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Research Article

Clinical and etiological profile of neonatal seizures: a tertiary care hospital based study

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ABSTRACT

Background: The most vulnerable period of life to develop seizures is the neonatal period. These events very often signify serious damage or malfunction of the immature developing central nervous system. Neonatal seizures may arise as a result of diverse etiologies and can have varied presentations. Objective: Our study was aimed at finding the incidence, etiological factors, and time of onset, clinical types and various biochemical abnormalities in neonatal seizures.
Methods: A hospital based prospective observational study was undertaken in a tertiary care paediatric hospital of Government Medical College Srinagar. A total of 100 consecutive neonates presenting with seizures from September 2013 to August 2014 were enrolled in the study. Detailed antenatal history and baseline characteristics of convulsing neonate were recorded at admission. Clinical details of each seizure episode reported by the mother and subsequently observed by the resident doctors on duty were recorded. Venous blood was collected as soon as possible and blood glucose, total serum calcium levels, Na+, K+, Mg and P-levels were done immediately after baby had seizures and before instituting any treatment. Data was described as mean ± SE and %age. SPSS 16.0 and MS Excel software were used for data analysis.
Results: Cumulative frequency of 3.9% was recorded in neonatal seizures in our setup. Hypoxic ischemic encephalopathy was the commonest etiology of neonatal seizures. Intracranial haemorrhage followed by Hypoxic ischemic encephalopathy was the commonest seizure etiology in preterm neonates. Majority of Hypoxic ischemic encephalopathy patients presented with seizures in the first 72 hrs. of life. Focal clonic and subtle seizures were the commonest seizure types encountered. 17 neonates (31%) had primary metabolic seizures. Hypocalcaemia was the commonest biochemical abnormality in primary metabolic seizures and was present in 70% neonates in this group. Hypoglycaemia was the next commonest abnormality and was present in 41% neonates within this group.
Conclusions: Hypoxic ischemic encephalopathy was the commonest etiology with focal clonic and subtle seizures being the commonest clinical types encountered. Hypocalcaemia was the most frequent biochemical abnormality found.

Keywords: Hypoglycaemia, Hypocalcaemia, Intracranial haemorrhage, Non-metabolic seizures, Primary metabolic

INTRODUCTION

Seizures are the most common and distinct clinical manifestation of neurological dysfunction in the newborn infant.[1] Neonatal seizures are a common neurological problem in neonates with a frequency of 1.5-14/1000 neonates.[2] The occurrence of neonatal seizures per se has been positively correlated with structural brain damage and its consequent sequels at later stages in life. Historically seizures were divided in following clinical

categories viz. focal clonic, multifocal clonic, tonic, myoclonic, & subtle seizures.[1] Diverse medical conditions in the newborn can be associated with neonatal seizures. Hypoxia-ischemia is nonetheless traditionally considered the most common cause of neonatal seizures.[1,4]

Cerebral infarction and stroke the second most common cause of neonatal seizures occurs in otherwise well term infants, without previous risk factors[5,6] and involves left middle cerebral artery territory and presents with right sided clonic seizures. Intracranial hemorrhage is implicated in 10% to 15% of seizures, and amongst them Intra-ventricular hemorrhage or Periventricular hemorrhagic infarction is the most common Intracranial hemorrhage in preterm infants and constitutes around 45% seizures in preterm.[7,8]

Central nervous system infections during intrapartum or postnatal period can be associated with seizures9. Biochemical disturbances occur frequently in neonatal seizures either as an underlying cause or as an associated abnormality.[10,11] Metabolic disturbances could be more commonly transient and rapidly correctable or less commonly inherited as persistent causes.

Infants of diabetic mothers, small for gestational age infants, infants with birth asphyxia are at more risk of hypoglycemia. Late onset hypocalcaemia due to use of high phosphate infant formula has been cited as common cause of seizures.[12,13] However commonly hypocalcaemia occurs in infants with trauma, hemolytic disease, asphyxia and IDM and usually coexists with hypoglycemia and hypomagnesemia[14] and presents at 2-3 days of life.

Hypomagnesaemia with serum <1.5 mg/dl can occasionally manifest with tetany and seizures at 2-4 weeks of age and has secondary hypocalcaemia associated.

Hypophosphatemia may be caused by ingestion of milk formulas containing high amounts of phosphorous, excessive parenteral administration of phosphorus, impaired renal function, and hypoparathyroidism.[15]

Hyponatremia as a result of fluid overload renal compromise and SIADH (syndrome of inappropriate ADH secretion) can be a frequent complication of birth asphyxia and could complicate the management of seizures in this condition.[16]

METHODS

A hospital based prospective observational study was undertaken in the Postgraduate Department of Paediatrics, G. B. Pant Hospital, which is a referral hospital of Government Medical College, Srinagar for children.

Estimation of sample size: Sample size was calculated on the basis of prevalence of neonatal seizures in hospitalised children reported from previous studies of around 4%.The total sample size calculated was around 65, however we decided to take at least 100 patients.

After taking an informed written consent from the attendants of babies who were admitted in our neonatology section, a total of 100 consecutive neonates within the age group of 0-28 days presenting with seizures from September 2013 to August 2014 were enrolled in the study. The study was approved by the ethics committee of the institution.

Inclusion criteria

Detailed and unequivocal description of neonatal seizures by the mother and attending doctor.

Occurrence of first seizure up to 28 days of life.

Exclusion criteria

Uncertain clinical manifestations.

Those who had first seizure > 28 days

Data collection procedure

Detailed antenatal history, i.e. maternal age, past medical history, parity, gestational age, history of illness during pregnancy, medication during pregnancy; natal history viz. evidence of foetal distress, Apgar score, type of delivery, medication given to mother during delivery were recorded. Baseline characteristics of convulsing neonate including sex, gestational age, weight, head circumference & length were recorded at admission. Clinical details of each seizure episode were recorded i.e. age at onset of seizures, duration of seizure, number and type of seizure. Seizure were classified into subtle, focal clonic, multifocal clonic, tonic, and myoclonic as per criteria by Volpe.[1] Before instituting specific treatment blood glucose, total serum calcium levels, Na+, K+, Mg and P-levels were determined.

Criteria for diagnosing various biochemical abnormalities:[16]

Hypoglycemia: blood sugar <40mg/dl (normal range 40-150 mg/dl)

Hypocalcaemia: total serum calcium <7 mg/dl (normal range 7-10 mg/dl) Or Ionized calcium <4 mg/dl (normal range 4-5.5 mg/dl)

Hypomagnesaemia: serum magnesium <1.5 mg/dl (normal range: 1.5-1.8 mg/dl)

Hypernatremia: serum sodium >150 meq/dl (normal range 130-150 meq/dl)

Hyponatremia: serum sodium <130 meq/dl

Hypokalemia: serum potassium <3.5 meq/dl (normal range 3.5-5.5 meq/dl)

Hyperkalemia: serum potassium >5.5 meq/dl

Hyperphosphatemia: serum phosphorus >8 mg/dl (normal range 6-8 mg/dl).

In addition complete blood counts, band cell count, absolute neutrophil count, micro-ESR, blood culture, USG cranium, MRI/CT, and CSF analysis were done as per the requirement in individual cases.

Statistical analysis:

Data was described as mean ± SE and %age. Software used for data analysis was SPSS 16.0 (statistical package for social sciences) and MS Excel.

RESULTS

A total of 2550 neonates were admitted during the study period (from the start of study till enrolment of last patient). A total of 100 consecutive babies developed seizures in the study period hence accumulative frequency of around 3.9% was recorded in neonatal seizures in our set up.

Table 1: Seizure incidence.

Neonates	Total	Seizure	Percentage
Inborn	1100 (43.1%)	28	2.54
Outborn	1450 (56.8%)	72	4.96
Total	2550 (100%)	100	3.9

A total of 2550 neonates were admitted during the study period. Out of them 1450 were referred to us from peripheral institutions (outborn), while around 1100 neonates were born in our institution (inborn). Seizure frequency of around 2.54% was recorded in inborn neonates, while it was around 4.96% in outborn group.

Cumulative frequency of around 3.9% was hence recorded in neonatal seizures in our set up.

Table 2: Socio-demographic characteristics of the neonates with seizures.

Socio-demography		n	%
Age on Admission (day)	mean ± SE	2.2 ± 0.5 (0, 25)	
Gender	Male	60	60.0
	Female	40	40.0
Residence	Rural	84	84.0
	Urban	16	16.0

Table 3: Presenting characteristics of the neonates with neonatal seizures.

Characteristic		n	%
Apgar Score at 5min	< 7	44	44.0
	7 to 10	56	56.0
Gestational Age (NBS)	Preterm	35	35.0
	Term	65	65.0
Weight	Appropriate for Gestation Age	68	68
	Large for Gestation Age	6	6
	Small for Gestation Age	26	26
Age of Onset of seizure (day)	mean ± SE	3.7 ± 0.4 (1, 25)	
Head Circumference (cm)	mean ± SE	33.8 ± 0.1 (30, 37)	
Length (cm)	mean ± SE	47.5 ± 0.3 (42, 53)	

Age on admission for neonates who presented with seizures or later on developed seizures in the hospital varied between 0 days to 25 days with a mean value of 2.2+0.5 days. Among the neonates convulsing in the hospital 60% (n=60) comprised of males and 40% (n=40) comprised of females. 84% (n=84) belonged to rural areas, while as around 16% were hailing from urban localities. The first day on which the seizures presented had a significant correlation with etiology, on an average

presented on 3.7+0.4 days and varied from as early as 1 day to as late as 25 days. Majority of HIE patients presented with neonatal seizures in the first 72 hrs. Intracranial hemorrhage in preterm neonates had a slightly delayed age of presentation usually at or greater than first 72 hrs. Primary metabolic seizures except for late hypocalcaemia had presentation in the first half of first week. Late hypocalcaemia presented around the end of first week.

Table 4: Maternal characteristics of the neonates.

Characteristic		N	%
Maternal Age	≤ 18	10	10.0
	19 to 29	29	29.0
	30 to 39	42	42.0
	≥ 40	19	19.0
Maternal Parity	Nulliparous	62	62.0
	Parous	38	38.0
Delivery Status	In Born	28	28.0
	Out Born	72	72.0
Delivery Type	Caesarean Section	28	28.0
	Operated Vaginal	24	24.0
	Routine Vaginal	48	48.0
Antepartum Risk Factors	Pre-eclampsia	5	5.0
	Oligohydramnios	5	5.0
	Diabetes Mellitus	3	3.0
Intrapartum Risk Factors	Premature Rupture of Membrane	7	7.0
	Maternal Fever	12	12.0
Labour Record of Foetal Distress		11	11.0

Table 5: Etiology of the neonatal seizures.

Etiology	n	%
Hypoxic Ischemic Encephalopathy	44	44
Intra Cranial Haemorrhage	13	13
Meningitis	15	15
Undiagnosed	4	4
Primary Metabolic	17	17
Septicemia	7	7

The overall etiological profile comprised of hypoxic ischemic encephalopathy, intracranial haemorrhage, meningitis, metabolic disorders and sepsis in that order. Seizure type and their relative occurrence in different etiologies recorded by clinical observation have been depicted in table 6 and in figure respectively. Tonic seizures and focal clonic seizures each comprised 53.8% (n=7) and 46.1% (n=6) among intracranial haemorrhage.

Table 6: Seizure characteristics.

Seizure Type	N	%
Focal Clonic	30	30
Multi Focal Clonic	17	17
Subtle	28	28
Tonic	25	25

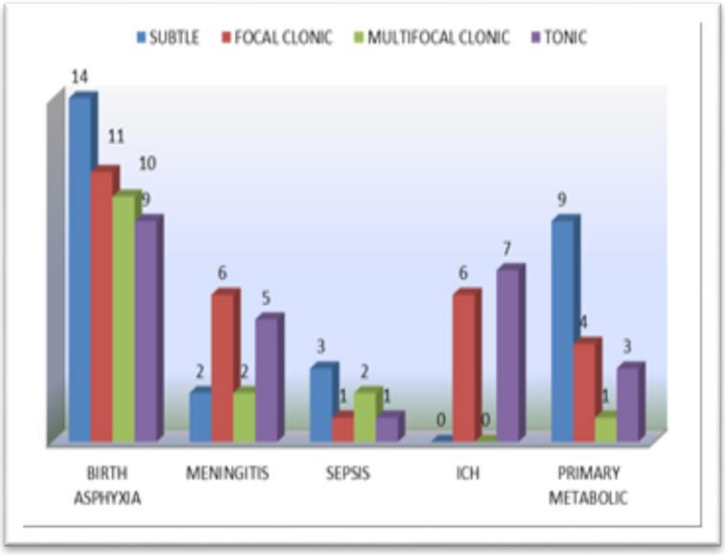

Figure 1: Seizure characteristics across etiology.

Focal clonic seizures were commonest seizure type in neonates with meningitis 40% (n=6). 17 neonates (31%) had primary metabolic seizures and 37 (69%) neonates had metabolic abnormalities superimposed or coincident on a primary illness like hypoxic ischemic encephalopathy, ICH, meningitis, sepsis etc.

DISCUSSION

The occurrence of seizures may be the first indication of neurological disorder and the time of onset of seizures has a correlation with the etiology of seizures and prognosis. Biochemicals disturbances occur frequently in neonatal seizures either as an underlying cause or as associated abnormalities and are often underdiagnosed. Hence the need for this study to determine etiology and biochemical abnormalities in neonatal seizures which would help in early recognition and treatment and hence better prognosis in neonatal seizures. The incidence data which is described around ~4% is the minimum since not all neonates would have attended the hospital. Being a tertiary care and referral hospital in Kashmir it is likely that many neonates managed at primary health centers may never have reached our hospital and we surely are missing them in our hospital attendance. Also the study group included the babies with seizures who were admitted not only in neonatal intensive care unit (NICU) but also in level 2 care nursery. Our center has no facility

for continuous EEG monitoring, and we are limited to assessing babies with seizures on clinical grounds alone. Hospital staff and doctors have differing abilities to recognize suspicious behaviours; this variability will lead to over diagnosis or underdiagnosed in the absence of confirmatory continuos videographic EEG. However our incidence rate is similar to 3% shown in studies by Mentet al.[17] and 4.1% by Asindi et al.[18]

In our study focal clonic seizures constituted 30% while as subtle seizures were present in 28% of neonates with tonic seizures in 25% of neonates. Taksandeet al.[19] showed subtle seizures as the commonest type of fits occurring in 50% of neonates. Tonic seizures were found in 16 preterm neonates with ICH (GM/IVH) as compared to 9 term neonates comprising 45% (16/35) in the preterm and 13% (9/65) in term group respectively.

In our study 83 neonates (83%) presented with seizures within the first 72 hours of life and most of them could be attributed to perinatal asphyxia. Roseet al.[13] also found early onset seizures in 75 (50.33%) babies whereas Coen RW et al.[20] found that 81% of babies had early onset seizures.

Our etiological studies were limited in the sense that we don't have elaborated investigational panels for specific diagnosis of inborn errors of metabolism although they can be assumed to be rare. In our study 13 neonates had convulsions after 7 days of life, with meningitis in 5, septicemia in 2 and primary metabolic disorders in 3 neonates and 3 had seizures of unknown etiology. Holden KR et al.[21] reported that 36 (13%) babies had convulsions after 8 days, which were due to sepsis and meningitis.

Frequency of birth asphyxia as a cause of seizures was 44% in our study. Sood A et al.[11]and Kumar A et al.[16] reported that birth asphyxia as the etiology of seizures was seen in 45.71% and 48.2% cases respectively, which are quite comparable to results of our study.

In our study infection as a cause, whether as meningitis or sepsis, for neonatal seizures accounts a total of around 22% (n=22). A study conducted by Legido A et al.[22] reported that out of 40 babies 17.2% had some kind of infection leading to fits. Bushraet al.[23] reported it as 34% comparable to our study. The difference between the results of Legidoet al.[22] and ours is partly because of high incidence of infections in our set up due to poor obstetric and early neonatal care facilities.

Intraventricular haemorrhage was there in around 13% (n=13) in our study. BushraA et al.[23] reported that ICH was there is around 9.5% of case. 12 preterm and 1 term neonate had intraventricular haemorrhage in our study. Incidence of intraventricular haemorrhage was much higher in preterm than term neonates. Roseet al.[13], Scher MS et al.[24] also reported higher incidence of intraventricular haemorrhage in preterm.

CONCLUSION

Hypoxic ischemic encephalopathy was the commonest etiology of neonatal seizures and in them most of the seizures had an onset in the first 72 hours. Overall focal clonic and subtle seizures were the commonest seizure types encountered. Hypocalcemia was the commonest biochemical abnormality in primary metabolic seizures. Biochemical abnormalities were commonly associated with other etiologies like asphyxia, intracranial hemorrhage and meningitis; hence these should be actively sought for and treated for optimal seizure control.

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REFERENCES

1. Volpe JJ. Neonatal seizures. Neurology of the new-born. Philadelphia, PA: WB Saunders, 2001;178-214.
2. Airede KI, Neonatal seizures and a two year neurological outcome. J Trop Pediatr 1991;37:313-17.
3. Nunez JL, Alt JJ, McCarthy MM. A novel model for prenatal brain damage. Long term deficits in hippocampal cell number and hippocampal-dependent behaviour following neonatal GABA receptor activation. ExpNeurol. 2003;181:270-80.
4. Sarnat HB, Sarnat MS. Neonatal encephalography following foetal distress. A clinical and encephalographic study. Arch Neurol 1976;33:696-705.
5. Mercuri E, Cowan M, Rutherford D, Pennoch J, Dubowitz L. Ischemic and haemorrhagic brain lesions in new-borns with seizures and normal Apgar scores. Arch Dis Child 1995;73:F67-F74.
6. Scher MS. Destructive brain lesions of presumed foetal onset: Antepartum causes of cerebral palsy. Paediatrics. 1991;88:896-906
7. Scher MS, Hamid MY, Steppe DA. Ictal and interictal durations in preterm and term neonates. Epilepsia 1993;34:284-8.
8. Sheth RD, Hobbs GR, Mullett M. Neonatal seizures: Incidence onset and etiology by gestational age. J Perinatol. 1999;19:40-3.
9. Kairam R, De Vivo DC. Neurologic manifestations of congenital infection. Clin Perinatol. 1981;8:455-65.
10. Brown JK, Cockburn F. Clinical and chemical correlates in convulsions of the new-born. Lancet. 1972;1;135-9.

11. Sood A, Grover N, Sharma R. Biochemical abnormalities in neonatal seizures. Indian Journal of Paed. 2003;70(3):221-4.
12. Keen JH, Lee. Sequelae of neonatal convulsions. Study of 112 infants. Arch Dis Child 1973. Jul; 48(7):542-546
13. Rose AL, Lombroso. CT: A study of clinical, pathological and electroencephalographic features in 137 full term babies with a long term follow up. Paediatrics 1970;45:404-425.
14. Mark S. Scher. Avery's Disease of New-born 8thed. Elsevier Health Sciences; 2005. Chapter 66, Neonatal seizures, p1020.
15. Carole Kenner, Judy, Wright Lott. Comprehensive neonatal care 4th ed. Elsevier Health Sciences; 2007. Chapter 8, 95.
16. Kumar A, Gupta V, Singla: Biochemical abnormalities in neonatal seizures. Indian Paed. 1995;32(4):424-8.
17. Ment LR, Freedman RM. Neonates with seizures attributed to perinatal complications. Am J Dis Child 1982;136:548-50.
18. Asindi AA, Antia Obong OE, Ibia EO. Neonatal seizures in Nigerian infants. Afr J Med Sci 1995;24:243-8.
19. Taksande AM, Krishna V, Manish Jain, Mahaveer L. Clinico-biochemical profile of neonatal seizures. PaedOncall Journal 2005 October;2(10).
20. Coen RW, Mc Cutchen CB, Wermer D, Snyder J, Gluck FE. Continuous monitoring of EEG following perinatal asphyxia. J Pediatr 1982;100:628-30.
21. Holden KR, Mellitis ED, Freeman JM. Neonatal seizures: correlation of prenatal and perinatal events with outcome. Pediatrics 1982;70:165-76
22. Legido A, Clancy RR. Neurologic outcome after EEG proven neonatal seizures. Paediatrics 1991;88:583-96.
23. Bushra AM, Butt MA. Seizure etiology in the new-born period. Journal of College of Physicians and Surgeons Pakistan 2005;15:786-90.
24. Scher MS. Controversies regarding the neonatal seizure recognition. Epileptic disord. 2002;4:139-58.

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