

A fast, lipid suppressed MR temperature imaging (MRTI) sequence based on interleaved gradient-echo EPI (iGE-EPI) was developed, tested in an agar phantom against a calibrated fast gradient-echo (fGRE) sequence, optimized in phantom, and used to provide real-time temperature monitoring during ultrasound thermal therapy ablation of canine TVT tumors implanted in the brain and prostate. MR temperature estimation was performed using complex phase-difference imaging to indirectly measure the temperature dependent shift in the water proton resonance frequency. Software tools were developed to run on a clinical 1.5T GE MR scanner to process and display temperature and thermal dosimetry data in real-time. Thermal dose was estimated from phase-filtered, magnitude masked temperature maps using an integral Arrhenius model to estimate the equivalent time the tissue spent at 43°C (t_{43}). Preliminary, *in vivo* results of the iGE-EPI MRTI sequence applied to real-time monitoring of ultrasound thermal therapy were demonstrated in canine TVT tumors using an interstitial ultrasound applicator in the brain and a transurethral applicator in the prostate. Compared with fGRE, iGE-EPI allowed use of a more optimal echo-time (TE), multi-planar acquisition, and lipid suppression, without significantly compromising signal-to-noise, in-plane spatial resolution or temporal resolution. Artifacts from regions of high magnetic susceptibility were minimal because of the interleaving. iGE-EPI MRTI provides fast acquisition of multiple planes of data that can be readily displayed on a clinical scanner. Calculated temperature distributions and thermal dosimetry also demonstrated excellent correlation with MR perfusion maps and observed tissue pathology.