Stereotactic Laser Ablation of Cortical Lesions for Refractory Epilepsy in a Pediatric Population

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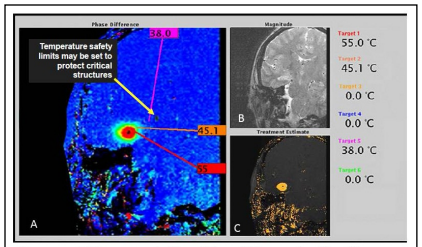
Introduction

Stereotactic laser ablation (SLA) with real-time MR thermographic monitoring is a new technology that offers minimally invasive ablation of intracranial tissue with the potential for improved precision and control compared to other stereotactic ablation technologies. Few reports address the use of this technique for cortically-based epileptogenic lesions.



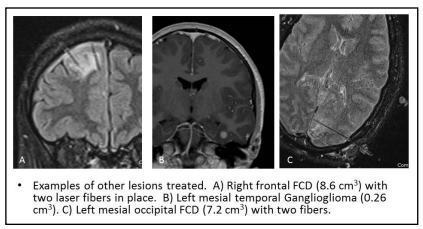
Thermographic images created in real-time. A) Temperature Map B) Anatomic image C) Permenantly ablated area (yellow) is calculated from time and temperature data for each voxel.

Methods

A single-center retrospective review was conducted of consecutive patients who underwent SLA for treatment of epilepsy caused by cortically-based lesions. All patients underwent thorough epilepsy pre-surgical evaluation and were felt at a multi-disciplinary conference to have a small, focal ictal onset zone.

Methods (CONTINUED)

SLA treatment was accomplished by using standard stereotactic technique to place a flexible laser fiber and cooling catheter (Visualase, Houston, TX) into the epileptogenic lesion. Needle biopsy of the lesion preceded when indicated. Careful pre-operative planning determined the number of catheters used and ensured that the catheter was positioned to ablate the maximal amount of the lesion. An anatomic MR image is obtained to ensure correct catheter position. While the laser is activated, repeated Proton Resonance Frequency MR images are obtained and processed in real-time to create thermographic maps of tissue temperature and ablation zone (see figure). The final ablated zone is confirmed with a contrast-enhanced T1 image.



- Examples of other lesions treated. A) Right frontal FCD (8.6 cm^3) with two laser fibers in place. B) Left mesial temporal Ganglioglioma (0.26 cm^3). C) Left mesial occipital FCD (7.2 cm^3) with two fibers.

Pt #	Age at Surgery	Duration of Epilepsy (yr)	Location	Lesion size cm^3 (XxYxZ/2)	Length of stay (days)	Complete ablation	Diagnosis	Follow-up (mo)	Engle
1	12.8	2.75	frontal convexity	8.6	2	no	FCD	18	1 - off meds 1 - weaning
2	10.5	2.3	Lateral frontal	12.4	1	No	DNET	13	last med
3	14.6	11	Medial occipital	7.2	1	No	FCD	11.5	1
4	12.5	1.75	Basal temporal	0.26	1	Yes	Ganglioglima	10.5	1
5	13.5	2.2	Basal temporal	1.4	1	Yes	Ganglioglima	5	1

Conclusions

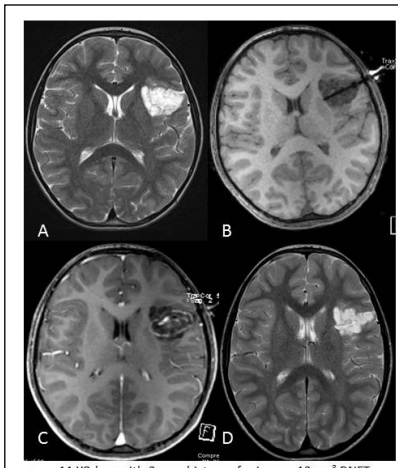
SLA can be effective for the treatment of epilepsy caused by small, well-localized cortical lesions. The minimally invasive, precise nature of the treatment offer potential advantages over open resection. Longer follow-up and a larger patient population are needed to confirm these preliminary results.

Results

Five patients with epilepsy have undergone SLA for cortical lesions, three with glio-neural tumors and 2 with focal cortical dysplasia. Age at treatment ranged from 10 to 14 years. Locations of lesions include basal temporal (2), medial occipital, frontal convexity, and lateral frontal (Broca). Lesion size ranged from 0.25 to 12.4 cm3 (mean 6.0). Three patients had two catheters placed while the remaining had a single catheter. Only two of the lesions were completely ablated as judged by the ablation zone visualized on gadolinium enhanced MRI at the end of the procedure.

All patients are seizure free.

Follow-up ranges from 5 to 18 months (mean 11.6). No complications occurred. Length of stay was 1 or 2 nights for all patients.



- 11 YO boy with 2 year history of seizures, 12 cm^3 DNET. A) Pre-op T2 image. B)Intra-op image showing position of the laser fiber. C) T1 with contrast shows the result of four contiguous ablations – residual lesion is present beyond. D) T2 MRI 1 year post op – patient is seizure free, off medication.

Learning Objectives

By the conclusion of this session, participants should be able to 1) recognize the difference between stereotactic laser ablation (SLA), open resection, and other stereotactic ablation technologies of cortically based lesions, 2) understand the preliminary nature of this work given the short follow-up and small number of patients, 3) appreciate the potential patient benfits from SLA.