Cervicothoracic Spinal Cord Injury Without Radiographic Evidence of Trauma (SCIWORET) in an Adult: A Case Report

Erişkinde Travmanın Radyografik Kanıtı Olmaksızın Servikotorakal Omurilik Yaralanması: Olgu Sunumu

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Summary

Spinal cord injury without a radiographic evidence of trauma (SCIWORA) is more frequently encountered in the pediatric age group, especially in cervical spinal cord. The case presented here has a rare picture of this type observed in adults rarely. The case developed a neurological deficit as a result of an accident involving a heavy substance fall on his neck and back junction. Conventional graphs, cranial and cervical tomographies taken in the acute period did not reveal any pathology that could explain the existing clinical picture. Myelomalacia was determined at C7-T1 level following cervicothoracic spinal magnetic resonance imaging (MRI). Based on his existing neurological picture (ASIA B) and MRI findings, the patient was given a diagnosis of SCIWORET (Spinal Cord Injury Without Radiographic Evidence of Trauma). Following the rehabilitation program, the patient's neurological level improved to ASIA D level. He became dischargeable with a left knee-ankle-foot orthosis and a walker support. SCIWORET should be born in mind also in adults with a neurological deficit but without any bone and ligamentous damage determined, and MRI should be utilized in the diagnosis. Keeping in mind that the prognosis is good, early rehabilitation program should be started. *Turk J Phys Med Rehab 2007;53:164-7.*
Key Words: SCIWORET, spinal cord injury, rehabilitation

Özet

Travmanın radyografik kanıtı olmaksızın spinal kord yaralanması (SCIWORA) daha yaygın olarak pediatrik yaş grubunda özellikle servikal omurgada oluşmaktadır. Sunulan olgunun özelliği, erişkinlerde nadir görülen bu tabloya sahip olmasıdır. Boyun ve sırt kavşağına ağır cisim düşmesi sonucu nörolojik defisit gelişen olgunun akut dönemde çekilen konvansiyonel grafilerinde, kraniyal ve servikal tomografilerinde mevcut klinik tabloyu açıklayacak bir patoloji saptanmadı. Servikotorakal spinal magnetik rezonans görüntüleme (MRG) sonucunda C7-T1 düzeyinde myelomalazi saptandı. Hastaya, mevcut nörolojik tablosu (ASIA B) ve MRG bulguları ile SCIWORET (Spinal Cord Injury Without Radiographic Evidence of Trauma) tanısı konuldu. Rehabilitasyon programı sonunda hastanın nörolojik seviyesi ASIA D düzeyine ilerledi. Hasta sol kısa yürüme cihazı ve walker desteği ile ambule duruma geldi. Nörolojik defisiti olan ancak kemik ve ligamentöz hasarın saptanamadığı erişkin olgularda da SCIWORET akla gelmeli ve tanıda MRG'den faydalanılmalıdır. Prognozun iyi olduğu akılda tutularak erken rehabilitasyon programına başlanılmalıdır. *Turk J Phys Med Rehab 2007;53:164-7.*
Anahtar Kelimeler: SCIWORET, omurilik yaralanması, rehabilitasyon

Introduction

Spinal cord injury observed without any radiographic abnormality in the form of fracture or dislocation in vertebrae is called spinal cord injury without radiographic abnormality (SCIWORA) in children whereas they are termed as spinal cord injury without radiographic evidence of trauma (SCIWORET) in adults (1,2). The concept of SCIWORA was proposed by Lyod first, but its acronym was coined by Pang and Wilberger (1) in 1982 and defined as "spinal cord injury without evidence of vertebral fracture or malaligment on plain radiographs and computed tomography" (3). Since its first description SCIWORA has been well documented in the pediatric literature (3-6). Launay et al. (3) reported a meta-analysis that an accurate estimation of SCIWORA in the pediatric population ranges from 19-34% of all spinal cord injuries. Whereas SCIWORA is known to occur in

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pediatric age group, SCIWORET is less frequently seen in adults since they have mature spines (1,5,7). The case presented here involves an adult SCIWORET and, his rehabilitation outcomes, which is rarely seen in adults.

The Case

A 31-year-old male applied to emergency clinic as a result of an accident involving a heavy material fall on his lower neck region. The first examination revealed that he was conscious and he could cooperate. Loss of strength was determined in his both lower limbs, and all dermatomes from T3 level were hypoesthesic. Conventional radiographs and computerized tomographies (CT) carried out during the acute period revealed no pathology in cranial, cervical and thoracic regions. The patient was given an intravenous bolus methyl prednisolone treatment. Without any change in his neurological status, the patient was sent to our clinic, after 17 days for rehabilitation program.

In the first neuromuscular system examination, it was seen that the patient did not have any sitting balance. He was able to turn aside in the bed and to get straight up with assistance. The neuromuscular system examination of his upper limbs was normal. In both of his lower limbs, he had full range of motion in hip, knee and ankle joints. His both lower limbs failed to show any active isolated motion including pelvic elevation. He had reduced deep tendon reflexes, with hypotonic muscle tonus. The dermatomes at and under T3 were hypoesthesic. Achilles clonus was determined in the right side. It was not possible to obtain plantar reflexes. Superficial and deep anal sensations were present, but voluntary anal contraction was absent. Bulbocarvenous reflex could be obtained. According to these findings, the patient was considered to be at T2 ASIA B level as per the American Spinal Injury Association (ASIA) 2000 classification (8). The examination made one week after the patient's admission to the service, an increase was found in the muscle tonus in both lower limbs. The plantar reflexes could be obtained bilaterally. Voluntary anal contraction was determined. However, the lower limbs had no motion except pelvic elevation. With these findings, the patient's neurological level was seen to have progressed to the level of ASIA C. The Functional Independence Measure (FIM) value at the time of hospitalization was determined to be 64. Conventional radiographies, cervical and thoracic CTs did not show any vertebral fractures or dislocation that would explain the patient's existing neurological status. Cervicothoracic spinal magnetic resonance imaging (MRI) was performed and revealed a hypointense milimetric myelomalacic region in T1 sequence within spinal cord at C7-T1 disk level, and a hyperintense millimetric myelomalacic field region in T2 sequence (Figure 1a, 1b, 2). With his neurological status and MRI findings, the patient was regarded to be a SCIWORET case. A rehabilitation program was planned for the patient. Both his lower limbs were applied exercises for passive joint motion while strength exercises were applied to upper limbs. Cushion exercises and push-up exercises were performed. Following a tilt-table program, he was verticalized in the parallel bar. He gained sitting balances. He had urinary and anal incontinence; he used diaper and permanent urinary catheter when hospitalized. He was taught an appropriate bowel training program. The urodynamic study revealed that he had overactive detrusor-hyperactive sphincter. The patient was administered oxybutinin hydrochloride at 15 mg/day dose, with clean intermittent catheterization at four hour intervals. At the end of the first rehabilitation program, the patient gained sitting balances, therapeutic verticalization, and became independent in his transfers. So he was discharged at the wheelchair level. At this time, his FIM score was determined to be 80. During the check-up at the 6th month, the patient had increased muscle strength, and his neurological status improved to ASIA-D level. So, the patient was hospitalized for the second time. At the end of this second program he was discharged by walking, with a left knee-ankle-foot orthosis (KAFO) and a walker. Finally his FIM score increased to 116.

Discussion

SCIWORA is more commonly observed in pediatric age group and affects cervical cord as well. Three anatomic characteristics have been proposed to explain the much higher incidence of SCIWORA in children than in adults, producing a neural injury

Figure 1. **A-** T1 weighted sagittal cervicothoracic spinal MRI, hypointense milimetric myelomalacic region in T1 sequence within spinal cord at C7-T1 disc level. **B-** T2 weighted sagittal cervicothoracic spinal MRI.

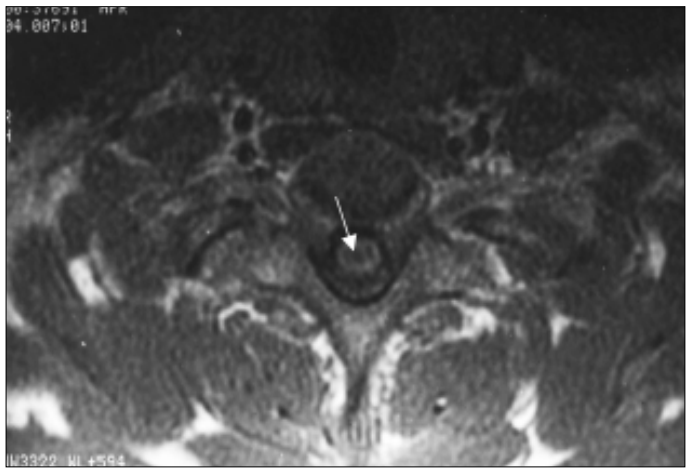

Figure 2. T1 weighted axial cervicothoracic spinal MRI, and a hyperintense millimetric myelomalacic field region.

rather than a fracture. First, in children the facet joints (and particularly those in the upper cervical spine) have a more horizontal orientation, allowing increased translational motion in an anteroposterior plane. Second, children have anterior wedging of the superior aspects of the vertebral bodies. Third, pediatric ligaments and joint capsules have greater elasticity. These features allow for excessive intersegmental movement and transient soft disc protrusion, resulting in neural injury without fracture of the vertebrae or frank rupture of the ligaments in the spinal column (3). Due to changes in the bone and ligamentous morphology in the spinal cord along with the growth, SCIWORET is rarely seen in adults with mature spine (7). Because the flexibility of the spine decreases by age, the skeleton completes its maturation and injuries occur more in the form of bone fractures (1,3,4). Kothari et al. (4) reported four adult cases of SCIWORA. Hendey et al. (9) reported SCIWORA in 27 of the 818 cases with cervical trauma in a clinical study conducted in 21 centers. Demetriades et al. (10) identified SCIWORA in 11 patients out of 292 cervical spinal injuries. Gupta et al. (7) determined cervical SCIWORA using MRI in 15 out of 151 adult patients with spinal injury in a year. Tewari et al. (2) reported that SCIWORA contributes 12% of cases spinal cord injury in adults.

Several mechanisms have been proposed in spine injury ethiopathogenesis, such as cord traction injury caused by spine hyperextension and hyperflexion, direct spinal trauma and delayed cord injury arising from rarely vascular damages (1,11). It was thought that neural injury in the patients with thoracic SCIWORA frequently arises from hyperflexion injury of the cord (12). Bhatoe (13) has reported that the injury mechanism may involve acute tension of the cord during flexion and torsional stiffness. Similarly, the lower cervical and upper thoracic spine flexion developing during the injury in our case has caused traction, leading spinal cord injury. Thoracic spine is generally recognized to be more stable because of chest cage compared with cervical and lumbar spines. Therefore, fractures and dislocations are less frequent in thoracic spine. Nevertheless, when fracture or fracture dislocation of upper thoracic spine occurs, spinal cord involvement and severe concomitant injuries are frequently associated (14). Adult example of a thoracic SCIWORET event was first reported by Hirsh (12) in the literature, with comments that thoracic spine may not be as stable as it is thought. Koizumi et al. (14) reported two thoracic SCIWORA cases. Samsani et al. (15) described thoracic spinal cord injury in a skeletally mature patient occured in the absence of associated bony and ligamentous injury.

Lateral conventional radiographies show about 75% of the fractures in the cervical spine, with sensitivity ranging between 82-85%. When all cervical graphs (lateral, anteroposterior, and oblique radiographies) are taken, the correct diagnosis ratio may reach up to 92-99% (16). Flexion and extension graphs are required in order to exclude instability (13). Tomography is able to show posterior arcus or lateral masses and hardly noticeable injuries in the atlantoaxial region (5). In patients with SCIWORET, radiological examinations are abnormal but x-rays show no evidence of trauma. Prior to the use of CT in spinal trauma, the incidence of SCIWORET in adults was approximately 14%. The addition of CT has reduced the reported incidence of SCIWORET to about 5%. There has been a recent analysis of the incidence of SCIWORET in a Japanese study of acute spinal cord injury which shows that many of these patients have demonstrable compression by myelography or MRI and should be considered for early surgical decompression (17). It is likely that very few spinal cord injuries will remain undetected by MRI, because of its high sensitivity for detecting mild spinal cord injury and nonbony spinal column lesions. Cervical spondylosis is the most common associated condition in adults with SCIWORET, but other arthropathies (e.g., spinal stenosis, ankylosing spondylitis, and disc herniation) may on rare occasion be associated with spinal cord injury and show no radiological evidence of trauma (17,18). MRI is important in the determination of the width of the spinal cord injuries (19). MRI demonstrates neural (hemorrhages, edema, or both) and extraneural (disc protrusions, extradural hematomas) injuries, and the location and type of the injury, and helps to pick up surgically correctable abnormality (2,3). For this reason, MRI is recommended for diagnostic and prognostic purposes in all cases considered to possibly have SCIWORET (5,20,21). Grabb and Pang (11) reported definite correlation between abnormal MRI findings and severity of neurological injury and summed up MRI findings in four categories: 1- Major hemorrhage: hemorrhage at least in 50% of the transverse area of the cord, 2- Minor hemorrhage: hemorrhage less than 50% of the transverse area of the cord, 3- Only edema: presence of hyperintensity in only T2 sequences, 4- No abnormal findings. MRI findings can be predictive of the outcome (6,22). Findings indicative of cord transection and major hemorrhage are correlated with poor outcome, minor hemorrhage or edema only is associated with moderate to good recovery, and the absence of any abnormal cord signal suggests the patient will make a complete recovery (2,23). Millimetric myelomalacia was determined in the cervicothoracic spinal MRI of our case during the chronic period. In accordance with the literature, our case was also an incomplete spinal injury case. Marcello et al. (24) evaluated 24 cases with acute spinal cord injury with MRI. Normal appearing cord had the best prognosis, whereas edema at one or more segment in the spinal cord indicated an unfavorable prognosis, and the case with intramedullary hemorrhage had the worst prognosis. Furthermore Schaefer et al. (20) reported motor improvement in 70% of the cases with spinal injury with focal edema. If MRI facility is unavailable or not possible and acute assessment is indicated then, CT myelography should be performed (25).

Recommended treatment is essentially nonoperative, including corticosteroids, and permenant (night and day) rigid external immobilization for 12 weeks rather than for 8 weeks (3). Kıymaz et al. (26) suggested that column of patients who had spinal trauma with neurologic deficits should be immobilized to prevent further morbidity and mortality unless radiologic examinations evaluated. Surgery may be useful only for patients with spinal cord compression or spine instability secondary to extraneural injury (3). Prognosis is reported to be better than in patients with fractures or dislocation in cervical spine (13). Applying conservative treatment, Gupta et al. (7) have reported a medium degree improvement in patients with cord edema, and a slight degree improvement in patients with intramedullar hematoma. Osenbach and Menezes (11) have reported that neurological improvement is directly associated with the severity of initial neurological damage. Our case also had an incomplete SCI initially and benefited from rehabilitation significantly. The follow-up have indicated that the patient has attained a good functional level.

In conclusion, possibility of SCIWORET should be kept in mind in adult patients who have neurologic deficit but who do not present any bone and ligamentous damage in conventional graphs and computerized tomography. It is possible to show spinal cord injury and obtain correct diagnosis by MRI in such cases. Prognosis is generally good and the conservative treatment program is usually applied. The rehabilitation program plays an important role for these subjects in achieving independence in their activities of daily living.

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