CNS 2018 ANNUAL MEETING
HOUSTON, TEXAS
OCTOBER 6-10, 2018

Individualized High Density Electroencephalographic Source Imaging Technique in Presurgical Workup: Contribution to Surgical Strategy Making for Intractable Epilepsy Involving Mesial Temporal Lobe Structures

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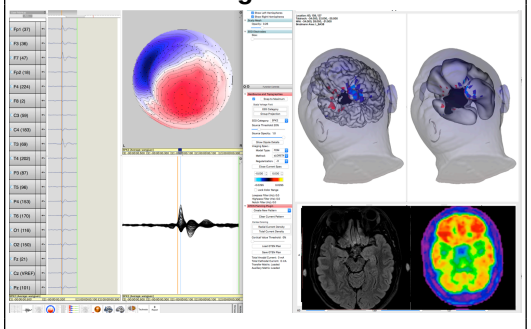
Introduction

Localization-related epilepsy frequently involves mesial temporal lobe structures (MTLS), but sometimes presurgical workup is confusing since lack of clear structural lesions or inconsistency among multiple tools. We recently improved accuracy of EEG source imaging technique (ESI) and applied it in presurgical epilepsy workup. This study evaluates its contribution to surgical strategy of epilepsy involving MTLS.

Figure 1



One-stage case with subtle MTLS structural lesion: ESI based on individualized head model located in left anterior mesial temporal region. One-stage left anterior temporal lobectomy made the patient seizure-free

Methods

We included patients who underwent resective surgeries encompassing MTLS in this study. In addition to traditional tools, ESI was available in all cases. ESI was accomplished based on 256-channel high-density EEG and individualized finite difference method head models. Patients accepted either one-stage or staged resective surgeries (SEEG implantation + stage-two resective surgeries). Contributions of multiple tools to surgical strategies were evaluated.

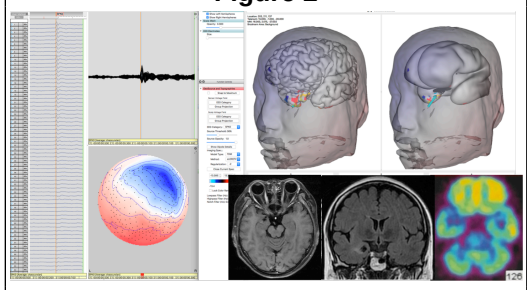
Results

Twenty-five cases with Engel I+II outcome after surgeries were included. ESI(80%) and MRI(76.0%) showed higher accuracy over ictal EEG(44.0%) and FDG-PET(56.0%) when defining resective scope as epileptogenic zone($p<0.05$).

In one-stage cases, ESI showed sources localized within MTLS region in 88.2% (same as MRI positive rate), while PET localized focally only in 64.7% ($p<0.05$). 62.5% staged cases showed complete concordance of ESI sources with SEEG findings, while for PET & MRI the ratio is 25% & 62.5%, respectively. ESI & PET contributed to SEEG plans in all, while MRI & ictal EEG contributed in 87.5% & 50%, respectively.

In subtle lesional/MRI-negative cases, 62.5% showed lesions in MTLS firstly diagnosed as "negative". ESI contributed more to detection/confirmation of these lesions (75% showed sources confined within MTLS region) than PET estimates (focally-localized in MTLS in 50%) ($p<0.05$).

Figure 2



One-stage case with tumoral MTLS lesion: ESI showed sources located in the mesial temporal region concordant to the tumor. PET and MRI indicated concordant results. After one-stage right lesionectomy the patient achieved seizure free

Conclusions

Non-invasive accurate ESI method described here is based on high density EEG and individualized head model, appearing contributable to surgical planning of epilepsy surgeries involving MTLS, by indicating MTLS region epileptic sources. This feature can help decide strategy of one-stage resective surgeries and SEEG implantation plans.

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