Structural Changes in the Contralateral Limbic System following Laser Interstitial Therapy for Selective Amygdalohippocampectomy

Allen Ho MD; Michael Zeineh MD, PhD; Eric S Sussman MD; Robert M. Lober MD PhD; Gerald A. Grant MD; Max Wintermark MD; Casey H. Halpern MD

Department of Neurosurgery and Department of Radiology, Stanford School of Medicine

Introduction

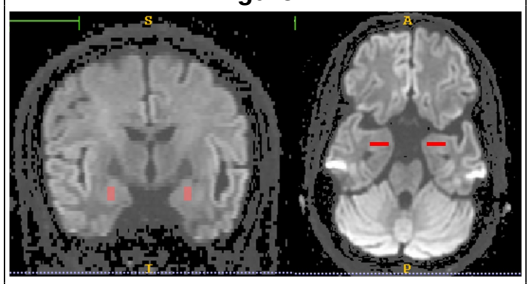
Diffusion tensor imaging (DTI) changes are indicative of white matter tract and axonal changes to neural structures in the brain. Degeneration of ipsilateral limbic system structures has been demonstrated in temporal lobe epilepsy, and reorganization of contralateral limbic system structures has been observed following anterior temporal lobectomy. These post-operative changes in mesial temporal lobe structures have been shown to correlate with continued post-operative seizures and cognitive function. To date, no study has examined the changes seen in white matter structures following laser interstitial therapy for selective amygdalohippocampectomy.

Methods

DTI evaluation was performed in 7 patients (median age, 53; age range, 17-69 years) who underwent pre- and serial post-operative MR imaging as part of routine follow-up after MR laser guided thermal ablation for selective amygdalohippocampectomy for epilepsy. Tensor metrics were obtain in the subacute period (<3 months, 36 days median follow-up) after surgery. We evaluated the following limbic system structures on the side contralateral to the surgical side: hippocampus, amygdala, parahippocampal gyrus.

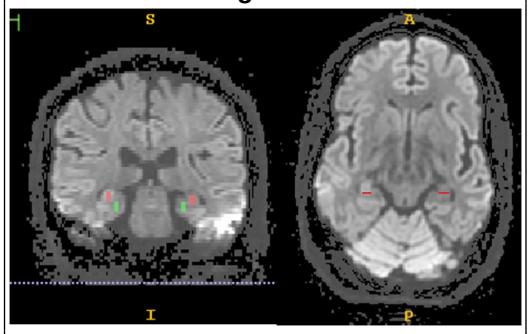
ROIs for these structures were selected as depicted in Figures 1 and 2 and their tensor metrics were normalized to the corpus callosum for each specific exam in order to correct for theoretical acquisition discrepancies between studies.

Figure 1



ROI in coronal and axial planes for Amygdala

Figure 2



ROI in coronal and axial planes for Hippocampus (red) and Parahippocampal Gyrus (green)

Results

Preoperative seizure frequency for our cohort ranged anywhere from 1-2 events/day to 1-2 events/year. Median follow-up was 5 months with a range of 4-8 months, and 5 of the 7 patients remained seizure free at time of follow-up.

Table

Patient No.	Gender	Age	Disease	Preop Seizure Frequency	Operation	Follow-Up (Mos)	Post-op Seizure Frequency
1	M	17	L mTLE	1/mos	L visualase AHC	7	None
2	M	62	L TLE	5/mos	L visualase AHC	8	None
3	M	63	R mTLE 2/2 VHL	1-2/day	R visualase AHC	5	None
4	F	29	L mTLE	1/wk	L visualase AHC	6	1-2/mos
5	F	53	L mTLE	1/mos	L visualase AHC	5	None
6	F	69	R mTLE	1-2/yr	R visualase AHC	5	None
7	F	24	R TLE 2/2 TS	1/mos	R visualase AHC	4	1/mos

Patient Clinical Information

The most significant changes to the contralateral limbic system white matter structures were an 18 and 16% increase in mean diffusivity (MD) seen in the hippocampus and amygdala, respectively. There was also a 9% increase in the MD of the parahippocampal gyrus. Finally, there was a 16% increase in the fractional anisotropy of the white matter tracts running through the parahippocampal gyrus.

Conclusions

Post-operative diffusion MR imaging following laser interstitial therapy for selective amygdalohippocampectomy demonstrated increased MD in contralateral limbic structures and increased FA in the white matter tracts of the parahippocampal gyrus. These changes are indicative of structural reorganization of contralateral limbic system structures following laser interstitial therapy for selective amygdalohippocampectomy.

Learning Objectives

By the conclusion of this session, participants should be able to:

1) Interpret and analyze MRI DTI sequences to assess white matter tracks

2) Describe DTI and white matter changes seen in epilepsy and following epilepsy surgery

3) Understand changes in contralateral limbic system white matter structures following following laser interstitial therapy for selective amygdalohippocampectomy

References

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