Conventional MRI and MR spectroscopy in primary central nervous system lymphoma


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Introduction (1)

- Primary CNS lymphoma is a rare disease, about 6.6% of all primary intracranial tumors.
- The incidence of the CNS lymphoma raised recently in both immunocompromised and immunocompetent people.
- Surgery is ineffective for CNS lymphoma because of its infiltrative growth pattern and can’t prolong survival.
- The majority of management is radiotherapy or chemotherapy.
Introduction (2)

- **Early diagnosis** is important to avoid unnecessary operation and prompt radiation therapy may prolong survival of patients with CNS lymphoma.

- Some studies had reported typical image features for CNS lymphoma. However, most of them were based on immunocompromised patients.
Purpose

• We retrospectively review the MR findings of primary CNS lymphoma in immunocompetent patients to identify major neuroradiological clues to achieve early diagnosis.
Material and Methods - Patients

- From 2000 to April 2010
  - 34 immunocompetent patients being pathologically diagnosed as having CNS lymphoma
  - All of them don’t have other locations affected by lymphoma.
  - 14 female and 20 males
  - 41y/o ~ 88 y/o (mean +/- SD= 66.94 +/-12.65 y/o)
  - Multiple : Solitary lesion =10:24
Material and Methods - Image Protocol

- **1.5T MR imaging units** (Vision; Siemens, Erlangen, Germany; Signa, GE Medical system, Milwaukee, WI).
- **Standard pre-treatment MRI and/or follow up MRI** (within one month):
  - Axial spin echo (SE) T1-weighted images (T1WI) (TR/TE 500/10), axial fast spin echo (FSE) T2-weighted images (T2WI) (TR/TE 3200/115), axial and coronal gadolinium-enhanced SE T1WIs.
  - Diffusion weighted image (DWI) : b=1000s/mm²
  - Slice thickness 5 mm.
  - MR spectroscopy (TR 1500 and 2000ms; TE 270 and 15 ms): 15 patients
Material and Methods

- **Signal intensity** of tumor on T1WI, T2WI, + contrast
- **Tumor margin**: infiltrative, irregular and well-demarcated.
- **MR spectroscopy**: NAA/Cr, Cho/Cr, lactate-lipid peak
- **DWI**
- There were **22 patients** having followed up images within one month after steroid administration.
Tumor Volume Measurement

- Tumor volume measured on contrast enhanced axial SE T1WI by two experienced neuroradiologists (H.M Wu and H.C Chen).
- Summation of each area (mm$^2$) X slice thickness (mm) = estimate tumor volume (mm$^3$=ml)
- Tumor regression: Tumor volume (TV) decreased more than 13% of baseline tumor volume (BTV).
- Stable: volume changes less than 13%
- Tumor progression: Tumor volume increased more than 13%; marginal recurrence or new lesions even the tumor volume smaller than the BTV.

## Results (1): Signal Change

<table>
<thead>
<tr>
<th></th>
<th>Low signal intensity</th>
<th>Iso-intense to gray matter</th>
<th>Slightly high signal intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T1WI</strong></td>
<td>9 (26.47%)</td>
<td>19 (55.88%)</td>
<td>6 (17.65%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hemorrhage in 3 (8.8%)</td>
</tr>
<tr>
<td><strong>T2WI</strong></td>
<td>11 (32.35%)</td>
<td>14 (41.18%)</td>
<td>9 (26.47%)</td>
</tr>
</tbody>
</table>

Axial T1WI  
Axial T2WI  
Post-contrast Axial and Coronal T1WI
Results (2): **DWI**

<table>
<thead>
<tr>
<th>Low signal intensity</th>
<th>High signal intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>DWI</td>
<td>0</td>
</tr>
<tr>
<td>ADC</td>
<td>34 (100%)</td>
</tr>
</tbody>
</table>

![DWI Image](image1)

![ADC Image](image2)
## Results (3): Margin

<table>
<thead>
<tr>
<th></th>
<th>Well defined</th>
<th>Irregular</th>
<th>Infiltrative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Margin</td>
<td>4 (11.76%)</td>
<td>17 (50%)</td>
<td>13 (38.24%)</td>
</tr>
</tbody>
</table>

![Brain MR images showing different margin types](image1.png)
### Results (4): MRS

<table>
<thead>
<tr>
<th></th>
<th>Decreased</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAA/Cr</td>
<td>14 (93.33%)</td>
<td>1 (6.67%)</td>
</tr>
<tr>
<td>Cho/Cr</td>
<td>1 (6.67%)</td>
<td>14 (93.33%)</td>
</tr>
<tr>
<td>Lactate or Lipid</td>
<td>14 (93.33%)</td>
<td>14 (93.33%)</td>
</tr>
</tbody>
</table>
Results (5): After Steroid

<table>
<thead>
<tr>
<th>Tumor volume</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>16</td>
</tr>
<tr>
<td>Stable</td>
<td>1</td>
</tr>
<tr>
<td>Progression</td>
<td>5</td>
</tr>
</tbody>
</table>

2009.2.11 Initial MR

2009.2.16
5 days after steroid
MR for Stereotatic biopsy
Case Illustration

Axial T1WI  Axial T2WI  Post-contrast T1WI  DWI  ADC

One week after steroid

Post-contrast T1WI  Axial T2WI
Case Illustration

- TR 1500
- TE 270

- TR 2000
- TE 15
Discussion (1)

• In our study, 73.5% patients have lesions showing hypo- to iso-intense to gray matter on T2WI.
• All patients have **diffusion restriction** on DWI.
• In previous study, hypointense or isointense signal on T2WI relative to gray matter and high signal on DWI were also found due to **densely packed cells**.
• Although GBM may have portions showing diffusion restriction, the lesions usually have relatively high signal on T2WI with more pronounced perifocal edema. **Hemorrhage** is more likely in GBM.

Johnson BA. AJNR 1997; 18: 563-572
Lanfermann H. Acta Radiol 1997; 38: 259-267
Discussion (2)

- MR spectroscopy with CNS lymphoma demonstrated elevated Cho/Cr, decreased NAA/Cr and presence of a lactate-lipid peak.
- Presence of a lipid peak in CNS lymphoma in MR spectroscopy was reported previously.
- Massive elevated lipid resonances maybe due to high turnover rate of membrane components in transformed lymphoid cells and in numerous macrophages.
- D/D: Meningioma usually have high choline, high Alanin but absence of NAA.

Discussion (3)

• **Rapid regression with corticosteroid** without other radiation or chemotherapy is noted in 72.73% of patients.

• Metastasis and GBM can’t have such rapid response after steroid treatment.

• The mean follow up date is **10.5 days**.

• The explanation include tumor lysis secondary to steroid therapy or cyclic biologic activity.

• Therefore, administration of steroid may be **contraindicated** in suspected cases of CNS lymphoma to reduce the likelihood of false negative biopsy results.

*DeAngelis LM. Neurology 1991; 41: 619-621*
Conclusion

• Combined conventional MR images and MR spectroscopy may help early diagnosis of CNS lymphoma.
  – A) Hypo- to iso-intense signal on T2WI, B) strong contrast enhancement, C) diffusion restriction.
  – MRS: Elevation of Cho/Cr, decreased NAA/Cr and elevation of lactate-lipid peak.
• Rapid tumor regression after corticosteroid administration.
• However, if lymphoma is already suspected initially, corticosteroid maybe contraindicated because of false negative results maybe seen in the follow up images.
Thank you very much

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