

REHABILITATION OF PATIENTS WITH PARAPLEGIA FROM SPINAL CORD INJURY: A REVIEW

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Introduction

Spinal cord injury (SCI) is injury that occurs to spinal cord from foramen magnum distal to the conus medullaries & cauda equinae. Acute injury of spinal cord are among the most common cause of sever disability & death¹. The common cause of SCI can varies in different geographical regions occurs most frequently in groups. 80% are under the age 45 years. The majority of persons are male. Vehicles crashes are the most common causes (45.4%) followed by fall (16.8%), sports injury (16.3%) and violence. Quadriplegia results from injury to the cervical cord. There is a loss of motor, sensory or both in arms trunk & legs as well as loss of bladder, bowel & sexual function. Paraplegia results from injury to thoracolumber or sacral segment. This includes injury to the conus medullaris and cauda equine. There may be involvement of the trunk bowel, bladder and sexual dysfunction to some degree¹. Life expectancy of person with SCI has increased in recent decades. Evidence of the benefits of medical rehabilitation is documented by the reduction in disability of person and a reasonable degree of independence in the performance of daily living skills².

Pathophysiology & mechanism of injury

Spinal injuries carry a double threat: damage to the vertebral column and damage to the neural tissues. A

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stable injury is one in which the vertebral components will not be displaced by normal movements; if the neural elements are undamaged, there is little or no risk of them becoming damaged. An unstable injury is one in which there is a significant risk of displacement and consequent damage to the neural tissues³.

There are three basic mechanisms of injury

1. Traction injury: in the lumber spine resisted muscle effort may avulse transverse processes; in the cervical spine the seventh spinous process can be avulsed ('clay-shov-eller's fracture').

2. Direct injury: penetrating injuries to the spine, particularly from firearms and knives, are becoming increasingly common.

3. Indirect injury: this is the most common cause occurs most typically in a fall from a height when the spinal column collapses in this vertical axis, or else during violent free movements of the neck or trunk. A variety of forces may be applied to the spine (often simultaneously): axial compression, flexion, lateral compression, flexion-rotation, shear, flexion-distraction and extension³.

The most common sites of fracture dislocation injuries are the C5-6, C6-7, and T12-L1 junctions.

Anterior cord syndrome: results from vascular injury to the anterior spinal artery, thus causing bilateral weakness, spasticity, and loss of pain/temperature sensation with sparing of bilateral proprioception and light touch sensation associated with the posterior columns.

Brown-Sequard syndrome: occurs from a lesion half of the spinal cord in the axial plane, resulting in weakness, spasticity and alternation of light touch on one side of the body, with decreased pain temperature sensation of the opposite side resulting from the decussation of the antero-lateral spinothalamic tract (ALST) within the cord.

Central cord syndrome: usually resulting from a cervical level hyperextension injury, this result in weaker upper extremities compared with lower extremities.

Quada equina syndrome: lesions below the conus medullaries result in lower motor neuron (LMN) type of symptoms, with flaccid lower extremities, bowel, and bladder.

Conus medullaris syndrome: lesions at the level of the conus usually have a mixture of upper motor neuron (UMN) and LMN characteristics.

Rehabilitative management

Rehabilitation program includes: (a) Assessment and evaluation of the patient (b) Identification of co-morbid conditions (c) Management of complication (d) Physical therapy (e) Occupational therapy (f) Orthosis (g) Gait retaining (h) Community re-integration.

In a comprehensive rehabilitation facility, interdisciplinary intervention begins as soon as the patient is medically stable enough to tolerate therapy. This may be as soon as the day following injury. In fact, the sooner therapies begin the better chance there is of preventing SCI complications such as the formation of joint contractures. The rehabilitation team should be meeting two to three times per week to facilitate progress in the patient's short and long-term goals, modifying them appropriately as the medical status dictates.

a. Assessment & evaluation of the patient: include evaluation of spinal stability, as well as assessment of neurological, musculoskeletal, pulmonary, cardiovascular gastrointestinal, genitourinary and integumentary systems.

b. Identification of co-morbid conditions: these include hypertension, diabetes mellitus, ischaemic heart disease, chronic obstructive pulmonary disease etc.

c. Management of complications: in rehabilitation management of spinal cord injury following complications should be managed (i) Bladder dysfunction (ii) Bowel dysfunction (iii) Spasticity (iv) Muscle weakness (v) Pain (vi) DVT (vii) Bed sore (viii) Postural hypotension.

Bladder dysfunction: bladder dysfunction, secondary to SCI is not only disabling medically & physically but also socially. The most common approaches to bladder management include intermittent catheterization (IC) and indwelling catheterization. Indwelling catheterization is used in acute injury and intermittent catheterization maintain urine output volume less than 450 ml. Suprapubic catheterization is used in a penile ulceration. Trigger mechanism e.g. valsalva, crede method are also beneficial to improve bladder function.

Drugs are used in bladder management includes: anticholinergics, antispasmodic etc. Other therapies are acupuncture, assistive devices, electrical stimulation or surgical augmentation may also be employed to assist bladder function⁴.

Bowel dysfunction: more than 20% of the person with spinal cord injury report difficulty with evacuation of their bowel. So bowel management should start during acute phase to avoid fecal impaction. Management of bowel includes: (i) Dietary fiber: insoluble fiber absorbs & holds water. These provide bulk that pushes food through the digestive system quickly. In soluble fiber promote regularity and treat constipation. (ii) Regular intake of high fluid prevents constipation. (iii) Pulse water irrigation (intermittent rapid pulses of warm water) in to rectum, to break up stool impaction & stimulates peristalsis. (iv) Stimulation: electrical stimulation of abdominal wall muscles & functional magnetic stimulation may reduce colonic transit times. (v) Pharmacological agents: prokinetic agents are presumed to promote transit through the GIT tract, there by decreasing the length of time for stool to pass through intestine and increase frequency of stool available for evacuation e.g. Cisapride (vi) Use of suppositories: glycerin suppository is a mild local stimulant and lubricating agents⁵.

Spasticity: is a common sequel of spinal cord injury. It starts gradually and after spinal shock and has been estimated about 55 to 70%. Following treatment currently available: (i) Physical therapy: rhythmic passive movement, prolonged or other methods of producing muscle stretch. (ii) Direct muscle electrical stimulation- a varieties of muscle electrical stimulation which reduce spasticity: patterned electrical stimulation (PES), patterned neuro muscular electrical stimulation (PNS), functional electrical stimulation, transcutaneous electrical nerve stimulation (TENS). (iii) Pharmacological therapy: oral baclofen: it is centrally acting drug which is gamma- aminobutyric acid agonist. Others drug: diazepam, tizanidine, clonidine, gabapentine etc. Blocking agent: phenol or botulinum toxin may be beneficial. (iv) Surgery includes percutaneous radio frequency rhizotomy, myelotomy etc ⁶.

Muscle weakness: paresis or paraplegia is common sequel of SCI. It is managed by following ways :

1) Strengthening exercise which increase muscle power and prevent muscle wasting. 2) Electrical

stimulation therapy which also increase muscle power and prevent muscle wasting⁷.

Pain: pain is a frequent complication of traumatic spinal cord injury. 30 to 40% of patient with spinal cord injury has experience severe disabling pain. 69% has been estimated as chronic pain. Older age has been associated with higher pain prevalence in a few studies. Pain is due to neuropathic or musculoskeletal pain is may be reduced by following methods: (i) Non pharmacological-massage & heat, TENS & exercises modalities decrease pain. (ii) Pharmacological: various drugs are available to reduce pain, e.g. gabapentin & other anticonvulsants⁸.

DVT: it is a common complication of spinal cord injury & major cause of morbidity & mortality. The incidence in person with spinal cord injury ranges from 12.5 to 55% and pulmonary embolism is reported approximately 5% of acute spinal cord injury patients. The following treatment is available for prevention and treatment of DVT. (1) Non pharmacological methods include compression stocking, external pneumatic compression and continuous rotation beads have been with variable effectiveness. (2) Pharmacological agent-antithrombotic or anticoagulant is used as a prophylactic measures against DVT. Use of low molecular weight heparin has extremely effective either alone or in combination with mechanical modalities^{9,10}.

Bed sore: pressure ulcer or bed sore develop any time after spinal cord injury. During acute phase sacral & heels ulcer are most common & in chronic case ischial ulcer is common. Bed sore can be prevented by following methods: (i) Posture change every 2 hourly. (ii) Use of minimal air loss beds. (iii) Use of pillows & foam wedges are used to prevent pressure on bony prominence. (iv) Electrical stimulation is used to decrease ischial ulcer and increase blood flow¹¹.

Postural hypotension: a frequent and dismaying problem encountered by patient with spinal cord injury. It occurs due to deprivation of sympathetic response.

Following treatment is available¹².

Pharmacological: Clonidin, Flucordison.

Non pharmacological: elastic stocking & abdominal binders.

Physical therapy: Comprise of physical agents and therapeutic exercises⁷.

Physical agents

1) **Thermotherapy:** are used to decrease the pain and spasticity. They are i) superficial heat: IRR, Wax bath etc ii) deep heat: SWD, MWD, UST etc.

2) **Electrical therapy:** is used to increase muscle power and to decrease the pain e.g. TENS, EST

Therapeutic Exercise: following therapeutic exercises are used in patient with spinal cord injury.

Mat exercise

PNF exercise

Active & passive ROM exercise

Strengthening exercise

Stretching exercise

Endurance exercise

Co-ordination exercise

e. **Occupational therapy:** it is also part of rehabilitation program and done by occupational therapist. Following activities are should be included self care, feeding, dressing, hygiene, grooming, toileting, bathing, and telephone use^{7,12}.

f. **Orthosis:** various orthosis are used to assist patient with spinal cord injury. These are: crutch, walker, cane, brace & wheelchair.

g. **Gait retraining:** it is the important part of rehabilitation program balance can be achieved by proper gait retraining. Gait retraining can be done by following methods⁷:

- Pre ambulation MAT program: rolling, prone on elbow, prone on hand, quadruped, pelvic tilting, setting and standing balance.

- Parallel bar progression.

- Advanced parallel bar activities.

- Assistive device: e.g., cane, crutches.

h. **Community re-integration:** the main factor for community reintegration is barrier in the natural environment, transport, home service health care and government policy¹³.

Literature review

To explore the predictions of professionals and patients regarding functional outcome after spinal cord injury a study was conducted by Schonherr et

al¹⁴. They collected data from 55 patients with spinal cord injury. Expectations of the rehabilitation team and the patients regarding future independence in performing six daily activities were compared to the functional results at discharge. In 52% of all performed skills, independence was achieved at discharge. By expecting independence after rehabilitation, 90% of the skills were performed independently at discharge. In Heinemann et al¹⁵ series the functional outcomes of 185 patients with spinal cord injuries undergoing rehabilitation who were initially treated in a specialized short-term care unit (center patients) were compared with those of 153 patients initially treated in general hospitals (non-center patients). After stabilization, all patients were admitted to the Rehabilitation Institute of Chicago and received the same rehabilitation program. The groups were comparable in terms of demographic, injury, and medical characteristics at the time of rehabilitation center admission. While center patients were discharged from the rehabilitation center at equivalent functional skill levels, their daily rate of functional gains during the rehabilitation center stay was significantly greater than that of non-center patients. These results support the practice of specialized short-term spinal cord injury care as a means of enhancing rehabilitation outcome.

A total of 33 patients with traumatic SCI were included in a study conducted by Chan and Chan¹⁶. The functional status changes measured by the Functional Independence Measure (FIM) and discharge placement were recorded as rehabilitation outcomes. 24 patients were tetraplegic while nine were paraplegic. Significant functional improvements during the hospital phase were found in the two tetraplegic and paraplegic subgroups. Significant differences were also revealed among subgroups with lower level tetraplegic appearing to stay much longer in the rehabilitation centre. In all, 64.5% of newly diagnosed patients returned to live in the community.

Sumida et al¹⁷ retrospectively investigated functional outcomes of 151 traumatic spinal cord injury patients in Japan. The motor score and the sensory score revealed the most improvement with incomplete tetraplegia. Compared with the Model system in USA, there were significant differences in the length of stay (LOS) average 217.6 days and onset admission interval (OAI) average 74.6 days. Those results in the efficiency of rehabilitation being reduced. Another study conducted by

Musulmanoglu et al¹⁸ with the aim to evaluate the sensory, motor and functional improvement in patients with a spinal cord lesion (SCL). Fifty-five patients (29 with paraplegia and 26 with tetraplegia) admitted in the departments of Physical Medicine and Rehabilitation during a period from 1992 to 1995. Each patient was evaluated at admission, before discharge and at 12 months after discharge. Motor status was evaluated by the motor score (MS), sensory status by the light touch score (LTS), and functional status by the Functional Independence Measure (FIM) score. The evaluation of MS, LTS and FIM scores at admission and discharge showed significant improvement in the MS and LTS in all of the patients with incomplete lesions and FIM scores only in those with complete or incomplete paraplegia.

The earliest available documentary on spinal cord injury is found in the Edwin Smith surgical papyrus, estimated to have been written between 3000 and 2500 B.C. with certain commentaries added 1000 years later.¹⁹ During the Balkan wars of 1972-1913 there was a mortality rate of 95 per cent within a few weeks²⁰. Among American troops during World War I, 80 % of the 2324 men who had received injury to the spinal cord died before they could be returned from overseas²¹.

Summary

Patients with spinal cord injuries are confronted with motor and sensory deficits as well as bladder, bowel and sexual dysfunction, which lead to a fundamental change of life. Because of the extensive medical, emotional and social consequences, multidisciplinary management is essential. Important goals of rehabilitation are maximizing the independence in daily activities and providing optimal reintegration in society.

Conclusion

Spinal cord injury leads to fundamental change of life. There is no curative treatment to overcome difficulty faced by the patients after spinal cord injury. Rehabilitation program like physical therapy, occupational therapy, orthosis, gait retraining and management of complications make significant improvement in the term of FIM score, ASIA score, muscle weakness pain and spasticity which is proved by current study. So rehabilitation program is the only hope of spinal cord injury patients and physiatrist have important role to achieve the goals of functional outcome in paraplegic patient from spinal cord injury.

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