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Clinical and Biochemical Profile Survey of Neonatal Seizures in a Tertiary Newborn Care Unit

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Abstract

Background: To look into the frequency of metabolic abnormalities connected to newborn convulsions, in the newborn section of the Department of Pediatrics, Government Medical College, Ongole, Andhra Pradesh, India. It was decided to do research on the clinical signs as soon as they appeared and how they related to neonatal seizures. **Material and Methods:** Retrospective hospital-based research approach on neonates hospitalised to a Department of Pediatrics, Government Medical College, Ongole, Andhra Pradesh, India, from birth until 28 days after birth. The trial, which lasted from January 2022 to November 2022 involved 100 newborns. This study identified the metabolic abnormality is the most common cause of neonatal seizures. **Results:** The mean seizure onset day was 3.26, ranging from 1 to 17. (95% CI 2.40 to 2.72). In our study, 33 seizures (33%) started within 24 hours, 24–72 hours (days 1–3), 4–7 days (days 4–7), and more than 7 days (9%) respectively. Convulsions on the first day account for 91%. Mild seizures were experienced by 14 (56%) preterm babies; 7 (28%) of them were tonic, and 4 (16%) were clonic. There were mild, tonic, and clonic seizures in 75 term newborns. Preterm infants in my study experienced 56% more mild seizures than term infants. Compared to term babies, preterm infants experienced 28% fewer tonic seizures. 16% of preterm and 14.6% of natal clonic seizures occur. **Conclusion:** Convulsions in newborns are frequent. The progression of the disease as well as its long-term neurological prognosis, mortality, and morbidity are influenced by the various causes of newborn seizures. Quick assessment, diagnosis, and strong treatment are required to stop these consequences. Biochemical anomalies may be the primary or secondary issue. Transient abnormalities have a good prognosis and are simply treated. The prognosis and outcome of the newborn are improved and neurological repercussions are avoided when metabolic disorders are treated early.

Keywords: Convulsions, Hyponatremia, Hypocalcaemia, Neonates.

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Introduction

One of the most prevalent and recognisable clinical signs of a neurological system in failure are neonatal seizures. Neonatal seizures cause significant neonatal mortality and long-term morbidity, including developmental motor and cognitive deficits.[1-3] They are non-specific reactions of the developing nervous system to many stressors. Multiple obstacles prevent the doctor from evaluating and managing the newborn with suspected seizures, even if urgent diagnostic and therapeutic interventions are required. These newborn convulsions are

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frequently misdiagnosed and challenging to manage. Therefore, it is crucial to identify seizures early and start treatment right away.
Understanding the cause is frequently beneficial for prognosis and treatment. However, in clinical practise at neonatal intensive care units (ICU), in developing countries where synchronised video-EEG monitoring is essentially non-existent, clinical observation is becoming the key to the diagnosis. Studies suggest that neonatal seizures and their aetiology have a significant effect on the growth brain.[3-5]
Because continuous video-EEG monitoring is not feasible at our facility, we conducted this study to both identify neonatal seizures using clinical criteria and to ascertain the biochemical abnormalities related to these clinical convulsions.[5,6]

Material and Methods
Neonatals who met the inclusion and exclusion criteria and were admitted to the Neonatal Intensive Care Unit of the Department of Pediatrics, Government Medical College, Ongole, Andhra Pradesh, India, were the subject of a Retrospective hospital-based observational study. Over the course of six months, from January 2022 to November 2022, 100 participants were used in this study.

Inclusion criteria
- All term and preterm infants who presented with seizures, including neonates who were born intramural and extramural

Exclusion criteria
- Babies who were already receiving anticonvulsant therapy.
- Mothers or caregivers who refused to give their consent.

RESULTS

A total of 100 neonates with seizures admitted to the neonatal unit of Department Of Paediatrics, in Department of Pediatrics, Government Medical College, Ongole, Andhra Pradesh, India, during the study period of six months from January 2022 to November 2022 were included in this study.

Table 1: Presents a descriptive statistical analysis of THE DELIVERY MODE in the sample population (N = 100)

Mode of Delivery	Number	Percentages
FORCEPS	12	12%
LSCS	44	44%
NVD	44	44%

In the sample group, FORCEPS made up 12% of the population, whereas LSCS and NVD made up 44%.

Table 2: IM/EM descriptive analysis in the study population (N = 100)

IM/EM	Number	Percentage
Intramural	79	79%
Extramural	21	21%

In the study population, 79 (or 79%) babies were born inside the institution, while 21 (21%) were referred from outside.

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Table 3: Presents a descriptive analysis of gender data from the study population (N = 100)

Gender	Number	Percentage
Male	59	59%
Female	41	41%

Males made up 59 percent of the study population while females made up 41 percent.

Table 4: Descriptive analysis of the study population's TERM/PRE TERM/POST TERM (N=100)

Term/Pre-Term/Post Term	Number	Percentage
Preterm	25	25%
Term	75	75%
Post term	0	0%

Preterm births made up 25 (25%) of the study group while term births made up 75 (75%) and there were no preterms.

Table 5: Descriptive analysis of the study population's AGA/SGA/LGA (N=100)

AGA/SGA/LGA	Number	Percentages
SGA	62	62%
AGA	29	29%
LGA	9	9%

The SGA, AGA, and LGA among the study population were 62 (62%), 29 (29.00%), and 9 (9%) correspondingly.

Table 6: Descriptive analysis of the research population's (N = 100) birth weight

Parameter	Mean ±STD	Median	Min	Max	95% C.I. for EXP(B)	
					Lower	Upper
Birth weight	2.56 ± 0.67	2.53	0.99	4.16	2.40	2.72

The average birth weight of the research population was 2.56 kg, ranging from 0.99 kg to 4.16 kg. (95% CI 2.40 to 2.72).

Table 7: Descriptive analysis of the category of birth weight in the study population (N = 100)

Birth weight cat (kg)	Number	Percentage
Low birth weight (<2.5kg)	61	61%
Normal Birth weight (•2.5kg)	39	39%

Babies with Low Birth Weight (2.5kg) made up 61 (61% of the study group) while babies with Normal Birth Weight (•2.5kg) made up 39 (39%).

Table 8: Descriptive analysis for the research population's (N = 100) day of onset of seizures

Parameter	Mean ±STD	Median	Min	Max	95% C.I. for EXP(B)	
					Lower	Upper
Day of onset of seizures	3.26 ± 3.06	2.00	1.00	17.00	2.53	3.99

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In the study population, the mean day when seizures started was 3.26, with a minimum of 1 and a high of 17. (95% CI 2.40 to 2.72).

Table 9: Presents a descriptive analysis of the Day of Onset Category in the population under study (N = 100)

Day of onset category	Number	Percentage
Within 24 hours	33	33%
24 to 72 Hours (day 1 to 3)	38	38%
4th day to 1 week (day 4 to 7)	20	20.00%
More than 1 week (More than 7 days)	9	9%

In our study, the percentage of seizures that began within 24 hours was 33 (33%), followed by 24 to 72 Hours (days 1 to 3), 4th day to 1 week (days 4 to 7), and More than 1 week (more than 7 days), at which points the percentages were 38 (38%), 20 (20.00%), and 9 (9%) correspondingly. 91% of cases are due to seizures within the first three days.

Table 10: Detailed analysis of the types of seizures experienced by the research population (N=100)

Type of seizures	Number	Percentages
Subtle	63	63%
Tonic	25	25%
Clonic	12	12%

In the study population, there were 63 (63%), 25 (25%) and 12 (12%) newborns that experienced tonic or clonic seizures.

Table 11: Hypo Glycemia descriptive analysis in the research population (N = 100):

HYPO GLYCEMIA	Number	Percentage
Yes	37	37%
No	63	63%

In our experiment, there were 100 participants, and 17 (24.29%) of those participants had hypoglycemia.

Table 12: HYOCALCEMIA descriptive analysis in the research population (N = 100)

HYOCALCEMIA	Number	Percentage
Yes	34	34%
No	66	66%

In our investigation, out of 100 newborns, 34 (or 34%) had hypercalcemia.

Table 13: Provides a descriptive analysis of the study population's HYPONATREMIA (N=100)

HYPONATREMIA	Number	Percentage
Yes	15	15 %
No	85	85 %

15 neonates, or 15% of the cases, were found to have hyponatremia.

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Table 14: Provides a descriptive analysis of the population's HYPOMAGNESEMIA (N=100)

HYPO MAGNESEMIA	Number	Percentage
Yes	9	9%
No	91	91%

Nine (9%) newborns out of 100 developed hypomagnesemia.

Table 15: Shows a descriptive analysis of the research population's hypernatremia (N = 100)

HYPERNATREMIA	Number	Percentage
Yes	13	13%
No	87	87%

13 (13%) out of 100 newborns in my study had hypernatremia.

Table 16: Summary of numerous biochemical anomalies in the research cohort

Various Biochemical Abnormalities	Number N=100	Percentage
HYPO GLYCEMIA	27	27%
HYPOCALCEMIA	24	24%
HYPO NATREMIA	8	8%
HYPO MAGNESIMIA	8	8%
HYPERNATREMIA	5	5%

The percentages may not add up to 100% because this table showed the prevalence of different metabolic abnormalities that are not exclusive to one another.

Table 17: Combined hypoglycemia and hypocalcemia descriptive analysis in the research population (N = 100)

Combine hypoglycemia and hypocalcemia	Frequency	Percentage
Yes	7	7%
No	93	93%

Seven (or 7%) of the 100 participants' neonates were found to have both hypoglycemia and hypocalcemia.

Table 18: Descriptive analysis of the research population's combination of hypocalcemia and hypermagnesemia (N=100)

Combination of Hypocalcemia and Hypomagnesemia	Frequency	Percentage
Yes	6	6%
No	94	94%

Six (6%) patients out of 100 were found to have both hypocalcemia and hypomagnesemia.

Table 19: Shows the relationship between the research population's (N=100) term/Pre-term and Hypoglycemia.

Hypoglycemia	Term/preterm		Chi square	P value
	Preterm (N=25)	Term (N= 75)		
Yes	9 (36%)	19 (25%)	2.236	0.135
No	16 (64%)	56 (74.6%)		

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Only 19 (25%) of 75 term babies and 9 (36%) of 25 preterm babies experienced hypoglycemia, respectively. There was no statistically significant difference in the percentage of hypoglycemia between term and preterm newborns (P value 0.135).

Table 20: Shows the relationship between the study population's (N=100) Term/Pre-Term and hypocalcaemia.

Hypocalcemia	Term/preterm		Chi square	Pvalue
	Pre term (N=25)	Term (N=75)		
Yes	9 (36%)	15 (20%)	2.185	0.139
No	16 (64%)	60 (80%)		

Only 15 (20%) of the 75 full-term babies (out of 75) developed hypocalcemia, compared to 9 (36%) of the 25 preterm infants. There was no statistically significant difference in the percentage of hypocalcemia between term and preterm neonates (P value 0.139).

Table 21: Shows the relationship between the research population's (N = 100) TERM/PRE TERM and HYPO NATREMIA.

HYPO NATREMIA	TERM/PRE-TERM		Chi square	Pvalue
	Pre term (N=25)	Term (N=75)		
Yes	5 (20%)	9 (12%)	0.127	0.721
No	20 (80%)	66 (88%)		

Only 9 (12%) of 75 term babies and 5 (20%) of 25 preterm infants developed hyponatremia, respectively. There was no statistically significant difference in the proportion of hyponatremia between term and preterm newborns (P value 0.721).

Table 22: Shows the relationship between the research population's (N = 100) TERM/PRE TERM and HYPO MAGNESEMIA.

HYPOMAGNESEMIA	TERM/PRETERM		Chi square	P-value
	Pre term (N=25)	Term (N=75)		
Yes	8 (32%)	6 (8%)	2.476	0.116
No	17 (68%)	69 (92%)		

Compared to 75 term newborns, only 6 (8%) of the 25 preterm babies exhibited hypomagnesemia. The proportion of hypomagnesemia between term and preterm newborns did not differ in a statistically meaningful way (P value 0.116).

Table 23: Shows how the study population's (N = 100) TERM/PRETERM and HYPERNATREMIA associations.

HYPERNATREMIA	TERM/PRE-TERM	
	Pre term (N=25)	Term (N=75)
Yes	0 (0%)	5 (6.6%)
No	25 (100%)	70 (93.3%)

75 term newborns were examined, and only 5 (6.6%) exhibited hypernatremia. In my study, premature infants with hypernatremia were not recorded.

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Table 24: Shows the study population's HYPOGLYCEMIA AND HYPOCALCEMIA (N=100)

Combine hypoglycemia and Hypocalcemia	Term/preterm	
	Pre term (N=25)	Term (N=75)
Yes	4 (16%)	0 (0%)
No	21 (84%)	75 (100%)

There were only 4 (16%) combined hypoglycemia and hypocalcemia cases out of 25 preterm infants. There are no reports of this combo in term infants.

Table 25: Shows the relationship between the research population's (N=100) term/preterm/post term and combination of Hypocalcemia and Hypomagnesemia.

Combination of Hypocalcemia and Hypomagnesemia	Term/preterm/postterm	
	Pre term (N=25)	Term (N=75)
Yes	3 (12%)	0 (0%)
No	22 (88%)	75 (100%)

Only 3 (or 12%) of 25 preterm infants had hypocalcemia and hypomagnesemia together.

Table 26: Shows how the study population's AGA, SGA, and LGA are related to term and preterm (N=100).

AGA/SGA/LGA	Term/pre-term/post term	
	Pre term (N=25)	Term (N=75)
SGA	9 (36%)	19 (25.3%)
AGA	16 (64%)	54 (72%)
LGA	0 (0%)	5 (6.6%)

Out of 25 preterm infants, 9 (36%) had SGA and 16 (64%) had AGA. In a group of 75 term infants, 19 (25.3%) had SGA, 54 (72%) had AGA, and only 5 (6.6%) had LGA.

Table 27: Shows how the research population's (N=100) term/preterm seizures are related to different seizure types.

Type of Seizures	Term/Pre-Term	TERM/POST	Chi square	Pvalue
	Pre term (N=25)	Term (N=75)		
Subtle	14 (56%)	42 (56%)	0.407	0.816
Tonic	7 (28%)	22 (29.3%)		
Clonic	4 (16%)	11 (14.6%)		

14 (56%) of the 25 preterm infants had mild seizures, 7 (28%) had tonic seizures, and 4 (16%) had clonic seizures. 42 (56%) of the 75 term newborns exhibited mild, 22 (29.3%) tonic, and 11 (14.6%) clonic seizures. There was no statistically significant difference in the proportion of different seizure types between term and preterm newborns (P value 0.116). In my study, the percentage of infants with mild seizures was 56% in preterm infants and 56% in neonates. Similar to how tonic seizures occurred in 28.8% of preterm infants versus 29.3% of term infants. About 16% of preterm and 14.6% of term births are caused by clonic seizures.

DISCUSSION

The most frequent neurological condition affecting newborns is seizures, which affect preterm neonates more frequently than term neonates. In our study, 100 newborns with

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seizures who met the inclusion and exclusion criteria and were admitted to the neonatal intensive care unit of a Government Medical College Ongole, Andhra Pradesh, India were included. 25 (25%) of the 100 neonates were preterm, while 75 (75%) were full term.[7-9] In our study, there were no post-term infants. Out of 100 neonates, 61 were within normal limits for gestational age, 39 were underweight for gestational age, and 0 were overweight for gestational age. The majority of the neonates in our study who experienced seizures were full-term, appropriately-sized infants.[10,11] Similar findings were made in the study by Aziz et al. where term newborns make up 65% of the population, preterm babies make up 35%, and AGA, SGA, and LGA make up 68%, 26%, and 6% of the population respectively. According to research by Park Weon et al. and Dinesh Das et al. term newborns likewise had a significantly greater incidence of the condition than preterm neonates. Dinesh das et al. noted seizures in 91.3% of term infants, 7.8% of preterm infants, and 0.9% of postnatal infants.[11,12] Male newborns contributed approximately 59% of the neonatal seizures in our study, whereas female neonates contributed approximately 41%, with a male to female ratio of almost 1.25:1. Male predominance was also noted in studies by Aziz et al. (male 60%, female 40%), and Dinesh Das et al. (male 62.6%, female 37.4%).[13-15] Another study by Tekgul et al. revealed a male:female ratio of 1.15:1 while Sudia et al. observed a male:female ratio of 1.73:1, validating our study that seizures are more common in males. In my study, 44 babies (44%) were delivered naturally vaginally, 44 babies (44%) underwent Caesarean sections, and 12 babies (12%) were delivered with forceps. In their study, Aziz et al. found that 48% of normal vaginal deliveries, 28% of lower segment caesarian sections, and 24% of vaginal operations resulted in the birth of neonates with convulsions.[15-17] In my research, 51 newborns (51%) and 49 neonates (49%) had birth weights under 2.5 kg and over 2.5 kg, respectively. Similar findings were reported by Dinesh Das et al, who found that newborns >2.5 kg were 65% and 2.5 kg were 35% of the population.

In our study, out of 100 neonates, 33 (33%) suffered seizures within 24 hours, 38 (38%) between 24 and 72 hours, 20 (20%) between day 4 and 7, and 9 (9 %) after 7 days. In our study, 71% of newborns had seizures within the first three days of life, which is when the majority of seizures occurred. Similar findings were made by Dinesh Das et al, who showed that 71.3% of seizures occurred within 3 days, and Nawab et al, who noted 73.6% of neonatal seizures within 3 days, findings that were close to our study.[17,18]

In our study, we discovered that subtle seizures were the most frequent kind of newborn seizures, accounting for approximately 63% in roughly 63 neonates, followed by tonic seizures in approximately 25% of neonates and clonic seizures in approximately 12%. Similar results were found by Sudia et al., who found that subtle seizures affected 63% of newborns, generalised tonic seizures affected 25 %, and multifocal clonic seizures affected 12%. In their research on newborn seizures, Dinesh Das et al. found that the most common kind, accounting for 42.6% of cases, was subtle seizures. Tonic seizures accounted for 33.9% of cases and clonic seizures for 15.7% of neonates. Similar to my work, several studies by Yadav et al, Park Weon et al, and Nawab et al indicated that mild seizures were the most frequently seen form.[18,19]

72 of the 100 newborns in our study who experienced seizures had one or more biochemical abnormalities, accounting of the cases. In their study, Sood et al., which was equivalent to mine, found that overall biochemical abnormalities were present in 29 instances, or around 49.15% of the cases. Similar findings were reported by Nawab et al. in their investigations, which found that out of 110 newborns, 46 babies had biochemical anomalies, accounting for a total of 41.8% of cases. Compared to Madhusudan et al 43.33%,'s Kumar et al. detected general biochemical abnormalities in 62.8% of newborns.[19,20]

In my research on infants with metabolic disorders, hypoglycemia was found in 27 infants, accounting for about 27% of the total. Hypocalcemia was found in 24 neonates (24%),

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hyponatremia in 8 neonates (8%), hypomagnesemia in 8 neonates (8 %), and hypernatremia in 5 neonates (5%) were next, each accounting for about 4% of the total. In our study, there were also 7 cases with hypoglycemia and hypocalcemia combined and 6 case with hypocalcemia and hypomagnesemia, both of which were most common in premature newborns. Hypoglycemia, hypocalcemia, hyponatremia, and hypomagnesemia were all identified in 48.27%, 48.27%, 17.25%, and 17.24% of 59 newborns in a study by Sood et al., which was equivalent to my data. In their study, Kumar et al. found that the prevalence of hyponatremia was 45.5%, hypoglycemia was 50%, hypocalcemia was 31.8%, and hypomagnesemia was 13.63%. He also noted hyperphosphatemia in 13.63% of cases and hypermagnesemia in 4.54% of cases.[20,21]

In our study, hypoglycemia and hypocalcemia were the two most often observed biochemical abnormalities, especially in preterm newborns. Hypoglycemia was more common in preterm infants—36% of them—than it was in term infants—25%. Preterm babies reported hypocalcemia at a rate of 36%, which was higher than term babies' 20% rate. Similar findings were made by Suganthi et al. in their study, which found that 89 (59.3%) out of 150 cases had metabolic abnormalities. The most prevalent of these were hypoglycemia and hypocalcemia, with 39 (43.8%) and 28 (35.4%) instances, respectively. Hypoglycemia, followed by hypocalcemia, was the most prevalent metabolic disruption in the studies of Sameer Kumar Jain et al., Shah et al., and Iype Maya Prasad et al., corroborating my findings. Contrarily, Yadav et al. and Sarkar et al. discovered that the most prevalent biochemical abnormalities in their study were hypoglycemia and hypocalcemia. Furthermore, as suggested by our study, Dinesh Das et al. stated in his study that preterm infants had a higher prevalence of hypoglycemia. Accordingly, all of these studies point out the significance of performing a biochemical work up in neonatal convulsions, particularly in cases when blood glucose and calcium levels are higher than usual. Correcting these temporary biochemical abnormalities is linked to a favourable prognosis and outcome.[21-23]

Two occurrences of combined hypoglycemia and hypocalcemia (6%) and one case of combined hypocalcemia and hypomagnesemia (12 %) were documented in our study, both of which primarily affected premature newborns. In their investigation, Sudia et al. reported hypoglycemia and hypocalcemia in 9% of cases and hypocalcemia hypomagnesemia in 7.9% of cases. In their study, Nawab et al. also discussed the occurrence of comparable combinations.[22,23]

CONCLUSION

Among the most prevalent neurological conditions in newborns is neonatal seizures. Neonatal seizures can have a variety of origins, which affects not only how the disease develops but also its long-term neurological consequences, mortality, and morbidity. To avoid these issues, quick examination, prompt diagnosis, and vigorous care in accordance with the aetiology are required. Additionally, metabolic abnormalities may be a secondary issue or they may be linked to other etiologies.

When detected early, these transitory anomalies are easily treated and have a favourable prognosis. Therefore, a biochemical workup should be performed on all infants who have seizures and should be the first line of inquiry in every situation. Early treatment of these biochemical anomalies helps to stop seizures from happening again and also helps to avoid overusing anticonvulsants, which may occasionally be unneeded. The prognosis and outcome of the newborn are improved by further early repair of these metabolic abnormalities, which also helps to avoid the accompanying long-term neurological sequelae.

To accurately assess the severity of the issue and administer prompt treatment for these seizures, continuous video EEG monitoring should be used whenever it is practical.

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REFERENCES

1. MillerSP, WeissJ, BarnwallA, Ferriero DM, Latal HB, Ferrer RA et al. Seizure-associated brain injury in term newborn with perinatal asphyxia. Neurology.2002;58(4):542-8.
2. Davis AS, Hintz SR, Van KP, LiL, Das A, Stoll BJ et al. Seizures in extremely low birth weight infants are associated with adverse outcome. JPediatr.2010;157(5):720-5.
3. Holanda MRR, Melo AN. Comparative clinical study of preterm and full-term newborn neonatal seizures. Arq Neuropsiquiatr 2006; 64: 282–8.
4. Mikati MA, Kliegman RM, Behrman RE, Stanton BF. Seizures inchildhood; Nelson textbook of Paediatrics,19th edition. Philadelphia. 2011: WB Saunders [586]:2013-2037.
5. Yadav R K, Sharma I K, Kumar D, Shukla K M, Jawwad K, Chaturvedi V. Clinicoetiological and Biochemical Profile of Neonatal Convulsions.Int J Med Res Rev 2015;3(9):1057-1063. doi:10.17511/ijmrr. 2015.i9.193.
6. Aziz A. Gattoo, M Aziz, G Rasool. Clinical and etiological profile of neonatal seizures: A tertiary care hospital based study Int J Res Med Sci. 2015 Sep; 3(9): 2198-2203.
7. Iype M, Prasad M, Nair PM, Geetha S, Kailas L, The newborn with seizures_a follow upstudy. Indianpediatr 2008; 45:749-52.
8. Park, Weon, et al. "Clinical study of neonatal seizure." Journal of the Korean Child Neurology Society 6.1 (1998): 71-82.
9. William W, Hay Jr, Tonse NK Raju, et al. Knowledge gaps and research needs for understanding and treating neonatal hypoglycemia: Workshop report from Eunice Kennedy Shriver National Institute of Child Health and Human Development. J Pediatr 2009; 155: 612-17.
10. Sood A, Grover N, Sharma R. Biochemical abnormalities in neonatal seizures. Indian Journal of Paed. 2003;70(3):221-4.
11. Das, Dinesh, and Sanjib Kumar Debbarma. "A Study on ClinicoBiochemical Profile of Neonatal Seizure." Journal of Neurology Research 6.5-6 (2016): 95-101.
12. Oden J, Bourgeois M. Neonatal endocrinology. Indian J Pediatr 2000; 67: 217-23.
13. Tekgul H, Gauvreau K, Soul J, et al. The current etiologic profile and neurodevelopmental outcome of seizures in term newborn infants. Pediatrics 2006; 117: 1270 –1280.
14. Suganthi V, Vikneshwari K, Thivya G. Prevalence of hypomagnesemia in neonatal seizures in a tertiary care hospital inSouth India. J PediatrRes.2017;4(01):64-68. doi:10.17511/ijpr.2017.01.13.
15. Sudia S, Berwal PK, NagarajN, Jeavaji P, Swami S, Berwal A.Clinicoetiologicalprofile and outcome of neonatal seizures. Int JContempPediatr2015; 2:389-90.
16. Sameer Kumar Jain. Study of the clinical profile of neonatal seizuresJune 2015; 2(6): 336-338.
17. Madhusudhan K, Nadavapalli Suresh S, Babu TR, Rao JV, Kumar S B. Study of biochemical abnormalities in neonatal seizures with special reference tohyponatremia.Int J Contemp Pediatr 2016;3:730-4.
18. Kumar A, Gupta V, Kachhawaha JS, Singla PN. Biochemical Abnormalities in neonatal seizures. Indian Pediatr.1995;32(4):424-428.
19. Nawab T, Lakshmipathy NS. Clinical profile of neonatal seizures with special reference to biochemical abnormalities. Int J ContempPediatr 2016; 3: 183-8.
20. Das, Dinesh, and Sanjib Kumar Debbarma. "A Study on ClinicoBiochemical Profile of Neonatal Seizure." Journal of Neurology Research 6.5-6 (2016): 95-101.
21. Sudia, Sanjeev, et al. "Clinicoetiological profile and outcome ofneonatal seizures." International Journal of Contemporary Pediatrics 2.4 (2017): 389-394.

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22. Shah, G. S., et al. "Clinico-Biochemical Profile of Neonatal Seizure." Journal of Nepal Paediatric Society 28.1 (2008): 7-9.
23. Sarker, S. A., Ahmed, S. F., Rahman, M. M., Ali, S. S., Rehana, Z., Ahmed, S., & Farzana, F. Neonatal Seizures: Etiology and Hospital Outcome.