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Myelopathy: Retrospective Evaluation of Twenty-Eight Cases

Miyelopati: Yirmi Sekiz Olgunun Retrospektif Değerlendirilmesi

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Abstract

Objective: Myelopathy is used to describe any neurologic deficit related to the spinal cord. Determining the etiology is important for detecting emergency situations and treating the cause.

Materials and Methods: We evaluated 28 patients who were diagnosed as having and treated for myelopathy between January 2014 and January 2015 in our hospital. The clinical and laboratory findings of the patients and their response to treatment were assessed.

Results: Of the 28 patients, 16 were male and 12 were female, the mean age was 48 years (range, 22-77 years). The most common initial symptoms were sensorial deficits and motor weakness. Demyelinating diseases were the most common diseases and multiple sclerosis was the most frequent etiology among demiyelinating diseases. Cervical spinal cord was the most frequent region involved in myelopathy episodes which was detected by magnetic resonance imaging on T2W images. We observed clinical improvement in 15 of the 20 patients who were treated with corticosteroids. In addition, vitamin B12 treatment led to clinical improvement in two patients who were diagnosed as having subacute combined degeneration.

Conclusion: The diagnosis and etiology of myelopathy and identification of rare conditions that require emergency surgery or interventional treatments are of utmost importance.

Keywords: Myelopathy, paraparesis, spinal cord damage

Öz

Amaç: Miyelopati spinal kord ile ilgili herhangi bir nörolojik defisiti tanımlamak için kullanılır. Etiyolojinin belirlenmesi, acil durumların saptanması ve nedene yönelik tedavilerin başlanması açısından önemlidir.

Gereç ve Yöntem: Bu çalışmaya Ocak 2014-Ocak 2015 yılları arasında hastanemizde miyelopati tanısı ile tetkik ve tedavi edilen 28 hasta dahil edildi. Hastaların klinik, demografik özellikleri, görüntüleme, laboratuvar bulguları ve tedaviye yanıtları değerlendirildi.

Bulgular: Hastaların 16'sı erkek, 12'si kadındı. Yaş ortalamaları 48 (aralık, 22-77) idi. Hastaların başlangıç şikayetleri çoğunlukla motor ve duyusal semptomlardan oluşmaktaydı. Etiyolojide en sık demiyelinizan hastalıklar, bunlar içerisinden de multipl skleroz saptandı. Manyetik rezonans görüntüleme sonuçlarına göre en sık servikal bölgede miyelopati ile uyumlu T2A görüntülerde sinyal artışı izlendi. Yirmi hastaya steroid tedavisi verilirken bu hastalardan 15'inde tedaviye yanıt alındı. Subakut kombine dejenerasyon tanısı alan iki hasta B12 tedavisinden yarar gördü.

Sonuç: Çalışmamızda miyelopati tanısı alan hastaların tanı, tedavi ve prognozları değerlendirildi. Acil durumların önemi, ayırıcı tanıda göz önünde bulundurulması gereken durumlar vurgulanmaya çalışıldı.

Anahtar Kelimeler: Miyelopati, paraparezi, spinal kord hasarı

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Introduction

Myelopathy is a degenerative, compressive or inflammatory disease of the spinal cord caused by different etiologies. Different clinical findings can be observed depending on the etiology, involved spinal cord segment, and spinal cord localization (1). The detailed history, neurologic examination, cerebrospinal fluid (CSF) examination, and neuroimaging methods are important in the diagnosis (2). The identification of the causes and clinical signs of myelopathy and the algorithms that can be created in this regard are of great importance in early diagnosis and treatment. In the literature, there are few studies related to myelopathy causes, treatment, and prognosis. We aimed to retrospectively evaluate the clinical, imaging, and laboratory findings of patients with myelopathy in this study.

Materials and Methods

Twenty-eight patients with myelopathy who were studied and treated in our clinic between January 2014 and January 2015 were included in the study. The age, sex, symptoms on admission, medical history, cranial and spinal magnetic resonance imaging (MRI) studies, laboratory results, visual evoked potential (VEP), somatosensory evoked potential (SEP), electromyography (EMG), CSF findings, treatment protocols, and treatment responses were evaluated retrospectively from the medical records of the patients. The MRI examinations were performed on a 1.5 Tesla GE Signa Excite (GE Medical Systems, Milwaukee, WI). Transverse myelitis (TM) was diagnosed using the Transverse Myelitis Consortium Group diagnostic criteria (3) and multiple sclerosis (MS) was diagnosed using the McDonald 2010 diagnostic criteria (4).

The study was approved by the Istanbul Training and Research Hospital of Local Ethics Committee (Protocol number/date: 897/09.12.2016).

Results

Sixteen (57%) of the 28 patients were male and 12 (43%) were female. The mean age was 48 years (range, 22-77 years). The duration of the symptoms prior to admission ranged from 1 day to 7 years. According to the distribution of symptoms on admission, numbness in the hands or legs was detected in 17 (61%) patients, weakness in the legs in 8 (28%), weakness in the extremities in 9 (29%), double vision in two (7%), and blurred vision in one (4%) patient.

The etiologies were as follows: MS in 13 (46%) patients, idiopathic in 4 (14%), compression in two (7%), spinal ischemia in two (7%), subacute combined degeneration (SCD) in two (7%), arteriovenous malformation (AVM) in one (4%), neuromyelitis optica (NMO) in one (4%), primary central nervous system lymphoma (PCNSL) in one (4%), intramedullary tumor in one (4%), and syringomyelia in one (4%) patient.

The onset was acute in two (7%) patients with spinal cord ischemia, whereas it was seen that the symptoms developed within days to months (20 days to 7 months) in 24 (86%) patients, and that symptoms were present for 7 years in one (4%) patient with MS and one (4%) patient with idiopathic myelopathy.

When MRI findings were examined, 14 (50%) patients had cervical involvement, 7 (25%) patients had cervical + thoracic, 6 (21%) had thoracic, and one (4%) patient had cervical + brainstem involvement. Contrast enhancement was detected in 7 (25%) patients.

When motor findings of the patients were evaluated, motor findings were seen in 21 patients (75%), including monoparesis in 9 (32%), paraparesis in 6 (21%), hemiparesis in 4 (14%), and tetraparesis in two (7%) patients. Sensory findings were observed in 18 patients (62%), including numbness in hands and feet in 15 (54%) and hemihypoesthesia in 3 (11%). Autonomic findings were present in only 4 patients, including urinary and fecal incontinence in two (7%) patients with spinal ischemia, urinary incontinence in one (4%) patient with MS, and urinary incontinence in one (4%) patient with unknown etiology.

Twenty-two patients underwent lumbar puncture. High CSF protein was detected in 14 (67%) patients. Vitamin B12 levels were found to be low in 10 (37%) of 27 patients who had vitamin B12 levels measured. Two of these patients had posterior cord involvement compatible with SCD.

When the treatment protocols were evaluated, 20 patients received an average of 7 days of pulse steroid treatment. Full response and partial response was achieved in 9 and 6 patients, respectively, and there was no response to treatment in 5 patients. The group that did not respond to steroid treatment included one patient with spinal ischemia, one patient with SCD, one patient with compression, one patient with AVM, and one patient with MS. Vitamin B12 treatment was started for the patient with SCD. The patient with compression due to disc fragment underwent surgery but no improvement was observed in clinical status. The arteriovenous fistula was closed in the patient with AVM. After pulse steroid treatment, radiologic improvement was observed in 11 patients and no improvement was observed in 7 patients. Follow-up radiographic images of two patients were not available.

VEP analysis of 13 patients with MS pre-diagnosis revealed delayed P100 latency and low amplitude in 6 patients. Findings consistent with marked axonal sensory polyneuropathy in the lower extremities were recorded in 3 of 11 patients who underwent EMG examinations. In these patients, vitamin B12 deficiency was observed as the etiologic cause in one patient, but there was no significant pathology explaining this condition in other patients with compression-related myelopathy and spinal tumors.

According to the prognosis of patients at the time of follow-up examinations, partial recovery was observed in 16 patients, complete recovery was observed in 3 patients, and no response was observed in 7 patients. Follow-up examination findings of two patients were not available.

The demographic characteristics of all patients, involved segment and spinal cord localization, and treatment responses are shown in Table 1.

Discussion

Myelopathy covers conditions that develop due to all kinds of damage to the spinal cord. Although myelopathy and myelitis appear to be synonymous for each other, myelitis expresses conditions related to inflammatory and infectious processes,

and myelopathy includes all other causes (vasculature, tumor, inflammatory), mainly compressive causes (1,5).

Regarding clinical findings, different neurologic findings such as paraparesis/plegia, tetraparesis/plegia, sensory loss, and bladder dysfunction may be seen (5). These signs and symptoms vary according to the affected spinal cord segments, spinal cord localization (e.g., anterior, posterior, lateral), and impairment process (acute, subacute, chronic). In the medical history, the patient should be assessed for the initial symptoms, presence of accompanying symptoms and signs, type and speed of progression, the presence or absence of pain, other systemic findings, and systemic disease (e.g., diabetes mellitus, malignancy, radiotherapy) (6).

Table 1. Demographic findings, laboratory and imaging results, treatment and responses of 28 patients with myelopathy

No	Age	Sex	Etiology	Involved segment	Spinal cord localization	CSF protein (mg/dL)	Pulse steroid duration	Prognosis	Other treatments
1	71	M	Spinal ischemia	T12-L1	Anterior	63	10 days	Partial recovery	No
2	41	M	MS	C3-C4	Lateral	48	7 days	Full recovery	No
3	57	F	Idiopathic	C3-C6	Central	63	7 days	No response	No
4	72	M	Spinal ischemia	T3-T4	Anterior	-	-	Partial recovery	No
5	60	F	Idiopathic	C7-T1	All	122	5 days	Partial recovery	No
6	62	M	Spinal AVM	T7-L1	All	85	5 days	No response	Fistula closure
7	32	F	MS	C1-C6	Central	56	7 days	Partial recovery	IMT
8	50	F	NMO	C4-C6	Lateral	28	7 days	Partial recovery	Azathioprine
9	22	F	MS	C4-6, T2-3	Posterior	-	5 days	Partial recovery	IMT
10	45	F	MS	C2-C5	Posterior and lateral	38	5 days	Partial recovery	IMT
11	65	M	Due to compression	C6-C7	Lateral	103	10 days	No response	Discectomy
12	53	M	SCD	C2-C7, T1-T12	Posterior	32	-	Full recovery	B12
13	73	M	Spinal tumor	T10-T11	Central	-	-	No response	Radiotherapy
14	71	M	PCNSL	C2-T2	All	282	7 days	No response	Chemotherapy
15	24	F	MS	C2-C7	Posterior	25	10 days	Partial recovery	IMT
16	77	F	Idiopathic	Pons-C7	Posterior	93	10 days	Partial recovery	Azathioprine
17	60	F	Syringomyelia	T4-T5	Central	-	-	Unknown	Unknown
18	68	F	Idiopathic	C6-T1	All	110	10 days	Partial recovery	No
19	51	M	Due to compression	C3-C4	Central	109	-	-	Discectomy
20	26	M	MS	C3-C7, T3	Lateral	30	-	Partial recovery	IMT
21	30	F	MS	C2-3, C5-6	Lateral and posterior	-	5 days	No response	Fingolimod
22	22	M	MS	C4-C5	Central	53	5 days	Partial recovery	IMT
23	45	M	MS	C4-5, C7-T3, T6-8,	Posterior	-	5 days	No response	No
24	28	F	MS	C3-C4	Lateral	63	-	Partial recovery	IMT
25	24	M	MS	C3-C4	Lateral	35	7 days	Full recovery	IMT
26	48	F	MS	C3-C5	Central	47	7 days	Partial recovery	No
27	24	M	MS	C2-3, C5-6	Lateral and posterior	20	7 days	Partial recovery	Fingolimod
28	38	M	SCD	T2-T7	Posterior	-	-	Partial recovery	B12

M: Male, F: Female, CSF: Cerebrospinal fluid, C: Cervical, MS: Multiple sclerosis, NMO: Neuromyelitis optica, PCNSL: Primary central nervous system lymphoma, AVM: Arteriovenous malformation, SCD: Subacute combined degeneration, T: Thoracic, IMT: Immunomodulatory therapy

Undoubtedly, there are various conditions that clinically mimic myelopathy and spinal cord injury, which need to be taken into account in the differential diagnosis. For example, neuromuscular junction diseases such as myasthenia gravis, Lambert-Eaten syndrome, cranial pathologies such as bilateral anterior cerebral artery infarction, bilateral medial frontal lobe injury, brain stem tumors, amyotrophic lateral sclerosis among degenerative diseases, hypokalemia among metabolic causes, Guillain-Barre syndrome causing peripheral nerve impairment, and gait disorders due to psychogenic causes may be confused with myelopathy. These clinical conditions should be questioned and screened in patients who present with paraparesis (7,8).

In a study in 79 patients with acute myelopathy, De Seze et al. (9) found MS in the etiology in 43% of patients. In a study by Miller et al. (10), idiopathic TM was found in the range of 9-60%. In our study, MS (46%) was also the most common cause in etiology and idiopathic TM (14%) was the second. Compressive (7%) and degenerative causes of myelopathy may have been detected at a low rate in our study due to the fact that the patients who presented to our clinic with conditions requiring surgical intervention such as compression or mass were referred to the Neurosurgery Clinic.

Regarding the onset of clinical symptoms, TM is frequently acute and subacute, whereas spinal cord ischemia or epidural spinal hemorrhages are acute conditions that worsen within hours or days (11). When symptoms occur, it is of the utmost importance to evaluate the need for emergency surgery. In this respect, spinal MRI contributes significantly to diagnosis. It should not be forgotten that emergency surgical intervention would be required in case of clinical conditions, such as epidural hemorrhage, metastasis, and abscess, which lead to spinal cord compression and cause serious clinical damage. It is also important to question the accompanying conditions (fever, back pain, bleeding diathesis, trauma) (7). In our study, clinical deterioration was acute in two (7%) patients with spinal ischemia and showed rapid deterioration within 24 hours, whereas the clinical deterioration was subacute or chronic in other patients with slow progression within months or even years.

If the symptoms persist for more than three weeks and progress, the diagnosis of TM should be abandoned and spinal tumors, chronic compressive diseases, dural arteriovenous fistulas, metabolic diseases or degenerative conditions should be considered. Epidural or intradural neoplastic diseases of the spinal cord, metabolic, degenerative, and demyelinating diseases can cause painless and progressive myelopathy (12). It was months after the onset of symptoms in our patients with spinal tumor and PCNSL, and their symptoms gradually progressed. The clinical course of the patient with spinal AVM was fluctuating; AVM was detected in spinal angiography performed due to gradually worsening clinical status of the patients, and the fistula was closed.

It is known that the affected spinal cord segment and its localization are related to the etiologic cause. The lesions related to MS are peripheral, asymmetric, and mostly located in the posterolateral part of the spinal cord in the presence of axonal loss and spinal atrophy (Figure 1). Diffuse involvement in long segment is observed in NMO, whereas the posterior part of the lower cervical and upper thoracic cord is frequently affected in SCD (1,13).

In demyelinating diseases, complete or incomplete involvement of the cord is important in terms of disease spectrum and risk of recurrence. Complete TM often tends to involve the central part of the cord, which is longer than 3 vertebral segments, whereas incomplete involvement is a shorter (1 segment or 2 segments) peripheral lesion. The Mayo Clinic reported that seropositive (NMO IgG positive) patients with long segment involvement are more likely to have myelitis recurrence than seronegative group (3,14). The first episode of incomplete TM may be classified as clinically isolated syndrome, and the risk of conversion to MS is 88% compared with patients with normal MRI findings, especially in the presence of MS-compatible lesions on cranial MRI (15). In our study, demyelinating disease was present in 14 of 28 patients. Thirteen of these patients were diagnosed as having MS, and one patient as having NMO; all were found to have involvement in the cervical spinal cord. Lesions were observed predominantly in the lateral and posterior of the cord. Long-segment complete myelitis was present in the patient with NMO. The clinical status of the patient with positive NMO IgG antibodies was progressive.

SCD involves the posterior and lateral parts of the cervical and upper thoracic segments of the spinal cord due to lack of vitamin B12. Paresthesia and loss of deep sensation due to involvement of the posterior cord and paresis due to involvement of the lateral cord may be seen clinically (16). Early identification of the etiologic causes is important for treatment and prognosis. Endoscopy should be performed in these patients, and anti-parietal antibodies should be screened and vitamin B12 therapy should be initiated as soon as possible. Only the posterior region of the thoracic cord was affected in one of our 2 patients with SCD, but long segment posterior involvement was observed in the cervical and thoracic spinal cord in the other patient (Figure 2). Both of these patients, whose vitamin B12 levels were significantly low, had loss of deep sensation, gait disturbance, and numbness in the hands and feet. The examinations revealed anti-parietal antibody positivity in both patients and atrophic gastritis was detected in endoscopic examinations. Although the patients' gait and deep sensation disturbances fully recovered, sensory symptoms in the distal part

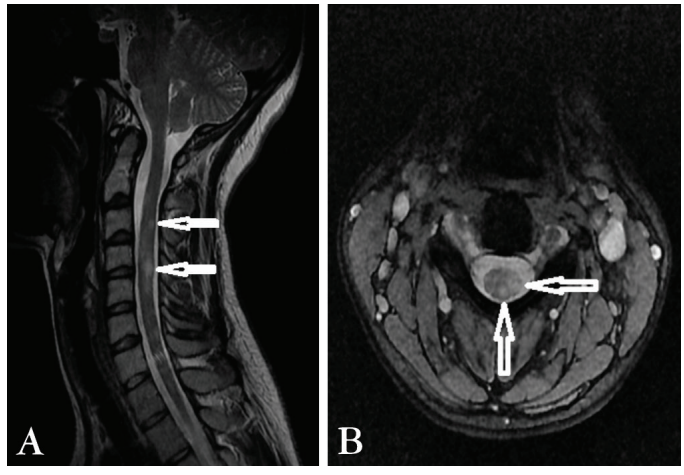

Figure 1. Cervical magnetic resonance imaging demonstrating multifocal, posterocentral, hyperintense demyelinating plaques most notably at C4-5 level in sagittal T2-weighted image (A) and left posterolateral hyperintense demyelinating plaques at the same level in axial gradient recalled echo T2-weighted image (B)

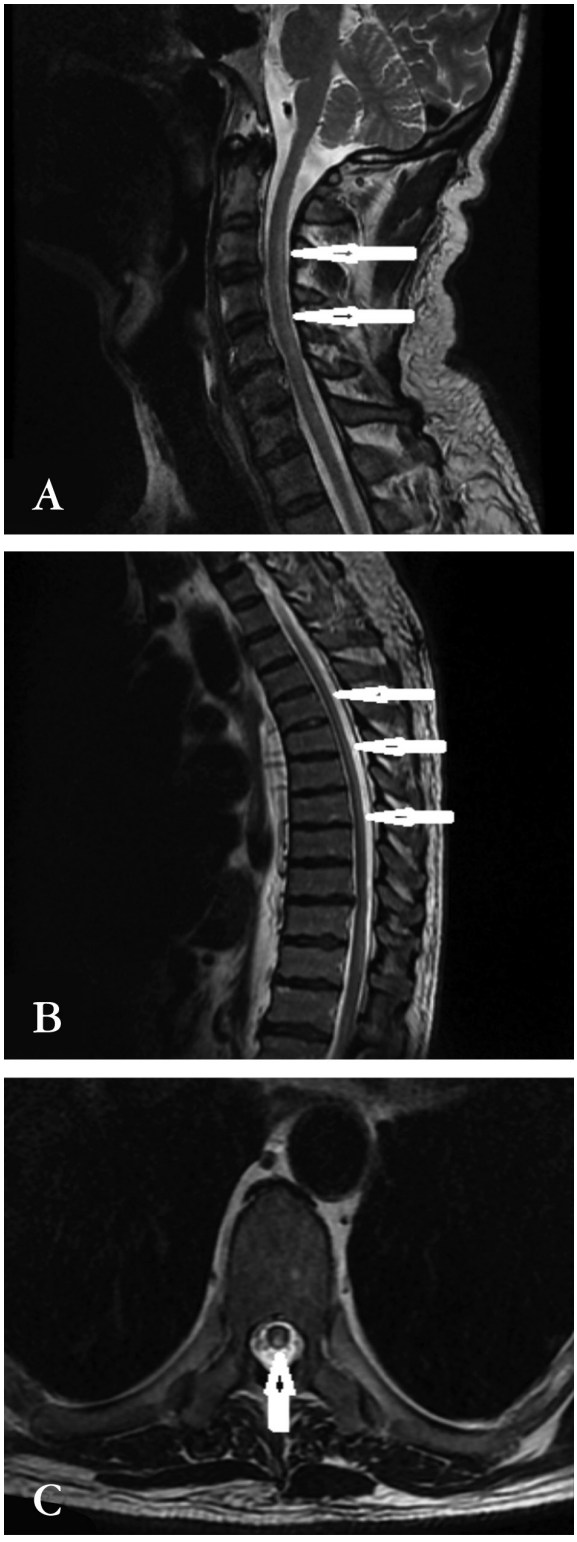

Figure 2. Cervical (A) and thoracic (B) sagittal T2-weighted magnetic resonance sequences showing posteriorly localized, long-segment hyperintense appearance more prominent in the cervical cord and posterocentral involvement on axial thoracic T2-weighted magnetic resonance sequence.

of the extremities remained at the 6th month examination after vitamin B12 replacement.

Spinal cord vascular pathologies may present in different forms. Symptoms develop suddenly in spinal ischemia or epidural hematoma; arteriovenous fistulas may present with slowly progressive clinical status. Clinical fluctuation in the history is of great importance in AVMs. It is important to evaluate symptoms such as progressive weakness developing within days and an increase in weakness after walking, particularly in middle-aged male patients presenting with gait disturbance (17,18). In our study, one patient presenting with clinical fluctuations having long segment myelopathy on spinal MRI diagnosed as spinal AVM by using digital subtraction angiography (DSA). We did not observe a significant improvement in the clinical status of the patient 6 months after the interventional therapy (Figure 3).

Spondylosis, tumors, disc herniation, or infections should be primarily considered in patients with severe radicular pain. Conditions causing compressive myelopathy such as degenerative changes, trauma, tumor infiltration, abscess, and syringomyelia may present with acute or chronic deterioration (19,20). The first step in traumatic myelopathy should be mechanical stabilization. Computed tomography is a more appropriate option for demonstrating vertebral fracture and ligament injury, although direct images may help in diagnosis (21). The compressive, space-occupying causes were responsible for etiology in 4 of our 28 patients. Two of these patients had cervical disc-associated myelopathy and they did not improve significantly after steroid treatment. Therefore, the patients underwent surgery, however we did not observe significant improvement in their clinical status. The remaining 2 patients had spinal tumors. One of them was underwent radiotherapy. The other patient with PCNSL had partial recovery after steroid treatment and the tumor was diminished in size but only chemotherapy could be applied due to the patient's poor general condition and the patient died after progressive worsening.

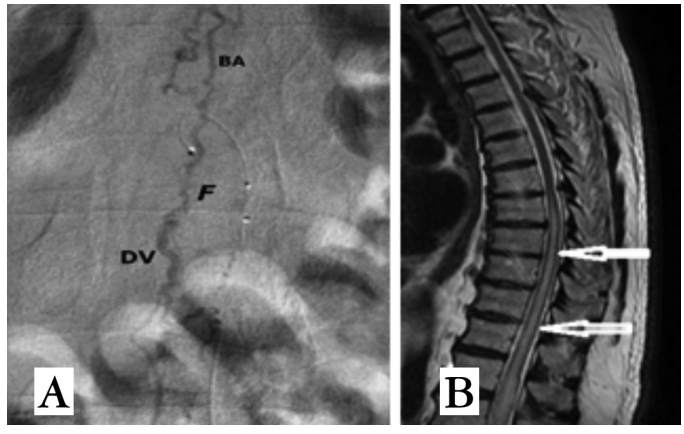

Figure 3. Spinal perimedullary arteriovenous fistula in digital subtraction angiography image obtained by T12 intercostal artery injection in anteroposterior projection in thoracolumbar region (A), venous engorgement causing diffuse expansion and signal increase in the lower thoracic spinal cord in sagittal T2-weighted thoracic magnetic resonance imaging (B)

BA: Feeding artery, DV: Drainage vein, F: Fistula

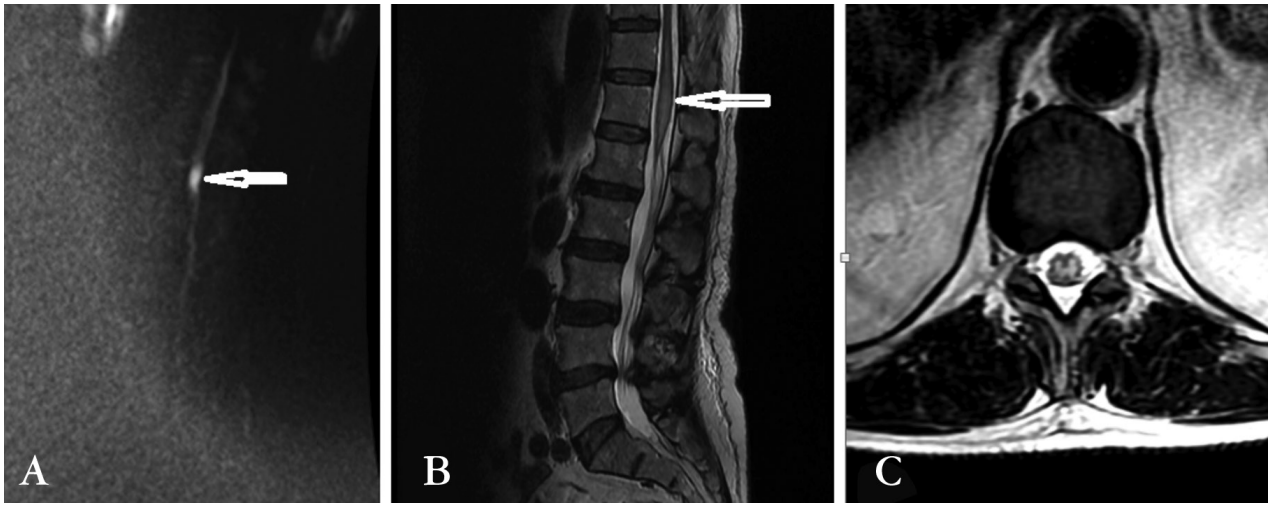

Figure 4. Hyperintensity due to constrained diffusion consistent with acute ischemia in conus medullaris at T12 level in sagittal diffusion-weighted imaging at the lumber site (A), signal increase consistent with focal expansion and edema at the same level on sagittal T2-weighted sequence (B), and "Owl's eyes'" finding secondary to ischemia on axial T2-weighted sequence (C)

Spinal MRI is important in the diagnosis and differential diagnosis. All sequences must be included, contrast-enhanced sections should be added to the examination, and diffusion-weighted imaging (DWI) should be performed especially in vascular diseases. In a patient who presented with sudden-onset weakness in the lower extremities and was diagnosed as having spinal ischemia, DWI revealed an appearance consistent with spinal ischemia (Figure 4). The role of spinal DSA in the diagnosis of treatable vascular myelopathy is very important. Spinal MRI has high sensitivity especially in the presence of non-traumatic myelopathies and signal enhancement is observed in T2-weighted images. Contrast administration should be preferred for oncologic, inflammatory, infectious, and vascular myelopathies (18,20).

In some cases, CSF examination and other auxiliary methods (e.g., SEP, VEP) are needed besides imaging methods. Performing CSF examination on time is important to eliminate the possibility of infectious causes and screening for oligoclonal bands (OCB) or NMO antibodies for the differential diagnosis of MS (1). In the present study, 22 patients underwent CSF examination. Of the 17 patients examined, type 2 OCB positivity was detected in 7 patients with MS.

The treatment approach to patients with myelopathy depends on the etiology. The identification of surgical or medical treatment candidates is essential. Spinal epidural hematoma, masses, and abscesses require early surgical treatment (18). Although steroid treatment against the inflammatory process and edema is the first-line medical treatment, plasma exchange and intravenous immunoglobulin (IVIG) can be applied in autoimmune-related conditions unresponsive to steroid treatment. Cyclophosphamide can be used in treatment refractory conditions and agents such as azathioprine can be used for long-term treatment (22). When we compared the groups treated with steroid treatment, MS patients showed more improvement than other patients. Eight of 12 patients with MS who were treated were found to benefit from treatment. The idiopathic myelopathy group was in second place with 2 of 4 patients responding to steroids. No plasmapheresis or IVIG treatment was given to patients who had no significant response to steroid treatment. While the patient with NMO benefited from steroid treatment at the admission, clinical progression evolved during the course of the disease. Clinical progression was observed to be slower after azathioprine treatment. Despite a good response from a patient in the myelopathy group of unknown cause, myelopathy recurred at a later stage, and then it was found that myelitis recurred less frequently and mildly after azathioprine treatment. Patients with spinal cord ischemia, myelopathy associated with disc herniation, spinal tumors, and SCD did not benefit from steroid treatment, whereas inflammatory myelopathies such as MS and idiopathic myelopathy demonstrated more favorable response to steroid treatment.

Conclusion

In conclusion, myelopathy is an important clinical situation covering different etiologic causes and associated therapies in the practice of neurology. The diagnosis and differential diagnosis of TM, which forms a large part of myelopathies, and identification of rare conditions that require emergency surgery or interventional treatments, are of utmost importance.

Ethics

Ethics Committee Approval: The study was approved by the Istanbul Training and Research Hospital of Local Ethics Committee (Protocol number/date: 897/09.12.2016).

Informed Consent: Consent form was filled out by all participants.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: Y.E., Z.S.D., Concept: Y.E., U.E., Design: Y.E., O.Ö.Y., Data Collection or Processing: Y.E., Analysis or Interpretation: Y.E., U.E., Literature Search: Y.E., U.E., Writing: Y.E., U.E., N.Ö.K.

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