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Original research article

Spinal cord lesions in children and adolescents with multiple sclerosis – Magnetic resonance imaging

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ABSTRACT

Purpose: The purpose of our study was to determine the prevalence of spinal cord lesions revealed by magnetic resonance (MR) imaging in children and adolescents with clinically definite multiple sclerosis (MS).

Material and methods: We retrospectively evaluated the spinal cord magnetic resonance examinations in a group of MS patients consisting of 58 children (37 girls and 21 boys) aged from 7 to 17.8 years (mean 13.7 years). All children met the criteria of clinically definite MS and had typical MS lesions revealed in the brain imaging.

Results: Spinal cord lesions, regardless of localization, were identified in 36 (62%) patients. In 22 of 58 patients (38%) no lesions were observed. The plaques were found in the cervical spinal cord and the thoracic spinal cord in 30 out of 36 (86.1%) and in 31 out of 36 (88.6%) patients, respectively. Contrast enhancement was noticed in 10 out of 36 patients (27.7%) and was not correlated with the number of lesions present.

We noticed a tendency to higher EDSS score in patients with lesions in more than 1 spinal cord region.

Our study showed that spinal cord lesions are more frequently present in patients with complex neurological disability.

Conclusion: The prevalence of spinal cord lesions in children and adolescents with MS is high. Therefore, spinal cord MRI should be included in diagnostic program of MS.

1. Introduction

Multiple sclerosis (MS) is a chronic inflammatory, demyelinating, neurodegenerative disease of the central nervous system. The disorder is most commonly diagnosed between ages 20 and 40, but can be seen at any age, including children and adolescents.

The term ''pediatric MS'' is applied to children with MS (<10 years of age) and adolescents (<18 years of age) [1]. About 2.2–

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4.4% (3–5%) of all MS cases have an onset of disease before the age of 16, less than 1% before 11 years of age [1–5]. The diagnosis is based primarily on clinical findings; however, laboratory tests and magnetic resonance imaging (MRI) play an important role in the diagnostic process [1,6–8]. Magnetic resonance imaging is a method of choice for demonstrating abnormalities of the brain and spinal cord tissue, as well as lesions dissemination in space and time [2,8,9].

Following the recommendation of the International Pediatric MS Study Group the MR examination should include a cranial and a spinal MRI with and without gadolinium [2]. However, although brain MRI is performed routinely in MS children, only few articles relating to lesions in the spinal cord [10] with the use of contrast media in children with MS have been published [11].

In Poland, limited use of spinal cord MRI in MS patients is related also to the requirements of the national program of MS therapy reimbursement, which include brain MRI only as an outcome measure (www.nfz.gov.pl).

The aim of our study was to describe the MR features and to determine the prevalence of spinal cord lesions revealed by magnetic resonance (MR) imaging in children and adolescents with clinically definite multiple sclerosis, based on the diagnostic criteria proposed by the International Pediatric MS Study Group.

2. Material and methods

Our series included 58 children who fulfilled the criteria for relapsing–remitting MS and were treated in the Department of Neurology and Epileptology at out hospital between 2010 and 2013. The group of patients consisted of 37 girls (63.7%), aged from 8.2 to 17.8 years, mean age 14.4 and 21 boys (36.2%) aged from 7 to 16.7, mean age 13.4 years.

We retrospectively evaluated the first spinal cord magnetic resonance examinations which were the part of routine radiological investigations of each MS patients. Both cranial and spinal exams were performed.

MRI of the spinal cord was performed on 1.5T scanner using a spinal phased array coil.

The MRI protocol consisted of T1-, T2-weighted sagittal and axial images visualizing the entire length of the spinal cord. The contrast medium is given for patients in whom lesions were found in the spinal cord; T1-weighted images in two planes following gadolinium administration in dose of 0.1 mmol/kg were obtained.

The parameters used for the sagittal T1-weighted sequence were as follows: repetition time/echo time: TR/TE = 486/10 ms, acquisition matrix = 269 × 384, field of view FOV = 340 × 340 mm, slice thickness 3 mm, gap 10%, averages 4; for T2-weighted: TR/TE = 3400/103 ms, acquisition matrix = 358 × 512, FOV = 340 × 340, thickness 3 mm, gap 10%. The parameters used for axial T1-weighted: TR/TE = 751/12 ms, FOV = 250 × 250, matrix = 185 × 384, thickness 4 mm; for axial T2-weighted: 3910/107 ms, FOV = 250 × 250, matrix = 245 × 384, thickness 4 mm. Acquisition time for spinal cord imaging was approximately 30 min.

The following features of MR images were analyzed: the presence of focal or diffuse lesions seen on T2-weighted images on both planes, lesion location, total lesions count and the number of enhancing lesions.

The spinal cord involvement is described as the presence of high intensity lesions on T2 weighted images, single, multiple or diffuse, with or without enhancement after contrast injection. The presence and number of enhancing lesions was scored in the spinal cord on T1-weighted images after contrast injection.

All spinal cord MRI scans were reviewed by consensus by two experienced neuroradiologists with minimum 15 years of experience in neuroradiology.

All patients underwent thorough clinical workout, including EDSS score. Clinical symptoms associated with spinal cord lesions were determined in five domains: motor, sensory, bowel or urinary disturbances and abnormal reflexes. Abnormal spinal reflexes included any disturbances in superficial abdominal or cremasteric (in males only) reflexes. Neurological status of the patients at the time point when spinal cord MRI was performed was taken into account.

3. Results

First spinal cord MRI was performed during first relapse of the disease in 36 (62%) of the disease, up to 3 months after first relapse in 10 (17.2%) patients, during second relapse in 5 patients (8.6%), and later on the course of the disease in 7 cases (12%).

Spinal cord lesions were disclosed in 22 patients out of 36 with spinal cord MRI performed during first MS relapse (61%), in 7 out of 10 with MRI performed up 3 months after first relapse in (70%) patients, in 4 out of 5 with MRI performed during second relapse (90%), and in 3 out of 7 with MRI performed later on the course of the disease (42.8%).

Spinal cord lesions, regardless of localization, were identified in 36 (62%) patients. In 22 of 58 patients (37.9%) no lesions were observed. The plaques were found in the cervical spinal cord and the thoracic spinal cord in 30 (52%) and in 31 (53%) patients, respectively. The number of lesions differed according to spinal cord segments. In the cervical spinal cord there were 67 lesions while in the thoracic region we observed 63 lesions (Fig. 1).

The lesions were found in only in the cervical spine in 5 children, only in the thoracic spine in 6 patients. Both segments were affected in 25 patients. 4 of 31 patients (11.1%) had uncountable, diffuse lesions.

Contrast enhancement was noticed in 10 out of 36 patients (27.7%). In 3 patients their only one lesion in the cervical spinal cord showed enhancement. One patient had one lesion in the thoracic spine which showed gadolinium enhancement. In 5 patients lesions in both evaluated segments enhanced.

MRI data are summarized in Table 1.

4. Clinical presentation of spinal cord lesions in MS children and adolescents

Mean EDSS score in MS children and adolescents at the time spinal MRI was performed was 1.6 (median EDSS – 1) and ranged from 0.5 to 5. Clinical signs and symptoms associated

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