Primary and secondary lymphoma of the central nervous system. Conventional and functional magnetic resonance imaging findings

Linfoma primário e secundário do sistema nervoso central. Aspectos de imagem na ressonância magnética convencional e funcional

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Lymphomas, and their different radiological presentations have motivated recent publications in the Brazilian radiological literature[1–5]. Primary lymphoma of the central nervous system (CNS) is becoming increasingly diagnosed both in immunocompetent and immunocompromised patients, and therefore recognition of the several imaging characteristics of such tumor in the conventional and functional imaging studies is essential. Currently, primary lymphoma represents 70% to 90% of all CNS lymphomas[6–8]. It is the most common CNS tumor after meningioma and glioma. Central nervous system lymphoma is almost always a B-cell non-Hodgkin's lymphoma. Its high cellularity and high nucleus to cytoplasm ratio result in some of the most known radiological characteristics of this tumor, such as hyperdensity on the computed tomography study, isointensity on the T2-weighted image, and restricted diffusion[7,8].

In an excellent article published in the present issue of **Radiologia Brasileira**, Reis et al.[9] describe some of the main radiological characteristics of primary and secondary CNS lymphomas at conventional magnetic resonance imaging as well as in the advanced imaging studies such as proton magnetic resonance spectroscopy, diffusion- and perfusion-weighted magnetic resonance imaging studies. The authors discuss the different tumor presentations (focal × multifocal), as well as the most typical tumor locations (periventricular, in the basal ganglia and corpus callosum). Characteristics of primary and secondary lymphomas are described, with leptomeningeal involvement, as well as infiltration of perivascular Virchow-Robin spaces and involvement of the cranial nerves most commonly observed in secondary lymphoma.

There are some other less common presentations of CNS lymphomas such as lymphomatoid granulomatosis[10], intravascular lymphoma[11,12] and lymphomatosis cerebri[13], which may represent a diagnostic challenge to radiologists. Another important fact is that, although hemorrhage is more common in lymphomas in immunocompromised patients, it may also be observed in immunocompetent patients, and if present, may result in sudden clinical manifestations that may simulate a vascular insult.

The mentioned article deserves special attention because it addresses relevant imaging findings of lymphomas, including those observed in advanced neuroimaging studies. Spectroscopy, diffusion, perfusion and, most recently, permeability studies have been increasingly used in the assessment of focal intracranial lesions, in the attempt to more appropriately characterize the lesion nature (tumor × vascular × infectious × demyelinating lesion) and, in the case of tumors, to suggest the histological type and the tumor grade.

At single voxel magnetic resonance spectroscopy, the lesion is analyzed by means of a rapid imaging sequence lasting only about two minutes. As reported by Reis et al.[9] as well as by other aothors[14–16], the presence of fat in an apparently solid lesion is a quite typical finding in lymphomas and is useful to suggest the diagnosis. However, such finding should not be considered pathognomonic, since glioblastoma multiforme (GBM) − the most common primary CNS tumor in adults − may demonstrate lipids in the spectra while no evidence of macroscopic necrosis is demonstrated in the conventional magnetic resonance imaging study.

Typically, lymphomas present with restricted diffusion[17], a useful information for both the diagnosis and estimation of the prognosis[18]. Lymphomas with more restricted diffusion present with higher cellularity and worse prognosis. However, diffusion restriction can be observed in GBMs, so it might be difficult to differentiate such tumor from lymphomas utilizing only diffusion-weighted imaging[19]. It is worthwhile to note that diffusion restriction is minimal or even absent in lymphomatosis cerebri, a rare presentation of CNS lymphoma[13]. Diffusion restriction may also be absent in lymphomas if the imaging study is performed in patients under steroid therapy (personal experience).

Neoangiogenesis is not characteristic of lymphomas, so perfusion may be low[20–22]. Reduced blood volume in the perfu-

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sion study is useful for differentiating lymphomas from GBMs, since GBMs typically present with a very high blood volume. However, some lymphomas may present with increased perfusion, quite similar to that observed in high-grade gliomas.

Our initial experience with permeability studies has shown that lymphomas do not present with a significant increase in permeability, since neoangiogenesis is absent[20–22]. Such information might eventually be used to aid in the distinction between lymphomas and glioblastomas, since GBMs demonstrate a significant increase in capillary permeability, a remarkable characteristic associated with the presence of leaky vessels resulting from the neoangiogenesis process.

As clearly exposed in the article by Reis et al.[9], knowledge of the conventional magnetic resonance imaging findings in lymphomas, in association with the information obtained with the addition of advanced imaging methods (magnetic resonance spectroscopy + diffusion-weighted imaging + perfusion-weighted imaging) and, more recently from the permeability studies is essential to the diagnosis of CNS lymphomas and to the distinction between tumor and high-grade gliomas.

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