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Incidence of recurrent seizures following hospital discharge in patients with LPDs (PLEDs) and nonconvulsive seizures recorded on continuous EEG in the critical care setting

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ABSTRACT

Purpose: Continuous EEG (cEEG) has helped to identify nonconvulsive seizures (NCS) and nonconvulsive status epilepticus (NCSE) along with lateralized periodic patterns (LPDs or PLEDs) in ICU patients with much higher frequency than previously appreciated, but understanding their implications may be more complex. The aim of this study was to investigate the incidence of recurrent seizures after hospital discharge and their associated factors in patients with PLEDs and NCS in the critical care setting.

Methods: After IRB approval, we used our EEG reporting database to find 200 consecutive patients who had PLEDs and/or NCSs on cEEG. Patients with less than 3 months of follow-up were excluded. Remaining patients were divided into three groups: PLEDs + Seizure (NCS/NCSE), PLEDs only, and Seizures (NCS/NCSE) only. Medical records were reviewed to gather demographical and clinical details. Univariate data analysis was done using JMP 9.0 (Marlow, Buckinghamshire, UK).

Results: There were 51 patients in 'PLEDs + Seizure' group, 45 in 'PLEDs only' group, and 22 in 'Seizure only' group. Ischemic stroke, hemorrhage, and tumors were the top three etiologies. Nearly 47% of our study population had postdischarge seizures during a mean follow-up period of 11.9 (+/− 6) months. We found that 24.4% of patients in the PLEDs only group had seizures after discharge, which increased to 60.7% if they had seizures as well during their ICU stay. Slightly more than 52% of patients had a postdischarge EEG, of which, 59% was in the form of inpatient cEEG during a rehospitalization, accounting for 30.5% of the total study population. It was an indicator of high readmission rates in this population.

Conclusion: Almost every other patient with PLEDs and/or NCS on cEEG had seizures after ICU discharge. A quarter of patients on cEEG in the ICU with PLEDs alone had seizures after discharge, and after excluding prior epilepsy, 17% of patients with PLEDs had seizures on follow-up. This was dramatically increased with the recording of PLEDs with NCS, with 60% of patients having seizures after discharge from the ICU and 48% of patients after excluding prior epilepsy. Patients with NCS on cEEG alone had 63% chance of seizure recurrence that dropped to 38% with exclusion of prior epilepsy. Future studies are needed to define the postdischarge outcomes including seizure recurrence in this patient population.

This article is part of a Special Issue entitled "Status Epilepticus".

1. Introduction

The use of continuous EEG (cEEG) monitoring has increased dramatically with the awareness of high prevelances of nonconvulsive seizures (NCS) and nonconvulsive status epilepticus (NCSE) in critically ill patients with acute to subacute brain insults [1–4], both of which impact short-term outcomes [5–7]. Apart from NCS and NCSE, several interictal periodic patterns are seen among these patients. One commonly identified and studied pattern is the lateralized periodic discharge (LPD, as per new terminology [8]) or more popularly and conventionally known as periodic lateralized epileptiform discharges (PLEDs; of note, LPDs and PLEDs are used interchangeably in this report due to historical reasons). Approximately 58-90% of patients with PLEDs experience clinical seizure activity during hospitalization [9–11]. The presence of PLEDs is an independent risk factor for poor outcome during hospitalization [6] and is associated with 25%–41% mortality rate [11,12]. Though cEEG has helped in frequent identification of such electrographic features, understanding the implications of these epileptiform discharges (PLEDs) and EEG seizures is more complex. While extensive data and knowledge have been generated in the last 10–15 years regarding the short-term significance of NCS/NCSE and PLEDs, there is only limited literature available regarding their long-term significance, specifically regarding seizures post-ICU discharge. A few pre-cEEG era case series, reporting

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on a small number of patients with PLEDs and clinical seizures, found 10–58% of them having recurrence of seizures during follow-up [12,13]. In fact, no study, to the best of our knowledge, has reported on seizures after discharge in patients who had only PLEDs during hospitalization. With PLEDs identified in around 15% of cEEG studies [6], it is an important information gap in the literature. Similarly, such information is lacking for patients who had NCS/NCSE during acute brain injury as well. One recent study of a critically ill pediatric population who were diagnosed with NCS/NCSE by cEEG found that 19 of 54 subjects had new onset epilepsy after ICU discharge [14].

We performed our study to fill the void in our current knowledge about the incidence of seizures in patients with PLEDs and NCS/NCSE following hospital discharge. Therefore, we aimed to investigate the incidence of recurrent seizures and associated factors with PLEDs and NCS/NCSE in patients in the critical care setting.

2. Methods

The study was approved by the institutional review board of the Cleveland Clinic. We searched our cEEG reporting database to screen all cEEG performed in 2013 to find 200 consecutive patients who had PLEDs and/or NCSs/NCSE during hospitalization. We did not differentiate between patients with NCS or NCSE in our cohort because of the authors' observation of wide variability in the strict application of the definition of NCSE at our center (NCS from here on implies either NCS and/or NCSE). Patients who had less than 3 months of follow-up after discharge were excluded from this population and further analysis. Remaining patients were divided into three groups: PLEDs + Seizure (NCS), PLEDs only, and Seizures (NCS) only.

Our electronic medical record system was used to review clinical charts of these patients. We extracted information regarding their demographics, etiology of acute presentation, and previous history of epilepsy. The charts were also reviewed until the last clinical follow-up to find recurrence of seizures postdischarge, their antiepileptic drug (AED) status, and Glasgow outcome scale (GOS) at this time. Glasgow outcome scale scores of ≤3 were categorized as unfavorable representing a functional status below moderate to severe disability. We also used our EEG reporting database to find out if these patients had an EEG postdischarge, type of the postdischarge EEG, and the presence or absence of epileptogenic activity (spike, sharp waves, or frank EEG seizures) on the postdischarge EEG.

Data analysis was done using JMP 9.0 (Marlow, Buckinghamshire, UK). Univariate analysis was performed on the categorical data using chi-square, Fisher's exact, and odds ratio. Analysis of variance was used to compare ages between different groups. A p-value of <0.05 was considered significant.

3. Results

A total of 1163 consecutive patients who had cEEG monitoring during 2013 were screened to find 200 patients with PLEDs and/or NCS. Eighty-two patients were excluded from this population because of less than 3 months of clinical follow-up (Fig. 1 shows the study flow chart). Table 1 compares the excluded population to the study population. The two populations were similar except for the presence of patients with anoxic brain injury in the excluded group. The remaining 118 patients formed the cohort for the analysis reported here.

When divided into subgroups, there were 51 patients in 'PLEDs + Seizure' group, 45 in 'PLEDs only' and 22 in 'Seizure only' group. Just over 53% of patient with PLEDs in our series had seizures during their ICU stay.

3.1. Demographics and clinical outcomes (Table 2)

The average age of our study population was 60.7 (+/− 18.3) years with no significant difference between the subgroups ($p = 0.16$). There were only 4 pediatric patients (<18 years of age) in the study population. The subgroups were well matched by gender and history of epilepsy.

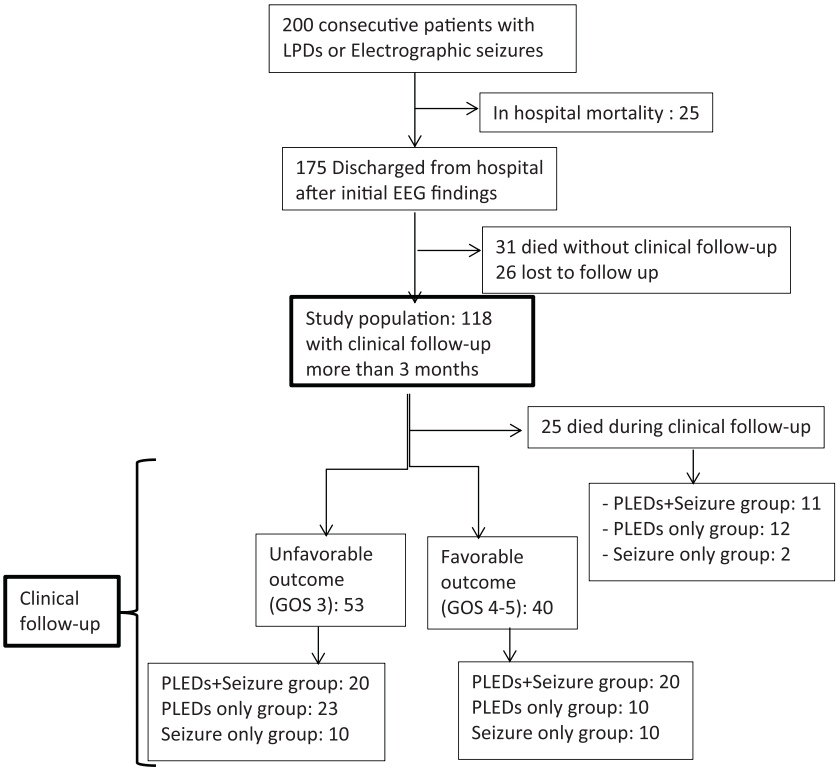

Fig. 1. Study flowchart (with functional outcome during follow-up). Note: no patient in our study population had a Glasgow Outcome Scale (GOS) score of 2.