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Outcome of intracranial electroencephalography monitoring and surgery in magnetic resonance imaging-negative temporal lobe epilepsy

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Summary We evaluated the outcomes of intracranial electroencephalography (iEEG) recording and subsequent resective surgery in patients with magnetic resonance imaging (MRI)-negative temporal lobe epilepsy (TLE). Thirty-two patients were identified from the Mayo Clinic Epilepsy Surgery Database (Arizona, Florida, and Minnesota). Eight (25.0%) had chronic iEEG monitoring that recorded neocortical temporal seizure onsets; 12 (37.5%) had mesial temporal seizure onsets; 5 (15.6%) had independent neocortical and mesial temporal seizure onsets; and 7 (21.9%) had simultaneous neocortical and mesial seizure onsets. Neocortical temporal lobe

Abbreviations: AVLT, Auditory Verbal Learning Test; BNT, Boston Naming Test; ECoG, electrocorticography; EEG, electroencephalographic, electroencephalography; iEEG, intracranial electroencephalography; IQR, interquartile range; MRI, magnetic resonance imaging; PET, positron emission tomography; SISCOM, subtraction ictal SPECT coregistered to MRI; SPECT, single-photon emission computed tomography; TLE, temporal lobe epilepsy.

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Temporal lobe epilepsy

seizure semiology was the only factor significantly associated with neocortical temporal seizure onsets on iEEG. Only 33.3% of patients who underwent lateral temporal neocorticectomy had an Engel class 1 outcome, whereas 76.5% of patients with iEEG-guided anterior temporal lobectomy that included the amygdala and the hippocampus had an Engel class 1 outcome. Limitations in cohort size precluded statistical analysis of neuropsychological test data.

Introduction

The role of surgical resection has been well established in medically intractable temporal lobe epilepsy (TLE) (Wiebe et al., 2001; Yoon et al., 2003; Cohen-Gadol et al., 2006; Schmidt and Stavem, 2009). Seizure-free outcome rates after resective surgery average around 70—80% in patients with hippocampal atrophy and concordant interictal and ictal electroencephalographic (EEG) discharges (Berkovic et al., 1995; Cascino, 2004). Unfortunately, the success rate is much lower in patients with non-lesional TLE (Berkovic et al., 1995; Holmes et al., 2000; Chapman et al., 2005; Tatum et al., 2008; Bell et al., 2009). Given the fact that mesial temporal structures are important for memory, physicians may be more reluctant to recommend anterior temporal lobectomy, which includes the mesial temporal structures, when no structural abnormality is identified on magnetic resonance imaging (MRI). In these complicated patients, intracranial EEG (iEEG) monitoring is often required to guide temporal lobe resection.

Because increased complication rates are related to longer monitoring and a greater number of electrodes being implanted, the extent of electrode implantation for iEEG should be determined judiciously and should be limited to reduce the risk of complications (Hamer et al., 2002). The prognostic value of interictal spiking in intraoperative electrocorticography (ECoG) remains controversial. Luther et al. (2011) reported that intraoperative ECoG can be useful in a subset of patients with TLE and non-lesional MRI. However, other authors could not find correlation between seizure-free outcomes and complete resection of irritative zone on ECoG (Schwartz et al., 1997; San-juan et al., 2011; Wray et al., 2012). Therefore, the role of chronic extraoperative iEEG monitoring in patients with MRI-negative TLE remains important and deserves further study. The purpose of this study was to determine the yield of extraoperative iEEG monitoring in patients with MRI-negative TLE. In addition, we sought to determine the outcome of subsequent resective surgery in these patients.

Materials and methods

Patient population

This study was approved by the Mayo Clinic Institutional Review Board. Patients were identified from the epilepsy surgery databases at Mayo Clinic, Jacksonville, Florida (January 1, 2005—December 31, 2012), Mayo Clinic, Rochester, Minnesota (January 1, 2000—December 31, 2012), and Mayo Clinic, Scottsdale, Arizona (January 1, 2000—December 31, 2012).

Noninvasive presurgical evaluations

Charts were reviewed to determine patient characteristics, including age at surgery, duration of epilepsy, seizure risk factors, history of status epilepticus, and treatment history. All patients had routine interictal scalp EEG and continuous video scalp EEG monitoring to record seizures. Clinical ictal semiology was classified as favoring either mesial TLE or neocortical TLE localization. Studies have shown that ipsilateral limb automatism, contralateral dystonic posturing, oroalimentary automatisms, psychic phenomenon, and viscerosensory auras are more commonly seen in mesial TLE (French et al., 1993; Dupont et al., 1999; Villanueva and Serratosa, 2005; Tatum, 2012). In contrast, early aphasia, vestibular symptoms, auditory phenomena, and visual hallucinations have been associated with the temporal neocortex (Gloor et al., 1982; Bercovici et al., 2012; Kennedy and Schuele, 2012). The scalp interictal and ictal epileptiform discharges were categorized on the basis of their location (anterior, posterior, or diffuse).

High-resolution MRI was performed according to a dedicated institutional epilepsy protocol (15 patients with a 1.5-Tesla scanner and 16 patients with a 3-Tesla scanner; 1 patient had MRI of indeterminate magnet strength at an external institution). Quantitative analysis of the hippocampal volumes was also obtained if subtle hippocampal asymmetry was appreciated during visual interpretation of the MRIs. The final designation of a nonlesional brain MRI was based on the consensus of a multidisciplinary team of neuroradiologists, epileptologists, and neurosurgeons. Subtraction ictal SPECT (single-photon emission computed tomography) coregistered to MRI (SISCOM), positron emission tomography (PET), or both were performed in patients for whom more information was needed for seizure localization. Three patients underwent fMRI for language and motor mapping. Language tasks performed during fMRI mapping were reading, semantic decision, silent word generation, and sentence comprehension.

Neuropsychological evaluations

A presurgical neuropsychological evaluation was routinely performed; however, only a subset of patients completed a postsurgical neuropsychological evaluation. Patients included in the current study with both presurgical and postsurgical neuropsychological testing completed the postsurgical evaluation within approximately 6 months of surgery. Select neuropsychological testing results that were reviewed focused on verbal learning and memory, and on confrontation naming as measured by the Auditory