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Original Research Article

Frequency, causes, and findings of brain CT scans of neonatal seizure at Ardabil City Hospital, Ardabil, Iran

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ABSTRACT

Background: Neonatal seizures are the primary and most important signs of neurologic function disorders that often lead to serious complications. However, this disorder is predictable and manageable with suitable diagnostic and therapeutic methods. The aim of this study was to investigate the frequency, causes, and findings of brain CT scans of neonatal seizure.
Methods: This descriptive cross-sectional study has been done on 70 neonates with seizures who hospitalized in Ardabil city hospital during 2016-2017. CT scans were done for all patients. Necessary information for each patient was recorded in a checklist including demographic data, history of diabetes mellitus, hypertension, and maternal endocrine disorders, and history of resuscitation and clinical data including type of seizure and its duration, Cause of seizure and CT scan findings (cerebral hemorrhage, local ischemic lesions, hypoxemic-ischemic encephalopathy, and anatomical cerebral malformations).
Results: The mean age of neonates was 12.41±9.33 days. Of them, 61.4% were boys, 3.24% LBW and 40% were preterm at birth time. Of all neonates, 21.4% had history of seizure in their relative degree family members. Fever was the most common symptom accompanying seizures (40%). The most common form was tonic seizure (n=30, 42.9%) and its duration time was 4.99 minute. A total of 41.4% of neonates (29 cases) had abnormal CT scan reports. Hypoxic-ischemic encephalopathy (47%) was the most common findings in the CT scans of neonates with seizures.
Conclusions: Results showed that, a considerable number of neonates had abnormal CT findings and the most common abnormal form was hypoxemic-ischemic encephalopathy.

Keywords: CT scan, Generalized seizure, Neonates, Seizure

INTRODUCTION

Neonatal seizures are the primary and most important signs of neural function disorders that often lead to serious neural complications. However, these disorders are predictable and manageable with suitable diagnostic and therapeutic methods. If left untreated, neonatal seizures can cause irreversible damage to the neural system and put neonates at risk of death. Furthermore, those that survive would be at risk of epilepsy, and neurological and developmental disorders.[1] Seizures are categorized as attack disorders meaning that it leads to sudden and reversible changes in the mental status and somatosensory performance of the individual. They have a repetitive nature and last from several seconds to several minutes, end quickly and return to the natural status gradually. Seizures that originate from a cerebrovascular region are called localized and those originating simultaneously from both lobes are called generalized seizures. Seizures can be categorized generalized categories including absence, tonic, clonic, petit-mal, myoclonic, atonic, and focal or partial seizures.[2]

Neonatal seizures are clinically referred to the abnormal and repetitive changes that occur in the brain function in

the first 28 days of term neonates and till 44 weeks of life in premature neonates.[1] The most important causes of seizures are hypoxic-ischemic encephalopathy, central nervous system (CNS) infection (neonatal bacteremia and meningitis), CNS inflammation, bleeding/trauma, metabolic disorders, cortical malformations, genetic causes and tuberculosis.[3-10] In general, seizures are more common in infants and afflict 2% of neonates.[11] Neonatal seizures occur in 1.8-3.5/1000 live births in the United States, and neonates are at risk population.[12] In totally, 10-50% of patients are at risk of death and 50% are at risk of disorders such as paralysis, mental retardation, and epilepsy.[11] Recent studies have shown that, short and repeated seizures can lead to permanent brain damage, cognitive disorders, behavioral changes, increased anxiety, and risk of epilepsy.[1]

Computed tomography (CT) and magnetic resonance imaging (MRI) can identify specific brain lesions that have the potential to create seizures. CT scan is a very useful diagnostic modality in acute and emergency cases because it can be done quickly. Since performing MRI is hard for neonates, CT is often preferred. Moreover, CT scan's sensitivity for showing lesions in cases such as hypoxemic-ischemic encephalopathy is higher than MRI and CT scan can identify acute cerebral hemorrhages better than MRI.[1]

So far, many studies have been done on brain CT scan images of neonates suffering from seizures showing a wide range of lesion that can lead to seizure. On the other hand, seizures in neonates could be an important indicator of a serious lesion in brain tissue. Therefore, immediate use of CT scan could identify the cause of these seizures and facilitate treatment and increase survival. The aim of this study was to investigate the brain CT findings in hospitalized neonates with seizures.

METHODS

In this cross-sectional descriptive study of infants with seizures admitted to the neonatal intensive care unit (NICU) of Bu-Ali hospital in Ardabil city from April 2016 until 31 December 2017 were included in this study. An informed written consent from completed for all the parents of the neonates and the aim of this study was explained to them and no fee was charged for performing CT scans. CT scans were done for all neonates and neonatal seizures were diagnosed clinically by a neonatologist. The required information for each patient was recorded in data collection forms, as follows: (1) demographic data form (sex, age, weight, history of interuterine infections before birth, drug use during pregnancy, details of delivery (vaginal delivery or Cesarean section), history of diabetes mellitus, hypertension, and maternal endocrine disorders, and history of resuscitation, (2) type of seizure (generalized, multifocal, partial, and subtle) and its duration, (3) Cause of seizure (hypoxemic-ischemic encephalopathy, intraventricular hemorrhage, subarachnoid hemorrhage, meningitis, sepsis, metabolic disorders, anatomical cerebral malformations), and (4) CT scan findings (cerebral hemorrhage, local ischemic lesions, hypoxemic-ischemic encephalopathy, and anatomical cerebral malformations). Collected data were analyzed using statistical methods in SPSS version 19.

RESULTS

In this study 70 neonates with a mean age of 12.41±9.33 days were studied. Of all neonates, 61.4% were boys, 3.24% LBW and 40% were preterm at birth time.

The mean weight of neonates was 3015.71±664.6 gr and 17 (24.3%) had LBW. Of all neonate mothers, 4.3% had endocrine disorders, 7.1% HTN and 4.3% diabetes.

A total of 39 infants (55.7%) were born with normal vaginal delivery and 31 infants (34.3%) with C-section.

Of all mothers, 15.9% had history of infection before childbirth and 74.3% used prenatal drugs.

The mean gestational age was 37.1±2.5 weeks and the history of icter was in 12.9% of neonates.

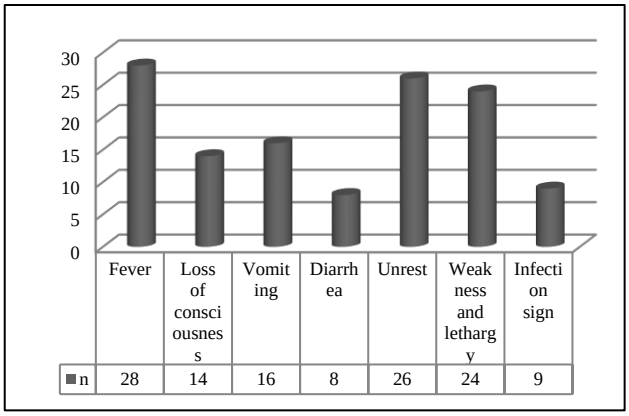

Figure 1: Frequency of the neonates based on accompanying clinical symptoms.

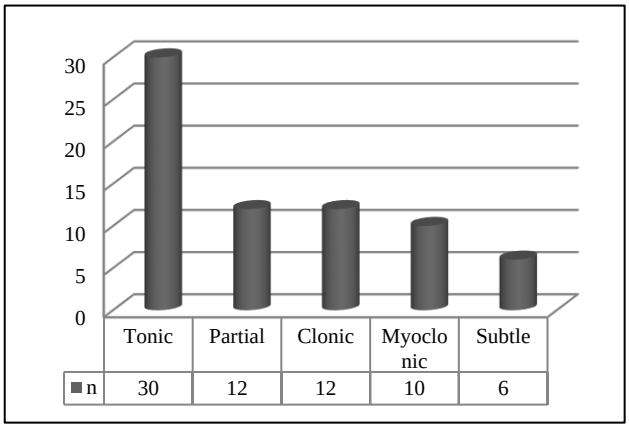

Figure 2: Frequency of neonates based on type of seizure.

Of all neonates, 15 (21.4%) had history of seizure in their relative degree family members. Fever was the most common symptom accompanying seizures (n=28, 40%) (Figure 1). The most common form was tonic seizure (n=30, 42.9%) and its duration time was 4.99 minute and most of seizures among neonates were seen in range 1-5 minutes (n=38, 54.3%) (Figure 2 and 3).

Of all neonates, 29 (41.4%) had abnormal CT scan findings which among them, hypoxemic-ischemic encephalopathy was the most common finding (n=13, 44.8%) (Figure 4 and 5).

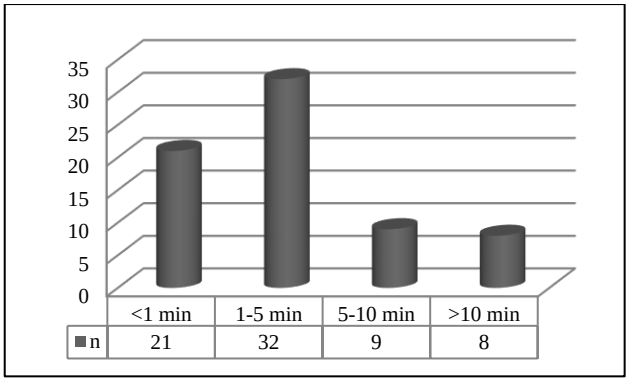

Figure 3: Frequency of neonates based on the duration of seizure.

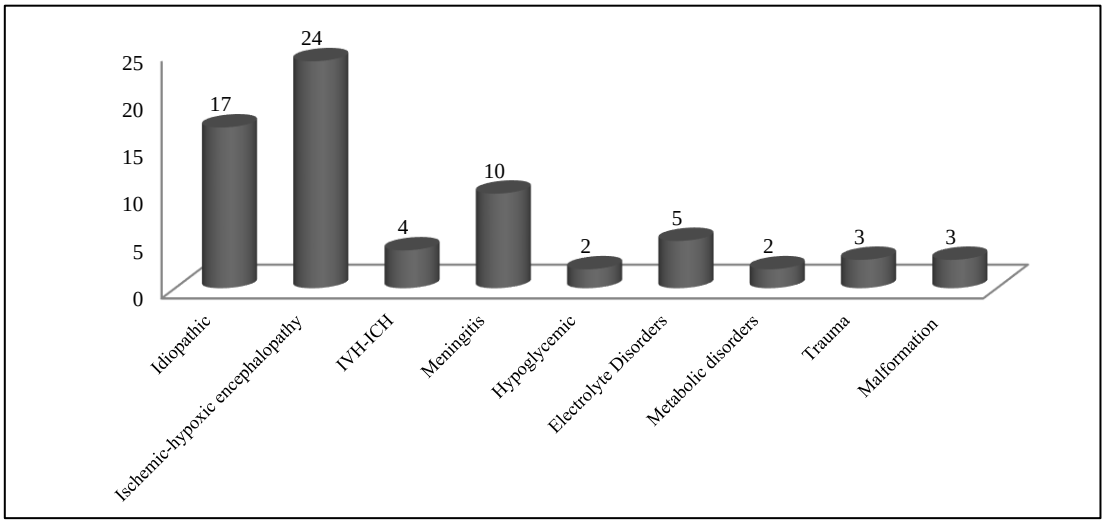

Figure 4: Frequency of neonates based on the etiology of seizure.

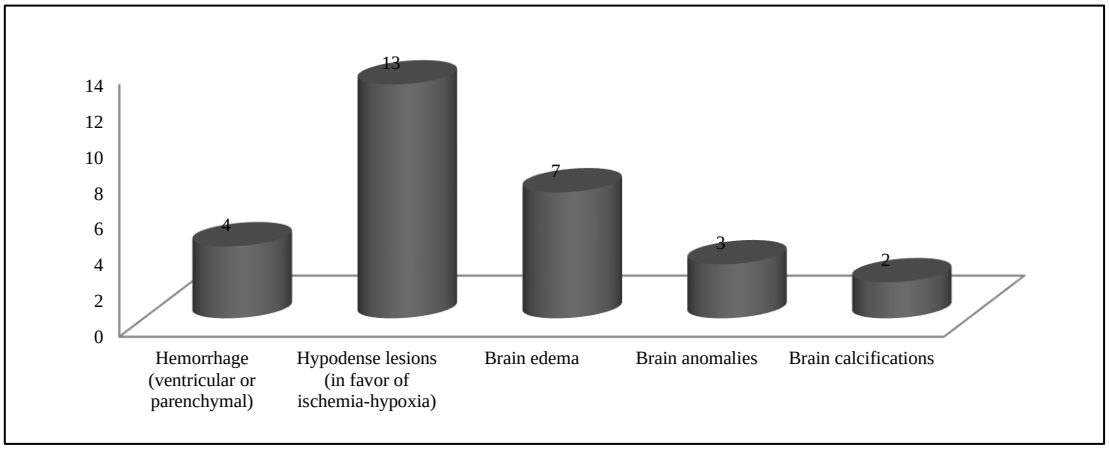

Figure 5: Frequency of neonates based on abnormal CT findings.

DISCUSSION

In this study, 70 (61.4% boys) neonates with a mean age of 12.41±9.33 days were studied. In another study, 60% of the participants were boys.[13] Moreover, other studies have reported different percentages for boys with seizures such as 53% with a mean age of 12 days and 36.4% with a mean age of 22 days.[14,15] Male sex was dominant in

neonate with seizures, as shown and confirmed by several previous studies.[16-18]

The mean±SD birth weight of the neonates in our study was 3015.71±664.55 grams. With respect to the type of delivery, we found that 39 (55.7%) of neonates were born via the vaginal route. 24.3% of the neonates were low birth weight (LBW) at the time of birth and 40% were preterm. Of all neonates, 15 (21.4%) had a positive history of seizure in their first relative members. Yilmaz and colleagues found that the mean weight of the neonates in their study was 2633 grams, and the mean gestational age was 36.3 weeks and 60.7% of the neonates were born through Cesarean section.[15] In another study, 17.6% and 14.7% of the neonates were LBW and very LBW, respectively.[1] AL-Hijia and co-workers found that 64.3% of neonates born through normal vaginal delivery were preterm.[19] They found that a considerable percentage of neonates with seizures were preterm and had LBWs. This could probably be attributed to brain lesions such as intracerebral hemorrhage (ICH) and intraventricular hemorrhage (IVH), as well as ischemic lesions in premature neonates.

We found that fever was the most common symptom accompanying seizures (40%). It should be mentioned that many neonates had multiple symptoms. The type of seizure was assessed in all neonates. We found that the most common form was tonic seizure (n=30, 42.9%). Moreover, the mean±SD duration of seizure as reported by the mothers was 4.99±3.37 minutes. Also we found that, 32 (45.7%) neonates experienced a seizure duration of 1-5 minutes. The most common suspected cause of seizure in these neonates were hypoxemic-ischemic encephalopathy (n=24, 34.3%). The most common etiology of seizure in another study was hypoxemia (35.3%) followed by asphyxia (32.4%), hypoglycemia (2.5%), ICH (206%), and hypernatremia (8.8%).[1] Yilmaz et al found that 28.6% of the seizures were due to hypoxemic-ischemic encephalopathy, 17% due to ICH, 10.7% due to metabolic disorders, 7.2% due to infection, 4.5% due to brain dysgenesis, and 8.9% of the etiologies remained unknown.[15] Najeeb et al reported the type of seizures to be as follows: 31% tonic, 45% clonic, 21% subtle and 3% myoclonic.[20] They also found that the etiologies of seizures were as follows: 46% asphyxia, 29% meningitis and septicemia, 23% metabolic disorders, and 6% kernicterus. Other researchers found that kernicterus was responsible for 20.5% of the seizures, followed by metabolic disorders (15.4%), meningitis (25.6%), and unknown causes (38.5%). This difference in the pattern of seizures in different studies could be attributed to the statistical population. For example, in our study we evaluated all neonates with seizures and considering that fever was more common, the generalized form of seizure was more prevalent in our study. In other studies, the seizures were either not accompanied by fever or included neonates with very low age, thus leading to different seizure patterns.

With respect to CT scan findings, we found that 29 (41.4%) neonate had abnormal finding, among which hypoxemic-ischemic encephalopathy was the most common finding (n=13, 44.8%). In Fallah et al study, 23% of the neonates with seizures had abnormal CT findings which was lower than our study rate.[13] In another study, 44.2% of neonates with seizures had abnormal CT findings, of which 21.7% were hypoxemic-ischemic encephalopathy, 14% brain dysgenesis and 7.2% ICH which was similar to our study results.[19] In another study, 35.6% of the neonates had brain edema, 17.9% disseminate hypoxic-ischemic lesions, 5.7% brain structural disorders, 10.3% brain hemorrhage, and 6.3% local ischemic lesions.[21]

Imaging studies such as CT scan and MRI can identify a wide range of brain lesions leading to seizures in neonates. On the other hand, CT scan's sensitivity to brain lesions caused by hypoxemic-ischemic encephalopathy is higher than ultrasound in neonates.[22] MRI is also used for neonates because of its non-ionized radiation. However, the choice between MRI and CT is difficult.[3] Moreover, in emergency cases CT scans are more practical.[24] In two separate studies assessing seizures in neonates, CT scan was the selected modality because of its accessibility.[25,26] Moreover, based on other study on the prognosis of neonates with seizures, the amount of lesions found in brain CTs was an important factor in prognosis.[27]

CONCLUSION

In this study, a considerable number of neonates had abnormal CT findings, the most common of which was hypoxemic-ischemic encephalopathy. It seems that CT is suitable for such evaluations in neonates, especially diagnosing hypoxemic-ischemic encephalopathy.

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

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