Research Article

Electroencephalogram (EEG) study in Different Stages of Chronic Kidney Disease

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Abstract
Introduction: Chronic kidney disease (CKD) refers to a condition related to irreversible kidney damage that can further progress to end- stage renal disease (ESRD).CKD is an increasing problem worldwide and is now being recognized as a global health burden particularly for cardiovascular and cerebrovascular ischemic events. Neurological manifestations related to electrolyte disorders, drug toxicity, and uremia are common in CKD. **Aim of the Work:** The aim of this study is to: Detect electroencephalogram (EEG) findings in different stages of chronic kidney disease for better evaluation and management of uremic encephalopathy. **Subjects and Methods:** This is a prospective observational study included 54 children with different stages of chronic renal diseases (from stage 1 to stage 5, undialysed and haemodialysed). All patients were recruited from the pediatric nephrology unit and pediatric hemodialysis unit at El-Minia university hospital, Minia governorate during the period from March 2015 to October 2016. **Results:** This is study included 54 children with different stages of chronic renal diseases (from stage 1 to stage 5). **Recommendation:** We recommend that EEG can be used to detect latent or subclinical encephalopathy, it will be helpful as a prognostic indicator of response to clinical therapy of CKD. One of our study limitations is the small number of studied cases, but our preliminary results could be the base for further evaluation. So, further studies with larger sample size is recommended for evaluating Electroencephalogram findings in different stages of chronic kidney disease.
Keywords: EEG, CKD, nephrology, neurology.

Introduction
Chronic kidney disease (CKD) refers to a condition related to irreversible kidney damage that can further progress to end- stage renal disease (ESRD).CKD is an increasing problem worldwide and is now being recognized as a global health burden particularly for cardio-vascular and cerebrovascular ischemic events. Neurological manifestations related to electro-lyte disorders, drug toxicity, and uremia are common in CKD. Appropriate drug dosing, awareness of potential side effects of medica-tions, prompt diagnosis, and treatment are essential in preventing neurological long-term morbidity and mortality[(1)].

Complex peripheral and central nervous disorders are seen in most patients with renal failure . Although patients with a cute renal failure mainly suffer from CNS symptoms such as cognitive deficits ,somnolence, or seizures, uremic encephalopathy in CKD has become less frequent with the use of modern techniques of renal replacement therapy. Uremic polyneuropathy is a common complication of chronic renal insufficiency in the peripheral nervous system (PNS). When patients reach the stage of chronic dialysis, a concomitant auto-nomic dysfunction is detectable in half of the cases[(2)].

Electroencephalography (EEG) is a non-invasive method to record electrical activity of the brain along the scalp. EEG measures voltage fluctuations resulting from ionic current within the neurons of the brain[(3)].

EEG is most often used to diagnose epilepsy, which causes abnormalities in EEG readings[(4)]. It is also used to diagnose sleep disorders, coma, encephalopathies, and brain death. EEG used to be a first-line method of diagnosis

for tumors, stroke and other focal brain disorders but this use has decreased with the advent of high-resolution anatomical imaging techniques such as magnetic resonance imaging (MRI) and computed tomography (CT), Despite limited spatial resolution, EEG continues to be a valuable tool for research and diagnosis, especially when millisecond-range temporal resolution (not possible with CT or MRI) is required.[5]

Aim of the Work

The aim of this study is to:
Detect electroencephalogram (EEG) findings in different stages of chronic kidney disease for better evaluation and management of uremic encephalopathy.

Subjects and Methods

This is a prospective observational study included 54 children with different stages of chronic renal diseases (from stage 1 to stage 5, undialysed and haemodialysed). All patients were recruited from the pediatric nephrology unit and pediatric hemodialysis unit at El-Minia university hospital, Minia governorate during the period from March 2015 to October 2016. The study was approved by the hospital's ethical committee and parental consents were obtained. The aim of this study was to investigate the Electroencephalogram findings in different stages of chronic kidney disease.
Patients were chosen according to the following:

- **Inclusion criteria:**

1) Children with different stages of chronic renal diseases.
2) Children with different ages (4-18 years).
3) Parent's approval to participate in the study.

- **Exclusion criteria:**

1) Children with hepatitis C (7 patients were already excluded).
2) Epileptic children(2 patients were excluded)
3) Children with abnormal CT, acute brain diseases or trauma.
4) Children with metabolic abnormalities and chronic liver diseases.
5) Children with central nervous system infections.

All patients were subjected to the following:

1. History taking including:
    1. Personal history: Name, age, sex and residence.
    2. History of chronic kidney disease and any infection.
    3. Familial history of chronic kidney disease.
    4. Neurological, developmental and psychogenic problems.
2. Examinations and investigations:
    1. Full clinical examination including: general examination, local, physical examination and measurements (weight, length and BMI).
    2. Laboratory investigations including:

Renal function including:

- Serum urea: Urea analysis was done by urease end point method (Modified Berthelot reaction) .In an alkaline medium, the ammonium ions react with the salicylate and hypochiorite to form green colored indophenols.
- Serum createnine: Createnine was done by createnine Jaffe kinetic method. Creatinine forms red orange colored complex with an alkaline picrate solution this method modified measure the rate at 510 nm.
- Elements: Including Sodium (Na) and Potassium (K) and Calcium (Ca) which were assayed on automated electro-lyte analyzers ILyte 4E002 122.
- Glomerular filtration rate (GFR) was calculated from serum creatinine by Schwartz formula.

Results

This is study included 54 children with different stages of chronic renal diseases (from stage 1 to stage 5).

The results will be presented as follows in tables (I:IX) and figures from (I :X) as follows:

Table (I): Demographic data of the studied group.

Variable		Description (54 cases)
Age (year) mean ± SD (range)		12.2 ± 3.5 (4-18)
Sex, No. (%)	Males	22 (40.7%)
	Females	32 (59.3%)
Distribution by residence	Urban	9(16.7%)
	rural	45(83.3%)
School attendace	Before illness	50(92.6%)
	After illness	14(26%)
Family history of kidney disease	Positive	5(9.3%)
	negative	49(90.7%)
Weight (kg) **Range** **mean ± SD**		9-53 30.7 ± 9.9
Height(cm) **Range** **mean ± SD**		76-174.5 141.1 ±18.6
BMI (body mass index) **mean**		15.5
SBP (mmHg) **Range** **mean ± SD**		75-160 108.12±22.63
DBP (mmHg) **Range** **mean ± SD**		50-100 70±15.44

Qualitative data presented as No. (%). Quantitative data presented as Mean ± SD

Table (I) shows that the mean age of the included children was 12.2 years (4-18) and 22(40.7%) of them were males and 32 (59.3%) were females.
Most of patients 45(83.3%) were from rural areas and the rest were from urban areas 9 (16.7%).

The majority of children 50(92.6%)were regularly attending school before illness but after illness only 14(26%) still regularly attend the school.
The mean ± SD weight for the study group was 30.7± 9.9 (range 9-53 Kg).
The mean ± SD height for the study group was 141.1±18.6 (range 76-174.5cm).
The mean ± SD systolic blood pressure was 108.12±22.63 (range 75-160 mmHg).

Discussion

According to the Kidney Disease Improving Global Outcome(KDIGO) guidelines, chronic kidney disease (CKD) is identified by the presence of kidney damage, either structural or functional, or by a decline in glomerular filtration rate (GFR) below 60mL/min/1.73m^2 of body surface area for more than 3 months[7].

The main etiologic factors of CKD in children are represented by congenital abnormalities of the kidney and urinary tract (CAKUT), steroid-resistant nephrotic syndrome (SRNS), chronic

glomerulonephritis (e.g. lupus nephritis, Alport syndrome) and renal ciliopathies[8].

The pediatric incidence of CKD in Europe is reported to be around 11–12 per million of age-related population (pmarp) for stages 3–5, while the prevalence is ~55–60 pmarp[9].

The prevalence of children diagnosed with end stage renal disease (ESRD) ranges from 65 to 85 per million age related population (pmarp) based on registries of western countries[10].

The median incidence of RRT in children < 20 years old is-9 pmarp worldwide, whereas the prevalence is reported as-65pmarp[11].

Recommendation

- We recommend that EEG can be used to detect latent or subclinical encephalopathy, it will be helpful as a prognostic indicator of response to clinical therapy of CKD.
- One of our study limitations is the small number of studied cases, but our preliminary results could be the base for further evaluation. So, further studies with larger sample size is recommended for evaluating Electroencephalogram findings in different stages of chronic kidney disease.

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