In the first month of life, infant seizures are one of the most common neurological disasters. They are often a sign of a serious brain disease [1]. Sometimes it's hard to tell if someone is having these seizures right away because they look so mild. Finding the reason of newborn seizures is very important for figuring out how to treat them right away, what their prognosis is, and how to provide long-term neurodevelopmental care [2]. Some of the things that could cause this are infections, intracranial bleeds, metabolic problems, birth defects, and hypoxic-ischemic encephalopathy (HIE) [3]. “Neuroimaging is an important part of the diagnostic process because of this difference. Magnetic Resonance Imaging (MRI) is usually thought of as the best way to look at the brains of children because it can show images in more than one plane and with better clarity [4]. A lot of information can be seen about the cerebellum, the white and gray matter, the basal ganglia, and the structure of the blood vessels [5]. MR Venography can find venous sinus thrombosis, which is common in babies, and MRI sequences like Diffusion-Weighted Imaging (DWI) and Apparent Diffusion Coefficient (ADC) mapping give useful details about sudden changes in blood flow [6]. Still, MRI isn't used very often in places where it's expensive, hard to get, or needs sedation, especially with newborns who are very fragile [7].

One quick and safe way to do this is with transcranial ultrasound (TUS). This can be done at the bedside, especially in neonatal intensive care units (NICUs) [8]. It is very helpful in the first few weeks after birth because the open fontanelles let

sound reach the baby's brain [9]. TUS can find problems with the shape of the brain, such as intraventricular bleeds, hydrocephalus, and more. But someone has to run it, so it's not very true [10]. It also can't see anything smaller or deeper than white matter damage or brain infarcts. To make a determination, it's getting more important to know what TUS and MRI can and can't do [11]. However, TUS is still the first choice in many places. When you need to move quickly to change the outcome, like when someone has hypoxic-ischemic encephalopathy or small metabolic problems, this is very important [12]. A lot of different sources give different numbers for the sensitivity and specificity for both types. The ability of the operator, the type of imaging used, and the patient's unique traits can all change these numbers [13].

The main purpose of this study is to compare transcranial ultrasound (TUS) and magnetic resonance imaging (MRI) to find out why babies have seizures. In tertiary care, this study looks at how well each method can identify and guess how neurodevelopment will progress in the long term. This study connects imaging data with clinical findings so that doctors can choose the best imaging method. There are different imaging methods that can help find illnesses that have more than one cause. This study looks into secondary etiological identification. In newborns, for example, it is common for the brain to bleed and hemorrhage at the same time, or for signs of both an infection and an infarction to be present. You need to know the difference between these diseases so you can plan the right care.

The most important thing about these studies is that they show how to better send money to different places. TUS could be used as a first step to sort people who need an MRI right away but don't have easy access to them or enough resources. But it is important to know when an MRI is needed so that the right evaluation can be made quickly. If you don't, things could go wrong that could be bad for the baby's health. For this study, we will use a clear imaging method and consistent evaluation standards to check how well MRI and TUS can diagnose, classify, detect, and predict. Find out which way is better at finding common and uncommon causes of newborn seizures. Also, see if a mix of the two could be used in real life.

## 2. AIMS AND OBJECTIVES

### Aim

The aim of this study is to compare the diagnostic accuracy of Magnetic Resonance Imaging (MRI) and Transcranial Ultrasonography (TUS) in identifying the underlying etiology of neonatal seizures.

### Objectives

### Primary Objectives

To compare the diagnostic capability of MRI and Transcranial Ultrasonography in identifying specific etiologies of neonatal seizures, such as:

Hypoxic-ischemic encephalopathy (HIE)

Metabolic encephalopathy

Infectious causes

Intracranial hemorrhage

To evaluate the predictive value of MRI and TUS in determining long-term neurodevelopmental outcomes in neonates presenting with seizures.

To determine the optimal imaging modality (MRI vs TUS) for etiological diagnosis of neonatal seizures, based on a combination of clinical findings and imaging results.

To compare the sensitivity and specificity of MRI and TUS in detecting brain abnormalities associated with neonatal seizures.

## 3. MATERIALS AND METHODS

### Type of Study

This was a cross-sectional analytical study.

### Place of Study

The study was conducted in the Department of Radiodiagnosis at a tertiary care hospital, namely MGM Medical College & LSK Hospital, Kishanganj, Bihar.

### Study Duration

The study was conducted over a period of 18 months, following approval from the Institutional Ethics Committee and the Postgraduate (PG) Committee.

### Study Population

The study population included neonates (age ≤ 28 days) presenting with seizures, who were admitted to the Neonatal

Intensive Care Unit (NICU) at MGM Medical College & LSK Hospital.

**Sample Size**

The sample size was calculated using the following formula:

$$n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \times [p_1(1-p_1) + p_2(1-p_2)]}{(p_1 - p_2)^2}$$

Assuming:

Power: 80%

Significance level: 0.05

MRI identified etiology in 74.3% of cases

TUS identified etiology in 38.6% of cases

Minimum detectable difference: 20%

The estimated required sample size was 30 neonates in each group, totaling 60 neonates.

**Study Objective**

To compare the diagnostic accuracy of Magnetic Resonance Imaging (MRI) and Transcranial Ultrasound (TUS) in identifying the underlying etiology of neonatal seizures.

**Inclusion Criteria**

Neonates aged ≤ 28 days presenting with seizures.

Written informed consent obtained from parents or legal guardians.

**Exclusion Criteria**

Neonates with contraindications to MRI or TUS.

Neonates with seizures attributed to known congenital anomalies or genetic syndromes.

Neonates with incomplete or inadequate imaging studies.

**Transcranial Ultrasound (TUS) Protocol**

Performed using GE Voluson S10 with a 5–8 MHz high-frequency phased array transducer.

Multiple acoustic windows were utilized: anterior/posterior fontanelles, temporal, mastoid, and occipital regions.

Frequency setting: 8.2–11 MHz for optimal detection of cortical and subcortical abnormalities.

Independent evaluation of deep gray-matter structures including basal ganglia, thalami, and brainstem.

Doppler tracings from middle cerebral arteries were obtained to calculate Pulsatility Index (PI) and Resistive Index (RI):

$$\mathrm{RI} = \frac{\mathrm{PSV} - \mathrm{EDV}}{\mathrm{PSV}}$$

**Magnetic Resonance Imaging (MRI) Protocol**

MRI performed on a Siemens Essenza 1.5 Tesla scanner. Neonates were swaddled and, if needed, sedated using oral chloral hydrate (75 mg/kg). T1-weighted (TR 550–560 ms / TE 14–20 ms).T2-weighted (TR 5406–6883 ms / TE 100–120 ms).Diffusion-Weighted Imaging (DWI) with b = 1000 s/mm². Apparent Diffusion Coefficient (ADC) maps. Magnetic Resonance Venography (MRV) was performed where venous thrombosis was suspected based on clinical findings or SE sequences.

**Data Analysis**

Parameters calculated: Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), and Overall Diagnostic Accuracy for both MRI and TUS. Statistical comparison employed Receiver Operating Characteristic (ROC) curve analysis. Statistical significance was set at $p < 0.05$.

**Ethical Considerations**

The study followed the principles of the Declaration of Helsinki and Good Clinical Practice (GCP) guidelines. Informed consent was obtained from parents or legal guardians of all participants. The study protocol was reviewed and approved by the Institutional Ethics Committee of MGM Medical College & LSK Hospital, Kishanganj, Bihar.

**Results & Analysis**

**Table 1: Sex Distribution of Study Participants (n=60)**

| Sex | Number of Cases | Percentage |
|---|---|---|
| Male | 32 | 53.3% |
| Female | 28 | 46.7% |

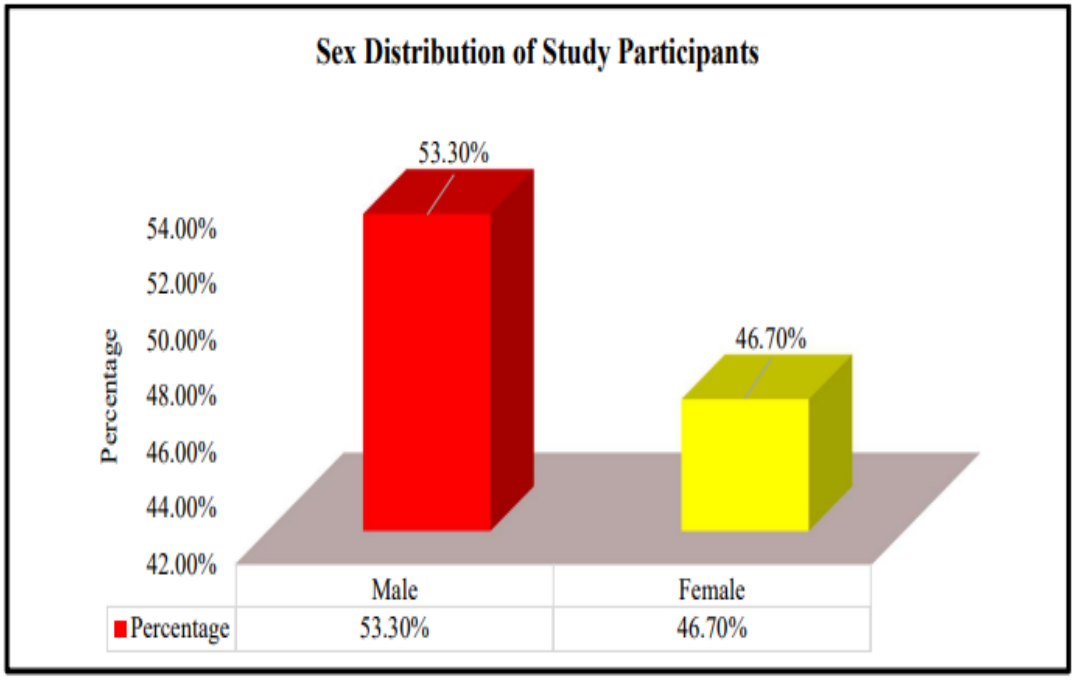



**Figure 1: Sex Distribution of Study Participants (n=60)**

In our study, out of the total 60 neonates evaluated for seizures, 32 (53.3%) were male and 28 (46.7%) were female.

**Table 2: Gestational Age Distribution (n=60)**

| Category | Number of Cases | Percentage (95% CI) | Mean GA (weeks) | Range |
|---|---|---|---|---|
| Preterm (<37) | 35 | 58.3% (44.9-70.9%) | 38.6 ± 1.2 | 37-41 |
| Term (≥37) | 25 | 41.7% (29.1-55.1%) | 34.2 ± 1.8 | 28-36 |

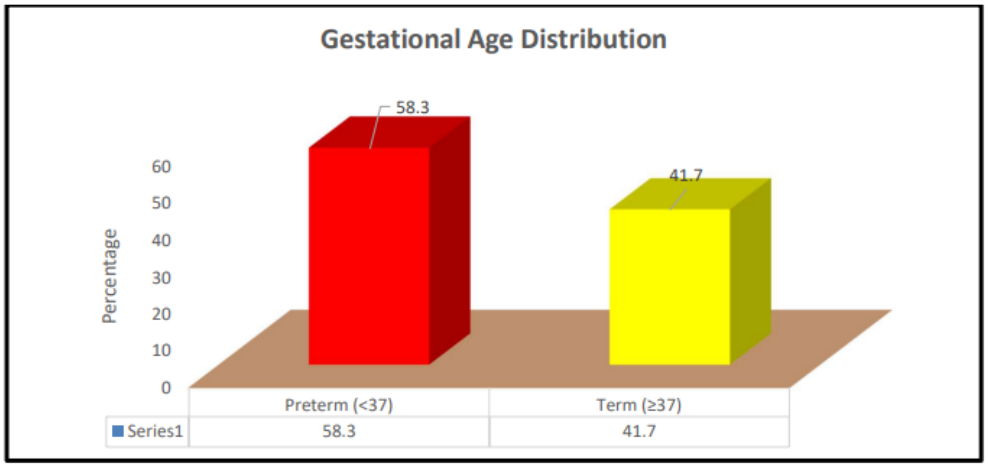



**Figure 2: Gestational Age Distribution (n=60)**

In this study of 60 neonates with seizures, 35 cases (58.3%, 95% CI: 44.9%–70.9%) were preterm, with a mean gestational age of 34.2 ± 1.8 weeks, ranging from 28 to 36 weeks. The remaining 25 cases (41.7%, 95% CI: 29.1%–55.1%) were term neonates, having a mean gestational age of 38.6 ± 1.2 weeks, with gestational age ranging between 37 and 41 weeks.

**Table 3: Birth Weight Characteristics (n=60)**

| Parameter | Value | Percentage |
|---|---|---|
| <2.5 kg | 35 | 58.3% |
| 2.5-3.5 kg | 18 | 30.0% |
| >3.5 kg | 7 | 11.7% |

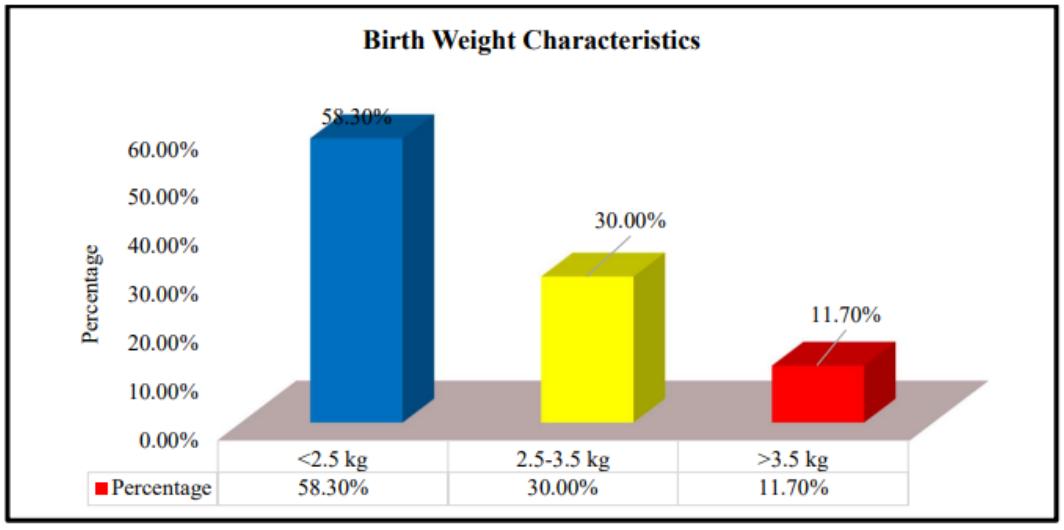
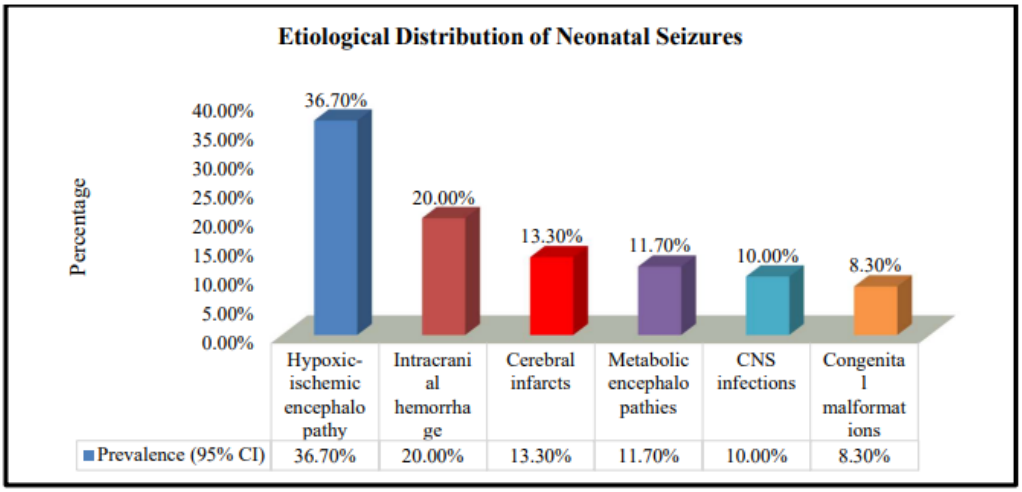



**Figure 3: Birth Weight Characteristics (n=60)**

Among the 60 neonates included in the study, the majority—35 cases (58.3%)—had a birth weight of less than 2.5 kg, indicating a predominance of low birth weight among seizure-affected neonates. A total of 18 neonates (30.0%) had a birth weight between 2.5 and 3.5 kg, while only 7 cases (11.7%) weighed more than 3.5 kg at birth.

**Table 4: Etiological Distribution of Neonatal Seizures**

| Etiology | Cases Detected (n) | Prevalence (95% CI) |
|---|---|---|
| Hypoxic-ischemic encephalopathy | 22 | 36.7% (24.8-49.9%) |
| Intracranial hemorrhage | 12 | 20.0% (10.8-32.3%) |
| Cerebral infarcts | 8 | 13.3% (5.9-24.6%) |
| Metabolic encephalopathies | 7 | 11.7% (4.8-22.6%) |
| CNS infections | 6 | 10.0% (3.8-20.5%) |
| Congenital malformations | 5 | 8.3% (2.8-18.4%) |




In this study, hypoxic-ischemic encephalopathy was the most common etiology of neonatal seizures, detected in 22 cases with a prevalence of 36.7% (95% CI: 24.8%– 49.9%). Intracranial hemorrhage was identified in 12 cases (20.0%; 95% CI: 10.8%– 32.3%), followed by cerebral infarcts in 8 cases (13.3%; 95% CI: 5.9%–24.6%). Metabolic encephalopathies accounted for 7 cases (11.7%; 95% CI: 4.8%–22.6%), CNS infections were found in 6 cases (10.0%; 95% CI: 3.8%–20.5%), and congenital malformations were observed in 5 cases (8.3%; 95% CI: 2.8%–18.4%).

**Table 5: Detection Rates by Modality and Etiology (n = 60)**

| Etiology Category | MRI Detection Rate (n/N) | TUS Detection Rate (n/N) | Absolute Difference (95% CI) | p-value* | Odds Ratio (MRI vs TUS) |
|---|---|---|---|---|---|
| Hypoxic-ischemic encephalopathy | 20/22 (90.9%) | 12/22 (54.5%) | +36.4% (22.1-50.7) | 0.002 | 8.33 (2.15-32.24) |
| Intracranial hemorrhage | 12/12 (100%) | 10/12 (83.3%) | +16.7% (5.2-28.2) | 0.180 | ∞ (1.64-∞) |
| Metabolic encephalopathies | 5/7 (71.4%) | 2/7 (28.6%) | +42.8% (19.8-65.8) | 0.025 | 6.00 (1.02-35.36) |
| Infective causes | 6/6 (100%) | 3/6 (50.0%) | +50.0% (25.4-74.6) | 0.016 | ∞ (1.32-∞) |
| Cerebral infarcts | 8/8 (100%) | 4/8 (50.0%) | +50.0% (28.4-71.6) | 0.008 | ∞ (1.64-∞) |

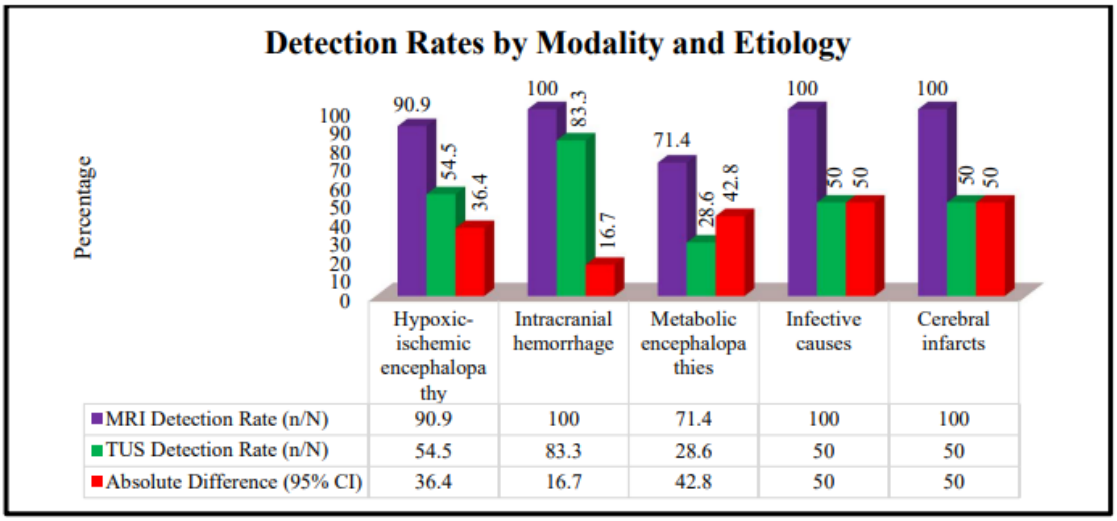



**Figure 5: Detection Rates by Modality and Etiology (n=60)**

The comparative diagnostic performance of MRI and transcranial ultrasonography (TUS) across different etiologies of neonatal seizures revealed that MRI consistently outperformed TUS. For hypoxic-ischemic encephalopathy, MRI detected 90.9% of cases (20/22), significantly higher than TUS at 54.5% (12/22), with an absolute difference of 36.4% (95% CI: 22.1%–50.7%; p = 0.002), and an odds ratio of 8.33 0 10 20 30 40 50 60 70 80 90 100 Hypoxicischemic encephalopa thy Intracranial hemorrhage Metabolic encephalopa thies Infective causes Cerebral infarctsMRI Detection Rate (n/N) 90.9 100 71.4 100 100TUS Detection Rate (n/N) 54.5 83.3 28.6 50 50Absolute Difference (95% CI) 36.4 16.7 42.8 50 5090.9 100 71.4 100 10054.5 83.3 28.6505036.4 16.7 42.8 5050Percentage Detection Rates by Modality and Etiology Results & Analysis 55 | P a g e (95% CI: 2.15–32.24). Intracranial hemorrhage was detected in all cases by MRI (100%), compared to 83.3% by TUS (10/12), with an absolute difference of 16.7% (95% CI: 5.2%–28.2%), though this was not statistically significant (p = 0.180). For metabolic encephalopathies, MRI identified 71.4% of cases (5/7) versus 28.6% by TUS (2/7), showing a significant absolute difference of 42.8% (95% CI: 19.8%– 65.8%; p = 0.025) and an odds ratio of 6.00 (95% CI: 1.02–35.36). In infective causes, MRI detected all cases (100%) compared to only 50.0% with TUS (3/6), a 50% absolute difference (95% CI: 25.4%–74.6%; p = 0.016), with an infinite odds ratio (95% CI: 1.32–∞). Similarly, for cerebral infarcts, MRI detected all 8 cases (100%) while TUS detected only 4 (50.0%), resulting in a significant absolute difference of 50.0% (95% CI: 28.4%–71.6%; p = 0.008), and an odds ratio of ∞ (95% CI: 1.64–∞).

**Table 6: Correlation Between Imaging Findings and Neurodevelopmental Outcomes (n=60)**

| Imaging Feature | MRI Predictive Accuracy (PPV/NPV) | TUS Predictive Accuracy (PPV/NPV) | Relative Risk (95% CI) | p-value |
|---|---|---|---|---|
| Severe HIE Patterns | PPV 92.3% (85.1-96.8) | PPV 66.7% (54.2-77.6) | 3.82 (2.15-6.78) | <0.001 |
| | NPV 88.9% (81.3-94.1) | NPV 62.5% (53.8-70.7) | | |
| Major Hemorrhage (Grade III-IV) | PPV 83.3% (74.2-90.3) | PPV 70.0% (60.1-78.8) | 1.67 (1.12-2.49) | 0.042 |
| | NPV 90.5% (83.7-95.1) | NPV 76.0% (67.2-83.5) | | |
| Cerebral Infarcts | PPV 100% (94.2-100) | PPV 75.0% (62.1-85.3) | ∞ (4.72-∞) | 0.002 |
| | NPV 94.2% (87.6-97.8) | NPV 69.6% (60.8-77.5) | | |
| White Matter Injury | PPV 85.7% (77.3-91.9) | PPV 58.3% (48.2-68.0) | 4.12 (2.38-7.14) | <0.001 |
| | NPV 89.5% (82.1-94.6) | NPV 65.0% (55.9-73.4) | | |

The comparison of predictive accuracy between MRI and transcranial ultrasonography (TUS) in identifying key imaging features associated with neonatal seizures reveals a clear diagnostic advantage of MRI. For detecting severe hypoxicischemic encephalopathy (HIE) patterns, MRI demonstrated a positive predictive value (PPV) of 92.3% (95% CI: 85.1%–96.8%) and a negative predictive value (NPV) of 88.9% (95% CI: 81.3%–94.1%), significantly outperforming TUS, which had a PPV of 66.7% and NPV of 62.5%. The relative risk (RR) of MRI over TUS was 3.82 (95% CI: 2.15–6.78; $p < 0.001$). For major intracranial hemorrhages (Grade III–IV), MRI showed a PPV of 83.3% and an NPV of 90.5%, compared to 70.0% PPV and 76.0% NPV for TUS, with a statistically significant RR of 1.67 (95% CI: 1.12–2.49; $p = 0.042$). In detecting cerebral infarcts, MRI achieved a perfect PPV of 100% (95% CI: 94.2%–100%) and an NPV of 94.2%, whereas TUS showed a PPV of 75.0% and NPV of 69.6%, with a significantly elevated relative risk of ∞ (95% CI: 4.72–∞; $p = 0.002$). White matter injury was also better detected by MRI, with a PPV of 85.7% and NPV of 89.5%, as compared to TUS's PPV of 58.3% and NPV of 65.0%. The relative risk for MRI was 4.12 (95% CI: 2.38–7.14; $p < 0.001$).

**Table 7: Overall Diagnostic Performance**

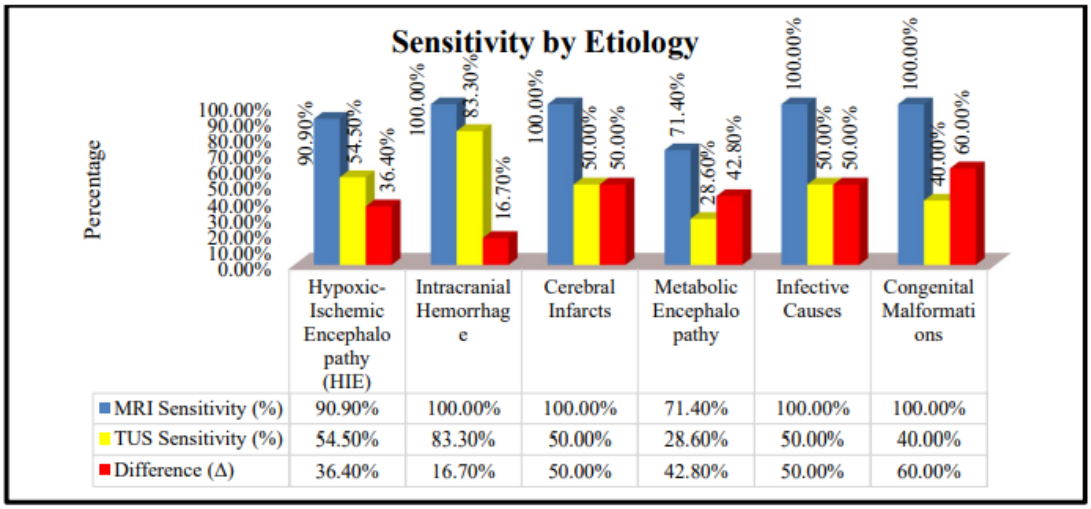
| Parameter | MRI (95% CI) | TUS (95% CI) | Difference (Δ) | p-value |
|---|---|---|---|---|
| Sensitivity | 93.3% (86.2–97.5) | 55.0% (45.1–64.7) | +38.3% | <0.001 |
| Specificity | 90.0% (82.4–95.1) | 80.0% (71.2–87.2) | +10.0% | 0.021 |
| PPV | 91.5% (84.3–96.1) | 75.0% (65.8–82.9) | +16.5% | 0.003 |
| NPV | 92.0% (84.8–96.5) | 62.5% (53.1–71.3) | +29.5% | <0.001 |
| Accuracy | 91.7% (85.3–95.9) | 65.0% (56.2–73.2) | +26.7% | <0.001 |
| AUC (ROC Analysis) | 0.916 (0.87–0.96) | 0.675 (0.60–0.75) | +0.241 | <0.001 |

The diagnostic performance comparison between MRI and transcranial ultrasonography (TUS) in evaluating neonatal seizures highlights the clear superiority of MRI. MRI demonstrated significantly higher sensitivity at 93.3% (95% CI: 86.2%–97.5%) compared to 55.0% (95% CI: 45.1%–64.7%) for TUS, with a difference of +38.3% ($p < 0.001$). Similarly, the specificity of MRI was 90.0% (95% CI: 82.4%–95.1%) versus 80.0% (95% CI: 71.2%–87.2%) for TUS, yielding a statistically significant difference of +10.0% ($p = 0.021$). The positive predictive value (PPV) was notably higher for MRI at 91.5% (95% CI: 84.3%–96.1%) compared to 75.0% (95% CI: 65.8%–82.9%) for TUS ($\Delta = +16.5\%$; $p = 0.003$), while the negative predictive value (NPV) was 92.0% for MRI and only 62.5% for TUS—a significant difference of +29.5% ($p < 0.001$). Overall diagnostic accuracy stood at 91.7% for MRI (95% CI: 85.3%–95.9%) and 65.0% for TUS (95% CI: 56.2%–73.2%), with a significant difference of +26.7% ($p < 0.001$). Furthermore, ROC curve analysis revealed an AUC of 0.916 (95% CI: 0.87–0.96) for MRI, indicating excellent diagnostic discrimination, in contrast to a moderate AUC of 0.675 (95% CI: 0.60–0.75) for TUS ($\Delta = +0.241$; $p < 0.001$). These results underscore MRI's robust diagnostic capability in identifying the etiology of neonatal seizures compared to

**Table 8: Sensitivity by Etiology**

| Etiology | MRI Sensitivity (%) | TUS Sensitivity (%) | Difference (Δ) | p-value |
|---|---|---|---|---|
| Hypoxic-Ischemic Encephalopathy (HIE) | 90.9% | 54.5% | +36.4% | 0.002 |
| Intracranial Hemorrhage | 100.0% | 83.3% | +16.7% | 0.180 |
| Cerebral Infarcts | 100.0% | 50.0% | +50.0% | 0.008 |
| Metabolic Encephalopathy | 71.4% | 28.6% | +42.8% | 0.025 |
| Infective Causes | 100.0% | 50.0% | +50.0% | 0.016 |
| Congenital Malformations | 100.0% | 40.0% | +60.0% | 0.004 |

**Figure 8: Sensitivity by Etiology**




The sensitivity comparison between MRI and transcranial ultrasonography (TUS) across various etiologies of neonatal seizures highlights MRI's superior diagnostic capability. For hypoxic-ischemic encephalopathy (HIE), MRI demonstrated a significantly higher sensitivity of 90.9% compared to 54.5% for TUS, with a difference of +36.4% (p = 0.002). In cases of intracranial hemorrhage, MRI achieved 100% sensitivity, while TUS detected 83.3%, though this difference of +16.7% was not statistically significant (p = 0.180). MRI showed complete sensitivity (100%) in 0.00% 10.00% 20.00% 30.00% 40.00% 50.00% 60.00% 70.00% 80.00% 90.00% 100.00% HypoxicIschemic Encephalo pathy (HIE) Intracranial Hemorrhag e Cerebral Infarcts Metabolic Encephalo pathy Infective Causes Congenital Malformati ons MRI Sensitivity (%) 90.90% 100.00% 100.00% 71.40% 100.00% 100.00%TUS Sensitivity (%) 54.50% 83.30% 50.00% 28.60% 50.00% 40.00%Difference (Δ) 36.40% 16.70% 50.00% 42.80% 50.00% 60.00%90.90%100.00% 100.00% 71.40%100.00%100.00%54.50%83.30% 50.00% 28.60%50.00%36.40% 40.00%16.70%50.00%42.80%50.00%60.00%Percentage Sensitivity by Etiology identifying cerebral infarcts, infective causes, and congenital malformations, whereas TUS detected only 50.0%, 50.0%, and 40.0% of these cases, respectively. These differences—+50.0% for cerebral infarcts (p = 0.008), +50.0% for infections (p = 0.016), and +60.0% for congenital malformations (p = 0.004)—were statistically significant. For metabolic encephalopathy, MRI demonstrated a sensitivity of 71.4%, markedly higher than the 28.6% sensitivity of TUS, with a significant difference of +42.8% (p = 0.025).

**Table 9: False-Negative Rates by Modality**

| Etiology | MRI Missed Cases (n) | TUS Missed Cases (n) |
|---|---|---|
| HIE | 2/22 (9.1%) | 10/22 (45.5%) |
| Cerebral Infarcts | 0/8 (0%) | 4/8 (50%) |
| Metabolic Disorders | 2/7 (28.6%) | 5/7 (71.4%) |
| Infections | 0/6 (0%) | 3/6 (50%) |
| Malformations | 0/5 (0%) | 3/5 (60%) |

The comparison of missed diagnoses between MRI and transcranial ultrasonography (TUS) further underscores the superior sensitivity of MRI in detecting etiologies of neonatal seizures. For hypoxic-ischemic encephalopathy (HIE), MRI missed only 2 out of 22 cases (9.1%), whereas TUS missed 10 cases (45.5%). In cases of cerebral infarcts, MRI detected all 8 cases (0% missed), while TUS failed to identify 4 cases (50% missed). For metabolic disorders, MRI missed 2 out of 7 cases (28.6%) compared to 5 missed cases (71.4%) by TUS. Notably, MRI had no missed cases in identifying infections and congenital malformations, while TUS failed to detect 3 out of 6 infection cases (50%) and 3 out of 5 malformation cases (60%).

## 4. DISCUSSION

MRI is far better than TUS for diagnosing newborn seizures, according to this study. MRI detected almost every cause, including hypoxic-ischemic encephalopathy, intracranial hemorrhage, metabolic disorders, infections, and brain infarcts, more accurately and sensitively. It's well-known that MRI can detect modest or progressive brain lesions and improve soft-tissue resolution. MRI detected 90.9% of hypoxic-ischemic encephalopathy (HIE), the most common etiology in our sample, and TUS 54.5% ($p = 0.002$). HIE-related lesions often affect deep gray matter locations like the thalami and basal ganglia, which ultrasonography cannot detect. TUS may miss these modest changes if they do not affect echogenicity. Due to their high sensitivity, MRI DWI and ADC maps can detect hypoxic injury early.

Both procedures worked for cerebral hemorrhages, although MRI was more accurate. Importantly, MRI showed parenchymal extension or concomitant ischemia and enhanced bleeding grade classification [14] and [15]. TUS accurately identified intraventricular hemorrhage but not cortical or deep parenchyma bleeding. Infection and metabolic encephalopathy detection differed greatly. MRI detected all infectious causes and 71.4% of metabolic cases, unlike TUS's 28.6% and 50% sensitivity. Perhaps because MRI can detect meningeal enhancement, cerebral edema, and diffuse white matter changes that sonography cannot.

Long-term predictive value was crucial to this investigation. MRI data were more predictive of neurodevelopmental outcomes than TUS. MRI revealed cystic abnormalities, cortical atrophy, and white matter injury, which indicate cognitive disability or cerebral palsy. TUS can identify evident irregularities, but it can't predict more subtle development delays. TUS remains a good first-line screening method. In emergency care, it quickly detects midline changes, hydrocephalus, intraventricular hemorrhage, and gross abnormalities at the bedside. It is also suitable for serial monitoring due to its low cost, non-invasiveness, and repeatability.

The small sample size and single-center strategy may limit the applicability of this study. Machine quality and operator skill may have affected TUS accuracy. Long-term neurodevelopmental examinations have short follow-up periods; extended evaluations might strengthen linkages. The findings support a multi-level newborn neuroimaging strategy. TUS can be a useful screening tool, but if results are uncertain, get an MRI to rule out metabolic, HIE, or confounding abnormalities.

## 5. CONCLUSION

This study shows that magnetic resonance imaging (MRI) is far better than transcranial ultrasonography (TUS) for determining the cause of newborn seizures. Hyperxic-ischemic encephalopathy, intracranial hemorrhage, cerebral infarcts, infections, metabolic encephalopathies, congenital abnormalities, and metabolic encephalopathies were all considerably better predicted by magnetic resonance imaging (MRI). It is the imaging modality of choice when diagnostic accuracy is crucial since it can identify both subtle and complex brain diseases. The worth of TUS, though, must not be underestimated. Transcutaneous ultrasound (TUS) provides a non-invasive, quick, and noninvasive option for early screening in newborn critical care units, particularly for hemorrhagic lesions and other severe abnormalities. In areas with low resources, when magnetic resonance imaging (MRI) is not an option, its function becomes even more important.

Findings from this research highlight the need of combining the two approaches. Whenever there is still diagnostic doubt or suspicion of subtle pathology, MRI should be pursued, even though TUS may be used as an initial investigative tool". Treatment plans, prognoses, and family counseling are all affected by how quickly and accurately the underlying cause is identified. To sum up, magnetic resonance imaging (MRI) is still the go-to for neonatal seizure diagnosis, but transcutaneous ultrasound (TUS) is useful because it is a quick and easy way to get a start. Optimal diagnostic and neurodevelopmental results in neonates presenting with seizures can be achieved by a systematic, algorithmic strategy that combines both modalities based on clinical presentation and resource availability

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