Long Term Pattern of Advanced Imaging Techniques After Laser Interstitial Thermal Therapy for Brain Metastases

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Poster # 2550
We have no conflicts of interest to disclose.
Laser interstitial thermal therapy (LITT) is relatively new minimally invasive modality for treatment of brain lesions including primary brain tumors, metastatic tumors and radiation necrosis.

As it is a newer treatment, long-term imaging follow up data is limited after LITT. ¹

Prior studies have demonstrated a characteristic increase in contrast-enhancing lesion size immediately after LITT with overall shrinkage over time. ², ³

The goal of this study was to determine long-term patterns in diffusion and perfusion imaging in patients when underwent LITT for brain lesions and determine if there is a difference in patients who have tumor recurrence vs not.

Methods

- Retrospective study of 9 patients with brain metastases who underwent 10 stereotactic biopsies and LITT treatments for 10 brain metastases.
- Imaging was obtained at 3, 6, and 1 year after treatment for routine follow up.
- Contrast enhancing tumor volume was calculated using OsiriX 32-bit advanced open-source imaging software (version 8.0, 2016 Pixmeo).
- Diffusion (DWI) and perfusion (kTrans or DSC) imaging was reviewed with an independent neurosurgeon reviewer and a trained neuroradiologist.
Results

<table>
<thead>
<tr>
<th></th>
<th>Pre-op</th>
<th>3 months</th>
<th>6 months</th>
<th>1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Diffusion signal</td>
<td>Perfusion (compared to brain)</td>
<td>Volume at 3 months/Pre-op volume (%)</td>
<td>Diffusion signal</td>
</tr>
<tr>
<td>114</td>
<td>Increased</td>
<td>None</td>
<td>37.68</td>
<td>Decreased</td>
</tr>
<tr>
<td>114</td>
<td>Increased</td>
<td>None</td>
<td>205.84</td>
<td>Decreased</td>
</tr>
<tr>
<td>116</td>
<td>Increased</td>
<td>Increased</td>
<td>104.72</td>
<td>Increased</td>
</tr>
<tr>
<td>117</td>
<td>Increased</td>
<td>None</td>
<td>161.01</td>
<td>Decreased from prior</td>
</tr>
<tr>
<td>121</td>
<td>Increased</td>
<td>Increased</td>
<td>132.33</td>
<td>Increased</td>
</tr>
</tbody>
</table>

Table 1: Change in Contrast enhancing Volume (CeV) at 3 month, 6 month and 1 year MRI as compared to pre-op volume.

- Responders are patients who did not require any further treatment for their tumors including more radiation or other surgeries within 1 year follow up.
- Some had increased central diffusion at 3 months, but disappeared later.
- Rarely patients had increased perfusion at 3 months, but disappeared later.
## Results

Table 2: Non-Responders are patients who did require any further treatment for their tumors including more radiation or other surgeries within 1 year. One patient was lost to follow up after 6 months. Another (**patient 118) was found to have radiation necrosis and excluded from calculations.

- Diffusion was increased at 3 months and in some remained increased.
- Perfusion signal returned at 6 months and remained increased.

<table>
<thead>
<tr>
<th></th>
<th>Diffusion signal</th>
<th>Perfusion</th>
<th>Volume at 3 months/Pre-op volume (%)</th>
<th>Diffusion signal</th>
<th>Perfusion</th>
<th>Volume at 6 months/Pre-op volume (%)</th>
<th>Diffusion signal</th>
<th>Perfusion</th>
<th>Volume at 1 year/Pre-op volume (%)</th>
<th>Diffusion signal</th>
<th>Perfusion</th>
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</thead>
<tbody>
<tr>
<td>110</td>
<td>None</td>
<td>None</td>
<td>317.84Increased</td>
<td>None</td>
<td>541.10Increased</td>
<td>Increased</td>
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<td>None</td>
<td>74.88None</td>
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<td>None</td>
<td>203.19Increased</td>
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<td>91.63None</td>
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<td></td>
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<tr>
<td>120</td>
<td>Increased</td>
<td>None</td>
<td>321.98Increased</td>
<td>None</td>
<td>202.31No change</td>
<td>Increased</td>
<td>1766.08Increased</td>
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<td></td>
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<tr>
<td>119</td>
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<td>122.64None</td>
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<tr>
<td><strong>118</strong></td>
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<td>59.01None</td>
<td>Increased</td>
<td>76.71None</td>
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</tbody>
</table>
Results

- Responders: Increase in CeV at the 3 month MRI compared to pre-op baseline followed by reduction in CeV over time.
- Non-responders: Increase in CeV at 3 months compared to pre-op baseline which increased over time.
  - Change in CeV at 3 months less in responders (mean 235% vs 128%, \( p=0.006 \)),
  - Not significant at 1 year (mean 644% vs 54%, \( p = 0.41 \)).

Figure 1: Change in CeV compared to pre-op scans at 3 month, 6 month and 1 year intervals in responders as compared to non-responders.
Results

Figure 2: Responder. Preop diffusion and perfusion scan compared to 3 month post-op and 1 year post op. Diffusion signal is increased at 3 month scan compared to pre-op, but disappears at 1 year. Perfusion signal decreasing over time.

Figure 3: Non-responder. Pre-op scan with small left frontal lesion, minimal diffusion and perfusion abnormalities, significantly increase at 3 months and 1 year post op.
Increased CeV after surgery is a documented phenomenon after LITT with subsequent shrinkage of tumors. Increased diffusion may be due to increased necrosis within the tumor and it resolves with time. Perfusion remains stable or also decreases in responders. In patients who are non-responders, increased diffusion signal and perfusion is seen over time, therefore they may be early indicators that a patient has not responded to LITT and may need other treatments for their brain metastases.

Limitations: small sample size and heterogeneous population with a variety of pre-LITT treatments and post-LITT treatments (including Avastin). Not all patients had the same type of perfusion imaging and therefore kTrans and DCE were used interchangeably.
• The CeV increases after LITT treatment and subsequently decreases over time.
• LITT responders will have a simultaneous increase in diffusion signal at 3 months after surgery likely due to necrosis with decreased signal over time. Perfusion will decrease or remain absent.
• LITT nonresponders will have a reemergence of increased diffusion signal and perfusion over time.