Magnetic resonance imaging evaluation of spinal cord lesions: what can we find? – Part 2. Inflammatory and infectious injuries

Abstract

Diseases involving the spinal cord include a heterogeneous group of abnormalities, including those of inflammatory, infectious, neoplastic, vascular, metabolic, and traumatic origin. Making the clinical differentiation between different entities is often difficult, magnetic resonance imaging being the diagnostic method of choice. Although the neuroimaging findings are not pathognomonic, many are quite suggestive, and the radiologist can assist in the diagnosis and, consequently, in the therapeutic guidance. In this second part of our article, the objective is to review the magnetic resonance imaging findings of the main inflammatory and infectious spinal cord injuries.

Keywords: Magnetic resonance imaging; Spinal cord/pathology; Spinal cord diseases; Inflammation; Infection.

INTRODUCTION

The spinal cord is the portion of the central nervous system that is within the vertebral canal, extending from the foramen magnum to the conus medullaris at the L1-L2 level, being surrounded by cerebrospinal fluid and contained by the thecal sac. Countless diseases can affect this region, leading to motor, sensory, and autonomic alterations, and magnetic resonance imaging (MRI) findings are essential for diagnostic elucidation and therapeutic orientations, and magnetic resonance imaging being the diagnostic method of choice. Although the neuroimaging findings are not pathognomonic, many are quite suggestive, and the radiologist can assist in the diagnosis and, consequently, in the therapeutic guidance. In this second part of our article, the objective is to review the MRI findings of the main inflammatory and infectious spinal cord injuries.

INFLAMMATORY CAUSES

Acute disseminated encephalomyelitis

Acute disseminated encephalomyelitis is a demyelinating immune-mediated disease, classically of a monophasic course, that is typically secondary to a viral infection or vaccination, spinal cord involvement occurring in up to one third of cases. Spinal cord lesions are typically longitudinally extensive (continuous involvement of ≥ three vertebral levels) and confluent, potentially affecting more than two thirds of the sectional area of the spinal cord. On T2-weighted MRI scans, such lesions are typically hyperintense, with variable contrast enhancement (Figure 1). The condition may regress after treatment(6).

Multiple sclerosis

Multiple sclerosis is a primary demyelinating disease that is more common in females and in the third and fourth decades of life. It is characterized by perivenular inflammation and demyelination with relative preservation of the axon. The most common site of involvement is the cervical spine. The lesions are typically well-defined and eccentric, primarily in a posterior location, affecting less than 50% of the sectional area of the spinal cord(6). On T2-weighted MRI scans, the disease is characterized by hyperintense lesions and there can be contrast enhancement when there

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is disease activity (Figure 2). Spinal cord atrophy may occur and is common in the advanced stages.

**Neuromyelitis optica**

Neuromyelitis optica is a demyelinating autoimmune disease induced by autoantibodies against aquaporin-4 water channels. The classic triad is optic neuritis, longitudinally extensive myelitis, and anti-aquaporin-4 antibody positivity. On T2-weighted MRI scans, longitudinally extensive hyperintense lesions can be seen, primarily involving the cervical and thoracic spine, typically with concentric involvement around the central canal of the spine (Figure 3). A suggestive finding is the presence of bright spotty lesions (spinal cord foci with signal intensity higher than that of the cerebrospinal fluid on T2-weighted images). Spinal cord atrophy is common in the advanced stages.

**Acute transverse myelitis**

Acute transverse myelitis is an immune-mediated inflammatory disorder associated with numerous infectious, inflammatory, and neoplastic diseases, rarely being idiopathic, affecting individuals of either gender and of any age. Clinically, it is characterized by acute symptoms. Paralysis, ataxia, and sphincter dysfunction are common. On
T2-weighted MRI, a longitudinally extensive hyperintense lesion is typically seen, primarily involving the cervical and thoracic spine, affecting more than two thirds of the sectional area. When there is contrast enhancement can occur, it is typically peripheral and irregular\(^{(7)}\).

**Anti-myelin oligodendrocyte glycoprotein antibody-associated myelitis**

Anti-myelin oligodendrocyte glycoprotein (MOG) antibody-associated myelitis is a demyelinating inflammatory disorder associated with the presence of the immunoglobulin G antibody against MOG, being most common in the third decade of life, with a predilection for females. The most common presentation is a longitudinally extensive lesion, although small concentric hyperintense lesions can be seen on T2-weighted images and there can be isolated involvement of the conus medullaris, the latter being high suggestive of the diagnosis. Heterogeneous enhancement is common in most cases\(^{(8)}\).

**Lupus**

Myelopathy is a rare manifestation in lupus, affecting \(\leq 2\%\) of all lupus patients, and is typically associated with thrombosis and vasculitis. The thoracic spine is the most common site of involvement, where it manifests as a longitudinally extensive lesion occupying more than two thirds of the cross-sectional area. On MRI, the signal is isointense or hyperintense on T1-weighted images, hyperintense on T2-weighted images and shows variable contrast enhancement\(^{(9)}\), as illustrated in Figure 4.
INFECTIOUS CAUSES

Zika

In cases of Zika, the severity of changes in the spinal cord and nerve roots shows an apparent correlation with the presence of arthrogryposis. In such cases, MRI provides better visualization of spinal cord atrophy, as well as of the reduction of the anterior roots of the conus medullaris (Figure 5). However, in cases of Zika without arthrogryposis, only a reduction of spinal thickness in the thoracic region, discreet thinning of the anterior roots of the conus medullaris, and involvement of the anterior descending tracts are observed, with apparent preservation of the ascending posterior tracts (10).

Spinal cord schistosomiasis

Spinal cord schistosomiasis is the most common ectopic form of infectious spinal cord injury, being the leading cause of nontraumatic non-neoplastic myelitis in endemic areas. The clinical picture is one of acute/subacute myelopathy. On MRI, spinal cord schistosomiasis typically presents as conus medullaris expansion, with a signal that is hypointense on T1-weighted images and hyperintense on T2-weighted images, with contrast media uptake (Figure 6), allowing the differential diagnosis to be made with anti-MOG antibody-associated demyelinating disease. The characteristic pattern of neuroschistosomiasis is linear, nodular tree-in-bud enhancement (11).

Human T-lymphotropic virus-1-associated myelopathy

Human T-lymphotropic virus-1 (HTLV-1)-associated myelopathy is a progressive chronic demyelinating disease affecting the spinal cord through multifactorial responses to HTLV-1 infection, being most common in females in the fourth decade of life. The most common clinical manifestation is chronic, slowly progressing spastic paraparesis (12). On MRI, spinal cord atrophy and a hyperintense signal are seen in T2-weighted and short-tau inversion-recovery (STIR) sequences, more pronounced in the lateral columns and mainly involving the white matter, as well as the gray matter and anterior nerve roots (Figure 7). In cases of acute exacerbation, which is rare, there is spinal cord edema and peripheral contrast enhancement.

AIDS-associated myelopathy

Typically, AIDS-associated myelopathy occurs in the final stages of the disease, being secondary to vacuolization of the white matter in the posterior and lateral regions of the spine, primarily in the thoracic spine. Clinically, AIDS-associated myelopathy is characterized by slowly progressing weakness in the lower limbs, gait disorders, sensory abnormalities, and impotence. On MRI, spinal cord atrophy is the most common finding, the most common site of involvement being the thoracic spine, followed by the cervical spine, T2-weighted images showing a well-defined symmetrical area of hyperintensity in the posterolateral region of the spine (Figure 8), predominantly in the gracile tract (13).

Poliomyelitis-like syndrome

Poliomyelitis-like syndrome is defined as acute flaccid myelitis (inflammation of the spinal cord), which usually
occurs after a viral disease (commonly related to enterovi-
rus), characterized by flaccid paralysis, back pain, decreased
sensitivity, and cranial nerve dysfunction. The MRI findings
may be normal in the first 72 h and, when altered, typically
indicate a longitudinally extensive lesion, primarily affect-
ing the cervical and thoracic columns, characterized by a
hyperintense signal on T2-weighted images, affecting the
gray matter in the acute phase and the anterior horns of the
spinal cord in the subacute phase (Figure 9). Enhancement
of the cauda equina and cranial nerves may occur\(^{14}\).

Zoster myelitis

Zoster myelitis is an infectious manifestation caused
by reactivation of varicella-zoster virus that has remained
inactive in the sensory ganglia since the first infection.
Clinically, it is characterized by pain and rash. On MRI,
the typical presentation is a hyperintense signal in the lateral
portion of the spine on T2-weighted images, related to
segments corresponding to the cutaneous eruption, with-
out significant contrast enhancement, and it may evolve to
segmental atrophy (Figure 10).

Tuberculosis

Tuberculous myelitis is rare and, in some cases,
evolves to ischemia and spinal cord necrosis. Spinal cord
involvement may manifest as tuberculoma or transverse myelitis or can even be secondary to the involvement of structures adjacent to the spinal cord. The lumbar spine is the most common site of involvement, followed by the thoracic spine. On MRI, the most common pattern is one of a longitudinally extensive hyperintense lesion on T2-weighted images, more evident in the central region of the spine, in some cases occupying more than two thirds of its sectional area\(^{15}\), as depicted in Figure 11.

**CONCLUSION**

In view of the aspects described above, it is obvious that spinal cord lesions pose a challenge for clinicians and radiologists. However, neuroimaging findings, when taken together with clinical and biochemical data, may facilitate the diagnosis and guide the treatment. Therefore, radiologists should be prepared to interpret such findings.

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