Brief Communication

Diagnostic utility of pediatric epilepsy monitoring unit: *Retrospective single center study*

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ABSTRACT

Objectives: To evaluate drug resistance epilepsy (DRE) patients with persistent seizures after using of standard antiepileptic drugs. This single center study aimed to investigate the utility of Epilepsy Monitoring Unit (EMU) resulted in a definitive diagnosis.

Methods: This was an observational retrospective study in 323 children who were admitted to the EMU for evaluation between 2012 and 2020.

Results: Of the 323 patients, 168 (52.01%) were males. The most common referral for EMU were better characterization 91 (28.17%) and pre-surgical evaluation 56 (17.3%). Of the participants, 273 (84.5%) had seizures one to 2 times per day. At discharge, 75.5% of admissions received a definitive diagnosis.

Conclusion: The EMU admission for pediatric epilepsy patients is very important for early accurate diagnosis and management with surgery for those consider DRE patients.

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The first epilepsy-monitoring unit (EMU) was established in eastern region of Saudi Arabia for delivery of specialized care, teaching and research in 2010. According to international league against epilepsy and local health ministry stated the comprehensive epilepsy care is essential for definitive diagnosis for adults and pediatric epilepsy patients with drug resistance epilepsy (DRE).[1] Previous study reported the epilepsy with a national prevalence of 6.54/1000 and each year the new case reported with range (20000-30000).[2] The epilepsy disease has huge impact on social, psychological and society, so it is important for proper and accurate diagnosis in early stage to control the disease and provide good care to the patients.[3,4] The early seizure reported and treated by general neurologist, which is challenging and miss-diagnosis of disorder that mimic with epilepsy.[1,5] The EMU center follow the international guidelines for referral epilepsy patients, in which the seizure is not control with treatment.[5] The multidisciplinary team do evaluation and diagnosis for therapeutic regimen (medical or surgical) for the epilepsy patients with video-electroencephalogram (EEG) monitoring.[1,5,6]

The objective of this retrospective review study was to investigate the pediatric patients admitted to an EMU for final diagnosis and this will change in initial diagnosis or treatment option.

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Methods. This observational retrospective study included patients between the ages of 0 and 18 years who were admitted for clinical evaluation to the Epilepsy Monitoring Unit (EMU) at King Fahad Specialist Hospital Dammam (KFSHD) between the years 2012 to 2020. The study was approved by the Institutional Review Board of the KFSHD and it was according to the ethical standards as was declared by Helsinki in 2020. Excluded from the study were records of patients older than 16 years of age, or discharged for nonmedical reasons (eg, personal matters).

Study variables. The variable selected for the present study based on previous similar study and NAEC guideline.[1,7] The following data were collected: demographic (age, sex), date of admission, date of discharge, number of days admitted, seizure semiology, seizure type, seizure duration, EEG data, neuroimaging findings of brain MRI, discharge diagnosis, medication regimen at discharge, follow-up plan, and referrals.

The attending epilepsy specialist based on video-EEG data, neurologic diagnostic tests, other diagnostic tests, and specialist consultation at discharge rendered the variable "definitive diagnosis". Four categories of definitive diagnosis were specified. The definitive diagnosis of epilepsy was established when the patient demonstrated symptomatology typical of the reason for admission with corresponding EEG abnormalities.[5,6] The category "unable to determine definitive diagnosis" was rendered by the attending epileptologist at discharge when diagnostic tests and consultation did not determine evidence of epilepsy events.

Table 1 - Demographics and clinical characteristics of patients.

Variables	n (%)
Gender	
Male	168 (52.1)
Female	155 (47.9)
Distribution of patients based on age	
0-12 months	29 (8.9)
13-48 months	75 (23.2)
49-120 months	123 (38.0)
121-202 months	96 (29.7)
Distribution of patients based on seizure onset	
0-12 month	135 (41.7)
13-48 months	89 (27.5)
49-120 months	58 (17.9)
121-202 months	23 (7.1)
Seizure frequency	
1 /Day	17 (5.2)
>2 /Day	273 (84.5)
NA	32 (9.9)
Duration of episode	
Seconds	81 (25.0)
<5 minutes	61 (18.8)
>5 minutes	127 (39.3)
NA	54 (16.7)

EMU Protocol. The Nihon Koden machines in the EMU used for the recording of video-EEG of long term montiring studies. IMPAX software used for obtaining the neuroimaging results and the reports. MRI was performed on a 1.5 Tesla GE Signa excite HDxt unit before June 2014, which was then upgraded to a 3 Tesla Siemens unit using a standard epilepsy protocol. The video-EEG monitoring setup used for continuous digital recording on the admitted patients to EMU.

Statistical methods. The data analysis was performed using IBM statistical package for the social sciences version for Windows, version 21 (IBM Corp., Armonk, N.Y., USA). Categorical data was analyzed by frequencies and percentages of occurrence. Continuous variables were analyzed using median and interquartile range or mean and standard deviation. All analyses were performed at a significance level of $p<0.05$.

Results. In 2020, there were 323 admissions to the EMU and data analysis based on exclusionary criteria. The mean patient age was 86.0 month (range, 0-202 months; **Table 1**), and 47.5% of the patients were female. The family history of epilepsy in reported (n=108, 33.4%), and not family history (n=182, 56.6%). Majority of the reported patient consanguinity (n=119, 36.8%) and not parents were related (n=113, 34.9%).

Table 2 - Distribution of patients based on reason for referral to EMU.

Reason for referral to EMU	n (%)
Non-Applicable	35 (10.8)
Better characterization of seizure	91 (28.1)
Presurgical evaluation	56 (17.3)
For diagnosis	14 (4.3)
Quantification (Intractable/refractory seizures or response to therapy)	48 (14.8)
Cognitive dysfunction (learning difficulties)	1 (0.3)
Multiple reason	80 (24.7)

Table 3 - Distribution of patients based on final diagnosis.

Final diagnosis for referral to EMU	n (%)
Epilepsy	244 (75.5)
Pseudo-seizure	20 (6.1)
Cardiogenic	2 (0.6)
Daydreaming	2 (0.6)
Other	51 (15.7)

Time since onset of seizures was between 0 and 202 months for all patients (median, 39.5; **Table 1**). The distribution of onset of seizure between 0 and 12 month (n=135, 41.1%), between 13-48 month (n=89, 27.3%), between 49-120 months (n=58, 17.7%) and between 121-202 months (n=23, 7.0%). 5.2 % had seizures 1 per day, and 83.7% had more than two seizures per day. 63.1% (n=206) of patients had received treatment for epilepsy. The duration of seizure reported one second (n=80, 24.7%), <5 minutes (n=59, 18.2%), >5 minutes (n=127, 39.3%).

The patient diagnosis no drug resistance epilepsy (DRE) (n=58, 17.9%) and DRE (n=35, 10.8%). The past medication reported with single drug (n=73, 22.6%), with 2 drugs (n=51, 15.7%) and more than 3 drugs (n=81, 25.0%). 25.3% of patients had been treated with 3 or more AEDs prior to admission. 20% (n=43) of patients received single dose and 16.0% (n=33) received 2 dose of AEDs. The longest period of seizure free more than years documented in 11.6% (n=38).

Eighteen of the patients (5.7%) presented with normal. The remaining 37 participants (11.4%) presented with focal and 39 (12.0%) with generalized EEGs (**Table 1**).

Eighty-two patients (25.3%) with normal, 13 (4.0%) with single lesion, 49 (15.1%) with diffuse lesion and 28 (8.6%) with localized lesion on MRI finding.

Primary reason for admission is described in **Table 2**. At discharge, 97.8% (n=319) of admissions were given a definitive diagnosis. Frequency for each diagnostic category is summarized in **Table 3**. Epilepsy was

diagnosed in 75.5% (n=244) of admissions. 17.3% of the 56 patients admitted for surgical evaluation were referred for surgery. Epilepsy was excluded in 15.9% (n=51) of admissions. A definitive diagnosis was not established in 4.7% of admissions.

Discussion. The main objective of good epilepsy care program is to provide accurate diagnosis, treatment with control side effect and better quality of life.[1,5,7] The medical history about seizure origin, duration and type obtained from family members or patients can lead to misdiagnosis in this disorder, so it is very important to obtain and record the EEG to capture the epileptic discharge and provide best option for treatment regimn.[7,8,9]

Around 5.7% of patients had normal EEG and did not show abnormal epileptic activity[10] and 19.4% showed focal and generalized seizure activity on video EEG in EMU. This is similar to previous studies.[10,11]

The previous studies showed higher number for normal EEG activity for epilepsy patients.[11,12] One of the reson for such difference is EMU in tertiary care and specialist hospital. The patient's referral to specialist hospital are diagnosed by not general neurologist and at early stages.[1,7] Second, the median time since onset of seizures was 39.5 months in our retrospective study. The previous studies in adult showed median of 6 years from onset of symptoms in EMU admission and highlighted the importance admission for accurate dignosis.[7] The surgery is option for the drug resistance epilepsy patients, which considered lack of efficacy and failed to response first line of AED treatment for more than two drugs.[9] The present study showed 16.0% (n=33) received two dose of AEDs.

The definitive diagnosis reported in the present study matched with previous literature about accurate diagnosis for EMU admission.[10,11] The early proper diagnosis and treatment is essential for better management of patients for quality of life, social life and cope with daily activity. This report is about pediatric epilepsy patients and global developmental delay (GDD) is major concern among such population .[13] Our previous study showed the 56% of GDD patients were diagnosed with epilepsy and other study reported 80% of pediatric epilepsy patients has one or more comorbid disease.[13,14] The EMU admission for pediatric epilepsy patients is very important for early accurate diagnosis and management with surgery for those consider DRE patients. Previous studies showed the temporal lobe epilepsy surgery is superior for seizure reeducation then medical therapy and for better quality of life.[12,15] In the present report, a 17.3% were referred for surgery, which is similar to previous reports about adult and children epilepsy patients.[11]

Conclusion. This is preliminary report consistent with international guidelines about the definitive diagnosis for pediatric patient's referral to EMU. These finding showed limitation due to retrospective study design. This study showed the importance to use of video EEG monitoring for detecting seizure event and help in diagnosis of refractory epilepsy in pediatric population. It is important to establish a local guideline at ministry level and send to primary health care facilities for recommendation of referral patients to EMU, in which seizure is not control with treatment. The early proper diagnosis is important and associated with better management and improved outcome. Future studies required include cost effective analysis, reason for delay of referral, surgery outcome and utilization of EEG, MRI analysis in final diagnosis.

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