Possible Interruption of Pilocarpine-Induced Status Epilepticus In Rats Via Concentric Ring Electrode Transcutaneous Electrical Stimulation

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Rationale:

We sought to evaluate the effect of transcutaneous electrical stimulation (TcES) via concentric ring electrodes on ictal electrographic and behavioral activity and mortality in rats with pilocarpine-induced status epilepticus (SE).

Methods:

Male Sprague-Dawley rats (280-330 g) were briefly anesthetized and three concentric ring electrodes were affixed to their scalps one day before the experiment. Scopolamine methylnitrate (2 mg/kg i.p.) was given 30 minutes prior to pilocarpine. Pilocarpine HCl (310mg/kg i.p) was given to cause long lasting SE. Laplacian EEG was recorded from tri-polar concentric ring electrodes on the scalp. TcES was applied five minutes after the onset of SE. Time-frequency analysis was performed on the Laplacian EEG signals to compare the electrographic activity before and after the application of TcES. Behavior was monitored by inspection. Survival was assayed at 24 h after administration of pilocarpine.

Results:

Control rats (n=13) followed the classic electrographic stages of pilocarpine-induced status epilepticus described by Treimen (1987) and expired on average 16 hours after the pilocarpine injection. Three outcomes were observed in the TcES treated rats (n=31): (A) 13 rats ceased all behavioral and electrical seizure activity within minutes; (B) 11 rats had lessened behavioral activity and lowered ictal frequencies with increased interictal periods; and (C) 7 rats had lessened behavioral activity but no evident changes in the LEEG. The 24 ((A)&(B)) TcES treated rats lived significantly longer than the 13 untreated controls ($p=0.024$, Two-Sample t-Test). Twenty-four hours after the pilocarpine injection, eighteen (58%) of the TcES-treated rats versus three (15.0%) control rats were alive ($p=0.005$, Mann-Whitney U test). All ((A)&(B)) TcES-treated rats recovered to baseline activity, including eating and drinking. By contrast, none of the control rats ate or drank after they entered SE. The time-frequency analysis showed evident differences before and after TcES.

Conclusions:

The application of TcES appears to have increased the survival chances of rats with pilocarpine-induced SE. Positive TcES effects on electrographic and behavioral manifestations of seizure activity were significant and persistent. TcES may represent a novel and effective early treatment for SE. Further testing of TcES via concentric ring electrodes is warranted.

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