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## Clinical Development of Laser Interstitial Thermal Therapy (LITT) For Brain Tumors: Experience and Evidence

Alireza Mohammadi<sup>1</sup>, Ammar Hawasli<sup>2</sup>, Analiz Rodriguez<sup>3</sup>, Jason Schroeder<sup>1</sup>, Adrian Laxton<sup>3</sup>, Symeon Missios<sup>1</sup>, Paul Elson<sup>1</sup>, Stephen Tatter<sup>3</sup>, Gene Barnett<sup>1</sup>, Eric Leuthardt<sup>2</sup>

<sup>1</sup>Cleveland clinic, Clevelan, Ohio, USA, <sup>2</sup>Washington University, St. Louis, USA, <sup>3</sup>Wake Forest University, Winston-Salem, USA

**Introduction:** The idea of laser interstitial thermal therapy (LITT) for tumor treatment was introduced in 1980s. However, the level of enthusiasm for using LITT in brain tumors had some fluctuations over past decades; mostly because of technical challenges and also the lack of evidence to show clinical benefits outweigh potential risks. In the past few years, advances in technology (e.g. new laser probe design, MR-thermometry sequence) as well as the need for a minimally invasive treatment modality for difficult-to-access brain tumors (typically considered high risk for regular surgery) resulted in resurgence of LITT in different intracranial pathologies. In this study, the impact of LITT on improvement of progression free survival (PFS) in high grade glioma patients is presented.

**Methods:** Thirty-five consecutive high grade glioma patients (24 GBM, 11 anaplastic gliomas) who underwent LITT at the Cleveland Clinic, Washington University in St. Louis, and Wake Forest University during 5/11-12/12 were retrospectively reviewed. LITT was performed using NeuroBlate System (Monteris, MN). Extent of thermal ablation was defined by software as thermal-damage-threshold (TDT) lines including: yellow TDT-line = 43°C for 2 minutes and blue TDT-line= 43°C for 10 minutes (shorter intervals were needed for higher temperatures based on Arrhenius equation). Pre- and post-operative MRI scans as well as TDT-lines were imported into the iPlan software (BrainLAB, Germany) and extent of coverage of tumor volume by TDT-lines was measured. Patient outcomes including PFS were evaluated and correlated with volumetric analysis results.

**Results:** Median age was 56 years and 40% were female. Treatment was upfront in 19 and salvage in 16 patients. Median tumor volume was 10.1cc (0.7-49cc). One patient died because of meningitis and 7 patients had neurological worsening after procedure (temporary in 5 patients). After 7.2 months follow-up, 80% of patients have progressed and 34% died. Median overall-survival was not reached (1-year overall survival is estimated to be 68%±9%). Median PFS was 5.1 months. Thirteen patients who had both ≥99% tumor coverage by yellow TDT-line and <1.5cc residual tumor volume uncovered by blue TDT-line had better PFS than others (9.7 versus 4.6 months; p=0.02) which was still prognostic in the subgroup of 24 GBM patients (p=0.04).

**Conclusions:** This initial report shows that LITT can be used safely and effectively for treatment of high grade gliomas. In addition, more complete coverage of tumor by TDT-lines improves PFS. This can be translated as the extent of resection concept in glioma surgery.