Case Report

The effectiveness of neurology resident EEG training for seizure recognition in critically ill patients

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ABSTRACT

EEG monitoring in the ICU is essential for diagnosing seizures in critically ill patients. Neurology residents are the frontline for rapid diagnosis of seizures. Residents received EEG training through didactic lectures and their epilepsy rotations. We hypothesized that seizure recognition was dependent on epilepsy rotation, not the seniority of the residency. Residents were taught ACNS Standardized Critical Care EEG Terminology, unified EEG terminology and criteria for non-convulsive status epilepticus. EEG segments were given to residents for seizure recognition, and explanations provided to residents after each test. Anonymous results with the postgraduate training year (PGY) and time spent in epilepsy rotation were collected. These tests were conducted 3 times, with total of 48 EEG segments, between October, 2017 and May, 2019. There were 43 participates, including 4 PGY-1 (9.3%), 20 PGY-2 (46.5%), 12 PGY-3 (27.9%), and 7 PGY-4 (16.3%) residents. The mean rate of seizure recognition was 57.1% in PGY-1, 63.8% in PGY-2, 58.4% in PGY-3, and 70.1% in PGY-4. Comparing the duration of epilepsy rotations, the mean correct scores of seizure recognition were 58.6%, 64.6%, 64.4%, and 67.3% for duration at 0, 0.5, 1, and 2 months respectively. There was no significant difference regarding the PGY or the time of epilepsy rotation statistically by ANOVA (p = 0.37). Seizure recognition in the EEG of a critically ill patient is not solely dependent time spent in epilepsy rotation or stage of residency training. EEG interpretation skill may require an alternate approach, and continuous training.

1. Introduction

Continuous EEG (cEEG) monitoring in the intensive care unit (ICU) is essential for diagnosing seizures in critically ill patients. Clinical conditions of the ICU patients are often dynamic. Immediate recognition of new or persistent seizures on EEG can lead to early seizure detection and treatment, especially since some seizures may not be clinically apparent. In patients with unexplained mental status change, seizures were found in the cEEG of 63% with lateralized rhythmic delta activity, 57% with lateralized periodic discharges, and 80%–90% of seizures were nonconvulsive [1]. The cEEG monitor often displays the ongoing electrocerebral activity at the bed side. At times, if a diagnosis of seizures is in question, immediate bedside review of the cEEG can offer information prior to the completion of the test and official report. Neurology residents in the neurocritical care units are dedicated to taking care of the ICU patients and understandably are the frontline for rapid diagnosis of seizures. This also holds true for neurology residents who are on call overnight.

Neurology residents in our program receive EEG training through their didactic lectures at noon conference, and during their structured epilepsy rotation to read EEG with the attending epileptologists. Historically, most residents experienced their epilepsy rotation in their postgraduate year (PGY) of training as senior PGY-3 or PGY-4 residents. Currently, given the importance of seizure recognition, some neurology residents are given a month of epilepsy rotation during PGY-2 year. The hypothesis being tested is that seizure recognition is dependent on duration of completed epilepsy rotation(s), and not the seniority of the residents. Early EEG training during residency may directly impact ICU patient care.
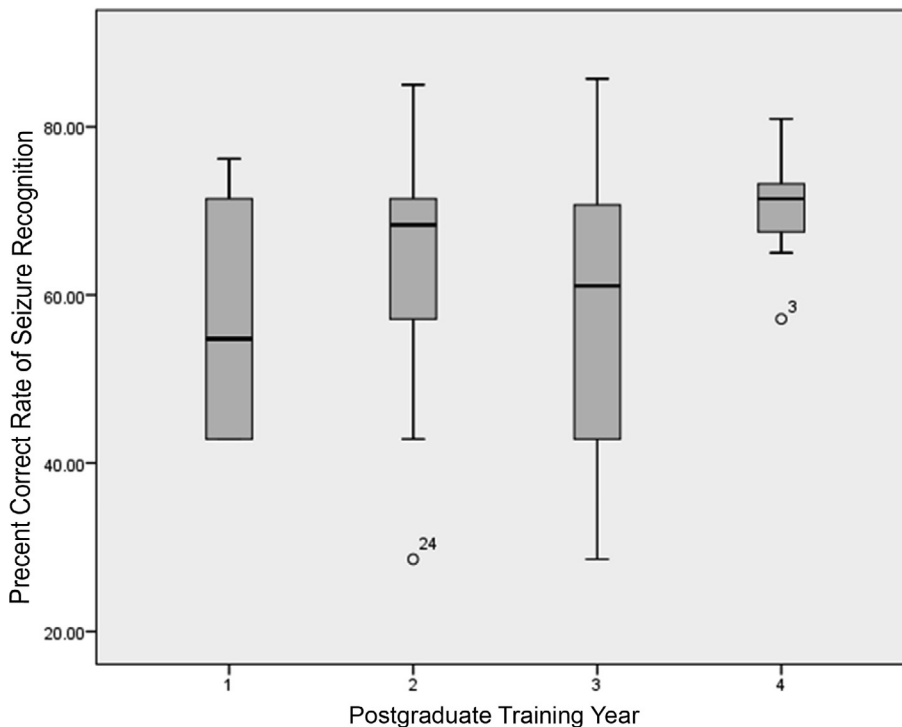
2. Materials and methods

The study was conducted during the neurology residents' noon conference as part of their routine didactic lecture education from Oct. 2017 to May, 2019. We are a 4-year adult neurology program
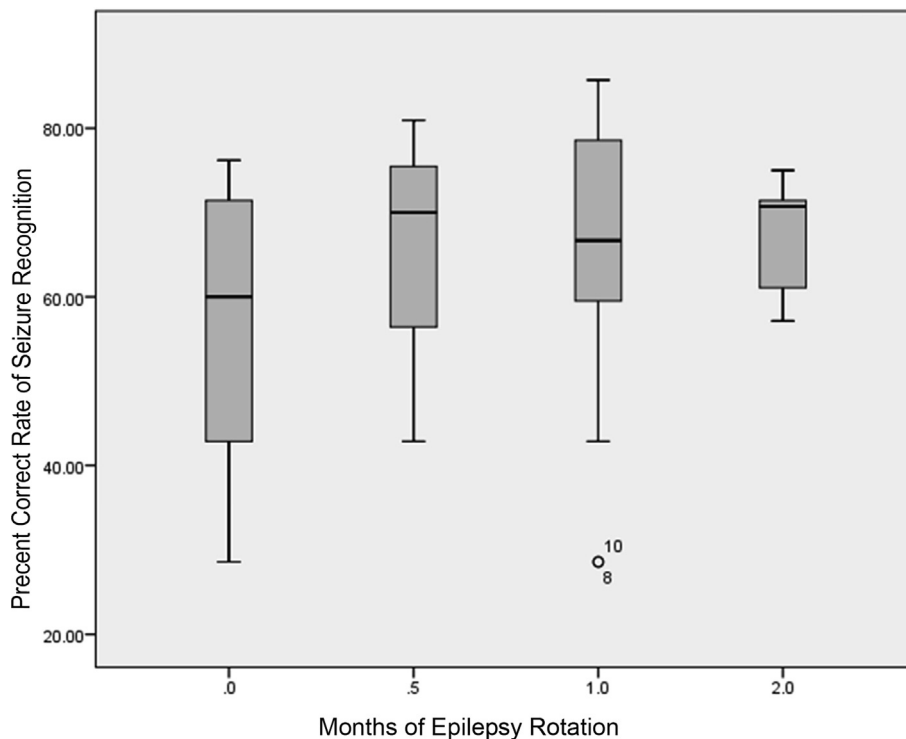

Fig. 1. Box plot reflecting the seizure recognition score distributed according to each PGY group. Each PGY group presents a median as shown by the line that divides the box into upper quartile and lower quartile with the whiskers for highest and lowest scores. The individual scores of PGY-4 residents have less variation than all other groups with only one lower at 57.

Fig. 2. Box plot method to depict seizure recognition score distribution in each epilepsy rotation duration in months. Each group presents a median as shown the line that divides the box into upper quartile and lower quartile with the whiskers for highest and lowest scores. The individual scores of residents who did 2 months epilepsy rotation have less variation than all other groups.

with an average of 23 total residents any given year, ranging from PGY 1to P4. The residents had lectures on America Clinical Neurophysiology Society (ACNS) Standardized Critical Care EEG Termi-nology [2], which were focused on seizure recognition and identifying rhythmic or periodic patterns, and unified EEG termi-nology and criteria for nonconvulsive status epilepticus [3]. There

was no screening or selection of participants. Some residents participated in the study 2 times in different PGY. Residents at conference were provided 48 cEEG clips during 3 noon conferences for interpretation. Continuous EEG clips were for convulsive or nonconvulsive seizures, generalized or lateralized periodic discharges, generalized or lateralized rhythmic delta activity with or without triphasic morphology, lateralized spike-and-wave discharges, alpha coma, sleep architecture with K complex, myogenic artifacts and blink artifacts. Continuous EEG segments were a pre-test questionnaire before the lecture. Participation was voluntary. Answer sheets were by checkbox seizure "yes" or "no" submitted anonymously aside from information on PGY and duration of epilepsy rotation. After the examination, the official cEEG results were given to residents as part of EEG teaching education. Only the answer sheets marked "yes" on "Permission to use the data for the propose of research" became this research data.

The rate of correct seizure recognition on EEG with the education levels, including PGY and months of epilepsy rotation were compared statistically with ANOVA by IBM SPSS 24.0 software for Windows (SPSS Inc., Chicago, IL). The statistical differences were considered significant as $p < 0.05$.

3. Results

There were 43 participants, including 4 PGY-1 (9.3%), 20 PGY-2 (46.5%), 12 PGY-3 (27.9%), and 7 PGY-4 (16.3%) residents. Most of the residents (39.5%) did not rotate through the epilepsy service at the time of testing. Only 18.6% completed 2 months epilepsy rotation, 34.9% completed 1 month, and 7% completed 2 weeks. The mean correct rate of seizure recognition was 57.1% in PGY-1, 63.8% in PGY-2, 58.4% in PGY-3, and 70.1% in PGY-4. The score distribution in each group is showed in Fig. 1. Comparing the months of epilepsy rotation, the mean correct seizure recognition was 58.6%, 64.6%, 64.4%, and 67.3% for duration of epilepsy rotation at 0, 0.5, 1, and 2 months respectively. The score distribution in each group is showed in Fig. 2. There was no significant difference regarding the PGY or the time of epilepsy rotation statistically ($p = 0.37$).

4. Discussion

Seizure recognition in a critically ill patient is challenging. We consider that the best way for residents to recognize electrographic seizures on cEEG is to read EEG with an attending during a structured epilepsy rotations. Therefore, our epilepsy rotation is offered to both junior and senior residents, and we hope that early EEG training during residency may directly impact ICU patient care. Our study did not show statistically significant differences by the postgraduate year in training or number of months of exposure during an epilepsy rotation. However, Figs. 1 and 2 illustrated that the distribution of resident's individual scores showed much less variation with the highest median score obtained by PGY-4 residents and residents who had epilepsy rotations for 2 months. A wide variation in the rate of correct seizure recognition is present among other groups of junior residents.

In general, EEG training is limited during neurology residency. In an adult neurology program, a median confidence score of 67% was present for PGY-4 residents using a scale of 0–100%. ,This was reported from fifty-five residents in 16 different neurology residency programs for interpreting common EEG abnormalities, creating a report, and recognizing a normal EEG [4]. Dericioglu and Ozdemir reported that the success rate of residents for correct EEG interpretation was between 17% and 50%, and that EEG train-

ing for 3 or 4 months and the amount of time since completimg training did not influence the results [5]. Due to resource constraints for the neurology residency program, most neurology residencies may not be able to increase their time for interpretation of EEGs during dedicated EEG rotations. New methods of EEG instruction, such as computer EEG teaching modules [6] and self-guided ACNS critical care EEG Terminology training slides [7] have been tested and used in neurology residency programs. We feel that it is difficult for residents to remember ACNS Standardized Critical Care EEG Terminology and unified EEG terminology and criteria for nonconvulsive status epilepticus when it is only presented in lecture format once every couple years. A two month opportunity to read EEG with an attending neurologist during an epilepsy rotation in a 3 year neurology residency training program is not enough to become competent in EEG interpretation. We have added EEG reading with an epileptologist to our monthly resident conference.

The limitation of the study is the small sample size for each level of training in our neurology program. With the large variation of individual resident's score, the power of the statistical analysis is low.

5. Conclusion

Seizure recognition in a critically ill patient is not solely dependent on time spent in an epilepsy rotation nor stage of one's residency training. Further research is required to determine whether alternate approaches, such as continuous exposure to EEG training throughout resident may lead to improved skill sets involving EEG interpretation.

Conflict of Interest

Declarations of interest: none.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical Statement

This human study was approved by Saint Louis University institutional Review Board on 8/31/2018, IRB Protocol 28506.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ebr.2020.100408.

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