

Update in Cranio-cerebral Lymphomatous Imaging Diagnosis

Emi Marinela PREDA; Anca LUPU; Ioana Gabriela LUPESCU

“Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania

I undersign, certificate that I do not have any financial or personal relationships that might bias the content of this work – Emi Marinela PREDA.

The incidence of cranio-cerebral involvements by malignant lymphoma has increased significantly in last 20 years. Therefore, interest in the pre-treatment diagnosis and post-treatment surveillance for residual disease using imaging and imaging biomarkers is increasing.

Lymphoma of the central nervous system (CNS) consists of 2 major subtypes: secondary CNS involvement by systemic lymphoma (the most common) and primary central nervous system lymphoma (PCNSL), in which the lymphoma is restricted to the brain, leptomeninges, spinal cord, or eyes, without evidence of it outside the CNS at primary diagnosis. Early diagnosis of CNS lymphoma is crucial for proper management in both immunocompetent and immunocompromised individuals (1).

Computed tomography (CT) and magnetic resonance imaging (MRI) represent the most important imaging modalities in the evaluation of patients with brain tumors. Although CNS lymphomas may have characteristic imaging findings on traditional CT and MRI, none of these will unequivocally differentiate CNS lymphoma from other neoplasms (eg, metastases, malignant gliomas, meningiomas) or non-neoplastic diseases (eg, multiple sclerosis, stroke, cerebral toxoplasmosis, pyogenic abscess) (1).

New MR techniques: diffusion weighted imaging (DWI) and MR spectroscopy (MRS) are increasingly used in clinical radiologic practice and may help to differentiate CNS lymphomas from other lesions of the brain (1,2).

Diffusion-weighted MRI is a powerful tool in characterization of brain neoplasms. DWI measures the diffusion of water molecules in biologic tissues; diffusion within the tumor is considered a marker of tumor cellularity because intact cells constitute a barrier to water diffusion (2). Tumor cellularity and tumor grade have been correlated with ADC values (2). Because CNS lymphomas are highly cellular tumors, water diffusion is often restricted, making them appear hyperintense on DWI and hypointense on ADC maps (Figure 1).

This characteristic is shared by acute ischemic stroke, the central necrosis of brain abscesses, the solid portion of high-grade gliomas, and some metastases. However, PCNSL lesions have often more restricted diffusion and lower ADC values than high-grade gliomas and metastases (1).

A recent study showed that pretherapeutic ADC tumor measurements within contrast-enhancing regions were predictive of clinical outcome in patients with PCNSL (3). Thus, repeated ADC measurements may be used as

Address for correspondence:

Emi Marinela Preda, str. Seneslav Voievod, nr. 212, sector 2, Bucharest, Romania. Phone: +40723680386 / +40743228962.
E-mail: emimpreda@gmail.com

Article received on the 15th of June 2012. Article accepted on the 14th of November 2012.

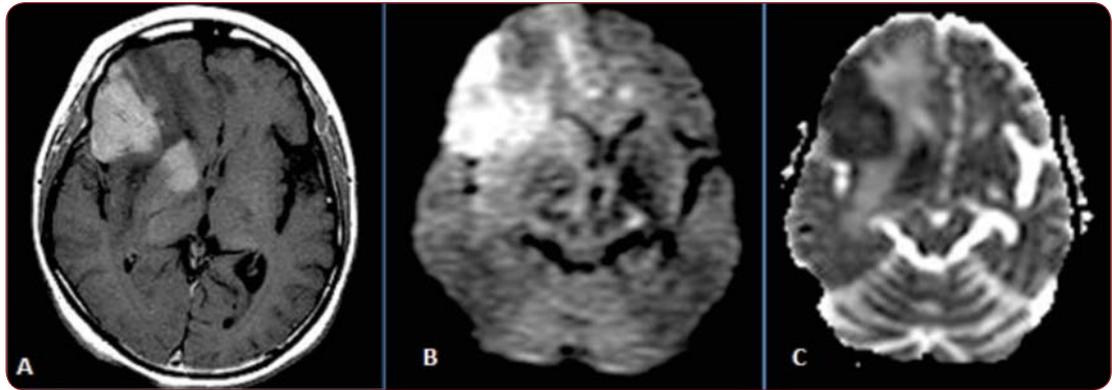


FIGURE 1. Homogeneously enhancing lymphomatous masses in the right frontal white mater and right basal ganglia (A), that manifest marked restriction of water diffusion on DWI sequences (B) and marked low signal on ADC map (C).

biomarkers in the surveillance of therapeutic response (3).

In many disease processes, biochemical changes are preceding morphologic alterations in tissues (2). MR Spectroscopy obtains biochemical information noninvasively from biological tissue; therefore it is a powerful technique to identify early tissues changes compared to conventional MRI morphologic techniques. Within a defined volume of interest, signals may be registered from chemical nuclei within the body; the most commonly used nuclei being protons (hydrogen). Two different approaches have been implemented: single voxel spectroscopy (SVS) and chemical shift imaging (CSI). With first technique, the signals detected from a 3D area or volume of tissues is transformed to a spectrum. In the second technique, multiple voxels are utilized either in a plane (2D CSI) or in a volume (3D CSI); therefore, this method allows studying larger areas with a single experiment. Metabolic maps can be calculated based on the information derived from each voxel (2).

In PCNSL, proton MRS has demonstrated elevated lipid peaks combined with high Cho/Cr ratios (Figure 2) (4). These may help in differentiating PCNSL from other pathologies (like toxoplasmosis and intracranial abscesses), but can also be seen in glioblastoma multiforme and metastases (2). However the peritumoral choline is decreased for lymphomas and metastases, whereas the peritumoral choline is increased for high-grade gliomas. In the immunocompromised patient, both toxoplasmosis and lymphoma may display increased lactate and lipid (1).

The most important clinical applications of MRS, either as a stand-alone technique or in combination with diffusion and perfusion weighted imaging techniques, can be summarized into the differentiation between (a) low and high-grade gliomas, (b) radiation induced necrosis and tumor recurrence, (c) primary and secondary malignant tumors and (d) abscesses and tumors. Another important clinical application of MRS is the assessment of the therapeutic outcome by performing a baseline evaluation and follow-up experiments to identify therapeutic-induced changes and guide the therapeutic scheme (2).

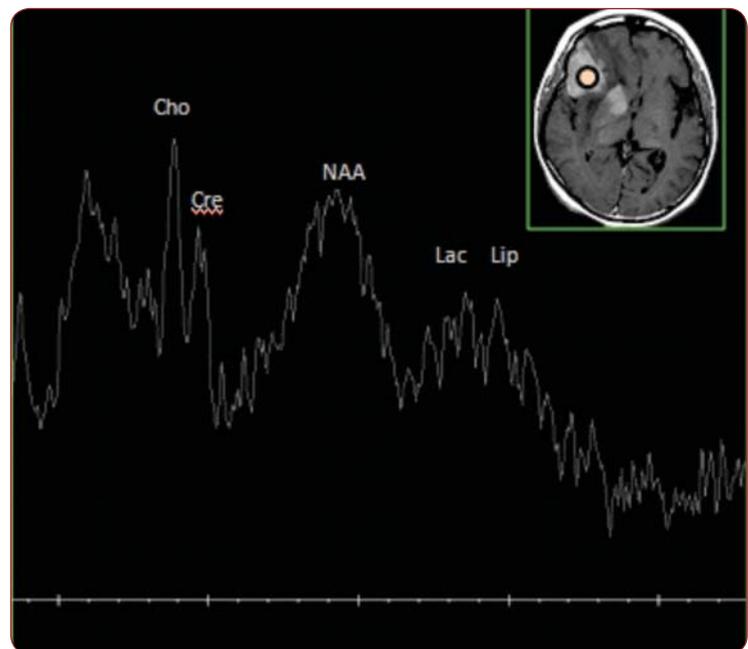


FIGURE 2. MR spectroscopic (MRS) markers at same patient include increase in choline, decreased creatine, decrease in NAA (N-Acetyl Aspartate) and presence of lipid and lactate.

With this update we tried to emphasize the value of existing evidence in the literature to differentiate lymphoma from other etiologies by combining DWI and MRS.

For future, new MRI techniques may disclose important information about tumor biology, thus being able to improve preoperative imaging diagnostic accuracy, enabling an appropriate early treatment for these patients. Some of these newer imaging techniques will likely play a pivotal role in the planning of new

targeted therapies, also in monitoring treatment response, and in the prediction of treatment outcomes (1). □

ACKNOWLEDGEMENTS

This paper is supported by the Sectoral Operational Program Human Resources Development (SOP HRD), financed from the European Social Fund and by the Romanian Government under the contract number POSDRU/6/1.5/S/17"

REFERENCES

1. **Haldorsen IS, Espeland A, Larsson E-M** – Central Nervous System Lymphoma: Characteristic Findings on Traditional and Advanced Imaging. *American Journal of Neuroradiology (AJNR)* 2011, 32:984-92
2. **Drevelgas Antonios, Papanikolaou Nickolas** – Imaging of Brain Tumors with Histological Correlations, Springer-Verlag, Berlin Heidelberg, 2011, 15-32
3. **Barajas RF, Rubenstein Jr JL, Chang JS, et al.** – Diffusion-Weighted MR Imaging Derived Apparent Diffusion Coefficient Is Predictive of Clinical Outcome in Primary Central Nervous System Lymphoma. *American Journal of Neuroradiology (AJNR)* 2010, 31(1):60-6
4. **Preda EM, Popa G, Ghiea SL, et al.** – Imaging in cranio-cerebral lymphomatous disease – a pictorial review, Educational Exhibit, ECR 2012, 10.1594/ecr2012/C-2461.