Annals of Pediatric Research

Research Article
Published: 21 Oct, 2021

The Blood Gas Lactate and Serum Glucose Levels of the Patients Admitted to the Pediatric Emergency Department with Seizure

*Esra Gur and Sabiha Sahin**

Department of Pediatrics, Eskisehir Osmangazi University, Turkey

Abstract

Aim: In this study, we aimed to retrospectively evaluate the patients presenting to the pediatric emergency service with seizure, to compare blood gas lactate and serum glucose levels according to the seizure types and to determine the effects of these values on prognosis.

Material and Methods: The patients presenting to the pediatric emergency service with seizure and aged between 1 month and 18 years who were admitted to Emergency Department (ED) between January 2012 and December 2016 were evaluated retrospectively.

Results: In this study 69 (43, 4%) of the patients were female and 90 (56, 7.6%) were male. The mean age of the patients was 69.8 ± 62.8 months. When the type of seizure was assessed, 73 (45, 9%) patients had febrile seizure, 75 (47, 2%) had afebrile seizure and 11 (6, 9%) patients had status epilepticus. There was a significant statistically relationship between the type of seizure and the serum glucose examined at the time of admission (p=0.015). There was no significant difference between seizure type, blood gas lactate, seizure history, family history of seizures, duration of stay in emergency department, need for hospitalization and seizure recurrence. The mean seizure time of the patients was 3.8 ± 3.1 min. There was a negative correlation between seizure duration and blood gas pH and positive correlation between seizure duration and serum glucose. 84 (52, 8%) patients had a blood gas lactate value of ≥ 2 mmol/L at admission. The 41 patients (25, 7%) had hyperglycemia at admission. There were no patients with hypoglycemia. The mean emergency department observation duration was 8 ± 2.9 h. It was observed that 12 (7, 5%) patients were hospitalized. The mean length of stay in hospital was 3 ± 1.8 days. The mortality rate was 0%. Seizure recurrence was observed in 27 (17%) patients. There was a significant statistically relationship between the seizure recurrence and the CO2 in the blood gas (p=0.04). ROC analysis of seizure recurrence revealed lactate cut off is 1.9 mmol/L and blood glucose cut off is 110 mg/dL.

This study contributes to literature in terms of illuminating efficient factors on clinical courses of seizures. Pediatric Emergency doctors should maintain seizure patients with high lactate and glucose levels at the time of admission under close clinical follow-up after discharge in terms of seizure recurrence.

Keywords: Seizure type; Child; Blood gas lactate; Serum glucose

OPEN ACCESS

Correspondence:
Sabiha Sahin, Department of Pediatrics, Division of Pediatric Emergency, Eskisehir Osmangazi University, Eskisehir, TR-26040, Turkey, Tel: +90 532 493 79 39;
E-mail: sabiha.sahin@mynet.com

Received Date: *15 Sep 2021*
Accepted Date: *12 Oct 2021*
Published Date: *21 Oct 2021*

Citation:
Gur E, Sahin S. The Blood Gas Lactate and Serum Glucose Levels of the Patients Admitted to the Pediatric Emergency Department with Seizure. Ann Pediatr Res. 2021; 5(2): 1062.

Introduction

Epilepsy is one of the most common serious neurological diseases. Epileptic seizures are commonly occurring in 3% to 5% of children. Although seizures are highest in the first year of life, they are more common in the first ten years, and their frequency decreases with age [1,2]. There are studies showing that it constitutes 10% to 20% of the reasons for applying to the Emergency Department in Turkey [3].

The International League against Epilepsy (ILAE) published a new seizure type classification in 2017, which is largely based on the existing classification formulated in 1981 [4]. Seizures are classified based on onset type as focal, generalized, unknown and unclassified onset seizures.

A seizure is an abnormal process in a part of the cerebral cortex of the brain with different

causes. It results in excessive or hyper synchronous discharge of nerve cell groups and clinical symptoms occur [5]. Seizures affect the brain at the molecular, cellular and neural network level and cause a rapid reaction [6].

During a seizure, ATP production must be accelerated through an aerobic metabolism (Krebs cycle) and glycolysis to maintain energy needs [7]. As neuronal activity and energy expenditure increase, the rate of brain metabolism increases rapidly. This causes most of the glucose to be consumed by the brain. Therefore, other energy sources are needed. Glycogen stores in astrocytes are decomposed by the glycogen phosphorylase enzyme and glycolysis pathway is initiated in a short time to provide the necessary energy [8]. It has been shown that an important source of energy for the brain during a seizure is obtained by the breakdown of glycogen into lactic acid [5].

Lactic acid can provide energy *via* the Astrocyte-Neuron-Lactate Shuttle (ANLS) and, *via* the gap- junction-mediated metabolic cycle when glucose is depleted. Therefore, lactic acid can meet the energy need in the first steps of seizures [5,9].

In this study, we aimed to retrospectively evaluate the patients presenting to the pediatric emergency service with seizure, to compare blood gas lactate and serum glucose levels according to the seizure types and to determine the effects of these values on prognosis.

Material and Methods

In the present study, children between the ages of 1 month and 18 years presenting with seizure to the Pediatric Emergency Department of Eskisehir Osmangazi University Faculty of Medicine were retrospectively analyzed and 159 patients who met the inclusion criteria were included in the study.

The patients diagnosed with epilepsy and have an antiepileptic medication story in the period of previous 6 months before his/her admission, who have trauma story before and during seizure and have a known chronic illness were excluded from the study. The age, gender, family story, personal background, the way how to came to the emergency, whether there was a medical intervention before the admission or not, the seizure that had been suffered and seizure types if there is a seizure history in the family, presence of medication in the last one week, seizure duration, type of seizure, finger stick blood glucose, serum glucose, blood gas pH, partial Carbon Dioxide (CO_2), Bicarbonate (HCO_3), Base Deficit (BE), Carboxyhemoglobin (COHb), lactate values examined at the time of, whether control blood gas were taken from the patients or not, and if so at which hour of their admission they were taken, serum glucose, blood gas pH, CO_2, HCO_3, BE, COHB, lactate levels of the patients were included in the study and recorded. First clinical admission within the 5 year-period of the patients with repetitive seizure history has been considered.

Seizure types in the family members of the patients who have a characteristic in the family history were classified as epilepsy, febrile seizure and afebrile seizure groups. Since the most common seizure type observed in children is febrile seizure, patients with seizure history were evaluated in 3 groups including febrile seizure, afebrile seizure and status epilepticus. Finger stick blood glucose, serum glucose and blood gas parameters of the patients at the time of were evaluated. Control blood gas was taken from the patients with abnormal results. The clinical procedures of the patients were evaluated according to the exitus condition, neurological loss and seizure recurrence.

The study was approved by Eskişehir Osmangazi University Non-Invasive Clinical Research Ethics Committee (Date: 21.11.2017, Number: 80558721).

Statistical analysis was performed using IBM SPSS 21 package program. Values belonging to the quantitative data were indicated as the mean ± standard deviation or median Q1-13, whereas values belonging to qualitative data were given as frequency and percentage. The compliance of the data to normal distribution was evaluated using the Shapiro-Wilk test. The groups showing normal distribution was compared with T test and the groups showing abnormal distribution was compared with the Maan Whitney U test. The relationship between qualitative variables was evaluated with chi square analysis and the relationship between quantitative variables was evaluated with Spearman correlation analysis. A p-value less than 0.05 were considered statistically significant.

Results

69 (43, 4%) of 159 patients included in the study were girls. The mean age was 69.8 ± 62.8 (2 to 218) months. 52 (32%) patients were between 1 to 2 ages, 44 (28%) patients between 3 to 5 ages, 35 (22%) patients between 6 to 12 ages, 28 (18%) patients found to be 13 years old and older (Table 1).

In the time period one week before the admission, sixty (37.7%) patients were found to use antibiotic, analgesic and/or anti-inflammatory drugs. Considering the family history of the patients, there was seizure history in the family of 36 (22.6%) patients. When types of seizures were evaluated in the families of these patients, epilepsy was found in 11 of them (31.4%), febrile seizure was found in 18 of them (51.4%) and afebrile seizure was found in 7 of them (17.2%). It was found that seizure was repeated in 7 (19.4%) of these patients.

The 104 (65.4%) patients had no seizure history. The mother and/or father of these 21 (23%) patients have seizure history. There is family history in 15 (27.2%) out of 55 (34.6%) patients who have recurrence seizures. No significant difference was found between family history and seizure recurrence (p=0.623).

55 (34.6%) patients have seizure history and these patients had not used anticonvulsant drugs within the period of 6 months before the admission. Considering previous seizure types of the patients with seizure history, epilepsy was found in 7 (12.7%) of them, febrile seizure was found in 23 (41.8%) of them and afebrile seizure was found in 25 (45.5%) of them. The mean seizure duration was 3.8 ±

Table 1: Demographic characteristics of the cases and seizure types.

	N (%)
Age range	
1-2 years old	53 (32)
3-5 years old	44 (28)
6-12 years old	35 (22)
>13 years old	28 (18)
Gender	
Girl	69 (43.4)
Boy	90 (56.6)
Type of seizure	
Febrile seizure	73 (45.9)
Status Epilepticus	11 (6.9)
Afebrile seizure	75 (47.2)

Table 2: Comparison of laboratory values at admission with control values.

	Admission mean ± SD	Control mean ± SD	P
pH	7.37 ± 0.63	7.42 ± 0.32	?
Carbon dioxide (CO_2) (mmHg)	35.3 ± 7.21	31.8 ± 4.9	?
Bicarbonate (HCO_3) (mmol/L)	21.3 ± 15.2	20.3 ± 2.4	?
Base deficit (BE) (mmol/L)	-4.1 ± 3.2	-2.9 ± 2.3	?
Lactate (mmol/L)	2.4 ± 1.9	1.3 ± 0.6	?
Carboxy hemoglobin (COHb)	0.67 ± 0.43	0.73 ± 0.25	?
Serum glucose (mg/dl)	116 ± 25.8	104.8 ± 21.8	?
Finger stick blood glucose (mg/dL)	110.7 ± 27.1		

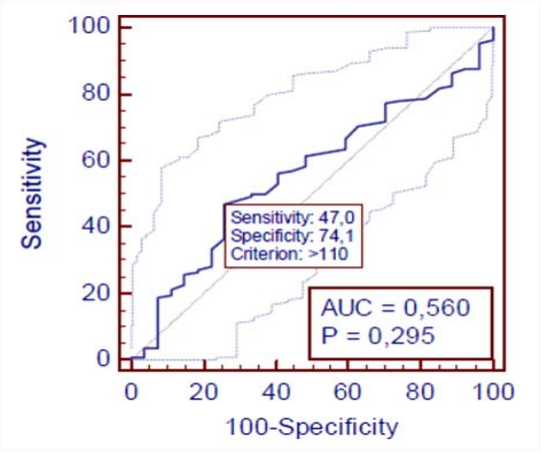

Figure 1: ROC curve for the effect of glucose on seizure recurrence.

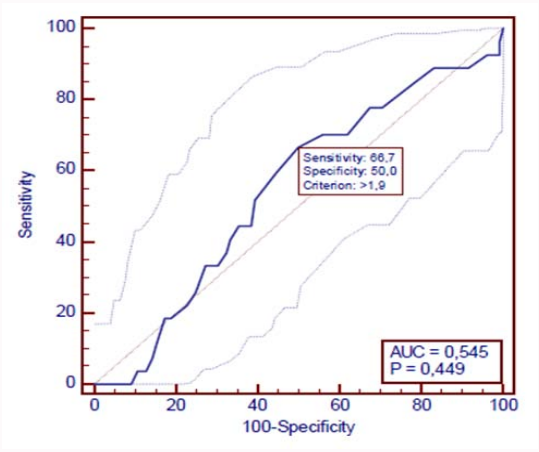

Figure 2: ROC curve for the effect of lactate on seizure recurrence.

3.1 min. Negative correlation (p=0.03) was found between seizure duration and pH, whereas positive correlation (p=0.02) was found between seizure duration and serum glucose.

No significant difference was found between seizure duration and length of stay in ED (p=0.28), hospitalization (p=0.92), type of seizure (p=0.386) and seizure recurrence (p=0.598). When seizure types of the patients were evaluated, it was defined that febrile seizure in 73 (45.9%) of them, afebrile seizure in 75 (47.2%) of them and status epilepticus in 11 (6.9%) of them.

No significant difference was found between lactate level measured at the time of and seizure type (p=0.498). A significant difference was found between serum glucose measured at the time of and seizure type (p=0.015). Serum glucose of the patients applying due of status epilepticus was higher and the mean serum glucose level of these patients was 126 ± 28.03 mg/dL. No significant difference was found between type of seizure and seizure history (p=0.684), seizure history in the family (p=0.308), length of stay at the emergency department (p=0.272), hospitalization (p=0.826) and seizure recurrence (p=0.684).

At the ED admission, acidosis was determined in 62 (38.9%) patients and lactic acidosis was found in 44 (27.6%) patients. It was observed that lactic acidosis of 1 (0.6%) patient continued during the period of emergency follow-up. The length of seizure of this patient was 30 min and it was observed that seizure recurrence did not occur. Blood gas lactate value of 84 (52.8%) patients at the time of was found as ≥ 2 mmol/L (Table 2). The mean seizure duration of these patients was 3.69 ± 2.8 min. When types of seizure were evaluated, it was seen that 40 (47.6%) had a febrile seizure, 40 (47.6%) afebrile seizure, and 8 (4.8%) had status epilepticus. It was observed that 18 (21.4%) of these patients had seizure recurrence.

Positive correlation was found between finger stick blood glucose and serum glucose at the time of (p<0.01). Control blood gas was taken from 26 (16.4%) patients whose lactate values were high at the time of. Control blood gases were taken after mean 5.8 ± 4.7 h from their admission to the ED. It was found that lactate value in the control blood gas of 6 (23%) patients was ≥ 2 mmol/L. Examining the seizure types of these patients, febrile seizure was found in 1 (16.6%), afebrile seizure was found in 4 (66.8%), status epilepticus was found in 1 (16.6%) of them and seizure recurrence was observed in 2 (33.3%) patients.

When finger stick blood glucose and serum glucose at the time of were evaluated, hyperglycemia was found in 41 (25.7%) patients. Hypocemia was not found in any of the patients. It was observed that hyperglycemia continued during the emergency follow-up of 3 (7.3%) patients. When seizure types of these patients were examined, febrile seizure was seen in 1 (33.3%) and afebrile seizure was seen in 2 (66.7%) of them. In ROC analysis conducted for the influence of serum glucose on seizure recurrence, cut off value for glucose was found as 110 mg/dL. (Sensitivity: 47, specificity: 74) (Figure 1).

No significant difference was found between the observation period of the patients at ED and pH (p=0.282), CO_2 (p=0.551), lactate (p=0.608), serum glucose (p=0.097), seizure type (p=0.272). No significant difference was found between length of stay at hospital and pH (p=0.429), CO_2 (p=0.625), serum glucose (p=0.338), length of

stay at ED (p=0.437).

No patient died. Mortality rate was 0%. In later clinical follow-up, it was found out from follow-up examinations that seizure recurrence occurred in 27 (17%) patients. A significant difference was found between seizure recurrence and CO_2. (p=0.04) Blood gas CO_2 levels at the time of the patients with recurrent seizure were higher (38.08 ± 9.04 mmHg). No significant difference was found between seizure recurrence and pH (p=0.17), serum glucose (p=0.32), seizure history (p=1), type of seizure (p=0.577), seizure history in the family (p=0.676), seizure duration (p=0.598). The rate of seizure recurrence of the patients with high lactate value was high. In ROC analysis, the cut off lactate value was as >1.9 mmol/L (sensitivity: 66.7, specificity: 50) (Figure 2).

Discussion

Seizure is one of the most common neurological disorders seen in childhood. In the previous studies, it was shown that 4% to 6% of the children between 0 to 16 years old suffered at least one seizure during their lifetime [10]. It consists of approximately 1% of all emergency admissions and approximately 2% of pediatric emergency admissions [11]. There are studies which show that it consists of 10% to 20% of the reasons for emergency admissions in our country [3].

During the seizure, the polarization of rapid and recurrent neuronal cell membrane and glucose and oxygen consumption with the cerebral blood increase occurs [6]. Thus, brain and cerebral cortex lower their ATP levels and are driven to a high metabolic condition. As a consequence of this, the energy need of the brain becomes insufficient [12]. Lactic acid can provide energy through astrocyteneuron-lactate shuttle and in case of glucose consumption through gap-junction-mediated metabolic cycle. Therefore, lactic acid can meet the energy need in the first steps of the seizures [5,9,13,14].

In this study, we compared the seizure types of the patients who applied to the pediatric emergency department measuring the glucose and blood gas values and we aimed to evaluate the influence of these parameters on the prognosis.

When all types of seizure were evaluated, the most common type of seizure becomes febrile seizure. Also, in our study, the most common type of seizure is febrile seizure with a percentage of 45.9%. The highest incidence of the first febrile seizure emerges in the second year of life [15]. After the first febrile seizure, recurrence is seen in 30% to 40% of the patients. The risk of developing epilepsy after febrile seizure increases compared to normal population and changes between 2% to 7% [16]. In our study, 81 (50.9%) patients suffered a seizure for the first time. Seizure recurrence was seen in 15 (18.5%) of these patients.

When the gender distribution of seizures was evaluated, higher rates were seen in the male gender in the majority of the studies; however, no statistically significant difference was mentioned in nearly all of the studies. In a study conducted in Turkey by Celik et al. [3], it was observed that male gender was more among the children who had suffered a seizure. In the study carried out by Sartori et al. [17] on the child patients admitted to the emergency with seizure for the first time, the percentage of boys was found as 52.7% and the rate of girls was found as 47.3%. In another study conducted by Mwipopo et al. [18], the percentage of boys was found as 54.5% and the percentage of girls was found as 45.5%. In a study conducted in the Erzurum City from Turkey [19], the percentage of boys was found as 56.3% and the percentage of girls was found as 43.7%, but no statistically significant difference was found between seizure and gender. In our study, the percentage of boys was found as 56.6% and the percentage of girls was found as 43.4%. No statistically significant difference was found between seizure and gender (p=0.113).

When literature was reviewed, there were differences between the ages of seizure incidence in children. In a study by Smith et al. [20], in which children who admitted to the emergency with seizure were examined, the mean age was found as 4.4 years. In another study by Valencia et al. [21], the mean age was 6.6 years. In a study conducted by Anıl et al. [22], at emergency, the mean age was found as 50.4 ± 40.1. In our study, the mean age was determined as 69.7 ± 62.8 months. In a study by Abdalkerim et al. [23], cumulative age range was found as 6 to 12 with a percentage of 41.5%. In a study from Turkey by Serdaroglu et al. [24], it was seen that cumulative age range was 13 years old and over with a percentage of 21.5%. In our study, it was found that it is seen more frequently between 1 to 2 years old with a percentage of 32.7%.

Epilepsy is a heterogeneous and multifactorial disorder. It results from the interaction between many genes and environmental factors. However, there are also rare epilepsy syndromes that might be originated from a single gene mutation and shows transition according to the classic principles of Mendelian genetics. Studies show that epilepsy incidence is 2.5 times higher in the relatives of epileptics compared to normal people [25]. In a study by Abdalkerim et al. [23], positive family history was found as 33.9%. In a study conducted by Daoud et al. [26], the patients who suffered a seizure for the first time were examined and positive family history was found as 31%. In another study by Unver et al. [27], the positive family history was found as 33%. In a study conducted retrospectively by Alaberg et al. [28], with the participation of 600 cases, positive family history was found as 25.6%. In our study, the positive family history was 22.6%.

In a study by Winckler et al. [29], the patients were divided into two groups including those who suffered a seizure for the first time and those who had recurrent seizures. When the family history of these patients was examined, family history was found positive in 56% of the patients who suffered a seizure for the first time and in 75% of the patients who had recurrent seizures and it was statistically significant ($p \leq 0.05$). In our study, 104 (65.4%) patients suffered a seizure for the first time and 21 (23%) of these patients had seizure history in their mother and/or father. Family history was positive in 15 (27.2%) of 55 (34.6%) patients with recurrent seizures. No significant difference was found between family history and seizure recurrence in our study (p=0.623). In a study by Maia et al. [30], it was found that recurrent seizures were seen in 39.4% of the patients with a positive family history. In our study, 36 (22.6%) patients had a positive family history and 7 (19.4%) had recurrent seizure.

Seizures often last between a few seconds and a few minutes. Seizures that take more than 30 min are accepted as status epilepticus. However, in recent years the argument that convulsive seizures which last more than 5 min to 10 min are to be approached as status epilepticus is widely supported [15]. We accepted the period of status epilepticus as 10 min in our study. In a study by Maia et al. [30], it was found that 47.8% of the patients had <5 min, 37% had 5 min to 15 min, 15.2% had >15 min of seizure duration. In our study, the mean seizure duration of our patients were 3.8 ± 3.1 min.

In 2017, International League against Epilepsy (ILAE) published a

new seizure type classification based on the current classification which was formulated in 1981 to a great extent. In this new classification, seizures were divided into 4 groups based on their onset including focal onset, generalized onset, unknown onset and unclassified. When types of seizure were evaluated in a study by Alaberg et al. [28], it was found focal with a percentage of 50.6%, 24% generalized 18.3% generalized-focal combination, and 7.1% unclassified. In a study by Maia et al. [30], it was found 65% generalized, 29.1% focal, and 5.8% unclassified. Since the most common type of seizure observed in children is febrile seizure, we classified the types of seizure as febrile, afebrile, and status epilepticus in our study. We evaluated generalized and/or focal seizures under the classification of afebrile seizure. It was found that febrile was seen in 73 (45.9%), afebrile in 75 (47.2%), and status epilepticus was seen in 11 (6.9%) patients in our study.

Electrolyte imbalance is among the reasons of seizure seen in children. Particularly hypoglycemia, hyponatremia, hypocalcemia, hypomagnesemia play a role in the etiology of seizure by the various mechanisms. During the seizure, the polarization of rapid and recurrent neuronal cell membrane and glucose and oxygen consumption with the cerebral blood increase occur [6]. Energy deprivation caused by hypoxia and hypoglycemia often results in coma and neuronal death. Thus, it is known that seizure activity begins [5,13,14,31,32]. Stress hyperglycemia is the temporary increase in the concentration of blood glucose based on various reasons of stress [32]. It was reported to be associated with various conditions in relation to stress in children. It is seen approximately in 5% of the children admitting to the emergency [33]. In a study which examines the cases of stress hyperglycemia at Pediatric Emergency [32], it was found 8% seizure-motivated. In a study conducted by Anıl et al. [22], on children taken to the emergency with seizure, hypoglycemia was found in 5% of patients and hyperglycemia was found in 50% of patients. When Valencia et al. [21], prospectively evaluated the children who were taken to the emergency with seizure, hypoglycemia was found in 1 (1.07%) of the patient. In a study by Idro et al. [34], the rate of hypoglycemia in patients suffering a seizure was found to be 3.1%. In our study, hypoglycemia was found in none of the patients. Hyperglycemia was found in 41 (25.7%) patients. In a study conducted by Lee et al. [35], hyperglycemia was found in 12.9% of the cases with a febrile seizure. In our study, hyperglycemia was found in 35.6% of patients with febrile seizure. When the relationship between serum glucose and the types of seizure was examined in our study, a significant difference was found (p=0.015). Serum glucose of the patients applying due to status epilepticus was higher and the mean serum glucose level was found 126 ± 28.03 mg/dL. A positive correlation (p=0.02) was found between serum glucose and seizure duration and it was found that blood sugar is higher in the patients with a longer seizure. In ROC analysis conducted for the influence of serum glucose on the seizure repetition, glucose cut off value was found as 110 mg/dL (Sensitivity: 47, specificity: 74). Patients with detected hyperglycemia at the time of should be monitored closely in terms of seizure recurrence.

As neuronal activity and energy consumption which emerge during the seizures increase, the metabolic rate of the brain rapidly accelerates. This causes a major part of glucose to be consumed by brain. Therefore, another energy source is needed [8]. Lactate acid can provide energy through the astrocyte-neuron-lactate shuttle and in case of glucose consumption through the gap-junction-mediated metabolic cycle. Therefore, lactate acid can meet the energy need in the first steps of the seizures [5,9,13,14]. In a study by Orringer et al. [14], it was determined that lactate levels measured from venous blood samples were significantly higher and metabolic acidosis was seen. Blood pH values typically turns to normal within 1 h. Metabolic anomalies which are revealed during the seizure limit themselves and do not require specific treatment [36]. There is no universally agreed value that represents the serum lactate increase. Generally, a serum lactate concentration over 2.0 mmol/l to 2.5 mmol/l is accepted as high. These serum lactate concentrations consist of lactate acidosis with blood pH value ≤ 7.35. The reason for lactate acidosis during the seizure is the increase of the anaerobic metabolism due to the increasing oxygen use during the seizure activity. When lactate values of the patients at the time of admission were examined in our study, lactate elevation was found in 84 (52.8%) patients. Control blood gas was taken from 26 (16.4%) patients during the emergency follow-up. Control blood gases were taken after mean 5.8 ± 4.7 h. It was found that the lactate levels of 6 (3.7%) patients were still high. Examining the seizure types of these patients, febrile seizure was found in 1 (16.6%), afebrile seizure was found in 4 (66.8%), status epilepticus was found in 1 (16.6%) of them and seizure recurrence was observed in 2 (33.3%) patients. At the time of admission, acidosis was found in 62 (38.9%) patients and lactic acidosis was found in 44 (27.6%) patients. It was observed that lactic acidosis of 1 (0.6%) patient continued during the period of emergency follow-up. The seizure duration of this patient was 30 min and seizure recurrence was not seen. In our study, a negative correlation was found between the seizure duration and pH values of the patients (p=0.03) and it was seen that as the length of seizure lasts longer, acidosis deepens based on the increase of the period remained hypoxic.

Lactate elevation is observed due to the increase of oxygen need in the tissues during the seizure. In a retrospective study by Contenti et al. [37], the lactate levels of the patients admitted to the emergency were examined and it was found that patients with seizure had the highest lactate elevation with a percentage of 31.4%. It was reported in the literature that serious lactate acidosis and metabolic acidosis were developed in patients suffering a generalized seizure [38]. In the study conducted by Matz et al. [39], a significant difference was found between the level of serum lactate and generalized tonic-clonic seizure (p<0.001). When literature was reviewed, there is no study which shows the relationship between the type of seizure and lactate in children. In our study, no significant difference was found between the type of seizure and lactate (p=0.0498).

The incidence of neurological loss, intracranial pathology, frequent seizure is seen in patients with seizure based on asphyxia in case of longer seizure. Generally neurological loss is not observed in patients who do not have an underlying disease and suffer from a seizure for the first time. In a study by Idro et al. [34], on children suffering from an acute seizure, neurological loss percentage was found as 1.3%. In our study, the percentage of neurological loss was found as 0%. Leaving patients who have chronic illness and are currently diagnosed with epilepsy out of this study might explain the low percentage of neurological loss.

In a study by Daoud et al. [26], the percentage of seizure recurrence was found as 37% and significant difference was found with positive family history (p<0.0001). In another study by Mizorogi et al. [40], significant difference was found between seizure recurrence and partial seizure type (p=0.001). In our study, the percentage of seizure recurrence was found to be 17%. A significant difference was found between seizure recurrence and CO_2 (p=0.04). Blood gas CO_2 levels at the time of admission of the patients with recurrent seizure

were higher and the mean value was mean 38.08 ± 9.04 mmHg. No significant difference was found between seizure recurrence and pH (p=0.17), seizure history (p=1), type of seizure (p=0.577), and positive family history (p=0.676). When literature was reviewed, there is no study showing the relationship between the seizure recurrence and lactate levels. Although sensitivity and specificity are low in our study, a relationship between lactate level at the time of admission and seizure recurrence was found. Cutoff value of lactate for seizure recurrence was found as 1.9 mmol/L. More significant results might be obtained increasing in the number of patients in our study. Patients with a lactate value over 1.9 mmol/L at the time of admission should be monitored more closely in terms of seizure repetition.

Epilepsy increases mortality in all ages. Within ten years after the first seizure, the mortality rate was found between 2.9% to 5.7%. The most important reasons that influence mortality include the onset of seizure being under 1-year old, infantile spasm, symptomatic epilepsy [41,42]. In a retrospective study conducted by Mwipopo et al. [18], the mortality rate was found as 0%. In a study carried out prospectively by Geerts et al. [43], the mortality rate was found as 0.02% during a 5-year follow-up. In a study by Brorson et al. [44], patients were re-evaluated after 12 years and the mortality rate was found as 0.05%. In our study, the percentage of mortality was 0%. We think that we found mortality rate as 0% because of leaving patients with chronic disease and epilepsy diagnosis out of the study and reaching patient files that died in our hospital since our study was carried out retrospectively.

Conclusion

There are studies in our country which show the pathophysiological evaluation of the seizures in pediatric population and the influence of these parameters on clinical courses. This study contributes to literature in terms of illuminating efficient factors on clinical courses of seizures. Pediatric Emergency doctors should maintain seizure patients with high lactate and glucose levels at the time of admission under close clinical follow-up after discharge in terms of seizure recurrence. In order to understand the pathophysiology of the seizures and the effects on clinical course, studies with greater samples are needed.

References

1. Goodridge DM, Shorvon SD. Epileptic seizures in a population of 6000. I: Demography, diagnosis and classification, and role of the hospital services. Br Med J (Clin Res Ed). 1983;287(6393):641-4.
2. Holmes GL. Epilepsy in the developing brain: Lessons from the laboratory and clinic. Epilepsia. 1997;38(1):12-30.
3. Celik BT, Celik N. The etiology and recurrence of acute symptomatic seizures during childhood. Pamukkale Medical J. 2014;19-25.
4. Robert S, Fisher M. Neurology MS, Director SEC. The 2017 ILAE Classification of Seizures. Epilepsia. 2017.
5. Yang H, Wu J, Guo R, Peng Y, Zheng W, Liu D, et al. Glycolysis in energy metabolism during seizures. Neural Regen Res. 2013;8(14):1316-26.
6. Wasterlain CG, Fujikawa DG, Penix L, Sankar R. Pathophysiological mechanisms of brain damage from status epilepticus. Epilepsia. 1993:34(1):S37-53.
7. Folbergrova J, Jesina P, Drahota Z, Lisy V, Haugvicova R, Vojtiskova A. Mitochondrial complex I inhibition in cerebral cortex of immature rats following homocysteic acid-induced seizures. Exp Neurol. 2007;204(2):597-609.
8. Wiesinger H, Hamprecht B, Dringen R. Metabolic pathways for glucose in astrocytes. Glia. 1997;21(1):22-34.
9. Rouach N, Koulakoff A, Abudara V, Willecke K, Giaume C. Astroglial metabolic networks sustain hippocampal synaptic transmission. Science. 2008;322(5907):1551-5.
10. Kasap T. Nobetle basvuran cocuk hastaya yaklasim. Pediatr Pract Res. 2014;2(1):27-40.
11. Martindale JL, Goldstein JN, Pallin DJ. Emergency department seizure epidemiology. Emerg Med Clin North Am. 2011;29(1):15-27.
12. Wasterlain CG, Thompson KW, Suchomelova L, Niquet J. Brain energy metabolism during experimental neonatal seizures. Neurochem Res. 2010;35(12):2193-8.
13. Yalaz K. Çocukluk cagı nobetlerine genel bakış. Turkiye Klinikleri Pediatrik Noroloji Ozel Sayısı. 2003;1:148-53.
14. Kabakus N. Konvulziyonlu cocuga yaklaşım. Turk Pediatri Arsivi. 2004;39(3).
15. Hauser WA. The prevalence and incidence of convulsive disorders in children. Epilepsia. 1994;35(1):1-6.
16. Yılmaz U, Ozdemir R, Celik T, Berksoy E. Clinical and paraclinical features in children with febrile seizures. Dicle Tip Dergisi. 2014;41(1):156.
17. Sartori S, Nosadini M, Tessarin G, Boniver C, Frigo AC, Toldo I, et al. First-ever convulsive seizures in children presenting to the emergency department: Risk factors for seizure recurrence and diagnosis of epilepsy. Dev Med Child Neurol. 2019;61(1):82-90.
18. Mwipopo EE, Akhatar S, Fan P, Zhao D. Profile and clinical characterization of seizures in hospitalized children. Pan Afr Med J. 2016;24:313.
19. Kivanc A. A Study on the convulsion frequency among 0-5 age group children in erzurum pasinler training and research area. Ann Med Res. 2000;7(3):244-9.
20. Smith RA, Martland T, Lowry MF. Children with seizures presenting to accident and emergency. J Accid Emerg Med. 1996;13(1):54-8.
21. Valencia I, Sklar E, Blanco F, Lipsky C, Pradell L, Joffe M, et al. The role of routine serum laboratory tests in children presenting to the emergency department with unprovoked seizures. Clin Pediatr. 2003;42(6):511-7.
22. Anil AB, Anil M, Ozturk YK, Bal Z, Akduman I, Cetin N. Acil servise konvülziyon nedeniyle getirilen çocuklarda yapılacak laboratuvar çalışmalarında seçici davranmanın gerekliliği. Türkiye Klinikleri. 2011;20(1):16-21.
23. Al-Qudah AA, Albsoul-Younes A, Masri AT, AbuRahmah SK, Alabadi IA, Nafi OA, et al. Type and etiology of pediatric epilepsy in Jordan. A multi-center study. Neurosciences (Riyadh). 2017;22(4):267-73.
24. Serdaroglu A, Ozkan S, Aydin K, Gucuyener K, Tezcan S, Aycan S. Prevalence of epilepsy in Turkish children between the ages of 0 and 16 years. J Child Neurol. 2004;19(4):271-4.
25. Annegers JF. Epidemiology and genetics of epilepsy. Neurol Clin. 1994;12(1):15-30.
26. Daoud AS, Ajloni S, El-Salem K, Horani K, Otoom S, Daradkeh T. Risk of seizure recurrence after a first unprovoked seizure: A prospective study among Jordanian children. Seizure. 2004;13(2):99-103.
27. Unver O, Keskin SP, Uysal S, Unver A. The epidemiology of epilepsy in children: A report from a Turkish pediatric neurology clinic. J Child Neurol. 2015;30(6):698-702.
28. Aaberg KM, Bakken IJ, Lossius MI, Lund Soraas C, Tallur KK, Stoltenberg C. Short-term seizure outcomes in childhood epilepsy. Pediatrics. 2018;141(6):e20174016.
29. Winckler MI, Rotta NT. Prognostic factors for recurrence of a first seizure during childhood. Arq Neuropsiquiatr. 1997;55(4):749-56.
30. Maia C, Moreira AR, Lopes T, Martins C. Risk of recurrence after a first

unprovoked seizure in children. J Pediatr (Rio J). 2017;93(3):281-6.

31. Semenza GL. Oxygen-dependent regulation of mitochondrial respiration by hypoxia-inducible factor 1. Biochem J. 2007;405(1):1-9.

32. Weiss SL, Alexander J, Agus M. Extreme stress hyperglycemia during acute illness in a pediatric emergency department. Pediatr Emerg Care. 2010;26(9):626-8.

33. Bhisitkul DM, Morrow AL, Vinik AI, Shults J, Layland JC, Rohn R. Prevalence of stress hyperglycemia among patients attending a pediatric emergency department. J Pediatr. 1994;124(4):547-51.

34. Idro R, Gwer S, Kahindi M, Gatakaa H, Kazungu T, Ndiritu M, et al. The incidence, aetiology and outcome of acute seizures in children admitted to a rural Kenyan district hospital. BMC Pediatr. 2008;8-15.

35. Lee JY, Kim JH, Cho HR, Lee JS, Ryu JM, Yum MS. Children experiencing first-time or prolonged febrile seizure are prone to stress hyperglycemia. J Child Neurol. 2016;31(4):439-43.

36. Kılıc TY, Yesilaras M, Atilla OD, Sever M, Aksay E. Can venous blood gas analysis be used for predicting seizure recurrence in emergency department? World J Emerg Med. 2014;5(3):187-91.

37. Contenti J, Occelli C, Lemoel F, Ferrari P, Levraut J. Blood lactate measurement within the emergency department: A two-year retrospective analysis. Am J Emerg Med. 2019;37(3):401-6.

38. Brivet F, Bernardin M, Cherin P, Chalas J, Galanaud P, Dormont J. Hyperchloremic acidosis during grand mal seizure lactic acidosis. Intensive Care Med. 1994;20(1):27-31.

39. Matz O, Zdebik C, Zechbauer S, Bundgens L, Litmathe J, Willmes K. Lactate as a diagnostic marker in transient loss of consciousness. Seizure. 2016;40:71-5.

40. Mizorogi S, Kanemura H, Sano F, Sugita K, Aihara M. Risk factors for seizure recurrence in children after first unprovoked seizure. Pediatr Int. 2015;57(4):665-9.

41. Camfield P, Camfield C. Sudden unexpected death in people with epilepsy: A pediatric perspective. Semin Pediatr Neurol. 2005;12(1):10-4.

42. Harvey AS, Nolan T, Carlin JB. Community-based study of mortality in children with epilepsy. Epilepsia. 1993;34(4):597-603.

43. Geerts A, Arts WF, Stroink H, Peeters E, Brouwer O, Peters B, et al. Course and outcome of childhood epilepsy: A 15-year follow-up of the Dutch study of epilepsy in childhood. Epilepsia. 2010;51(7):1189- 97.

44. Brorson LO, Wranne L. Long term prognosis in childhood epilepsy: Survival and seizure prognosis. Epilepsia. 1987;28(4):324-30.