

Regional cerebral blood flow changes after accelerated repetitive transcranial magnetic stimulation of the canine frontal cortex.

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Abstract:

Repetitive transcranial magnetic stimulation (rTMS) is a non-invasive, FDA approved treatment for depression. Nevertheless, this treatment's neurobiological mechanisms remain unclear.

Aim: To compare the regional cerebral bloodflow prior and after accelerated High Frequency Accelerated Repetitive Transcranial Magnetic Stimulation (HF-rTMS) of the normal canine left frontal cortex.

Material and Methods: Eight dogs underwent a 3 Tesla MRI scan at the Ghent University Hospital. This scan was the basis for pointer-based neuronavigation (Brainsight 2, Rogue Resolutions, LTD), a technique used to externally locate the stimulation site. Each dog's left frontal cortex was subjected to 5 consecutive stimulation sessions a day with a figure 8 coil (Magstim Company Limited, Wales, UK) at 20 Hz. The sessions consisted of 40 trains of 1.9 seconds duration, separated by a 12 second intertrain interval (1560 pulses per session). The stimulation intensity was set at 110% of the motor threshold. One day prior and after the last stimulation session, a ^{99m}Tc-HMPAO SPECT scan was acquired under general anaesthesia. SPECT data were acquired with a triple head gamma camera (Trionix, Triad) 30 minutes after tracer injection (step and shoot, 120 steps of 3°, 10" per step). The data were reconstructed with HOSEM reconstruction and application of resolution recovery algorithms (Hybrid, Hermes, NUD, Sweden). A BW filter was applied (cut-off 1.6 cycles/cm, order 5). The perfusion indices (PI) in the frontal, parietal, temporal, rostral cingulate and caudal cingulate cortex as well as subcortical regions (thalamus, striatum) were obtained by semi quantification (normalization to total brain counts). A Wilcoxon signed rank test was used to analyze the perfusion indices. Significance level was set at $p < 0.05$.

Results: The stimulation sessions caused a significantly increased PI in the left frontal cortex ($p = 0.01$) and a decrease in the right parietal cortex ($p = 0.03$). No significant differences were noted for the other regions compared to baseline.

Conclusions: Accelerated HF-rTMS of the frontal cortex in dogs provokes an increase in rCBF at the stimulation site. This finding is line with its effects in humans and implies that rTMS could be used as a treatment for behavioral disorders in dogs. This study provides again proof that the canine species can be a valuable natural animal model for human disease and treatment. Further investigation is needed to evaluate the stimulation parameters and long-term effects of such stimulation.