

# Brown-Sequard Syndrome after an Accidental Stab Injury of Cervical Spine: A Case Report

Soo Dong Park, MD, Sang Woo Kim, MD, and Ikchan Jeon, MD

Department of Neurosurgery, Yeungnam University College of Medicine, Daegu, Korea

We report a case of Brown-Sequard syndrome (BSS) caused by an accidental stab injury of the cervical spine that shows clear magnetic resonance imaging (MRI) findings and clinical presentation. A 42-year-old woman was brought into the emergency department after a stab injury on the right side of the posterior neck from a knife that was lying in a fruit basket after slipping. The patient complained of hemiparesis of the right-side extremities, and ipsilateral hypoesthesia and contralateral sensory loss of pain and temperature were also found on neurological examination. MRI showed a signal change of the C6–7 cord level and the tract of the stab wound through the posterior neck. Irrigation and primary closure of the laceration was performed under the impression of BSS. The neurologic deficit was improved with rehabilitation therapy.

(Korean J Neurotrauma 2015;11(2):180-182)

**KEY WORDS:** Brown-Sequard syndrome · Cervical vertebrae · Spinal cord injuries.

## Introduction

Brown-Sequard syndrome (BSS) was first described in 1840 by Charles-Édouard Brown-Sequard through experiments of spinal cord hemi-section in animal models.<sup>1)</sup> BSS is a rare condition as an incomplete spinal cord injury (SCI) that is caused by traumatic events, such as, most commonly, stab wounds, followed by tumor and degenerative disease.<sup>4,5,8)</sup> However, most patients diagnosed with BSS show partial clinical features rather than typical symptoms of ipsilateral motor deficits and contralateral sensory disturbances associated with pain and temperature. These cases are categorized as Brown-Sequard-plus syndrome consisting of asymmetric paresis, and bilateral sensory changes which are more marked on the less paretic side. In this re-

port, we describe a female patient presenting typical clinical features of BSS caused by an accidental stab injury on the right side of the posterior neck.

## Case Report

A 42-year-old woman was brought into the emergency room in our hospital with a stab wound on the right side of the lower posterior neck. She complained of right lower leg weakness and difficulty in ipsilateral hand grasping with alert consciousness. The injury was developed when she slipped accidentally and received a stab wound from a knife lying in a fruit basket.

On neurological examination, the patient presented motor weakness of the right-side extremities, grade 4 for wrist extension, and grade 2 for elbow extension and the distal key muscles (grade 2 below C6 level). There were hypoesthesia for tactile and vibration distally from C6 on ipsilateral side of the injury site, and sensory disturbance for nociceptive pain and temperature sensation distally from C7 on contralateral side. There was a single laceration of 3 cm in length on the lower-right area of the posterior neck (level of 6th cervical spinous process) (Figure 1). Magnetic resonance imaging presented a high signal change of the cervical cord and the tract of the stab wound through the right side of the

**Received:** August 14, 2015 / **Revised:** September 28, 2015

**Accepted:** September 30, 2015

**Address for correspondence:** Sang Woo Kim, MD  
Department of Neurosurgery, Yeungnam University College of Medicine, 170 Hyeonchung-ro, Nam-gu, Daegu 42415, Korea  
Tel: +82-53-620-3796, Fax: +82-53-620-3770  
E-mail: sw902@ynu.ac.kr

© This is an Open Access article distributed under the terms of Creative Attributions Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted noncommercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

posterior neck at C6–7 on T2-weighted images. The knife injured the cervical cord, passing through the inter-laminar space of C6–7 and avoiding the destruction of bony structures (Figure 2).

Based on their clinical and radiological features, the patient was diagnosed with BSS of the C6 neurologic level (American Spinal Injury Association Impairment Scale C) on the right side. There was no acute hemorrhagic lesion or cervical instability requiring surgical treatment, and primary closure of the laceration was performed after massive irrigation. The patient then underwent conservative treatment with systemic steroids, antibiotics, and analgesics. The motor deficits were improved, and the patient was able to walk 7 days after the accident. On 6-month follow-up, the patient returned to the workplace and resumed their normal daily life with only some remaining hypoesthesia and hyperalgesia on the left side without motor weakness.

## Discussion

Damage to the spinal cord as a type of incomplete SCI

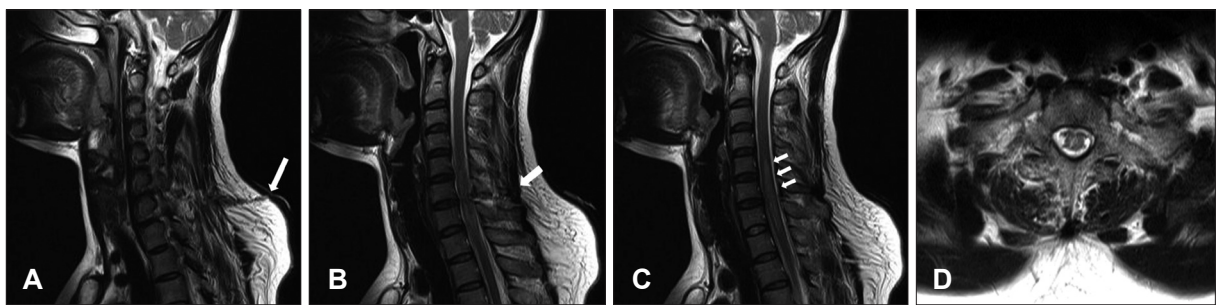


**FIGURE 1.** A lacerated wound in the right posterior cervical region, measuring 3 cm in length is shown.

can develop into BSS, which often occurs in the cervical spinal cord region and is considered equivalent to a hemi-cordectomy.<sup>10</sup> Each year, 12,000 cases of SCI occur in the United States. BSS accounts for 1% to 4% of them, and SCIs caused by stab injury are rare and account for less than 1.5% of all cases.<sup>7,11,12,19</sup> A cervical lesion associated with BSS is present in 18% to 30% of cases.<sup>11,18</sup>

Most motor neurons from the cerebral cortex run in the descending corticospinal tracts of the spinal cord, which decussate in the lower medulla. The posterior column is responsible for the position and vibration sensations that enter through the dorsal root ganglion and ascends ipsilaterally. Whereas the spinothalamic tract is responsible for the sensation of pain and temperature, it decussates at the level of few segments above its entrance into the spinal cord and ascends contralaterally.<sup>2,6,9,14</sup> Therefore, a hemi-section of the spinal cord results in BSS with ipsilateral hemiplegia, ipsilateral loss of position and vibration sensation, and contralateral loss of pain and temperature sensation.<sup>10,18</sup>

Lipschitz and Block<sup>7</sup>) described three main mechanisms of SCI from a penetrating injury. First, the direct damage by the weapon or bony fragments developed by the weapon can usually cause irreversible neurologic damage to the spinal cord. Second, the vascular supply of the spinal cord may be damaged, resulting in an edema. The neurological disabilities associated with this type of injury will frequently improve with the mitigation of the edema. Third, countercoup or direct contusion of the spinal cord may cause neurological deficits. According to the aforementioned mechanisms, typical BSS presenting ipsilateral motor and contralateral sensory deficits caused by a hemi-section are not common. When a knife blade enters through inter-laminar space, like in our case, local damage occurs in the spinal cord at the impact site and countercoup damage develops due to the spinal cord pushing against the spinal canal wall of the opposite side. In addition, the severity of neurologic damage and neurologic level can be affected by the extent of edema



**FIGURE 2.** A: Magnetic resonance imaging (MRI) reveals an injured tract, through the posterior neck (arrow). B: MRI reveals disruption of the C6–7 interlaminar structures and ligamentum flavum (arrow). C: There is high signal intensity lesion at cervical spinal cord in T2-weighted MRI (arrows). D: Axial T2-weighted MRI also shows injured tract and signal change in the spinal cord.

within the spinal cord.

BSS shows a favorable prognosis compared with the other types of incomplete SCI.<sup>13)</sup> In a study conducted by Pollard and Apple,<sup>13)</sup> BSS showed the best prognosis among 412 patients with traumatic incomplete SCI. Roth et al.<sup>15)</sup> also reported that nearly all patients with BSS showed good outcomes in neurological recovery, including bladder and bowel continence and functional ability. The surgical treatment of BSS is controversial and has shown no benefits in patients with penetrating injuries over conservative treatment.<sup>17)</sup> Surgical treatment is indicated in the presence of a foreign body, leakage of cerebrospinal fluid, persistent compression of the spinal cord or root, sepsis, or progressive neurologic deterioration.<sup>3,7,11,12,16,18)</sup> Conservative treatment, including local wound debridement and primary closure, a tetanus booster, antibiotics, physiotherapy, and rehabilitation, produces favorable outcomes in most cases of BSS.<sup>3,17,18)</sup>

The recovery of neurologic function results from the resolution of the conduction block in the injured axons as the spinal cord edema resolves. The duration of recovery usually takes more than 1 to 6 months, although it may begin at 24 hours post-injury, and recovery is developed in the order of extensor-to-flexor and proximal-to-distal-portion muscles. This patient achieved a walking state within one week post-injury and regained most of her motor functions after 6 months with slight hypoesthesia and hyperalgesia.

This case shows BSS caused by a stab injury with quite typical neurologic symptoms that have been described in previous studies and a favorable outcome after conservative treatment. In many SCIs caused by a stab injury, surgical treatment, including exploration, has been required to remove parts of the weapon and bone fragments compressing the neural components, confirm and repair cerebrospinal fluid leaks, or for irrigation of the injured site.<sup>16)</sup> However, when a stab injury does not have any lesions compressing the neural components, conservative treatment alone could be a reasonable treatment modality.

## Conclusion

BSS shows a more favorable prognosis than the other types of incomplete SCI. The treatment modality depends on the causes and the condition of the lesion. Conservative treatment could be a treatment of choice in BSS caused by a

stab injury unless there is a lesion compressing the neural components.

■ The authors have no financial conflicts of interest.

## REFERENCES

- 1) Diabira S, Henaux PL, Riffaud L, Hamlat A, Brassier G, Morandi X. Brown-Sequard syndrome revealing intradural thoracic disc herniation. *Eur Spine J* 20:65-70, 2011
- 2) Herr RD, Barrett J. An unusual presentation of Brown-Sequard syndrome. *Ann Emerg Med* 16:1285-1288, 1987
- 3) Kamaoui I, Maaroufi M, Benzagmout M, Sqalli Houssaini N, Boujraf S, Tizniti S. MRI findings in spinal cord penetrating injury: three case reports. *J Neuroradiol* 34:276-279, 2007
- 4) Kobayashi N, Asamoto S, Doi H, Sugiyama H. Brown-Séquard syndrome produced by cervical disc herniation: report of two cases and review of the literature. *Spine J* 3:530-533, 2003
- 5) Kohno M, Takahashi H, Yamakawa K, Ide K, Segawa H. Postoperative prognosis of Brown-Séquard-type myelopathy in patients with cervical lesions. *Surg Neurol* 51:241-246, 1999
- 6) Lee HM, Kim NH, Park CI. Spinal cord injury caused by a stab wound--a case report. *Yonsei Med J* 31:280-284, 1990
- 7) Lipschitz R, Block J. Stab wounds of the spinal cord. *Lancet* 2:169-172, 1962
- 8) Mastronardi L, Ruggeri A. Cervical disc herniation producing Brown-Sequard syndrome: case report. *Spine (Phila Pa 1976)* 29:E28-E31, 2004
- 9) McCarron MO, Flynn PA, Pang KA, Hawkins SA. Traumatic Brown-Séquard-plus syndrome. *Arch Neurol* 58:1470-1472, 2001
- 10) McLean MM, Vert C, Dutcher M, Kollar R, Tilney PV. A 41-year-old man with an incomplete spinal cord injury. *Air Med J* 33:6-9, 2014
- 11) O'Neill S, McKinstry CS, Maguire SM. Unusual stab injury of the spinal cord. *Spinal Cord* 42:429-430, 2004
- 12) Peacock WJ, Shrosbree RD, Key AG. A review of 450 stabwounds of the spinal cord. *S Afr Med J* 51:961-964, 1977
- 13) Pollard ME, Apple DF. Factors associated with improved neurologic outcomes in patients with incomplete tetraplegia. *Spine (Phila Pa 1976)* 28:33-39, 2003
- 14) Ross ED, Kirkpatrick JB, Lastimoso AC. Position and vibration sensations: functions of the dorsal spinocerebellar tracts? *Ann Neurol* 5:171-176, 1979
- 15) Roth EJ, Park T, Pang T, Yarkony GM, Lee MY. Traumatic cervical Brown-Sequard and Brown-Sequard-plus syndromes: the spectrum of presentations and outcomes. *Paraplegia* 29:582-589, 1991
- 16) Rubin G, Tallman D, Sagan L, Melgar M. An unusual stab wound of the cervical spinal cord: a case report. *Spine (Phila Pa 1976)* 26:444-447, 2001
- 17) Simpson RK Jr, Venger BH, Narayan RK. Treatment of acute penetrating injuries of the spine: a retrospective analysis. *J Trauma* 29:42-46, 1989
- 18) Takemura S, Sasai K, Ohnari H, Ichikawa N, Akagi S, Iida H. Brown-Séquard-plus syndrome due to stab injury: a case report. *Spinal Cord* 44:518-521, 2006
- 19) Waters RL, Sie I, Adkins RH, Yakura JS. Motor recovery following spinal cord injury caused by stab wounds: a multicenter study. *Paraplegia* 33:98-101, 1995