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Artificial intelligence system, based on mjn-SERAS algorithm, for early detection of seizures in patients with refractory focal epilepsy: a cross-sectional pilot studydy

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Introduction

About one-third of patients with epilepsy develop drug-resistant seizures. The seizure prediction could help to improve safety, reduce patient anxiety, increase independence and allow acute treatment. Over the past years the use of artificial intelligence and machine learning algorithm techniques has increased significantly in different health conditions including epilepsy. The main aim of this study is to determine if the artificial intelligence algorithm (developed by MJN Neuroserveis) is able to early detect accurately seizures in previously diagnosed epilepsy patients based on a video-EEG training set.

Methods

A retrospective cross-sectional, observational, multicenter study to determine the sensitivity and specificity of the artificial intelligence algorithm. We performed a search in the database of the Epilepsy Units of three Spanish medical centers and selected 50 patients evaluated between January 2017 and February 2021, diagnosed of refractory focal epilepsy with video-EEG monitoring records between 3 to 5 days, a minimum of 3 seizures per patient, lasting more than 5 seconds and the interval between each seizure was greater than 1 hour. The exclusion criteria included age <18 years, intracranial EEG monitoring and severe psychiatric,

neurological or systemic disorders. The identification of preictal and interictal patterns from EEG data was performed using our learning algorithm, mathematical models of each patient were trained using these features data set.

Results

A total of 1,963 hours were recorded from 49 video-EEG monitoring, with an average per patient of 39.26 hours. The video-EEG monitoring registered 309 epileptic seizures according to the posterior analysis of the epileptologists from each patient EEG data. The MJN Neuroserveis algorithm employed 100% of the seizures collected by the video-EEG monitoring, where 119 seizures were used only to train algorithms and 188 seizures were used for the test split. This model showed 10 false negatives (no detection of episodes recorded by video-EEG) and 22 false positives (the alert is detected without a clinical correlation or abnormal EEG signal in the next 30 minutes). Specifically, the MJN AI algorithm achieved 94,7% (CI95% 94.67-94.73) of sensitivity, 92,2% (CI95% 92.17-92.23) compared to reference yield represented by a mean F-Score (harmonic mean or average) of specificity and positive predictive value of 91% with 0.55 false-positive detections (FPs)/24 hours in the patient-independent model.

Conclusions

Our model showed a high performance, both in terms of sensitivity and false positive rate. Furthermore, the training of the algorithm and the calculation of new samples have a high computational requirement in specialized cloud servers, but a light computational load in real-time, which allows its implantation in embedded devices for online seizure detection.