Poster P419

Seizure Duration and Time-point Cutoffs for Statistically Defining a Prolonged Seizure: A Post-Hoc Analysis of the SCORE Video-EEG Database

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Overview

QUESTION

What are the statistically appropriate time-point(s) for defining possibly or probably prolonged seizures by seizure type?

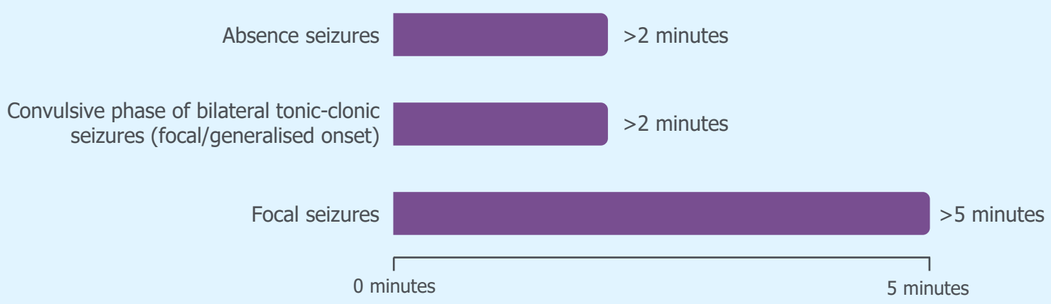
INVESTIGATION

This was a post-hoc analysis of 2742 seizures from 887 video-electroencephalography (V-EEG) recordings of 725 patients. Seizure duration was measured clinically or via EEG and analysed using Tukey's box plot (including outliers).

BACKGROUND

Previous research

Consensus definition of time-point cutoffs for prolonged seizures[1,2]



1. Dobesberger J, et al. *Epilepsy Behav* 2015;49:111-117. 2. Pina-Garza JE, et al. *Epileptic Disord* 2024;26(4):484-497.

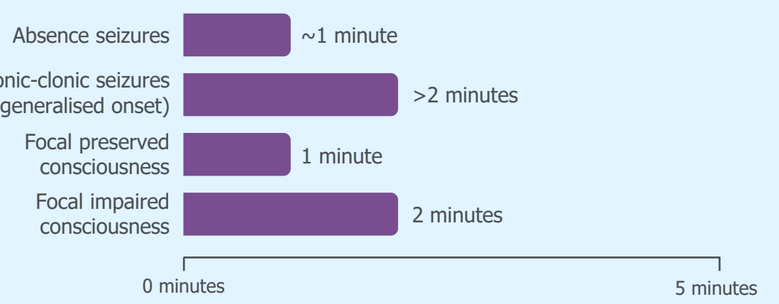
RESULTS

Proportion of prolonged seizures by observation type

	Clinical	EEG
Possibly/ probably prolonged	**4%** (n=97/2742)	**6%** (n=159/2742)
Probably prolonged	**1%** (n=30/2742)	**3%** (n=69/2742)

Current analysis

Statistical time-point cutoffs for possibly prolonged seizures



CONCLUSIONS

Our data suggest an appropriate focus on absence, tonic-clonic, and focal seizures as being more prolonged than other seizure types. The findings support the 2-minute cutoff for tonic-clonic seizures (focal or generalised onset). However, the statistical cutoff of ~1 minute for absence seizures and 1-2 minutes for focal seizures suggest the consensus definition may be too conservative at 2 and 5 minutes, respectively. Other generalised seizure types may become abnormally prolonged earlier (within <30 seconds).

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Background

- Most seizures are brief and self-limiting; however, some will cluster, become prolonged and progress in severity.
- Accurately defining the time-point at which seizures become prolonged is important, as it helps inform when to ideally administer acute medication to prevent status epilepticus (SE).
- Prolonged seizures have been defined as >2 minutes for absence seizures and the convulsive phase of bilateral tonic-clonic seizures (focal or generalised onset), and >5 minutes for focal seizures.[1,2]

Objective

- The objective of this study was to explore statistically appropriate time-point(s) for defining possibly or probably prolonged seizures by seizure type.

Methods

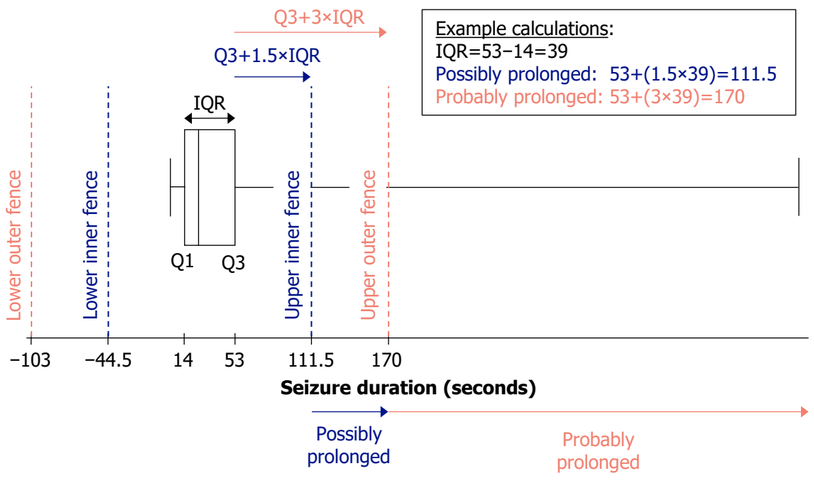
SCORE DATABASE

- Routine video-electroencephalography (V-EEG) recordings were conducted in patients at the Danish Epilepsy Centre, Dianalund, Denmark, and in a satellite EEG laboratory in Nuuk, Greenland between April 30, 2013 and September 7, 2020.[3]
- EEG and semiology features were prospectively registered in a large, structured V-EEG database (Standardized Computer-Based Organized Reporting of EEG [SCORE]).[3]
- Recordings were carried out for either 30 minutes (routine EEG), 60 minutes (sleep EEG), or up to 4 hours (short-term V-EEG monitoring), and included provocations such as hyperventilation and intermittent photic stimulation.[3]

POST-HOC ANALYSIS

- This was a post-hoc analysis of 2742 seizures from 887 V-EEG recordings of 725 patients (including outliers for seizure durations).
- The durations of various seizure types from consecutive patients were measured clinically or via EEG; myoclonic jerks were measured by surface electromyography (EMG).
- Clinical seizure duration was defined as the time between initial clinical signs, either reported by the patient or observer, and cessation of clinical phenomenon.
- EEG seizure duration was defined as the time between the initial transition from background activity to ictal activity (focal or generalised) and the cessation of that activity/initiation of postictal EEG activity (suppression or slowing).
- For each seizure type, seizure durations were analysed using Tukey's box plot and outliers were categorised as possibly prolonged (>1.5 × interquartile range [IQR] above the 75th percentile [Q3]), or probably prolonged (>3 × IQR above Q3).
- Each patient had a maximum of 5 seizures captured and analyses were conducted at the seizure level; therefore, each patient could have had multiple seizure types analysed.
- Patients with SE or suspected SE were excluded.

Schematic of Tukey's method (example for focal impaired consciousness seizures captured clinically)



IQR, interquartile range; Q1, 25th percentile; Q3, 75th percentile.

Results

PATIENT DEMOGRAPHICS

- The median age was 17 years (range: 3 weeks to 79 years; 60% female).[3]

PROPORTION OF PROLONGED SEIZURES

- Using Tukey's method, 4% (97/2742) of seizures observed clinically were classified as either possibly or probably prolonged, and 1% (30/2742) were classified as probably prolonged.
- For seizures observed via EEG, 6% (159/2742) were classified as either possibly or probably prolonged, and 3% (69/2742) were classified as probably prolonged.

STATISTICAL CUTOFFS FOR POSSIBLY PROLONGED SEIZURES

Time-point cutoffs for defining possibly prolonged seizures

SEIZURE TYPE	NUMBER OF SEIZURES CAPTURED CLINICALLY AND VIA EEG		TIME-POINT CUTOFFS FOR DEFINING POSSIBLY PROLONGED SEIZURES, IN SECONDS	
	CLINICAL	EEG	CLINICAL	EEG
Focal seizures				
Focal preserved consciousness	31	32	48.75	60.5
Focal impaired consciousness	75	79	111.5	146.75
Focal consciousness unknown	79	66	48.5	70.25
Focal clonic	6	7	48.5	56.5
Focal tonic	67	66	45.75	51.75
Bilateral tonic-clonic seizures				
Focal to bilateral tonic-clonic	8	7	167.75	189.5
Generalised tonic-clonic	8	8	127	120.25
Absence seizures				
Typical absence	442	449	20	23.25
Atypical absence	130	134	44.25	50
Myoclonic absence	26	26	20.75	21
Absence with eyelid myoclonia	27	27	10	9
Other generalised seizures				
Generalised clonic	13	13	14	15.25
Generalised tonic	169	156	24.5	21.25
Myoclonic tonic	9	9	9	7
Tonic spasm	46	46	15.5	15.5
Eyelid myoclonia	206	206	6.3	6
Repetitive myoclonic seizures in series				
Myoclonic jerks	11 (EMG)		1.18 (EMG)	

EEG, electroencephalography; EMG, electromyography.

- The statistical time-point cutoffs (clinical/EEG duration in seconds) for defining possibly prolonged seizures were as follows:
  - **Focal seizures**: 48.75/60.5 for focal preserved consciousness, 111.5/146.75 for focal impaired consciousness, 48.5/70.25 for focal consciousness unknown, 48.5/56.5 for focal clonic, and 45.75/51.75 for focal tonic.
  - **Bilateral tonic-clonic seizures**: 167.75/189.5 for focal to bilateral tonic-clonic, and 127/120.25 for generalised tonic-clonic.
  - **Absence seizures**: 20/23.25 for typical absence, 44.25/50 for atypical absence, 20.75/21 for myoclonic absence, and 10/9 for absence with eyelid myoclonia.
  - **Repetitive myoclonic jerks in series**: 1.18 for myoclonic jerks in series (measured by surface EMG).
- The most appropriate time-point for defining a possibly prolonged seizure may need to differ depending on the method of data capture, i.e., clinical or EEG recording.

Strengths

- This study had a large sample size, and to our knowledge is the first study to apply a statistical approach to assessing the time-point at which seizures become abnormally prolonged.
- Patients did not undergo withdrawal from antiseizure medication and therefore the recordings reflected the patient's habitual state.[3]

Limitations

- Patients with SE or suspected SE were excluded (n=20) because it was not possible to capture the duration of the seizure/ictal activity.
  - For these excluded patients, it was unclear when seizure activity started before the recording or for how long it continued after the recording.
  - The effect of excluding these 20 patients might have caused an underestimation of the seizure durations presented here.
- Differences between clinical and EEG recordings were observed; however, statistical tests for significance were not conducted.
- The seizure categorisation used in this study was not the exact same as all the categories used in the consensus definition[2]; for example, we could not directly compare the "convulsive phase of bilateral tonic-clonic seizures".

Conclusions

- Our data suggest an appropriate focus on absence, tonic-clonic, and focal seizures as being more prolonged than other seizure types.
- The findings support the 2-minute cutoff for tonic-clonic seizures (focal or generalised onset).
- However, the statistical cutoff of ~1 minute for absence seizures and 1-2 minutes for focal seizures suggest the consensus definition may be too conservative at 2 and 5 minutes, respectively.
  - Focal preserved consciousness seizures may become prolonged from 1 minute, and focal impaired consciousness seizures from 2 minutes.
- While there are differences, our findings align with the consensus recommendations in that the statistical time-point cutoffs for defining prolonged seizures are much earlier than previously thought, particularly compared with the thresholds used to describe SE (from 5-15 minutes).[2] This helps to clarify the ideal timing of intervention to stop the progression to an even longer or more severe seizure.
- Other generalised seizure types may become abnormally prolonged earlier (within <30 seconds).

References

1. Dobesberger J, et al. *Epilepsy Behav* 2015;49:111-117.
2. Pina-Garza JE, et al. *Epileptic Disord* 2024;26(4):484-497.
3. Meritam Larsen P, et al. *Epilepsia* 2023;64(2):469-478.

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