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EVALUATION OF CERVICAL SPINAL CORD ATROPHY BY MAGNETIC RESONANCE IMAGING IN PATIENTS WITH MULTIPLE SCLEROSIS

MULTİPL SKLEROZLU HASTALARDA SERVİKAL SPİNAL KORD ATROFİSİNİN MANYETİK REZONANS GÖRÜNTÜLEME İLE DEĞERLENDİRİLMESİ

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Abstract

Aim: Multiple sclerosis (MS) is an inflammatory disease of the brain and spinal cord (SC) that leads to demyelination and neurodegeneration. The relationship between cervical cord atrophy and disability in MS patients was demonstrated.

Methods: The examinations were made with MR-Philips Medical System 1.5 tesla device in sagittal and axial planes with T1-WI and T2-WI. Images were evaluated by two experienced radiologists through the hospital image archive system.

Results: In the sagittal plane measurement from the C3 vertebra level, the mean SC measurement of the patients in the MS group was 7.3 ± 0.7 millimeters (mm), while the mean of the control group was 8.3 ± 0.6. In the sagittal plane measurement from the C6 vertebra level, the mean SC measurement of the patients in the MS group was 6.9 ± 0.7 mm, while the mean of the control group was 7.8 ± 0.5. In the measurements made at all levels, SC thicknesses were lower in MS group patients compared to control group patients, and this decrease was statistically significant.

Conclusions: In daily practice, cervical spinal cord measurements in MS patients can be easily and quickly performed with conventional MRI in two dimensions.

Keywords: MRI, Multiple Sclerosis, Cervical Cord, Spinal Cord

Öz

Amaç: Multipl skleroz (MS), beyin ve spinal kord (SK) demiyelinizasyon ve nörodejenerasyona yol açan inflamatuar bir hastalığıdır. MS hastalarında servikal kord atrofisi ile disabilite arasındaki ilişki gösterilmiştir.

Yöntemler: Muayeneler MR-Philips Medical System 1.5 tesla cihazı ile sagital ve aksiyel planda T1-WI ve T2-WI ile yapıldı. Görüntüler deneyimli iki radyolog tarafından hastane görüntü arşiv sistemi aracılığıyla değerlendirildi.

Bulgular: C3 vertebra seviyesinden sagital düzlem ölçümünde MS grubundaki hastaların ortalama SK ölçümü 7,3 ± 0,7 milimetre (mm), kontrol grubunun ortalaması ise 8,3 ± 0,6 idi. C6 vertebra seviyesinden sagital düzlem ölçümünde MS grubundaki hastaların ortalama SK ölçümü 6.9 ± 0.7 mm, kontrol grubunun ortalaması 7.8 ± 0.5 idi. Tüm seviyelerde yapılan ölçümlerde MS grubu hastalarda kontrol grubuna göre SK kalınlıkları daha düşüktü ve bu azalma istatistiksel olarak anlamlıydı.

Sonuç: Günlük pratikte MS hastalarında servikal omurilik ölçümleri iki boyutlu konvansiyonel MRG ile kolay ve hızlı bir şekilde yapılabilmektedir.

Anahtar Kelimeler: Multiple skleroz, MRG, servikal kord

Introduction

Multiple sclerosis (MS) is an inflammatory disease of the brain and spinal cord (SC) that leads to demyelination and neurodegeneration. Atrophy is considered to be the result of neurodegeneration in MS and can be assessed through magnetic resonance imaging (MRI), the most sensitive technique for detecting changes in tissue integrity in the brain and spinal cord[1-4].
SC abnormalities were observed in 83% of patients with MS, 60% of them in the cervical region[5,6]. SC lesions are of prognostic as well as diagnostic importance in MS[7]. The relationship between cervical cord atrophy and disability in MS patients was demonstrated in a study[8]. SC volume (SCV) or cross-sectional area measurements have been shown to be strongly associated with disability in MS[1,6,9] and SCV loss is more common in progressive forms of the disease[10,11].
Despite the prediction revealed by cross-sectional and volumetric SC studies with short-term follow-up, there is a lack of large-scale, long-term studies on SCV loss in MS for economic, temporal, and technical reasons[12,13]. Accordingly, there is a lack of information about the dynamic changes of SC measurements and their relationship to the patient's clinical picture over time.
In this study, we basically investigated the detectability of atrophy by measuring two-dimensional Cervical Spinal Cord (CSC) diameters and spinal canal diameters. Thus, we aimed to draw attention to the fact that these two-dimensional measurements can be made easily and quickly in routine practice, and that they can be used in the follow-up of MS patients.

Materials and Methods

Our study is retrospective and MS patients who underwent cervical MRI in Malatya Training and Research Hospital between 01.01.2015-30.10.2021 were included in the study. Patients with image artifacts and patients with demyelinating lesions at measurement levels were excluded from the study. MRI sections of 17 MS patients who met the criteria were evaluated. For comparison purposes, a control group consisting of 34 patients who were randomly selected between 01.06.2021 and 30.09.2021, who did not have MS, who were matched with MS patients in terms of age and gender, was formed.
The examinations were made with MR-Philips Medical System 1.5 tesla device in sagittal and axial planes with T1-WI and T2-WI. Images were evaluated by two experienced radiologists through the hospital image archive system.
SC diameters from sagittal to C3 and C6 vertebral levels were measured from the midpoint between the upper and lower end plateaus of the vertebral body and on a line drawn perpendicular to the anterior surface of the SC[14].
SC diameters at the axially C3 and C6 vertebral levels were measured on a line drawn from the midpoint of the vertebral body to the midpoint of the corresponding posterior elements. In addition, axial and sagittal spinal cord diameter measurements were made on the lines defined from these levels (Figures 1 and 2).

- *Statistical Analysis*

SPSS 22 version was used for statistical analysis. Mann-Whitney U test was performed to compare the spinal canal and spinal cord sizes of MS and control group patients. Statistical significance level was taken as $p<0.05$.

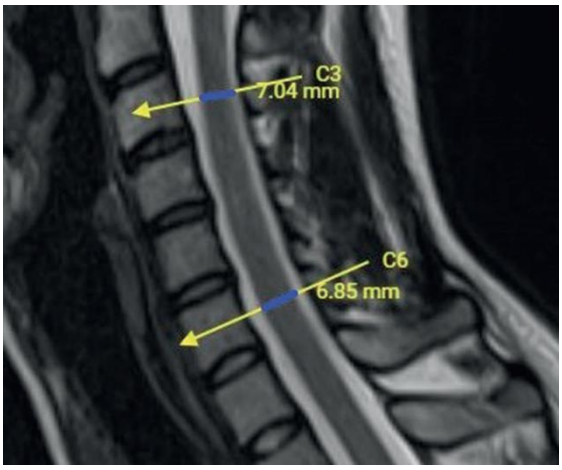

Figure 1. Sagittal diameter measurement of cervical spinal cord from C3 and C6 vertebra levels

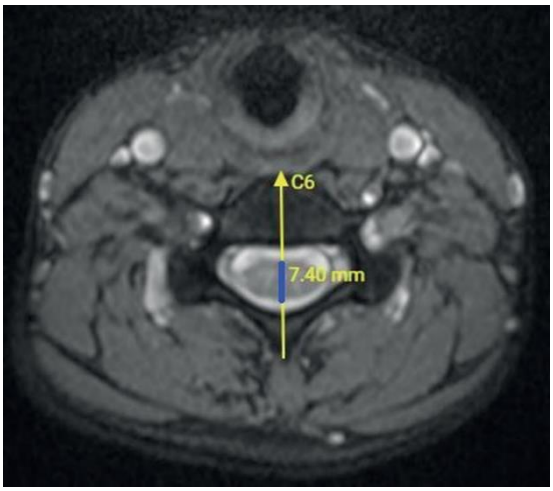

Figure 2. Axial diameter measurement of the cervical spinal cord at the level of the C6 vertebra

Results

27(52.9%) of the patients included in the study were women. The patients were between the ages of 19-62 and the mean age was 39.4 ± 9.9 years.

In the sagittal plane measurement from the C3 vertebra level, the median SC measurement of the patients in the MS group was 7.6 (5.7 - 8.2) millimeters (mm), while the median of the control group was 8.2 (6.8 - 9.1). In the sagittal plane measurement from the C6 vertebra level, the median SC measurement of the patients in the MS group was 7.1 (5.2 - 8.0) mm, while the median of the control group was 7.9 (6.7 – 8.9). In the measurements made at all levels, SC thicknesses were lower in MS group patients compared to control group patients, and this decrease was statistically significant.

There was no significant difference between the control group and MS patients in terms of spinal canal measurements.

The median values of the SC and spinal canal measurements made in the sagittal and axial planes from the C3 and C6 vertebra level and the p values obtained by the Mann-Whitney U test are presented in Table 1.

Table 1. Median (min-max) cord and canal diameters in sagittal and axial planes at C3 and C6 vertebral level

Measurement Location	MS group (n=17)	Control group (n=34)	P
	Median (min-max)		
C3 sagittal cord	7.6 (5.7-8.2)	8.2 (6.8-9.1)	<0.001
C3 axial cord	7.6 (5.4-8.3)	8.2 (7.0-9.4)	0.003
C6 sagittal cord	7.1 (5.2-8.0)	7.9 (6.7-8.9)	<0.001
C6 axial cord	7.3 (5.5-8.0)	7.7 (6.5-8.9)	0.011
C3 sagittal canal	12.7 (10.8-15.9)	13.2 (11.2-14.9)	0.575
C3 axial canal	12.9 (11.2-15.8)	12.9 (11.1-14.2)	0.704
C6 sagittal canal	13.3 (11.1-16.2)	13.5 (11.2-15.0)	0.719
C6 axial canal	13.4 (11.1-16.5)	12.9 (11.0-14.6)	0.826

Discussion

Since most centers do not have workstations or software to perform volumetric analysis in routine practice, most centers do not make any assessment of SC dimensions in the reporting of MS patients. This study is showed that, we can basically assess atrophy by measuring two-dimensional CSC diameters.

The SC is a clinically important region that is affected by pathological changes in most MS patients[13]. Focal spinal cord lesions are commonly seen in patients with MS and are reported in 80-90% of patients on conventional MRI[5,15].

Spinal cord atrophy (SCA) may be due to focal tissue destruction in lesions or pathological changes that damage axons[13]. SCA can be used to determine axon loss, which may be common in patients with MS, and is especially important in the progressive stages of the disease[16,17]. In addition, SCA is a measure that can be used to evaluate the effects of neuroprotective treatments in the management of MS[18]. Recent studies in MS patients with long-term follow-up have shown that SCA measured on MRI is associated with disability independent of brain volume or lesion load[19,20].

Atrophy assessments through qualitative visual assessment are less accurate, resulting in subjective bias. However, it is easy to identify when there is focal atrophy reflecting focal tissue loss in short segments of the SC[5]. Due to the difficulties in the technical detection of gray matter atrophy, which may be clinically significant, current research has aimed to improve the SCA measurement by measuring the spinal cord area[21,22].

Measurement of SC area at the high cervical level has been the most reported MRI measurement of SCA[23]. However, it should not be forgotten that sagittal MRI has a great advantage as it is faster and covers a large SC area[5]. In a recent study, measurement of SCV loss was shown to be a reliable imaging marker for monitoring disease activity and progression in MS[24].

In our current study, we evaluated the diameters of the CSC in the axial and sagittal planes. In our study, as in previous studies, CSC measurements were found to be lower in MS patients. We also examined the axial and sagittal plane measurements of the spinal canal in the MRIs of these patients. Since there was no difference between MS patients and control group patients in terms of cervical spinal canal measurements, it is not meaningful to use it for follow-up in routine practice. We think that it will be sufficient to measure the CSC in the axial and sagittal plane when evaluating cord atrophy in MRI in patients with MS.

The small number of patients can be shown as a limitation of our study, since most of the MS patients are not followed up in public hospitals. However, this study supports that neurology and radiology physicians working under current conditions can take responsibility and follow up patients with the resources available.

Conclusion

In daily practice, cervical spinal cord measurements in MS patients can be easily and quickly performed with conventional MRI in two dimensions. Including these measurements in the reporting will be useful in the follow-up of cord atrophy in MS patients.

Author contributions

All authors contributed to the study conception and design. All authors read and approved the final manuscript.

Conflict of interest

The authors declare that they have no conflict of interest.

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Ethical approval

This study, in which patients participated on a voluntary basis, was conducted in accordance with all ethical procedures /standards and the Declaration of Helsinki.
Approval numbered 2021/10 was obtained from Malatya Turgut Özal University Non-Interventional Clinical Research Ethics Committee.

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