Minimally invasive localization and treatment of focal epilepsy: paradigm shift

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Introduction

• The underutilization of surgical options is especially pronounced in the context of non-lesional or diffusely lesional epilepsies. Many groups have reservations about surgical interventions in cases where imaging abnormalities are relatively diffuse or are focal but inconsistent with the electrophysiology.

• Stereoelectroencephalography (SEEG) allows for broad sampling of epileptic networks, provides a potential solution for delineating the network on these cases. This may then be combined with MR guided laser interstitial thermal therapy (MRgLITT) – the Visualase™ procedure for targeted ablation of certain types epileptic foci. The combination of these two minimally invasive approaches – SEEG + MRgLITT, theoretically provides epilepsy surgeons with the ability to identify and destroy a seizure focus without the performance if a craniotomy. This approach, if successful, represents a paradigm shift in the treatment if focal intractable epilepsy.

Here, we report the first ever report of a series of patients managed by this approach and evaluate the decision process, the surgical strategy, the risks and the outcomes of minimally invasive epilepsy surgery.

Methods and Patient Data

• We used a prospectively compiled database of all patients undergoing surgical interventions for medically intractable epilepsy at the Texas Comprehensive Epilepsy Program to identify all adult patients undergoing minimally invasive procedures for their epilepsy. These included all patients undergoing MRgLITT / SEEG over a 56-month interval 6/12 – 1/17.

• Demographic data, types of seizures and their frequency, pre-operative anticonvulsants, video-EEG data, decision making at surgery conference, number of SEEG depth electrodes or laser ablation probes placed, duration of intracranial monitoring, findings from the intracranial evaluation and the laser ablation target data were all compiled. Patients undergoing SEEG were followed after the removal of electrodes until either the decision for no surgery, additional electrode placement or resection/ablation was made. All patients undergoing ablative procedures were followed for as long as possible for neurological, cognitive as well as the seizure outcomes (Engle/ILAE).

• Over almost a five-year interval, 105 patients underwent 117 total SEEG procedures. 4 patients received additional electrodes after the first implant during the same hospital stay and 4 others underwent a second SEEG implant after an initial failed focal resection. Thus, 109 distinct SEEG implants were performed.

• In the first three, a stereotactic frame was utilized. The remaining underwent electrode placement using a stereotactic robotic arm (ROSA). In all cases SEEG electrodes (0.8 mm outer diameter PMT) were placed.

• Of the patients undergoing SEEG, 84 (80%) underwent resection or ablation. Of these, 27 patients underwent localization of the seizure focus using SEEG techniques, followed by MRgLITT using the Visualase™ system. 20 MRgLITT procedures were performed without an intracranial evaluation – based on the imaging and the electro-clinical syndrome.

• The 27 patients undergoing SEEG evaluation AND laser ablation form the cohort that we discuss further.

• The median age at surgical intervention was 33 years (range 18-61) while median age at seizure onset was 15.5 years (range 1-58); median duration of epilepsy was 16 years (range 0-58). All patients failed at least 2 medications prior to surgical intervention (median = 4 meds). Median follow-up post resection/ablation was 3 months, when not including patients with surgery in the last 6 months, the median follow up time was 6 months.

• Of the 27 patients undergoing laser ablation, 17 underwent purely MRgLITT of the hippocampus and amygdala (12 in the dominant hemisphere and 4 in the non-dominant hemisphere), one underwent a selective laser ablation of only the amygdala in the dominant hemisphere. Eight underwent neocortical resections followed by ablation of the medial temporal structures (6) or deep-seated PVNH (2). One underwent ablation of two adjacent PVNHs in the dominant hemisphere and one underwent ablation of PVNH with overlying polymicrogyria.

• 18 patients were seizure free at last f/u (ILAE 1) and all had significant improvement in seizure outcome.

Ablation type and outcomes

Results

Distribution of patient undergoing minimally invasive procedures

Illustrative case of PVNH and PMG – interested in preserving vision

Discussion

• We report here the rationale, the strategy and the outcomes in patients managed using a strategy of minimally invasive localization and then selective ablation – this represents a paradigm shift in the management of epilepsy. While thermo-coagulation with SEEG electrodes is a similar approach, it is heavily biased to locations where the electrodes are implanted rather than targeting particular structures or networks. Additionally there is no real time confirmation of the damage zone using this approach. Such approaches may lead to a greater utilization of surgery for focal epilepsy.

References:


