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Abstract

Objective: To determine the inter-rater agreement (IRA) of a standardized nomenclature for EEG spectrogram patterns, and to estimate the probability distribution of ictal-interictal continuum (IIC) patterns vs. other EEG patterns within each category in this nomenclature.

Methods: We defined seven spectrogram categories: "Solid Flames", "Irregular Flames", "Broadband-monotonous", "Narrowband-monotonous", "Stripes", "Low power", and "Artifact". Ten electroencephalographers scored 115 spectrograms and the corresponding raw EEG samples. Gwet's agreement coefficient was used to calculate IRA.

Results: Solid Flames represented seizures or IIC patterns 69.4% of the time. Irregular Flames represented seizures or IIC patterns 38.7% of the time. Broadband-monotonous primarily corresponded with seizures or IIC (54.3%) and Narrowband-monotonous with focal or generalized slowing (43.8%). Stripes were associated with burst-suppression (37.2%) and generalized suppression (34.4%). Low Power category was associated with generalized suppression (94%). There was “near perfect” agreement for Solid Flames (κ=94.36), Low power (κ=92.61), and Artifact (κ =93.72). There was “substantial agreement” for all other categories (κ =74.65-79.49).

Conclusions: This EEG spectrogram nomenclature has high IRA among electroencephalographers.

Significance: The nomenclature can be a useful tool for EEG screening. Future studies are needed to determine if using this nomenclature shortens time to IIC identification, and how bst to use it in practice to reduce time to intervention.

Keywords: Continuous EEG monitoring, quantitative EEG nomenclature, spectrograms, inter-rater agreement, seizures, IIC patterns.

Highlights

The proposed standardized spectrogram EEG nomenclature has high inter-rater agreement.

The probability of ictal-interictal continuum (IIC) vs. other patterns with each nomenclature category can aid EEG screening.

Prospective studies will determine if the nomenclature can expedite IIC detection and treatment.

Abbreviations: ACNS, American Clinical Neurophysiology Society; cEEG, continuous EEG; GRDA, generalized rhythmic delta activity; GPDs; generalized periodic discharges; ICU, intensive care unit; IIC, ictal-interictal continuum; IRA, Inter rater agreement; LPDs, lateralized periodic discharges; LRDA, lateralized rhythmic delta activity; MGH, Massachusetts General Hospital

1. Introduction

Seizures and ictal-interictal continuum (IIC) EEG patterns occur in up to 40% of critically ill patients monitored with continuous EEG (cEEG) (Claassen et al., 2007; Oddo et al., 2009; Kurtz et al., 2014; Sivaraju and Gilmore, 2016). Higher seizure and IIC burden are associated with worse functional outcomes (De Marchis et al., 2016; Zafar et al., 2018), and delay in diagnosis and treatment of non-convulsive seizures has been shown to be associated with higher mortality (Young et al., 1996). However, implementation of real-time screening of seizures and IIC using cEEG has been challenging given the limited availability of experts with training in clinical neurophysiology and the time consuming nature of raw EEG review (Gavvala et al., 2014; Moura et al., 2014).