ÇOCUK VE ERİŞKİN YAŞ GRUBU ÜREMİLİ HASTALARDA BEYNİN ELEKTRİKSEL AKTİVİTESİNİN DEĞERLENDİRİLMESİ

Evaluation Of The Electrical Activity Of The Brain In Children And Adult Uremic Patients

Abdulkadir Koçer[1], Hazma Yazgan[2], Nurhan İnce[3]

Abstract

Purpose: *Electroencephalography (EEG) is a study showing cerebral functions and particularly important in neurological disorders where structural abnormalities in the brain cannot be demonstrated. Using EEG monitoring, we evaluated brain functions in pediatric and elderly population with uremia.*

Material and Method: *EEG recordings of 30 adult and 27 pediatric chronic renal failure patients under hemodialysis therapy were evaluated. During EEG evaluations of pediatric patients, age related changes observed by EEG were also recorded and not considered as pathologic abnormalities.*

Results: *In 24.6% of the patients (n=14), EEG results were within normal limits. The most frequently observed EEG abnormality was slow wave activity in both groups. Among thirty adult patients enrolled in the study, various abnormalities were observed in EEGs of 22 cases (73.3%). On the other hand, twenty one cases (77.8%) showed EEG abnormalities in children. When evaluated with respect to the presence of EEG abnormalities, a statistically significant difference was not detected between two age groups, shown in Table III (p=0.69). When adult and pediatric patients were compared, statistically significant differences were observed for EEG abnormalities (p< 0.05).*

Discussion: *In the early stages of uremia, EEG recordings are generally normal or decreases in amplitudes of potentials can be seen. After termination of acute encephalopathy, slow waves persist continuously. Children are more affected than adults in uremia, therefore slow wave abnormality in EEG is more prominent in comparison to adults.*

Key Words: *Brain; Electroencephalography; Uremia; Child; Adult.*

Özet

Amaç: *Beyin fonksiyonlarını ortaya koyan bir ölçüm çalışması olan Elektroensefalografi (EEG), beyin strüktüründe değişikliğin gösterilemediği nörolojik rahatsızlıklarda özellikle önemlidir. Bu çalışmada EEG ile çocuk ve erişkin yaş grubu üremili hastalarda beyin fonksiyonlarını araştırdık.*

Materyal ve Metod: *30 erişkin ve 27 çocuk hemodiyaliz hastasına ait EEG'ler değerlendirildi. Çocuk hastaların EEG değerlendirilmesinde yaşa bağlı gözlenebilecek değişiklikler patolojik olarak kabul edilmedi.*

Sonuçlar: *Hastaların %24.6'sında (n:14) EEG incelemesi normal sınırlardaydı. Her iki yaş grubunda da en sık gözlenen EEG patolojisi yavaş dalga aktivitesiydi. Otuz erişkin hastanın 22(%73.3)'sinde EEG'de değişik anormallikler saptandı. Çocuk yaş grubunda 27 hastanın 21(%77.8)'inde anormal EEG paterni izlendi. Her iki grup normal ve anormal EEG bulgularının varlığı yönünden değerlendirildiğinde istatistiksel olarak anlamlı farklılık saptanmadı (p=0.69). Anormal EEG değişiklikleri karşılaştırıldığında istatistiksel olarak anlamlı farklılığın olduğu tespit edildi (p<0.05).*

Tartışma: *Üremilerde erken dönem EEG'si genellikle normaldir veya hafif bir voltaj düşüklüğü görülür. Akut ensefalopatinin sona ermesinden sonra yavaş dalgalar kalıcı olabilir. Çocuklar daha çok etkilenirler ve erişkinlere kıyasla yavaş dalga patolojisi daha belirgindir.*

Anahtar Kelimeler: *Beyin; Elektroensefalografi; Üremi; Çocuk; Erişkin.*

[1]*Dr Lütfi Kırdar Kartal Eğitim Hastanesi Nöroloji Kliniği – İstanbul*
[2]*Göztepe SSK Eğitim Hastanesi Çocuk Kliniği - İstanbul*
[3]*İÜ İstanbul Tıp Fakültesi Halk Sağlığı ABD - İstanbul*

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Chronic renal failure (CRF) is a clinical spectrum encompassing all pathological processes occurring as a result of inadequacy of renal filtration and regulatory functions (1-3). This syndrome may consist of nonspecific symptoms such as anorexia, nausea and fatigue, as well as manifestations of pericarditis, convulsions and finally coma. Neuronal degeneration is widespread and insufficiencies are known to occur besides serious neuronal losses in long lasting cases (2). Electrophysiological tests are indispensable in the exploration of neurological complications in uremia (4). Electroencephalography (EEG) is a measurement study which revealed cerebral functions, particularly important in neurological disorders where structural abnormalities in the brain could not be demonstrated. In this study our aim was to evaluate brain functions in pediatric and elderly population with uremia and also to compare EEG findings.

MATERIAL AND METHOD

EEG recordings of 30 patients without epileptic seizure or antiepileptic drug usage history attending dialysis in PTT Teaching and Training Hospital and also 27 pediatric patients without epileptic seizure or antiepileptic drug usage history under hemodialysis therapy in Göztepe SSK Teaching and Training Hospital were evaluated. Hemodialysis was performed using dialysis equipment (Gambro), GFE-II dialyser, and deionised water. Before initiating hemodialysis, blood glucose, urea, creatinine, sodium, potassium, calcium and complete blood count values were recorded. Blood urea, creatinine, and calcium levels were analyzed using an autoanalyser (Cem-Profiler autoanalyser) and Bio-Clinica kits. Concommitant diseases, the number of sessions of dialysis, and time passed since the initiation of dialysis therapy were recorded. Normal and evoked EEG potentials were obtained for 20 minutes in neurological clinics with 8 channel EEG machine (Grass 8-10 brand) just before and within the same day of hemodalysis. During EEG evaluations of pediatric patients, age related changes which could be observed in EEG were also recorded. These changes were not considered pathologic abnormalities. All patients underwent complete neurological and mental evaluation. In statistical evaluations, correlations between abnormal EEG findings and age, gender, age at the initiation of dialysis, duration of CRF, blood urea, and creatinine and calcium levels were investigated. In a statistical model designed, Chi-square and Mann–Whitney–U tests were used respectively for the evaluation of binominal data and continuous variables.

RESULTS

Descriptive data relating to all the cases included in the study are shown on Table I. In 24.6% of patients (n=14) EEG results were within normal limits, while various EEG abnormalities were observed in 74.4% of cases (n=43). The most frequently observed EEG abnormality was slow wave activity and generalized slow wave activity was observed in 24 (42.11%) patients, (Table II). When evaluated with respect to the presence of EEG abnormalities, a statistically significant difference was not detected between the two age groups seen (Table III) ($p=0.69$).

Thirty adult patients were enrolled in the study. Among the adults, EEG findings of 8 cases were within normal limits being consistent with their age groups, while various abnormalities were seen in EEGs of 22 cases (Table I). When duration (years) of hemodialysis sessions and abnormal EEG findings were compared a statistically significant correlation was not found between EEG findings and the number of dialysis sessions ($p=0.46$). EEG abnormalities observed did not corelate to the number of dialysis sessions. In all patients with established cases of hyperparathyroidism (n=3), abnormalities in pre- and post-dialysis EEGs were observed. A significant relationship between other systemic diseases (hypertension, diabetes) and EEG findings could not be established in adult patients ($p>0.05$). In logistic regression analyses there was no significant correlation between EEG abnormalities and blood calcium, urea, creatinine and sodium values ($p> 0.05$).

Twenty-seven patients in the pediatric age group whose ages ranged between 8 and 15 years were included in the study. Twenty one cases (77.8 %) showed EEG abnormalities, shown in Table II. When adult and pediatric patients were compared, statistically significant differences were observed for EEG abnormalities ($p<0.05$). The medians of blood calcium levels in patients with EEG abnormalities and in patients with normal EEG patterns were 8 mg/dL and 8 mg/dL, respectively. The difference was not statistically significant (MWU:227, p:0.64).

DISCUSSION

Clinical utility of reproducible and measurable EEG examinations with respect to the timing of hemodialysis, evaluation of brain damage, and monitoring of cognitive functions have been demonstrated in numerous studies (4,5). A pathognomonic EEG finding relevant to chronic renal insufficiency does not exist. Abnormal EEG findings can be detected in CFR patients without any alteration in their clinical status and laboratory values. Although EEG recordings are nonspecific for CRF, they can be beneficial in the diagnosis and monitoring of patients with chronic renal insufficiency (5). In metabolic and toxic encephalopathy, amplitudes of EEG potentials fall secondary to decreased cerebral blood flow and metabolic rate. In addition to abnormal activity with low amplitudes, EEG waves with decreased amplitudes, generalized slow wave activities and other EEG abnormalities can be observed. In early stages, EEG recordings are generally normal or a slight decrease in voltage of potentials can be seen. After termination of acute encephalopathy, slow waves suggestive of brain damage can persist (6-8).

In our adult patients the most frequently observed abnormalities in EEG were EEG potentials with low amplitudes (Figure 1) and generalized slow wave activities. Among patients with generalized slow wave activities, cranial MRI examinations of 2 cases revealed diffuse cortical atrophy and multiple infarcts, while MRI findings of other patients were reported as normal. Slow wave activities in these 2 cases were considered to be related to diffuse cortical atrophy and occlusive vascular diseases rather than uremia (7). When we evaluated patients in the pediatric age group, we observed diffuse slow waves in 8 (47 %) and slow waves in combination with sharp waves in 3 cases (17 %) However in the EEG survey of 23 cases with CRF, Elzaghi et al. found diffuse slow waves in 90% of their patients (2). When adult and pediatric patients were compared, statistically significant differences were observed for EEG abnormalities ($p<0.05$).This present study showed that children are more vulnerable than adults because of changes resulting from uremia.

Abnormalities in uremia could not be attributed to a single etiology. When the relation between blood chemistry and basal EEG activities are taken into consideration, hypernatremia and hypocalcemia are known to impair basal EEG activities (9-11). EEG abnormalities are seen in cases whose blood urea levels are >60 mg/dL (11). In all our adult patient population, BUN values were >60 mg/dL and EEG abnormalities were detected in 17 cases (68%). In 2 out of the 3 patients with established hypernatremia, EEG abnormalities (focal sharp waves superimposed on basal slow wave activity n = 1; activity with low amplitude n =1) were found. Although in an experimental study, after 4 months of follow-up period a correlation was not detected between EEG findings and blood urea and creatinine levels, Paul et al. separated 72 pre-dialysis patients into two groups according to their blood creatinine levels (below or above 10 mg/dL) and found a significant correlation between these variables and EEG abnormalities (12). In our pediatric patients with CRF, a statistically significant difference did not exist between cases with normal and abnormal EEGs with respect to blood urea and creatinine levels ($p>0.05$). Variable results were reported regarding the impact of blood calcium level on EEG activities (6,7,9). In our study the correlation between blood calcium values and the presence of abnormality in EEG was not statistically significant ($p> 0.05$).

Although EEG is not diagnostic for uremia, it can be used to monitor uremia patients within the context of clinical findings (5). The efficacy of dialysis and the severity of encephalopathy can be assessed via quantitive EEG measurements. In another study reported by Koçer et al., the treatment of uremia and general metabolic status of uremia patients resulted in improvement in cerebral functions measured through EEG (12). Therefore, EEG analysis was considered to be beneficial for the assessment of efficacy of dialysis.

Prior to observation of clinical symptoms of encephalopathy, a generalized slow wave activity is seen which plays an important role in the follow-up of these patients (13). In the literature, generalized slow wave activity in CRF patients was reported to be directly related to blood urea and creatinine values, while only 6 cases of our series manifested slow wave activities. In our series, variations in blood urea and creatinine levels and slow wave abnormalities did not manifest significant correlations ($p > 0.05$). In uremic encephalopathies, generalized epileptic activity is frequently noted, while focal spikes or sharp waves, likely to be associated with a previous exposure to trauma, have been observed to a lesser extent. Generalized spikes or sharp waves develop on a background of diffuse, bisynchronous or asynchronous wave patterns. Bilateral spike wave activity evolving in association with generalized slow wave indicates dialysis encephalopathy, in which paroxysmal waves are more dominant on frontal lobe tracings (14,15). Focal slow wave activity is rarely observed in metabolic disorders. In uremic encephalopathy, generalized slow waves are seen more frequently than focal waves (16). In the present study we found that generalized slow waves with or without low amplitude activity was the most prominent abnormality. Spikes or sharp waves developed on a background of diffuse, bisynchronous or slow wave patterns in adult patients, although no sign of dialysis dementia was determined. In conclusion, we showed that slow wave abnormality is the most important sign of encephalopathy in uremia patients similar to the literature. Children are more effected than adults in uremia, therefore slow wave abnormality in EEGs of children are more prominent than adults in whom low amplitude waves in EEG are seen.

Table I: Descriptive characteristics of cases included in the present study.

Descriptive characteristics	*CHILDREN*	*ADULTS*	*TOTAL*	*u*	*z*	*p**
Gender						0.26
Male	13	19	31 (56.4%)			
Female	*14*	*11*	24 (43.6%)			
Mean Age (year)	13 (R:8-15)	50.5 (R:28-74)	30 (R:8-74)	<0.001	-6.35	<0.001
Duration of Dialysis (year)	3 (R:1-10)	2.5 (R:1-7)	3 (R:1-10)	236	-2.39	0.02
Blood Urea Level	89 (R:35-170)	68 (R:60-125)	77 (R:35-170)	247	-2.17	0.03
Blood Creatinine Level	5 (R:2-7)	9.3 (2.3-15.1)	7 (R:2-15.1)	56	-5.41	<0.001
Blood Calcium Level	9 (R:7-10)	8 (R:6-9)	8 (R:6-10)	136	-4.19	<0.001

* Two-tailed p value.

Table II: EEG abnormalities classified and seen in children and adults with chronic renal failure.

	EEG Abnormality											
Group	Normal		Slow wave Normal		Slow wave and sharp wave		Slow wave and low amplitude		Low amplitude		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Children	6	22.2	13	48.1	3	11.1	5	18.5	0	0.0	27	100.0
Adults	8	26.7	11	36.7	4	13.3	0	0.0	7	23.3	30	100.0
Total	14	24.6	24	42.1	7	12.3	5	8.8	7	12.3	57	100.0

Table III: The presence of EEG abnormalities seen in both groups.

Groups	**EEG Abn (-)**		**EEG Abn (+)**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**
Children	6	22.2	21	77.8	27	100.0
Adult	8	26.7	22	73.3	30	100.0
Total	14	24.6	43	75.4	57	100.0

Abbreviations: EEG Abn: EEG abnormality, (+):Present, (-):Not present.

Chi –square: 0.15 df: 1 p: 0.6

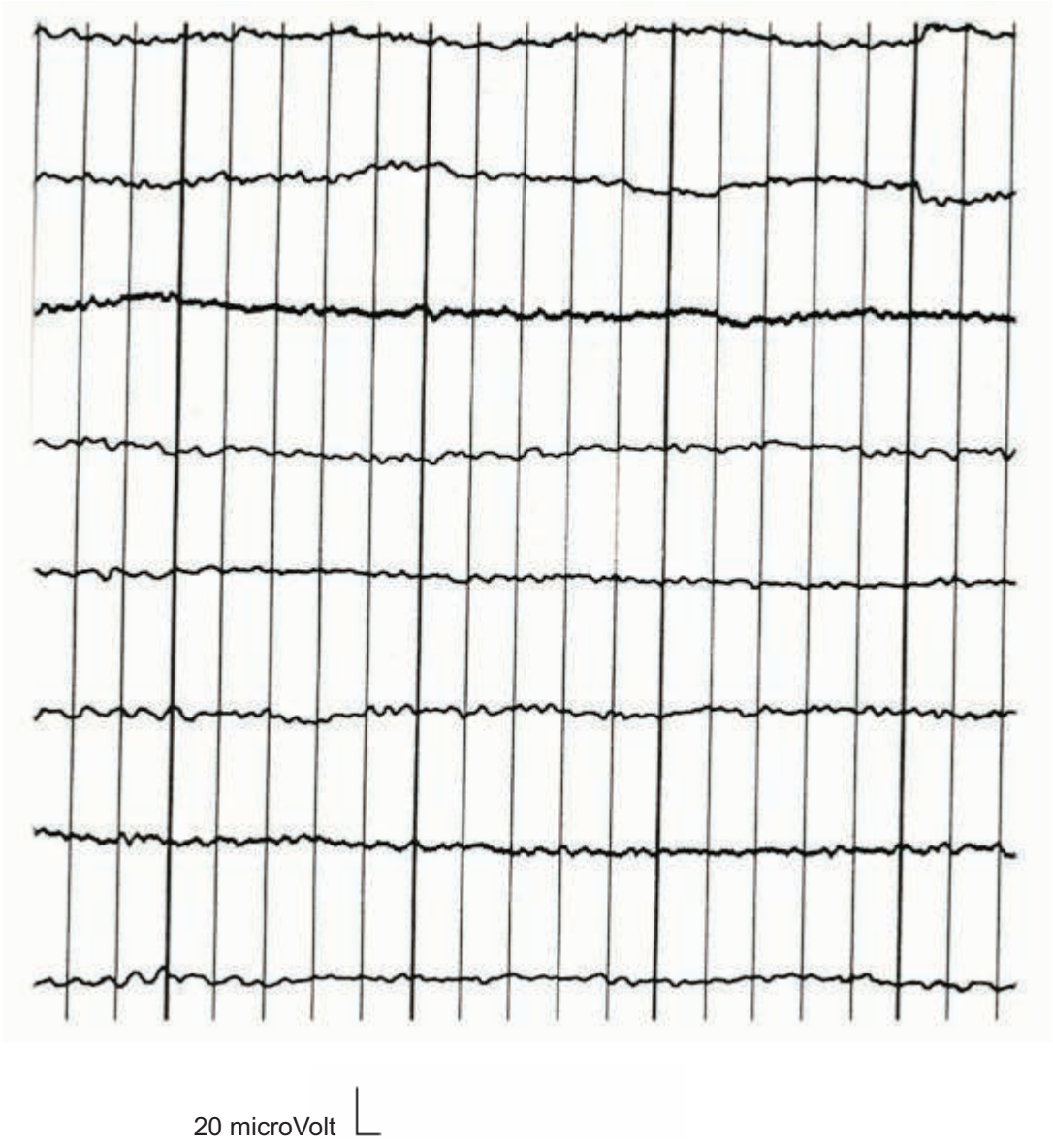

Figure 1: The low amplitude (<20microVolt) EEG pattern was seen in adult patients.

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