Seizure Control with Thermal Energy? Modeling of heat diffusivity in brain tissue and computer-based design of a prototype mini-cooler.

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Automated seizure blockage is a top priority in epileptology. Lowering nervous tissue temperature below a certain level suppresses abnormal neuronal activity, an approach with certain advantages over electrical stimulation, the preferred investigational therapy for pharmaco-resistant seizures.

A computer model was developed to identify an efficient probe design and parameters that would allow cooling of brain tissue by no less than 21oC in 30 s. maximum. The Pennes' equation and the computer code ABAQUS were used to investigate the spatio-temporal behavior of heat diffusivity in brain tissue.

Arrays of distributed probes deliver sufficient thermal energy to decrease inhomogeneously approximately 1 inch (the volume of amygdala and hippocampus) of brain tissue temperature from 37oC to 20oC in 30s and from 37oC to 15oC in 60s.

Tissue disruption/loss caused by insertion of this probe is considerably less than that caused by ablative surgery.

This model may be applied for the design and development of cooling devices for seizure control for any brain region and any tissue volume.