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CASE REPORT

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Diffusion-Weighted MR Imaging of Intramedullary Spinal Cord Abscess

SUMMARY: Early diagnosis and prompt initiation of adequate treatment are essential for clinical outcome in ISCA. We report a case in which DWI provided a more specific diagnosis than conventional MR imaging and allowed differentiation of a ring-enhancing lesion from intramedullary tumor. Diagnosis was proved by PCR from CSF (*Streptococcus intermedius*). Adequate antibiotic treatment was immediately initiated, and the patient recovered completely.

ABBREVIATIONS: ADC = apparent diffusion coefficient; DWI = diffusion-weighted imaging; Gd = gadolinium; ISCA = intramedullary spinal cord abscess; PCR = polymerase chain reaction

ISCA is a rare entity that was first described by Hart in 1830,¹ and until now, to our knowledge, <100 cases have been reported in the literature. The early clinical suspicion and radiologic diagnosis are mandatory to start appropriate medical or surgical treatment and to avoid irreversible spinal cord damage. The radiologic technique of first choice is unambiguously MR imaging with intravenous Gd-chelates application, but differentiation from intramedullary tumors may be difficult.

Case Report

A 80-year-old female patient with diabetes mellitus had been admitted with thoracic back pain after a collapse 2 days before. Other complaints were weakness in both legs, headache, and urinary incontinence.

The clinical examination revealed slightly elevated body temperature (37.8°C), local tenderness along the thoracic spine, monoparesis, and hypoesthesia of the left leg below the T7 level and a positive Babinski sign on the left side. Blood tests at admission showed the following values: increased leukocytes of 16,700/ μ L, an erythrocyte sedimentation rate of 16 mm/h, and moderately elevated C-reactive protein (69.5 mg/L). Findings of repeated blood and urine cultures were negative.

Unremarkable conventional radiographs of the thoracic spine were followed by conventional MR imaging (including intravenous Gd-chelates application), which did not show any signs of contusion or fracture in the thoracic vertebral bodies but did show an edema of the spinal cord extending from level T4 to T12 and a focal ring-enhancing lesion on level T8 with central necrosis and a diameter of 2 cm (Fig 1A, -B). On T2-weighted images, the hypointense rim of the lesion could be delineated (Fig 1B). To differentiate an abscess from a tumor, we performed additional DWI with an axial and sagittal single-shot echo-planar spin-echo sequence. The images were acquired with b-values of 0 and 1000 s/mm². The cavity of the lesion appeared strongly hyperintense on DWI and showed low ADCs on the ADC map compared with the myelon above and below the lesion, suggesting an intraspinal abscess (Fig 1C, -D).

Lumbar puncture yielded the following values: white blood cells, 466/ μ L; protein, 800 mg/L; and lactate, 4.7 mmol/L. CSF microscopy

found predominantly polynuclear white blood cells but no tumor cells. Results of CSF Gram stain and culture were negative. PCR from CSF yielded deoxyribonucleic acid of *Streptococcus intermedius*. Therapy was initiated with ceftriaxone (2 g twice a day), dexamethasone (4 mg 3 times a day), and metronidazole (500 mg 3 times a day), corresponding to our standard regimen for treatment of a brain abscess. Antibiotic treatment was continued for 6 weeks.

A follow-up MR imaging 2 weeks after admission showed a nearly complete regression of the spinal cord edema and a substantial decrease of the abscess cavity. Six weeks after admission, the ring-enhancing lesion had disappeared, and minimal residual contrast enhancement was completely dissolved 11 weeks after initial diagnosis. The patient had a full recovery of the neurologic symptoms, and laboratory findings were normal.

Discussion

ISCA is a rare suppurative infection of the central nervous system that may resemble a spinal cord neoplasm. Symptoms include pain (60%), motor and sensory deficits (68%), urinary incontinence (56%), fever (40%), meningismus (12%), and brain stem dysfunctions (4%).² Our patient presented with a rather acute onset, and 4 of the main clinical signs were present. The urinary incontinence was assigned to a pre-existing condition.

In many cases, spinal dysraphism and extension of bacterial meningitis or ependymoma is the leading cause of ISCA, thus affecting mostly children.³ Other cases are associated with direct trauma, neurosurgical intervention, or extension from another adjacent source of infection. One important mechanism of infection appears to be hematogenous spread,² as seemed to be the case with our patient, though we were not able to identify the origin of infection. We assume in our case that the patient's diabetes was the only important predisposing factor, and the mechanism of infection remains cryptogenic.

A spinal intramedullary ring-enhancing mass is basically a nonspecific imaging finding that can be seen in various non-inflammatory benign and neoplastic processes and rarely in ISCA. The differential diagnosis includes primary or secondary cord tumors (necrotic glioma, metastases) and resolving hematoma, infarction, or even demyelinating disease. Because of the very rare appearance of ISCA, MR imaging features were only known from single reports and seem to be similar to changes with brain abscesses. They included extended hyperintensity of the spinal cord on T2-weighted images with a circular enhancement on T1-weighted images after intravenous

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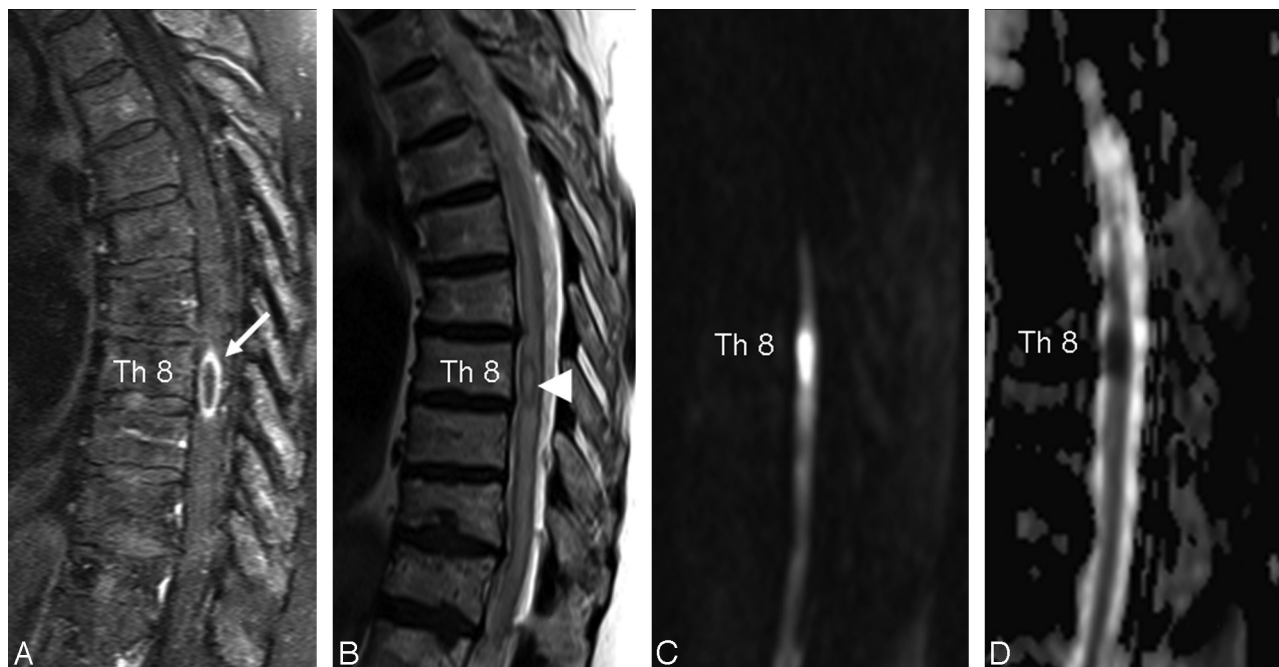


Fig 1. A, Sagittal fat-saturated T1-weighted turbo spin-echo sequence after intravenous Gd-chelates application shows an intramedullary ring-enhancing lesion at T8 (white arrow). B, Sagittal T2-weighted turbo spin-echo sequence demonstrates an extended thoracic spinal cord edema and a hypointense capsular rim of the lesion (white arrowhead). C, The lesion is hyperintense on sagittal DWI. D, Restricted diffusion is illustrated on ADC maps.

Gd-chelates application. The severity of edema and the grade of contrast enhancement probably vary with lesion stage. Because the clinical manifestations are often nonspecific and only 40%–50% of patients are febrile on examination, MR imaging is mostly performed in a later capsular stage. In our study, we found a hypointense abscess capsule on T2-weighted spin-echo MR images, which is caused by the susceptibility effects from free radicals and an extended edema of the entire thoracic myelon. The purulent fluid in the abscess cavity showed a hyperintense signal intensity on DWI and low ADC values in comparison with the surrounding myelon, reflecting decreased diffusion properties.

Pus in an abscess cavity is a thick and mucoid fluid that consists of inflammatory cells, bacteria, necrotic tissue, and proteinaceous exudates with high viscosity. The water mobility and the microscopic diffusional motion of water molecules are heavily impeded and lead to the decrease of ADC in the abscess center. These phenomena are extensively described with brain abscesses and other intracranial infectious processes.^{4,5} DWI is recommended as a more sensitive and specific method for differentiating abscesses from cystic or necrotic tumors, because the latter present with low signal intensity and show increased values of ADC. The cystic and necrotic cavities of tumors usually consist of necrotic tumor-tissue debris, fewer inflammatory cells than in an abscess, and clearer serous fluid than pus.^{4,6} However, it has to be considered that the high signal intensity on DWI and the decrease of ADC may vary in the abscess cavity, which may be due to a difference in the concentration of inflammatory cells and particularly the viscosity of abscess fluid. Factors determining the viscosity are the age of the abscess, the etiologic organism, and the host's immune response.

PCR of the CSF showed *S intermedii*, which has a recognized tropism for abscess formation in the liver and central

nervous system.⁷ Similar to the recommendations for the management of brain abscess, which may frequently be polymicrobial, initial antibiotic therapy with ceftriaxone and metronidazole was administered. In most reported cases, patients underwent surgical abscess drainage together with antibiotic treatment. We chose medical treatment as single approach because of the fast and satisfactory initial response of both the clinical and the radiographic findings.

Despite a relatively low mortality rate of 8% of 25 reported ISCA cases between 1977 and 1997,² the known rate of patients with persistent neurologic deficits was 70%, despite medical and surgical treatment. Because our patient was cured, showed complete neurologic recovery, and was treated with antimicrobial therapy only, we document that excellent outcome can be achieved with prompt initiation of medical therapy only and we emphasize the importance of early diagnosis with MR imaging, which may be enhanced by DWI.

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