Comparison of neonatal electroencephalogram changes in three month old neonates with seizure in Bu-Ali Hospital of Ardabil city, Iran 2017

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ABSTRACT

Background: The prevalence of neonatal seizure in term neonates is 3 per 1000 births, but in preterm newborns is 50 per 1000 births. Babies who have seizures are at high risk of death or neurological disabilities. Seizure is often the first sign of neonatal dysfunction and may be effective in long-term prognosis. EEG is the only available method for the diagnosis of seizures in neonates. Therefore, authors compared EEG changes in the first EEG infant seizure with 3 months of age in newborns who referred to the Aristotelian hospital in BuAli Hospital.

Methods: The present study is a cross-sectional descriptive analytical method. In this study, neonates referred to Ardabil BooAli Hospital, EEG, were screened for seizure and EEG was monitored 3 months later and the results were evaluated. Finally, all the data were entered into the SPSS-24 statistical analysis program and authors analyzed the data according to the type of variables by statistical tests.

Results: In this study, 50 neonates with seizure were enrolled in this study, 70% of which had an average age of 14.92 days. 80% of infants were born at the time of term. The average birth weight was 3.208 kg. 6.2% of infants had abnormal CT scan findings, with an IVH infant and one baby showing brain edema. In this study, only 14% of neonates with abnormal brain strain were observed in the neonatal period and near the seizure. However, after 3 months, 40% of infants experienced abnormal brain stroke findings. Among the changes in EEG with age (p=0.173), gestational age (p=0.616), gender (p=0.176), seizure (p=0.145), neonatal hypoglycemia (p=0.594), hypocalcaemia (p=0.607) no statistic was found.

Conclusions: The results of this study showed that a small percentage of neonates had abnormal EEG in the neonate, but after 3 months of seizure, the larger percentage of them found abnormal EEG.

Keywords: Electroencephalography, Neonatal, Seizure

INTRODUCTION

Seizures are one of the most common problems in neonates and sometimes it’s the first symptom of neurological dysfunction in neonates with a prevalence of 1.4-8.6 per 1000 live births.1-5 In most cases, neonatal seizures improve by age, but in 25% to 35% of cases, neurological developmental defects persist.6 Neonatal seizures develop due to various causes such as hypoxic-ischemic encephalopathy, central nervous system infection, intracranial hemorrhage, brain structural abnormalities, and metabolic disorders that among them, hypoxic-ischemic encephalopathy is the most common cause and accounts for 50-75% of all causes.1 In most cases, the diagnosis of neonatal seizures is based on history, direct observation, and para-clinical findings, and in the absence of timely diagnosis and treatment, it can be associated with increased mortality and persistent neurological complications.7-9 Prognostic factors for neonatal seizures include seizure characteristics, prenatal factors, neurological symptoms, causative factors, laboratory studies, and EEG abnormalities that are the
most common prognostic factors in the etiology of cerebral seizures.\textsuperscript{6,10} Electroencephalography is the recording of the brain's electrical activity. This technique involves obtaining the signal from the surface electrodes, amplifying the signal, printing the signal, and analyzing it. Unlike older children and adults, infants do not always have clear clinical signs during seizures, so EEG is the only available method to diagnose seizures in infants.\textsuperscript{8-9}

Since the baby's brain is growing and developing in the first three months of life, so, evaluation of neurodevelopmental status in the infants is important and if the EEG study would be normal at the first three months of life the administered anticonvulsant drugs can be discontinued at this age.\textsuperscript{11-13} This study aimed to compare EEG changes in neonates with changes in three-month-old infants with seizures who referred to Ardabil Bou Ali Hospital, Iraq.

**METHODS**

This descriptive-analytical study was performed on 50 neonates less than one-month years old with seizures admitted in Bu-Ali Hospital in Ardabil in 2017.

**Exclusion criteria**

- The deceased infants during follow-up and who without parental consent to participate in the study were excluded from the study.

**Data collection**

Required data were collected through checklists including maternal gestational age, neonatal age at the time of convulsion, neonate's birth weight, serum level of calcium and blood glucose in neonates. EEG was obtained at the time of seizure occurrence and three months later. Total serum calcium levels were considered to be between 7.6-10 mg / dL and glucose levels between 40-140 mg / dL.

**Statistical analysis**

The collected data were analyzed using descriptive and analytical statistical methods in SPSS 24. p values less than 0.05 was considered as statistically significant.

**RESULTS**

Of all neonates, 86% had normal and 14% abnormal EEG, but at three-month-old ones, the number of abnormal EEG cases was 40% high and statistically significant (p=0.001) (Figure 1). 70% of neonates were boy and 30% were girls and 8.6% of boys had abnormal EEG with no significant difference. Of neonates, 88% were term and 12% were preterm. Of term neonates 13.6% and 16.7% of preterm neonates had abnormal EEG with no significant difference.

![Figure 1: Frequency of EEG changes in onset time of seizure and three month later.](image)

The mean age of neonates was 14.92±8.62 days and the mean neonatal birth weight was 3208±515 gr. The causes of seizures were unknown in 50% of neonates and the most common cause was hypoglycemia in 26% of cases, of which 15.4% had abnormal EEG. There was no significant relationship between the cause of seizure and EEG changes in neonates (Table 1).

| Parameters         | EEG changes | Total | p-value |
|--------------------|-------------|-------|---------|
|                    | Normal  | Abnormal |       |         |
| Gestational age    |          |         |       |         |
| Preterm            | 5       | 83/3     | 16/7  | 6       | 12     | 0.62    |
| Term               | 38      | 86/4     | 13/6  | 44      | 88     |         |
| Gender             |          |         |       |         |
| Boy                | 32      | 91/4     | 8/6   | 35      | 70     | 0.18    |
| Girl               | 11      | 73/3     | 4     | 26/7    | 15     | 30      |
| Causes of seizure  |          |         |       |         |
| Hypoglycemia       | 11      | 84/6     | 2     | 15/4    | 13     | 26      |
| Hypocalcemia       | 8       | 100      | 0     | 0       | 8      | 16      |
| Cerebral problems  | 0       | 0        | 100   | 1       | 2      |         |
| Infection diseases | 3       | 100      | 0     | 0       | 3      | 6       |
| Unknown            | 21      | 84       | 4     | 16      | 25     | 50      |
The mean of serum glucose level in neonates with abnormal EEG changes was higher than neonates with normal EEG but there was no statistically significant difference. Also, there was no significant relationship between the mean neonates' serum level of calcium and EEG changes at the time of seizure.

The comparison of neonatal age in the two normal and abnormal EEG groups showed that the mean age of neonates with abnormal EEG was higher than mean age of neonates with normal EEGs, but difference wasn’t significant (Table 2).

**DISCUSSION**

In this study, most of the neonates were male and with a mean age of 14.92 days. In the study of Fallah et al., 60% of neonates were male, and in the study of Dehdashian and colleagues, 53% of neonates were male with a mean age of 12 days. The study of Abbaskhanian et al., 56.8% of boys had a mean age of 13.4 days. The results of above studies show that the male gender is more common in neonates with seizure which are in line with the present study. In the present study, 88% of neonates had a mean birth weight of 3.208 kg. In the study of Najeeb et al., 90% of neonates were full-term and the mean birth weight of them was 2.56 kg. In the study of Yıldız et al. the mean birth weight was 2633 g and mean gestational age was 36.3 weeks. In a study by Shahrahi, the mean birth weight of neonates was 2995.2 gr and 65% of them were term. As seen in the above studies, most neonates with seizure were premature and had low birth weight, which may be due to cerebral lesions including ICH, IVH and ischemic lesions. However, in the present study, the prevalence of preterm neonates was low and none of them were LBW. The study found that 14% of neonates had abnormal EEG, while three months after seizure only 40% of infants had abnormal EEGs. Koellfen stated in his study that changes in the EEG of neonatal seizures are focal slowing at first, and later become in the form of sharp waves or local voltage drop. Another study by Clancy showed that the EEG indicated the presence and location of brain structural damage in all the patients he had examined. The study of Ashrafzadeh et al. reported that abnormal findings were observed in the interictal EEG of 39% of the patients under study, which almost all of the cases with concurrent seizures had an abnormality in EEG.

Almubarak et al in a study reported that 57% of neonates with seizures had an abnormal EEG background. Anand et al also reported in a study that 43% of neonates with seizures had abnormal EEG findings. Pisani also stated in his study that EEG findings were abnormal in 38% of neonates after seizure diagnosis. The above studies show that a high percentage of neonates had abnormal EEGs which is not in line with the present study because the percentage of abnormal EEGs in the present study was lower than the above studies, which may be due to several reasons, including lack of definitive diagnosis of seizures in many neonates of present study, the absence of cerebral lesions in the majority of neonates, the idiopathic seizures and electrolyte disorders which may show a normal EEG in first time. Metabolic disorders, including disorders of glucose, calcium and magnesium, can cause neurological manifestations. In this study, no correlation was found between neonatal hypoglycemia or hypocalcemia with abnormal EEG findings. But the study by Ashrafzadeh et al. reported that 13% of seizures were due to hypoglycemia and 13% due to other metabolic disorders. In a study by Abbaskhanian et al, the most common cause of seizure was hypoxic-ischemic encephalopathy and in the study by Seyed-shahabi et al, 16% of seizures were due to ischemic cerebral lesions but in the present study, there was no relationship between EEG findings and the causes of seizures.

**CONCLUSION**

The results of this study showed that a small number of neonates with neonatal seizures had abnormal EEG findings but after three months of seizure, had higher abnormal findings, so a higher sample-sized study is recommended to investigate the causes of the increase in abnormal EEG findings percentage in breastfeeding period along with the causes that affect seizures in the future.

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**Ethical approval: The study was approved by the Institutional Ethics Committee**

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**Table 2: Relation between EEG changes with mean of age, hypoglycemia and hypocalcemia.**

| Parameters       | EEG changes | n | Mean±SD     | p-value |
|------------------|-------------|---|-------------|---------|
| **Age of neonates** |             |   |             |         |
| Normal           | 43          |   | 14.8±8.5    | 0.17    |
| Abnormal         | 7           |   | 15.4±9.2    |         |
| **Hypoglycemia** |             |   |             |         |
| Abnormal         | 43          |   | 78.05±40.9  | 0.61    |
| Abnormal         | 7           |   | 86.9±46.9   |         |
| **Hypocalcemia** |             |   |             |         |
| Abnormal         | 43          |   | 8.83±1.61   | 0.57    |
| Abnormal         | 7           |   | 8.47±0.81   |         |
REFERENCES

1. Greene BR, Faul S, Marnane WP, Lightbody G, Korotchikova I, Boylan GB. A comparison of quantitative EEG features for neonatal seizure detection. Clin Neurophysiol. 2008 Jun;119(6):1248-61.

2. Scher MS, Aso K, Beggarly ME, Hamid MY, Steppe DA, Painter MJ. Electrographic seizures in preterm and full-term neonates: clinical correlates, associated brain lesions, and risk for neurologic sequelae. Pediatrics 1993;91(1):128-34.

3. Hellstrom-westas L, Blennow G, Lindroth M, Rosen I, Svenningsen NW. Low risk of seizure recurrence after early withdrawal of antiepileptic treatment in the neonatal period. Arch Dis Child 1995;72:97-101.

4. Lanska MJ, Lanska DJ, Baumann RJ, Krysió RJ. A population-based study of neonatal seizures in Fayetee country. Neurology 1995;45:724-32.

5. Shellhaas RA, Soaita AI, Clancy RR. Sensitivity of amplitude-integrated electroencephalography for neonatal seizure detection. Pediatrics 2007;120(4):770-7.

6. Brunquell PJ, Glennon CM, Dimario FJ, Lever T, Eisefeld L. Prediction of outcome based on clinical seizure type in newborn infants. J pediatr 2004;140: 707-12.

7. Shellhaas RA, Clancy RR. Characterization of neonatal seizures by conventional EEG and single-channel EEG. Clin Neurophysiol. 2007 Oct;118(10):2156-61.

8. Temko A, Thomas E, Marnane W, Lightbody G, Boylan G. EEG-based neonatal seizure detection with Support Vector Machines. Clin Neurophysiol. 2011 Mar;122(3):464-73.

9. Co JP, Elia M, Engel J Jr, Guerrini R, Mizrahi EM, Moshé SL, et al. Proposal of an algorithm for diagnosis and treatment of neonatal seizures in developing countries. Epilepsia 2007;48(6):1158-64.

10. Sanker R, Koh S, Wu J, Menkes JH. Paroxysmal disorders in: Menkes child neurology. Philadelphia Williams & Wilkins company. 2005:922-6.

11. Fallah R, Abedi M. The evaluation of children brain CT scan results and it's relationship with requesting clinical complaints. Horizon Med Sci. 2008;14(1):27-32.

12. Dehdyshtan M, Momen A, Kajbaf ZT, Mordakhani SH. Investigating the causes of seizure in admitted infants due to seizure in Imam Khomeini (AH) and Ahvaz Ahoozar hospitals from 2003 to 2005. Jundishapur Scientific Med J. 2008;8(2):163-7.

13. Abbaskhanian A, Mohammadi M, Farhardi R, Khademloo M. Prevalence and associated factors of neonatal seizure in neonates admitted in neonatal ward of Bu-Ali Sina and Imam Khomeini hospitals, Sari, Iran. J Mazandaran Univ Med Sci. 2014;23(2):89-94.

14. Najeeb S, Qureshi AM, Anis-ur-Rehman, Ahmad F, Shah S, Khan AY, et al. Aetiology and types of neonatal seizures presenting at Ayub Teaching Hospital Abbottabad. J Ayub Med Coll Abbottabad. 2012 Jan-Mar;24(1):33-7.

15. Yıldız EP, Tatlı B, Eskin E, Aydınlı N, Çalışkan M, et al. Evaluation of etiologic and prognostic factors in neonatal convulsions. Pediatr Neurol. 2012 Sep;47(3):186-92.

16. Shahraki Nasab F "Determination of frequency of seizure which can be detected in hospitalized patients in neonatal department" Ph.D. thesis, Zahedan University of Medical Sciences, 2000.

17. Koellen W, Freund M, Varnholt V. Neonatal stroke involving the Middle cerebral artery in term infants: clinical presentation, EEG and imaging studies, and outcome. Devel Med Child Neurrol. 1995;37:204-12.

18. Clancy R, Malin S, Laraque D, Baymgart S, Younkín D. Focal motor seizures heralding stroke in full term neonates. Am J Dis Child. 1985;139:601-6.

19. Ashrafzadeh F, Mahmodi E, Hydarian F, Kharazmi A. Outcome of term neonates with identified seizures. Horizon Med Sci. 2006;11(4):37-41.

20. Almubarak S, Wong PK. Long-term clinical outcome of neonatal EEG findings. J Clin Neurophysiol. 2011 Apr;28(2):185-9.

21. Anand V, Nair PMC. Neonatal seizures: Predictors of adverse outcome. J Pediatr Neurosci. 2014;9(2):97-9.

22. Pisani F, Spagnoli C. Neonatal Seizures: A Review of Outcomes and Outcome Predictors. Neuropediatr. 2016 Jan;47(1):12-9.

23. Shahibi NS, Fakhraee H, Afjei A, Kazemian M. Ischemic brain lesions and brain imaging findings in neonates with seizure. 2009;13(4):347-53.

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