Predictive Value Of Autonomic Variable And Their Correlation With Electrophysiological Signals For Seizures In Refractory Epilepsy

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There has been much recent interest in the role played by autonomic dysfunction in seizure generation. Here we investigate circadian and peri-ictal changes in surrogate measures of autonomic activity in epilepsy patients using a wearable device. With prior IRB approval, one patient admitted for presurgical evaluation using electrocorticography (ECoG) was monitored for four days with additional sensors for surface EEG (fronto-central), submental EMG and a wrist-worn device that measured acceleration (ACC), heart rate (HR), electrodermal activity (EDA), skin temperature (ST), and blood volume pulse (BVP). Six clinical seizures, all during sleep, and corresponding one-hour preictal segments, were extracted for analysis along with six one-hour interictal segments, 4 during wakefulness and 2 during sleep. In each segment, the mean value of each variable (excluding EEG and EMG) was computed in successive 2-min epochs and compared for interictal sleep, interictal wake, and preictal periods using ANOVA. A naive Bayes classifier was designed and tested using ten-fold cross-validation to assess the feasibility of distinguishing preictal from interictal epochs using autonomic variables alone. EDA increased drastically, while ACC, HR and BVP experienced marked variability, in the ictal versus the preictal period. There were significant differences in EDA and HR between preictal and interictal segments (ANOVA; $p < 0.001$); a slight difference seen in skin temperature (ST) did not reach significance ($p = 0.052$). The naive Bayes classifier labeled preictal epochs with 90% sensitivity and 96% specificity. Appreciable preictal changes in EDA, ST, and HR were documented in the one patient monitored thus far. These findings, though anecdotal, raise the possibility that autonomic measurements may help detect critical states in patients with epilepsy.

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