Neuroimaging in Central Nervous System Lymphoma

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KEYWORDS

• Lymphoma • Central nervous system • MRI • CT

KEY POINTS

- Most cases of primary central nervous system lymphoma (PCNSL) are of the B-cell type (90% are diffuse large B-cell lymphoma) and a small subset are of T-cell lineage.
- PCNSLs are highly cellular lesions with tightly compacted cells, which translate into high density on computed tomography scan, low signal on T2-weighted imaging, and restricted diffusion on diffusion-weighted imaging.
- A variety of intracranial pathologic conditions can mimic PCNSL, such as high-grade gliomas, toxoplasmosis, subacute infarction, and tumefactive demyelinating lesions.

INTRODUCTION

Primary central nervous system lymphoma (PCNSL) is a rare aggressive high-grade type of extranodal lymphoma.[1] In PCNSL, the lymphoma is restricted to brain parenchyma, meninges, spinal cord, or eyes, without evidence of disease outside the central nervous system (CNS) at the time of initial diagnosis.[1,2] Most cases of PCNSL are of the B-cell type (90% are diffuse large B-cell lymphoma), and a small subset are of T-cell lineage.[3] PCNSL is more frequently seen in immunocompromised patients but it can occur in the immunocompetent population. The incidence of PCNSL has shown a growing trend from 3.3% before 1978 to 6.6% to 15.4% of all primary brain tumors in the early 1990s, due to increased prevalence of human immunodeficiency virus (HIV) infection and use of immunosuppressive drugs for transplantation.[1] However, subsequently, the incidence of PCNSL declined secondary to the introduction of highly active antiretroviral therapy (HAART).[4,5]

The mean age of diagnosis for PCNSL is 60 years old and it is more common in women.[6] Patients with acquired immunodeficiency syndrome (AIDS) are generally

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diagnosed at a younger age than those without this disease.[7] A smaller peak is also observed in the first decade of life due to pediatric AIDS.[1]

Clinically, PCNSL may mimic other intracranial pathologies on imaging such as encephalitis, demyelination, and stroke. Personality changes, cerebellar signs, headache, seizure, and motor dysfunction may occur. Constitutional symptoms may also be present[1] but they are more common in T-cell lymphoma.[8] Early diagnosis and treatment can sometimes reduce the irreversible deficits of this disease.

In addition to primary lymphoma, the CNS can be secondarily involved by systemic lymphoma in 10% to 15% of patients,[9] with a tendency to occur early at a median lag of 5 to 12 months after the primary diagnosis of non-Hodgkin lymphoma (NHL).[10] The systemic lymphoma is almost always aggressive NHL and patients with systemic Hodgkin disease are at very low risk of CNS involvement.[10]

IMAGING FINDINGS

Secondary Central Nervous System Lymphoma

CNS involvement by systemic lymphoma presents as leptomeningeal disease in two-thirds and as parenchymal disease in one-third of patients.[10] Approximately half of the patients with secondary CNS lymphoma have progressive systemic lymphoma. Most of the remaining patients with apparently isolated CNS involvement will develop systemic disease within months.[10,11] In addition, systemic lymphoma of the face (nasal cavity and paranasal sinus) can spread to the orbit and CNS via extraocular muscle involvement and direct perineural spread of neoplasm.[12]

Contrast-enhanced MRI is the imaging modality of choice and can detect enhancement along the pial surface of the brain and spinal cord, subependymal ventricular system, and cranial or spinal nerve roots.[10] It is more sensitive compared with contrast-enhanced computed tomography (CT).[13] Leptomeningeal disease can also invade the brain parenchyma and cause superficial cerebral lesions. Communicating hydrocephalus is frequently observed in patients with leptomeningeal disease.[10]

Parenchymal CNS involvement in systemic lymphoma can present as single or multiple parenchymal masses (**Figs. 1** and **2**) and may accompany leptomeningeal disease.[14,15] In a study of 18 subjects with parenchymal lymphoma, Senocak and colleagues[16] demonstrated that homogenous nodular enhancement and supratentorial white matter involvement were present in all subjects with secondary lymphoma, with a butterfly pattern and infiltrative or perivenular enhancement in half of the subjects, with no significant distinctive radiologic characteristics between primary and secondary lymphoma of the brain parenchyma.

Primary Central Nervous System Lymphoma

General features

The most common presentation of PCNSL is a single intracranial mass.[17] However, multiple masses are also quite common, and are seen in 20% to 40% of immunocompetent cases and 50% of the immunocompromised patients.[17–19] The classic location of PCNSL is supratentorial in up to 70% of cases and has a predilection to involve the periventricular white matter. Basal ganglia are involved in 13% to 20% of patients.[17–20] Involvement of the corpus callosum and extension to the other side of the brain can mimic the butterfly glioma appearance of glioblastoma multiforme (GBM).[21] Superficial locations are also sometimes seen.[10] Less commonly, lymphoma may involve other CNS structures (**Fig. 3**) such as the hypothalamus, brainstem, cerebellum pituitary talk, and spinal cord.[3,21]