Transcranial Magnetic Stimulation (TMS) in Clinical and Experimental Epilepsy

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TMS Basics

- Focal, noninvasive cortical stimulation
- Two FDA-approved devices:
  - presurgical motor mapping
  - treatment of major depression

Frye, Rotenberg et al., 2007

Nexstim Inc.

Neuronetics Inc.
TMS in Presurgical* Motor ** Mapping

*Particularly for patients who do not tolerate Wada or fMRI

**TMS for language mapping: likely soon
Antiepileptic rTMS

Epilepsy Therapy Project Award:
Controlled trial of 1 Hz rTMS for treatment of temporal lobe epilepsy

- Numerous open label trials; three RCT
- Most effective if over superficial neocortical focus
- 1 Hz rTMS more effective than other low frequencies

Change in Seizure Frequency (%) after 0.3-1 Hz rTMS
(modified from Bae et al., Epilepsy Behav 2011)
Measures of Cortical Excitability by Paired-Pulse TMS (ppTMS)

Conditioning TMS

Test TMS

Control

SICI; 2 ms ISI

ICF; 12 ms ISI

LICI; 200 ms ISI

Rotenberg and Pascual-Leone, 2010
TMS Biomarkers in Epilepsy

Loss of inhibition in epilepsy

Brodtmann et al., Neurology 1999

Enhanced inhibition with VNS

Di Lazzarro et al., Neurology 2004

TMS and drugs

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<th>SICI</th>
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Zieman, Clin Neurophys 2004

Enhanced inhibition in keto diet

Cantello et al., Epilepsia 2007;
Future directions:

**ppTMS in ketogenic diet:**
Does increase in cortical inhibition predict diet success?

**TMS for preoperative language and motor mapping:**
Can rTMS supplement (or replace) Wada for some patients?

**rTMS in status epilepticus:**
Can rTMS suppress ongoing focal seizures?

Translational TMS:
Measures of cortical inhibition in post-traumatic epileptogenesis:

![Graph showing LICI ratio over weeks after TBI for normal and TBI rats, data from Hsieh et al., 2011](image)

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- CIMIT
- CURE
- Department of Defense
- NIH NINDS
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Language mapping