Self-Regulation of the Primary Auditory Cortex Activity via Directed Attention Mediated By Real-Time fMRI Neurofeedback

Monday 11:30-11:40 AM | SSC11-07 | Room: N226

PURPOSE

To determine the potential efficacy of treating auditory cortex hyperactivity by self-regulation of the primary auditory cortex (A1) based on real-time functional magnetic resonance imaging neurofeedback training (fMRI-NFT).

METHOD AND MATERIALS

10 healthy volunteers with normal hearing (no more than 1 frequency >40 dB on a standard audiogram) underwent 5 fMRI-NFT sessions. Each session was composed of a simple auditory fMRI followed by 2 runs of A1 fMRI-NFT. FMRI data was acquired using 2D, single-shot echo planar imaging during all 3 runs using a 3T. The auditory fMRI was comprised of 6 blocks, each containing a 20s period of no auditory stimulation followed by a 20s period of white noise stimulation at 90 dB. A1 activity, defined from a region using the activity during the preceding auditory run, was continuously updated during fMRI-NFT using a simple bar plot, and was accompanied by white noise (90 dB) stimulation for the duration of the scan. Each fMRI-NFT run contained 8 blocks, each separated into a 30s relax period followed by a 30s lower period. Subjects were instructed to watch the bar during the relax condition and actively lower the bar by decreasing A1 activity during the lower condition. The average A1 activity was measured from the simple auditory task from each session. Average A1 deactivation was extracted from each fMRI-NFT run, representative of A1 self-regulation performance.

RESULTS

A one-way ANOVA evaluated the effect of session on A1 activity during the simple auditory task. The main effect of session was not significant ($p = 0.41$, sphericity assumed, two-tailed). A 5x2 (session by run) ANOVA was carried out on A1 deactivation during fMRI-NFT. There was a significant effect of session ($p = 0.0275$, sphericity assumed, one-tailed) and a significant interaction effect ($p = 0.0395$, sphericity assumed, one-tailed). The most successful subjects reportedly adopted mindfulness tasks associated with directed attention.

CONCLUSION

For the first time, fMRI-NFT has been applied to teach A1 self-regulation using more than 1 session. This is important to therapeutic development as it is unlikely a single fMRI-NFT session will reverse the effects of tinnitus.

CLINICAL RELEVANCE/APPLICATION

Chronic tinnitus has implications of impaired auditory and attentional networks. Our study indicates that fMRI-NFT may provide an innovative approach to alter of these systems simultaneously.