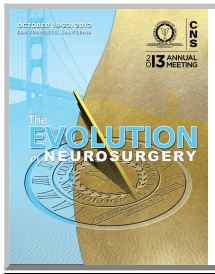

Understanding Relationship Between Seizures and Primary Brain Tumors in Tumor-Associated Epilepsy: Multimodal Analysis Using 3D Volumetric MRI, Quantitative Analysis of Intracranial EEG Compared to Non-Lesional Epilepsy

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Introduction

Brain tumors are frequently associated with recurrent seizures. Surgery has traditionally focused on aggressive resection of the tumor, but careful identification and removal of associated epileptogenic zone is not done routinely. We investigated whether the use of long-term intracranial EEG recordings and quantitative analysis of the interictal epileptiform activity could improve identification of the epileptogenic zone and our understanding of tumor-associated epilepsy.

Methods

Eleven patients with intractable tumor-associated epilepsy underwent staged surgery with implantation of intracranial subdural grids and depth electrodes. Each electrode was categorized based on involvement in seizure onset or early spread (epileptogenic zone). Quantitative analysis of various morphological parameters of interictal spikes was performed using three 10-minute extraoperative EEG recordings. For comparison, similar analysis of quantitative EEG was performed in 14 patients with non-lesional epilepsy.

Results

The epileptogenic zone, either in part or in its entirety, was located at least 1.5 cm beyond the MRI-defined tumor margin in 10 of 11 patients. Both spike frequency and power were significantly higher in the epileptogenic zones. Upon further quantitative analysis of interictal EEG in patients with tumor-associated epilepsy, we noted that electrodes in close proximity to the tumor had lower amplitudes and less steep slopes than electrodes distant from the tumor margin. In addition, electrodes located at the tumor margin often had the highest interictal spike frequencies and steepest slopes. Also, patients with infiltrating tumors showed a wider area of both ictal and interictal abnormality compared to those with discrete neoplasms. At 1-year follow-up, all patients remained seizure-free without evidence of tumor recurrence.

Conclusions

Seizures often originate from brain areas distant from the tumor margin. Quantitative analysis of interictal spike parameters may help identify epileptogenic zones in patients with tumor-associated epilepsy. Further prospective studies are needed to determine whether intracranial EEG monitoring can improve seizure outcomes in patients with primary brain tumors.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) Discuss the incidence of seizures related to brain tumors; 2) Describe the role of intraoperative electrocorticography in patients with tumor-associated seizures; 3) Discuss the benefits of two-stage surgical approach of prolonged extraoperative intracranial EEG monitoring to identify the epileptogenic zone in patients with tumor-associated epilepsy; and 4) Describe the differences in quantitative EEG analysis of interictal spike activity in patients with tumor-associated and non-lesional epilepsy.