Brain Lesion Response to Laser Interstitial Thermal Therapy

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Background

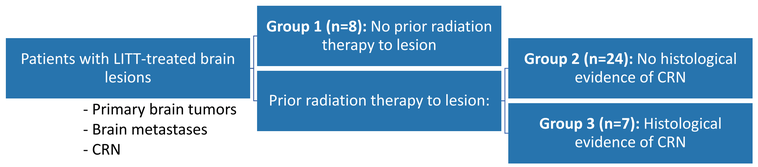
- Laser interstitial thermal therapy (LITT) is an ablation technique that uses photons to generate thermal energy within target lesions.
- The noninvasive nature and specificity of the treatment allows for its use in surgically inaccessible or functionally eloquent regions of the brain.
- Previous studies have demonstrated an initial increase in lesion size and subsequent regression.

Purpose

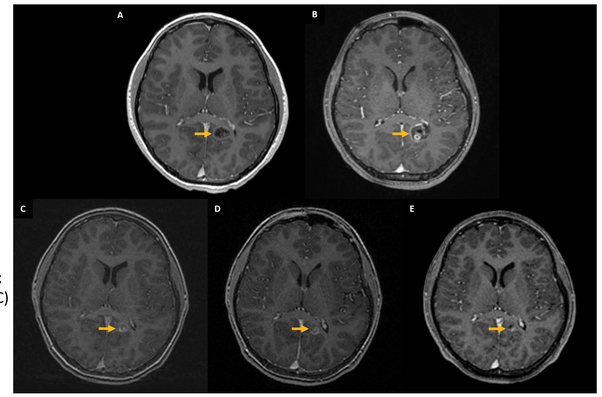
- The purpose of this study was to examine the change in lesion size of brain tumors and cerebral radiation necrosis (CRN) before, during, and after treatment with LITT.

Methods

- Single-center retrospective study.

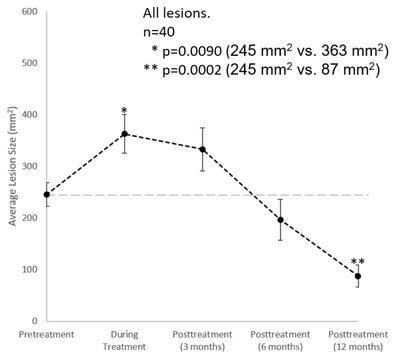


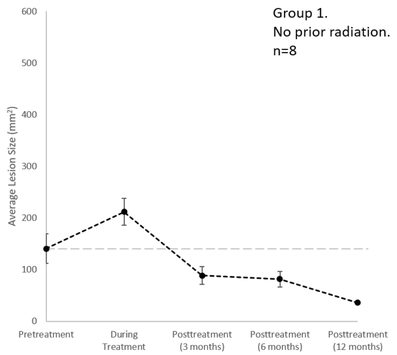
- Evaluated on axial T1-weighted post-contrast MR images.
- Measured on the long axis and the perpendicular axis.
- Lesion measurements were used to calculate area.
- Measurements were done at 5 timepoints:
  - Pretreatment
  - During treatment
  - 3, 6, and 12 months posttreatment

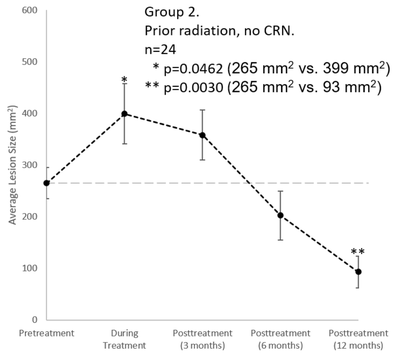


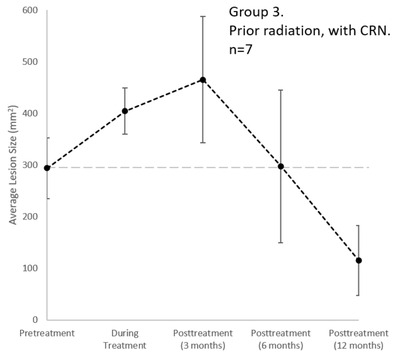
13 y.o. M with oligodendroglioma of the L posterior cingulate gyrus, axial T1-weighted post-contrast MRI at A) pretreatment; B) treatment; and C) 3 months, D) 6 months, and E) 12 months posttreatment.

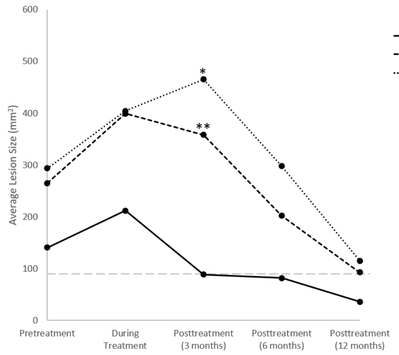
Results











Group 1: No prior radiation (n=8).
Group 2: Prior radiation, no CRN (n=24).
Group 3: Prior radiation, with CRN (n=7).

* p=0.0168 (88 mm² vs. 465 mm²)
** p=0.0084 (88 mm² vs. 358 mm²)

Discussion

Lesion Size Change

- Overall, when compared to the pretreatment lesion size, there is a significant increase in size during LITT treatment and a significant decrease in size at 12 months posttreatment.
- On subgroup analysis, only the group that had received prior radiation but did not show evidence of CRN (Group 2) demonstrated a significant size change during treatment and at 12 months.
- The lack of significance in the other groups is likely due to their small sample size.

Between-Group Size Difference

- At 3 months posttreatment, between-group analysis showed a significant difference in lesion size between the group that did not receive radiation (Group 1) and the groups that did (Groups 2 and 3).
- Although limited by a small sample size, this difference could be due to a smaller initial size of the lesions that did not require radiation therapy (ANOVA approaching significance at p=0.07).
- These results could also suggest a faster response to LITT treatment in the group that had not undergone prior radiation therapy.
- There were no significant differences found at the other timepoints.

Conclusions

- This study demonstrates that LITT induces an initial increase in lesion size during treatment, with lesion size then shrinking by 12 months posttreatment.
- The results support the efficacy of LITT on brain lesions and demonstrate expected size change over time.
- These findings contribute to the development of an appropriate follow-up imaging schedule after LITT treatment.

References

- Hawasli AH, Bagade S, Shimony JS, Miller-Thomas M, Leuthardt EC. Magnetic Resonance Imaging-Guided Focused Laser Interstitial Thermal Therapy for Intracranial Lesions. Neurosurgery. 2013;73(6):1007-1017. doi:10.1227/neu.0000000000000144.
- Holste KG, Orringer DA. Laser interstitial thermal therapy. Neuro-Oncology Advances. 2019;2(1). doi:10.1093/noajnl/vdz035
- Medvid R, Ruiz A, Komotar R, et al. Current Applications of MRI-Guided Laser Interstitial Thermal Therapy in the Treatment of Brain Neoplasms and Epilepsy: A Radiologic and Neurosurgical Overview. American Journal of Neuroradiology. 2015;36(11):1998-2006. doi:10.3174/ajnr.a4362
- Missios S, Bekelis K, Barnett GH. Renaissance of laser interstitial thermal ablation. Neurosurgical Focus. 2015;38(3). doi:10.3171/2014.12.focus14762
- Patel B, Kim AH. Laser Interstitial Thermal Therapy. Missouri Medicine. 2020;117(1):50-55.
- Patel NV, Jethwa PR, Barrese JC, Hargreaves EL, Danish SF. Volumetric trends associated with MRI-guided laser-induced thermal therapy (LITT) for intracranial tumors. Lasers in Surgery and Medicine. 2013;45(6):362-369. doi:10.1002/lsm.22151.
- Rammo R, Asmaro K, Schultz L, et al. The safety of magnetic resonance imaging-guided laser interstitial thermal therapy for cerebral radiation necrosis. Journal of Neuro-Oncology. 2018;138(3):609-617. doi:10.1007/s11060-018-2828-2.
- Rao MS, Hargreaves EL, Khan AJ, Haffty BG, Danish SF. Magnetic Resonance-Guided Laser Ablation Improves Local Control for Postradiosurgery Recurrence and/or Radiation Necrosis. Neurosurgery. 2014;74(6):658-667. doi:10.1227/neu.0000000000000332.