

Brown-Sequard Plus syndrome produced by different traumatic injuries to the spinal cord with a good neurologic recovery

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Objectives: To evaluate the demographic, neurological and functional characteristics and course of recovery of patients with Brown-Sequard Plus Syndrome.

Methodology: This study was carried out at Armed Forces Institute of Rehabilitation Medicine, Rawalpindi, Pakistan from May 2007 to April 2013. It included 7 patients, with traumatic Brown-Sequard Plus Syndrome who were evaluated clinically and radiologically and their functional outcomes observed.

Results: Out of patients, 6 were male and one was female; mean age was 32 ± 13 years. All had traumatic cervical spinal injuries. Causes of injury were fall in two patients, a gun shot injury in one, improvised explosive device blasts in two and road traffic accident in one patient. Only three

became voluntarily continent for bowel and bladder at discharge and the other four were successfully trained in clean intermittent catheterization for bladder management. All were able to walk independently; four of them required orthoses and five needed gait aids. After an average hospital stay of 9 ± 4 weeks, four patients were sent home and the other three continued with their jobs with some modification.

Conclusion: All our cases of Brown-Sequard Plus Syndrome were caused by trauma and demonstrated favorable neurologic and functional outcomes after rehabilitation and returned acceptably near to pre-injury lifestyles. (Rawal Med J 2013;38: 366-370).

Key words: Brown-Sequard Plus Syndrome, spinal cord injury,

INTRODUCTION

Spinal cord injury (SCI) can be classified as complete or incomplete depending upon lack or preservation of any motor or sensory function below injury level.¹ There are distinct syndromes for incomplete SCI and these should be mentioned separately in addition to the standard American Spinal Injury Association Impairment Score (AIS).¹ Among these are Central Cord, Brown-Sequard (BSS), Anterior Cord, Conus Medullaris and Cauda Equina Syndromes.¹ The BSS is described as a syndrome of ipsilateral hemiplegia and proprioceptive loss; and contralateral deficit of pain and temperature sensations.² Its pure forms are rare and most cases appear partially as the Brown-Sequard-Plus syndrome (BSPS).² The clinical data regarding these syndromes is sparse in Pakistan. The purpose of this study was to evaluate the demographic, neurological and functional characteristics and course of recovery in patients with BSPS resulting from traumatic injury to the spinal cord.

METHODOLOGY

After approval from Hospital Ethical Review

Committee, seven patients of BSPS were included in this study from May 2007 to April 2013 after taking verbal informed consent. All were selected from Spinal Cord Injury Indoor Rehabilitation Unit, Armed Forces Institute of Rehabilitation Medicine, Rawalpindi, Pakistan. Age, duration of stay in hospital (in weeks), cause of injury, unconsciousness at time of injury, persistent signs of brain injury, surgical intervention, part of spinal cord involved, presence of pain, achieved ambulation and bladder/bowel control were recorded.

RESULTS

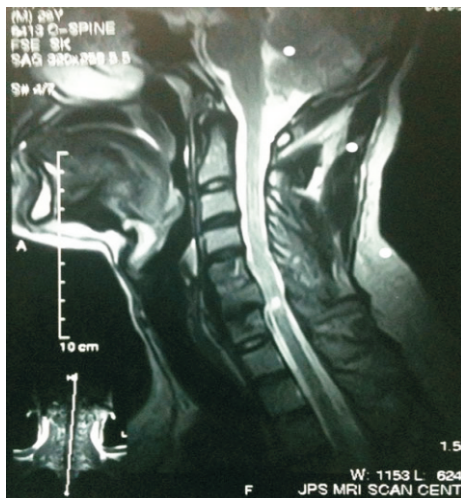
Out of 7 patients, 6 were males and one was female. The mean age was 32 ± 13 years (Range: 22-62 years). The inciting injuries were motor vehicle accidents (MVA) in 2 (27%), fall from height in 2 (27%), improvised explosive device (IED) blast in 2 (27%) and gunshot injury in 1 (14%) patient. All had injury to cervical segment of spine. Three males had intervertebral disc herniation, two had vertebral fractures and one had cord contusion. The female had vertebral fracture as well as disc herniation and cord hemorrhage. Two (28.6%) patients had loss of

consciousness at the time of injury but were left with no residual signs of brain injury. All patients had bladder and bowel incontinence immediately following injury and experienced neuropathic pain in legs.

The spine was fixed surgically in three (43%) patients. At discharge, three(43%) patients became voluntarily continent for bowel and bladder. The other four (57%) used clean intermittent catheterization (CIC) for bladder management. All subjects were able to walk independently; four (57%) of them required orthoses and five (71%) needed gait aids (some needed both). One patient was mobile without any support. Four (57%) cases were sent home and three (43%) continued with their jobs with some modification. The average length of stay at hospital was 9 ± 4 weeks (range = 1-12 weeks).

Case 1: A 28 year old male presented with 1½ week history of backache, weakness and stiffness in left arm and leg secondary to an MVA caused by an IED blast that led to a compression injury to his neck. He noticed inability to move his legs associated with numbness and incontinence of bowel and bladder. MRI of cervical spine showed disc prolapse at CV₆/CV₇ level causing cord compression. Spinal surgeon fixed his spine and after a week of observation he was transferred to our rehabilitation unit.

Fig1. Sagittal Film of MRI of the cervical spine showing disc prolapse at CV₆/CV₇ level causing mild indentation on thecal sac along with a tiny syrinx at this level. The disc space at CV₅/CV₆ is also lost.

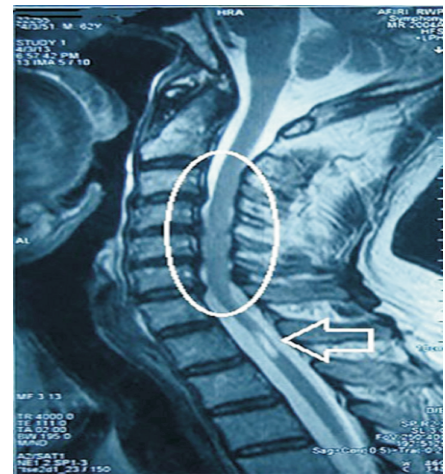


At presentation, motor examination revealed muscle power of 5/5 according to Medical Research Council (MRC) Scale³ in right arm. MRI of the

cervical spine showed disc prolapse at CV₆/CV₇ level causing mild indentation on thecal sac (Fig. 1) along with a tiny syrinx at this level. The rehab plan formulated comprised of family and patient education, physical modalities, therapeutic exercises, gait training with front-wheeled walker, occupational therapy and vocational training. After 3 months, there was improvement in power in all limbs. He attained independence in ambulation with front-wheeled walker. He used self CIC for managing bladder and was discharged on home management plan.

Case 2: A 62 year old male veteran presented with 1 week history of sudden onset lower back pain radiating to right leg following lifting a modest load. It was 8/10 on Visual Analogue Scale (VAS).⁵ Past history revealed Gunshot Injury (GSI) to neck in 1971 Indo-Pak war that was followed by progressive improvement in weakness of right half and numbness of left half of his body.

Fig 2. Sagittal Film of MRI of the Cervical Spine showing myelomalacia at DV₁ level, and Intervertebral Disc protrusion at CV₃/CV₄, CV₄/CV₅ and CV₅/CV₆ levels.



In lower limbs, the power on right side was 2/5 in L₃, 1/5 in L₂, L₄ and L₅ and 0/5 in S₁ myotomes. The patient had spasticity of grade 2 as per Modified Ashworth Scale (MAS)⁶ in lower limbs with normal tone in upper limbs. MRI of the whole spine revealed myelomalacia at DV₁ level, left paramedian protrusion at CV₃/CV₄ and posteromedian protrusion at CV₄/CV₅ and CV₅/CV₆ levels causing compression on exiting nerve roots bilaterally, more on left side at CV₃/CV₄ level (Fig. 2). Nerve conduction studies and electromyography showed

Polyradiculopathy L₄ S₄ bilaterally. He had developed Cauda Equina Syndrome and refused surgical intervention. Over a month of rehabilitation, his pain improved to 2/10 on VAS. He started walking using a Knee-Ankle-Foot-Orthosis (KAFO) on right and front-wheeled walker and was sent home.

Case 3: A 22 year old male fell in a 100 feet deep well and developed quadriplegia along with incontinence for bowel and bladder. The power in right arm and leg was 3/5 proximally as well as distally. There was spasticity of grade 2+ in right arm and leg according to MAS.



Fig 3. Sagittal Film of MRI of the Lumbar Spine showing disc bulges with compression on exiting nerve roots bilaterally at L₄/L₅ and L₅/S₁ levels.

MRI revealed cord contusion at CV₆ level with right sided intense signal on T₂ weighted image. (Fig. 4) He was managed with standard rehabilitation protocols i.e. self CIC for bladder and timed evacuation for bowel.

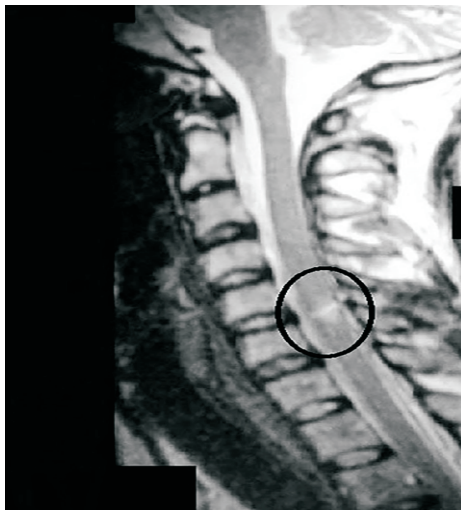


Fig 4. Sagittal Film of MRI of the Cervical Spine revealing cord contusion at CV₆ level.

He was given oral pregabalin for neuropathic pain. On discharge after three months' time, he was continent in sphincters with some motor deficit. He was walking with a forearm crutch and a KAFO on right side. The sensory impairment however, persisted.

Case 4: A 26 year old female had a fall from a height of 12 feet and developed quadriplegia with urinary and fecal incontinence immediately following the impact. She had a 3/5 muscle power on right and 4/5 on left side. She had frequent urinary leakages at night. MRI of the cervical spine showed a left posterio-lateral herniation of the disc at CV₆/CV₇ level along with fracture of CV₇. (Fig. 5)



Fig 5. Sagittal Film of MRI of the Cervical Spine showing herniation of the disc at CV₆/CV₇ level along with fracture of CV₇ and cord edema from CV₄ to DV₁ level along with cord contusion.

The fractured vertebra was fixed by spinal surgeon. She developed neuropathic pain in right leg for which she was given oral gabapentin with local application of capsaicin. She underwent routine rehabilitation training. After two months, she was successfully managing bladder by self CIC and oral anticholinergics. She was mobile with a forearm crutch and an Ankle-Foot-Orthosis (AFO) on right side and was discharged to home.

Case 5: A 28 year old soldier suffered blast injury by an IED resulting in incontinence for bowel and bladder, stiffness and weakness in right arm and leg and neuropathic pain in right leg. An urgent X-Ray and MRI revealed fractures of right bony

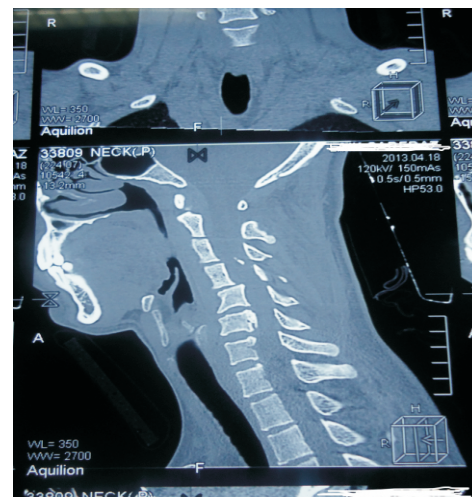
components of CV₃, CV₄ and CV₅, a prevertebralsubacute hematoma with retrolisthesis of CV₄/CV₅ and spinal cord narrowing. Emergency spinal fixation was performed and the muscle power improved to -4/5 in right arm and leg and +4/5 in left arm and leg. There was a self-sustained knee and ankle clonus on right side and spasticity of grade 2+ in right arm and leg. He was managed through Electrical Muscle Stimulation (EMS) of weak muscle groups, therapeutic exercises, training for bladder and bowel management and ambulation. Oral gabapentin and baclofen were given and patient achieved independent mobility within 3 months.

Case 6: A 29-year-old man was involved in a road traffic accident resulting in incontinence for bowel and bladder and neuropathic pain in left arm and leg. He had paresis of voluntary movements on right side. Plain radiography was unremarkable. A CT Scan of the cervical spine revealed right-sided contusions in the cord at CV₄ and CV₅ levels. The MRI of the cervical area showed a left posterolateral herniation of the intervertebral disc at CV₄/CV₅ level and abnormal signal intensity within the right parasagittal segment of the spinal cord parenchyma reflecting tissue laceration due to soft tissue injury.

He underwent rehabilitation with EMS of weak muscle groups, therapeutic exercises, oral baclofen for spasticity and oral gabapentin. After bladder retraining program through bio-feedback, he was mobilized with an AFO on right and an elbow crutch on left side. He became continent for urine and feces over 3 months and was ambulating independently at discharge.

Case 7: A 31 years old male met a MVA resulting in quadriparesis with bowel and bladder incontinence. X-rays and CT showed fracture dislocation of CV₅/CV₆ (Fig.6). Spinal fixation was done on fourth day by neurosurgeon. He had a rapid motor recovery in next two days in right arm and both legs. In next three days, bladder and bowel continence convalesced and he was sent to us for rehabilitation.

Fig 6. Sagittal Film of CT of Cervical Spine showing fracture dislocation of CV₅/CV₆



After rehabilitation, he started walking independently in a week period.

DISCUSSION

BSS, first described by Charles Edouard Brown-Séquard in 1846,⁷ is more frequent at cervical level and is usually associated with stab-wound injuries.⁸ However, it can also be the result of tumors, cord ischemia, epidural hematoma, inflammation, disc herniation and cervical spondylosis.^{8,9} Patients with BSS have a good functional outcome. Seventy-five percent ambulate independently at discharge from rehabilitation unit and nearly 70% perform functional skills and activities of daily living independently.^{10,11} Patients with BSSPS have a better prognosis than those with 'pure' BSS.^{10,11} The most important predictor of function is muscle power in arms and legs: when arm is weaker than leg, patients are more likely to ambulate at discharge.^{10,11}

In our study, all patients had traumatic cervical spinal injuries with injury to cervical segment of spine. This is comparable to international data. Jomin et al reported the commonest level in BSSPS, mainly involving C₅ or C₆ levels.¹² Spinal fixation was carried out in two male patients who had vertebral fracture and in another with disc prolapse

The etiologies in our patients were MVA in 2 (27%), fall from a height in 2 (27%), IED blasts in 2 (27%)

and GSI in 1(14%). In a study by Roth et al, BSS and BSPS were caused by MVA in 22 (58%), penetrating wounds in 8(21 %; 6 GSI and 2 stab wounds), diving in 5 (13%), and other causes in 3.⁹

Nearly all of our patients were incontinent for bowel and bladder at the time of presentation to rehabilitation setup. Three (43%) became voluntarily continent for bowel and bladder at discharge and four (57%) used CIC for bladder evacuation. None was on indwelling catheter nor unable to manage bowel program. Roth et al reported that 25 patients out of 38 (65.8%) were incontinent at admission and 21 (84%) became continent spontaneously and 2 (8%) used CIC, 33 out of 38 (86.8%) were incontinent for bowel at admission and 20 out of 33 (60.6%) became continent spontaneously on discharge.⁹ All our patients had neuropathic pain. Roth et al also reported the most common complications in BSS and BSPS patients to be urinary tract infection and dysesthetic pain.⁹

The average stay at the rehabilitation unit was 9±4 weeks or 63±28 days (range: 7– 84 days). Roth et al reported mean length of rehabilitation stay 79.3±46.0 days. Four out of our seven (57%) cases were sent home. The rest three(43%) continued with their jobs with some modification. According to Roth et al, 14 out of 32 (43.75%) were able to continue their jobs or studies. All of our subjects (100%) were able to walk independently; four(57%) of them required orthoses and five (71%) needed gait aids. The patient with the best initial motor score had the best recovery in terms of mobility. Comparable study by Roth et al noted 79% cases to be independent in mobility at discharge.

Limitations of the study include a single center experience. Being an army institute we primarily receive armed forces personnel. We believe that the actual number of BSPS is much higher than reported in our study because most of the patients do not have access to adequate spinal care, as there is little expertise to manage and rehabilitate SCI in Pakistan.

CONCLUSION

We reported seven cases of BSPS caused by trauma. All patients demonstrated favorable neurologic and

functional outcomes after rehabilitation and returned acceptably near to pre-injury lifestyles.

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Conception and design: Ali Raza Qureshi
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Analysis and interpretation of the data: Saeed Bin Ayaz, Noreen Akhter
Drafting of the article: Saeed Bin Ayaz, Ali Raza Qureshi, Sumeera Matee
Critical revision of the article for important intellectual content: Noreen Akhter
Statistical expertise: Saeed Bin Ayaz
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