

Brown Sequard Syndrome Resulting from Cervical Disc Herniation Treated by Anterior Foraminotomy

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The authors describe two cases of Brown-Sequard syndrome associated with cervical disc herniation. In both cases, magnetic resonance images of the cervical spine showed a large paramedian disc herniation at C5-C6 with ipsilateral severe spinal cord compression. Microsurgical removal of the herniated disc via anterior foraminotomy was performed and complete decompression of the spinal cord was achieved. Postoperatively, the neurological symptoms recovered rapidly and both patients experienced a complete remission of their symptoms. Although Brown-Sequard syndrome is rarely associated with degenerative cervical spine disease, cervical disc herniation should be kept in mind and prompt evaluations are mandatory. To the best of our knowledge, these are the first reported case of Brown-Sequard syndrome produced by cervical disc herniation which was treated by anterior foraminotomy.

KEY WORDS : Brown-Sequard syndrome · Cervical disc herniation · Cervical foraminotomy.

Introduction

Brown-Sequard syndrome(BSS) involves corticospinal tract compression resulting in ipsilateral loss of motor function and spinothalamic tract dysfunction resulting in contralateral loss of pain and temperature sensation. BSS is observed most frequently in association with traumatic injuries to the spinal cord and extramedullary spinal cord tumors^{15,16,18)}. On the other hand, cervical disc herniation has rarely been considered to be a cause of BSS, and only 27cases have been reported. We report two cases of disc herniation at the C5-C6 level with severe hemicompression of the spinal cord, resulting in BSS. To the best of our knowledge, these are the first reported cases of BSS caused by cervical disc herniation, which were successfully treated by anterior foraminotomy.

Case Report

Case 1

A 56-year-old man suffering from a sudden onset of right hemiparesis was brought to the emergency room. During the 4days prior to admission, he experienced right shoulder pain,

which was managed conservatively. He was admitted to the Department of Neurology and treated under the diagnosis of focal infarction, because the brain magnetic resonance (MR) images showed the presence of a multifocal lacunar infarction in both basal ganglia, the centrum semiovale and the periventricular white matter. There was no history of trauma to the head or neck. On admission, motor examination revealed right hemiparesis (grade 4/5), with particular weakness of the intrinsic muscles of the right hand (grade 2/5). On the day following admission, his right hemiparesis worsened progressively with significant weakness developing in the right leg. Difficulty in urinating was then noted and catheter insertion became necessary. Finally, 4days after his admission, the patient was referred to our department after the cervical MR images were checked. On admission to our department, a neurologic examination revealed diminished sensation to pain and temperature on the left side below the T10 dermatome. Right-arm weakness had progressed to a grip strength of grade 1/5, and the patient was unable to ambulate because of significant weakness in the right leg, which was consistent with a diagnosis of BSS. The patellar tendon reflexes were hyperactive bilaterally. Cervical spine X-rays showed diffuse spondylosis, which was most marked at C5-C6. MR images

• Received : March 2, 2005 • Accepted : March 25, 2005

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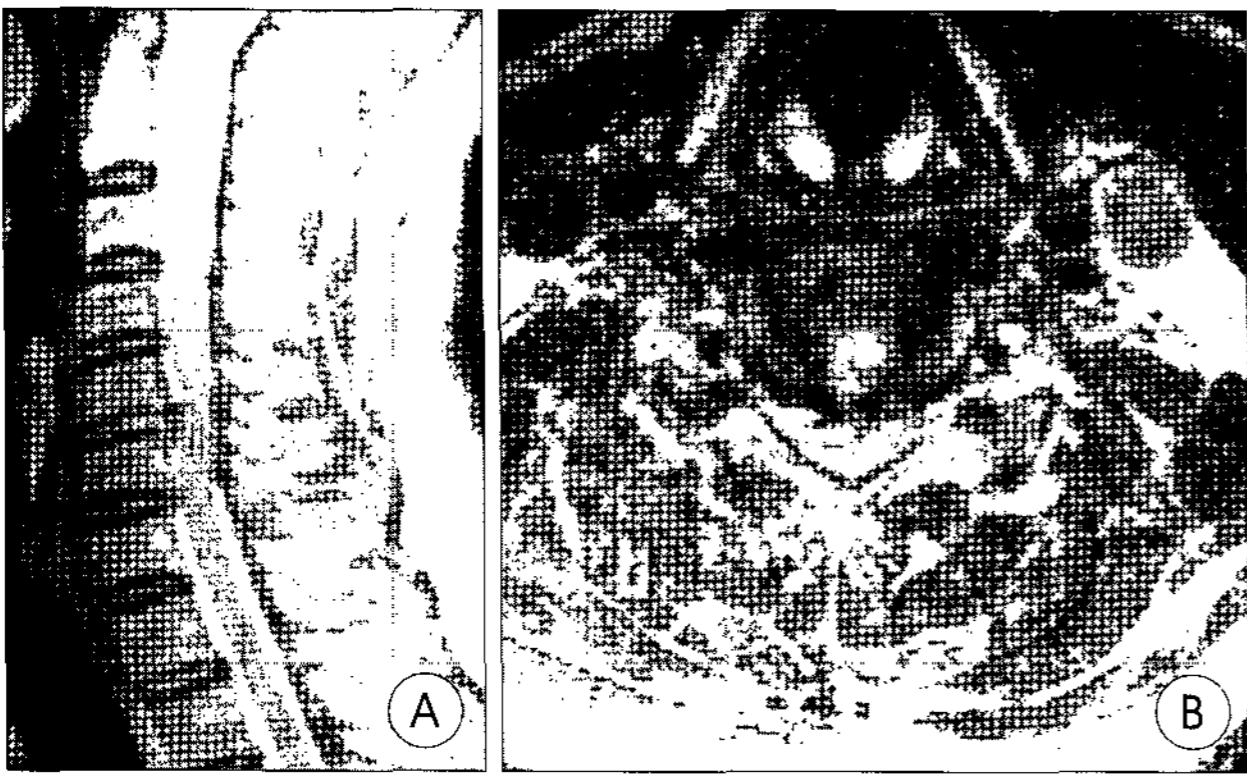


Fig. 1. Case 1. Preoperative T2-weighted sagittal (A) and axial (B) magnetic resonance images revealing a large C5-C6 disc herniation, compressing the right side of the spinal cord.



Fig. 2. Case 1. T2-weighted sagittal magnetic resonance images, obtained one month after surgery, showing excellent decompression of the spinal cord and maintenance of the intervertebral space at C5-C6.

large amount of herniated disc material, which had herniated posterior to the annulus, was found to be compressing the right side of the cord. The herniated disc fragments were gently removed with a microforceps and complete decompression of the spinal cord was achieved. It was confirmed with a blunt nerve hook that no more disc material was remained, and the small hole was packed with thin gelatin sponge. Postoperatively, the patient improved rapidly and was discharged on the 7th postoperative day. One month later, the patient was able to walk without assistance and was found to have slowly regained strength in his right arm. The postoperative MR images, obtained 1 month after surgery, showed complete removal of the disc fragment and satisfactory decompression of the spinal cord (Fig. 2). At the follow-up examination 5 mo-

of the cervical spine showed a large disc herniation at the C5-C6 level causing focal right-sided cord compression (Fig. 1A, B). Right anterior foraminotomy was performed to decompress the spinal cord. Using an operating microscope, a 5 × 8mm hole was made medial to the uncus joint with a drill. There was a large tear in the right posterolateral annulus. A



Fig. 3. Case 2. Preoperative T2-weighted sagittal (A) and axial (B) magnetic resonance images demonstrating a large left paramedian disc herniation at the C5-C6 level, with ipsilateral severe spinal cord compression and high signal intensity within the spinal cord adjacent to the herniated disc.

nths later, the numbness and weakness had disappeared and the patient was able to return to his former job as a medical doctor.

Case 2

A 47-year-old man presented with a 2-week history of numbness in the left hand and left shoulder pain, which subsequently developed into left hemiparesis. He was then managed conservatively at a local hospital under the diagnosis of a cerebrovascular accident, until progressive left leg weakness and ataxia led him to be transferred to our hospital. There was no history of trauma to the head or neck. The motor examination revealed mild weakness of the left arm and a moderate weakness in the left leg with a spastic gait. The patient presented diminished sensation to pain and temperature in the right arm and leg, hypesthesia and hypalgesia in the left arm and hyperreflexia of the lower extremities, which were consistent with BBS combined with radicular symptoms. MR images of the cervical spine revealed a large left extradural paramedian disc herniation at the C5-C6 level, with ipsilateral severe spinal cord compression and high signal intensity within the spinal cord adjacent to the herniated disc (Fig. 3 A, B). The patient underwent a left anterior foraminotomy following the same procedure as that described above. We removed six large disc fragments, which had herniated through the annulus tear and complete decompression of the spinal cord was obtained. The postoperative course was uneventful, with gradual improvement



Fig. 4. Case 2. Postoperative axial computed tomography image revealing complete decompression of the spinal cord through a small tunnel.

of the patient's neurological function being observed. The patient regained normal motor strength and sensation at 2 months after surgery. Postoperative computed tomograms showed complete decompression of the spinal cord through the small tunnel (Fig. 4). A follow-up examination at 3 months demonstrated only mild left shoulder pain.

Discussion

BSS was first described in a patient with hemisection of the spinal cord as a consequence of a knife injury in 1849. BSS is characterized by ipsilateral loss of motor function, proprioception and vibratory sense, combined with contralateral loss of pain and temperature sensation. Complete hemisection with classic clinical features of pure BSS, is rare and incomplete hemisection causing BSS plus other signs and symptoms is more common¹⁸. Spasticity and hyperactive reflexes may not be present in the case of an acute lesion. It

occurs most often after traumatic injury to the spinal cord¹¹. However, other reports have described the syndrome in association with spinal cord ischemia, infectious and inflammatory causes including multiple sclerosis, spinal hemorrhages including hematomyelia, and subdural and epidural hematoma¹⁸. Cervical disc herniation has rarely been reported as a cause of BSS. Since the first three cases of BSS caused by cervical disc herniation reported by Stookey in 1928, 29 cases including our own have been described in the literature^{1-5,7,10,15,16,18-24}. According to Jomin et al., the frequency of BSS caused by cervical disc herniation is 2.6%, but details were not mentioned in this report¹⁴. Another case was cited by Jabbari et al. in their series, but no details for this case were given¹¹. In reviewing the literature, we could find only 27 cases of BSS caused by cervical disc herniation, and so our present cases raises the total to 29 cases (Table. 1). Among these 29 cases, there were 19 males and 10 females, whose ages ranged from 25 to 73 years (mean 45.1 years). The

Table 1. Summary of cases of Brown-Sequard syndrome caused by cervical disc herniation reported in the literature*

Authors (Year)	Age/Sex	Level	Initial symptoms	Surgery	Intradural or extradural	Outcome
Stookey (1928)	44/M	C3-C4	Lt. leg weakness, Neck pain	Lam	Extradural	?
	52/M	C5-C6	Neck pain	Lam	Extradural	?
	68/M	C6-C7	Neck pain	Lam	Extradural	?
Dürig et al. (1977)	52/F	C5-C6	Thoracic pain	Lam	Intradural	Mi, Si
Roda et al. (1982)	43/M	C6-C7	Thoracic pain	Lam	Intradural	Mi, Sc
Eisenberg et al. (1986)	25/M	C5-C6	Lt. arm and Neck pain	Lam	Intradural	Mi, Si
Schneider et al. (1988)	50/F	C5-C6	Lt. leg numbness, Neck pain	AD	Intradural	Mi, Si
Sprick et al. (1991)	49/F	C6-C7	Rt. arm and thoracic pain	ADF	Intradural	Mi, Si
Finelli et al. (1992)	28/F	C5-C6	Bil hand and Rt. leg numbness	ADF	Extradural	No change
	61/M	C6-C7	Lt. hand numbness	AD	Extradural	CR
	46/F	C4-C5, C5-C6	Bil hand numbness	AD	Extradural	CR
Rumana et al. (1996)	56/F	C4-C5	Lt. leg numbness	ADF	Extradural	CR
Shin et al. (1996)	32/F	C5-6	Lt. leg weakness	AD	Extradural	Mc, Si
Antich et al. (1999)	73/F	C2-C3	Neck pain	ADF	Extradural	CR
Kohno et al. (2000)	33/M	C4-C5	?	ADF	Extradural	CR
	31/M	C5-C6	?	ADF	Extradural	Mi, Si
	38/M	C5-C6	?	ADF	Extradural	Mi, Si
	45/F	C4-C5, C5-C6	?	ADF	Extradural	Mc, Si
	34/M	C3-C4	?	ADF	Extradural	Mi, Si
Börm et al. (2000)	40/M	C5-C6	Lt. arm pain, Bil leg sensory disturbance	ADF	Intradural	CR
Clatterbuck et al. (2000)	40/M	C4-C5	Neck pain and Rt. arm pain	ADF	Intradural	Mi, Si
	52/F	C3-C4	Rt. leg weakness	ADF	Intradural	CR
	32/M	C5-C6	Rt. arm and leg weakness	ACF	Intradural	CR
Iwamura et al. (2001)	45/M	C6-C7	Neck pain and stiffness	ACF	Intradural	Mc, Si
Kobayashi et al. (2002)	64/M	C5-C6	Lt. leg paresthesia	ADF	Extradural	CR
	39/M	C2-C3	Neck and Rt. shoulder pain	ADF	Extradural	CR
Mastronardi et al. (2002)	36/M	C5-C6	Neck and Lt. arm pain	ADF	Extradural	Mc, Si
Present cases	56/M	C5-C6	Rt. shoulder pain	AF	Extradural	CR
	46/M	C5-C6	Lt. shoulder pain, Lt. hand numbness	AF	Extradural	CR

* ACF=Anterior corpectomy and fusion, AD=Anterior discectomy, ADF=Anterior discectomy and fusion, AF=Anterior foraminotomy, Bil=Bilateral, c= Complete resolution, CR=Complete recovery, i=Improved, Lt.=Left, Rt.=Right, Lam=Laminectomy, M=Motor function, S=Sensory function, ?=Details not reported

disc herniation involved one interspace in 27 cases and two contiguous interspaces in 2 cases. The disc herniation was at C2-C3 in 2 cases, at C3-C4 in 3 cases, at C4-C5 in 5 cases, at C5-C6 in 16 cases and at C6-C7 in 5 cases. There were 10 cases of intradural herniation and 19 cases of extradural herniation. Intradural disc herniation is very rare and accounts for less than 0.3% of all disc herniations and only 3% occurs in the cervical region²⁾. Only 17 cases of cervical intradural disc herniation have been reported in the literature and BSS was observed in 10 of these 17 cases¹⁰⁾. As regards the treatment, all patients underwent surgery after diagnosis. 6 patients were treated by laminectomy or hemilaminectomy, 4 patients by anterior discectomy without interbody fusion, 14 patients by anterior discectomy with interbody fusion, 2 patients by anterior corpectomy and interbody fusion, 1 patient by anterior discectomy with interbody fusion and laminectomy and our own 2 patients by anterior foraminotomy. The postoperative evaluation of the patient's motor and sensory deficits were favorable in most cases, although minor residual deficits sometimes were remained. The outcomes of the cases of extradural disc herniation were better than those of intradural disc herniation. Complete recovery occurred in 9 of the 19 extradural cases and 3 of the 10 intradural cases. Intradural disc herniation may have a worse effect on the spinal cord than extradural disc herniation, because the intradural fragment can cause hemispinal cord damage directly.

In our cases, we performed anterior foraminotomy and obtained good decompression of the spinal cord. Anterior discectomy followed by bone fusion, with or without a cervical plate, is the standard surgical treatment for cervical disc herniation, because it allows easier exposure of and a direct approach to the pathology, as well as less frequent epidural bleeding than the posterior foraminotomy approach¹³⁾. However, the main drawback of this procedure is that the functioning motion segment is lost. Consequently, it has been postulated that fusion of the cervical segments produces an acceleration of degenerative changes at adjacent segments. The common findings of the adjacent segments in the MR images are intervertebral disc herniations, spinal malalignment in both the superior and inferior directions, hypertrophy of the yellow ligaments and ossification of the posterior longitudinal ligaments⁸⁾. The rate of symptomatic adjacent-segment disease following anterior cervical fusion ranges from 8 to 25%^{6,9)}. Cervical canal stenosis is the most common finding in the cervical spine X-rays of patients with BSS produced by cervical disc herniation¹⁵⁾. In patients with cervical spondylotic radiculopathy or myelopathy, anterior foraminotomy leads to an excellent outcome without bone fusion and eliminates the risk of consequent adjacent-segment disease. Anterior foraminotomy provides direct elimination

of the compressive pathological lesion, while preserving the remaining disc as much as possible. The remaining disc can still function as a mobile unit along with the facet joints^{12,13)}. Additionally, anterior foraminotomy eliminates the bone fusion or postoperative immobilization¹³⁾. Although the symptoms of BSS were quite severe in our patients, a 5 × 8 mm hole was sufficient for adequate decompression of the spinal cord and root, resulting in a favorable outcome.

The safety and resolution of MR imaging clearly demonstrates its usefulness in evaluating degenerative cervical spine disease¹⁷⁾. Because of the ready availability of MR imaging, the number of contemporary reports of BSS has been increased. Since MR imaging can accurately indicate the presence or absence of a disc herniation, MR imaging is indispensable for the diagnosis of all patients with BSS, as well as in patients with extremity numbness of unknown etiology. Although BSS is rarely associated with degenerative cervical spine disease, cervical disc herniation should be kept in mind and early evaluation is mandatory, even in the absence of pain or significant spine radiographic abnormalities. Sometimes BSS can be misdiagnosed as a cerebrovascular accident and diagnostic workup can be delayed, because of the similar motor weakness, as shown in our own cases. Because serious symptoms can progress rapidly, early accurate diagnosis and immediate surgical treatment should be recommended to prevent serious morbidity.

Conclusion

Based on our cases, we emphasize the need for early diagnosis and prompt surgical intervention, in order for the patients involved to have the best chance of functional neurological recovery in cases of BSS associated with cervical disc herniation. Cervical disc herniation should be considered in the differential diagnosis of patients with BSS, even in the absence of the typical symptoms. Anterior foraminotomy suffices for the removal of a cervical disc protrusion, without the risk of consequent adjacent-segment disease.

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