

Paraplegic Rehabilitation in Asia A Thoracolumbar Injuries – Options and Recent Advances

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Abstract

Traumatic paraplegic is a devastating injury due to spinal cord injury. Motor and sensory impairments along with bowel and bladder dysfunction causes activity limitation and causes severe impact on participation in life. The nature and severity of activity limitations and participation restrictions are dependent on the severity and site of the lesion as well as the person's social roles and contextual Factors. The rehabilitation is crucial to prevent complications such as pressure ulcers, to improve functions and to assist with community integration and economic independence. Rehabilitation helps in attaining a reasonable degree of independence in performance of daily skill and reduction of disability. Interdisciplinary approach is optimum with the team being led by a physiatrist and involving patient and his family, physiotherapist, occupational therapist, dietician, psychologist, speech therapist, social worker and other specialist consultants.

Introduction

Loss of motor power is the most apparent manifestation of spinal cord injury. Paraplegia can result from injury to thoracolumbar or sacral segment of spinal cord. Injury manifests as loss of power in lower limbs, sensory loss with involvement of bowel, bladder and sexual dysfunction. The most common cause of spinal cord injury in developed world is road traffic accident whereas fall from height in developing countries. American Spinal Injuries Association Impairment Scale (AIS) has been used to define SCI into complete or incomplete. Complete lesions are defined as AIS A, and incomplete lesions are defined as AIS B, AIS C, AIS D or AIS E. A complete injury means complete loss of motor and sensory functions at the distal level of injury[7]. Incomplete injury defines partial preservation of sensory and motor functions below the neurological level and in the lower sacral segments. With this lesion, deep anal sensation and/or anal mucocutaneous superficial sense is expected to be preserved. Loss of motor power is the most apparent manifestation leading to loss of independence and physical function. Neurogenic bladder and bowel, urinary tract infections, pressure ulcers, orthostatic hypotension, fractures,

deep vein thrombosis (DVT), spasticity, heterotrophic ossification, contractures, autonomic dysreflexia, pulmonary and cardiovascular problems, and depressive disorders are frequent complications after SCI. These complications are directly related to the patient's life expectancy and quality of life. Bladder infections, pressure ulcers and autonomic dysreflexia can lead to isolation of patient from society. Negative changes occur in the patient's perception of health. These complications especially cause delay of integration with society and psychosocial distress for patients. Low self-esteem can also occur as a result of the decrease in sexual dysfunction, negatively affecting the patient's body image.

The treatment and rehabilitation process for paraplegia caused by SCI is long, expensive and exhausting, which brings biophysical, psychosocial and economic problems. The rehabilitation of a paraplegic is long, expensive and exhausting. It starts shortly after injury with acute care and early surgical interventions if required; thereafter, sensory, motor and autonomic dysfunction treatment in the chronic phase and finally, lifelong treatment in the home environment.

Rehabilitation can be divided into following

Acute and sub-acute phase

Aim of acute medical management is to minimize further neurological damage to spinal cord and optimize recovery. The primary aim is to achieve spine stability, which is achieved by conservative or surgical intervention. Other aspects to be taken care of include maintenance of blood pressure, circulation, respiration, bladder drainage, bowel care, nutrition and body temperature, and minimizing psychological distress for patients and their families. Rehabilitation should start as soon as patient is medically stable. This duration depends on primary injury with associated injuries and subsequent medical or respiratory complications. The overall aim of rehabilitation is to enable the person to return to a productive and satisfying life.

Rehabilitation management includes

- assessment and evaluation of patient,
 - identification of co-morbid conditions,
 - management of dysfunctions,
 - physical therapy,
 - occupational therapy,
 - orthosis,
 - gait training, community re-integration.
- a) Assessment and evaluation of patient: overall assessment of spinal stability, as well as assessment of neurological, musculoskeletal, pulmonary, cardiovascular, gastrointestinal, genitourinary, and skin. Assessment is important for setting realistic goals and identifying obstacles. Assessments are also used to provide an objective way of monitoring improvement over time. More standardized and objective assessments are required for this purpose. The most commonly used assessments that are specific to SCI and physiotherapy include the Spinal Cord Independence Measure (SCIM) 2,3 and

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Figure. 1: Case 28 year old male sustained burst fracture L1 with AIS-A neurology. He was treated by corpectomy L1 with autologous bone grafting with titanium mesh cage anterior reconstruction with posterior stabilization D11-L3. Figures a) pre-operative antero-posterior x-ray, b) pre-operative lateral x-ray, c) post-operative antero-posterior and lateral x-ray, d) patient doing push-ups, e) standing with help of walker and braces and f) moving on wheelchair

the Walking Index for SCI (WISCI)4. The SCIM is equivalent to the Functional Independence Measure and provides a score out of 100 to reflect a person's ability to live and move independently⁵. It includes items that address a person's ability to transfer, walk, dress, feed, breathe and maintain bladder and bowel continence The WISCI is a 21-point scale that summarizes a person's ability to walk after taking into account need for assistance, orthoses or walking aids.⁶ The WISCI also includes a 10-m timed walk test. B) Identification of co-morbid conditions : hypertension, diabetes mellitus, ischemic heart disease, chronic lung disease etc. C) Management of dysfunctions; Bladder dysfunction: Bladder dysfunction symptoms are disabling

medically, physically as well as socially. The primary goal of bladder management is to achieve low pressure urine storage and low-pressure emptying of the bladder [7]. The bladder dysfunction can be divided into two phases; first of overflow incontinence and second phase of detrusor hyperactivity. If spontaneous voiding is not possible, intermittent catheterization is to be employed. Preferably intermittent self-catheterization whenever feasible is the method of first choice. It should be employed as soon as possible. If it cannot be established, suprapubic or transurethral indwelling catheters can be used. Even a single episode of indwelling transurethral catheterization increases the risk of urethral strictures⁸. Urethral scarring is directly related to

frequency and duration of indwelling catheter. No significant difference in urethral scarring is seen between intermittent catheterization and those doing self-void. In case of poor local skin condition such as penile ulceration suprapubic catheter to be used. Transurethral indwelling catheters should be used only if either intermittent catheterization (e.g. due to urethral strictures) or suprapubic catheterization (e.g. due to blood clotting disorders, intake of drugs interfering with thrombocyte function, acute abdomen, bladder capacity < 200 cc, pregnancy) are not possible [7]. Anticholinergic drugs (oxybutynin) are used to decrease the detrusor tone. Anticholinergic drugs act by blocking the muscarinic receptors of the cholinergic nerves, therefore interfering with

the neuromuscular coupling. For the reduction of bladder outlet resistance, the non-selective alpha blocker phenoxybenzamine has been widely used in the past. Because of less side effects selective alpha blockers are getting popular. If anticholinergic treatment is either not effective or is not tolerated due to side effects, botulinum toxin-A injections in the detrusor are a minimally invasive alternative [7.] It acts by blocking the pre-synaptic release of acetylcholine, leading to detrusor muscle relaxation. Various studies demonstrated the efficacy and good tolerability of this substance. Long-lasting (mean 9 months) detrusor relaxation can be achieved by injection of 300 units of Botox leading to a significant increase of mean cystometric bladder capacity and to restored continence in the majority of patients [9,10]. Bladder dysfunction is a dynamic and irreversible process, surgical treatments should be avoided till it can be safely possible. Other therapies include electromodulation. The evidence supporting electromodulation is at best grade C.

Bowel dysfunction: Bowel management should start in acute stage itself to avoid fecal impaction. There are two type of bowel dysfunction (Fig. 1)

- Aim is to achieve predictable, regular and thorough evacuation of bowel to reduce gastrointestinal and evacuation problem
- i. Dietary fiber: Insoluble fiber absorbs and hold water. These provide bulk that pushes food through the digestive system quickly. Insoluble fiber promote regularity and treat constipation. At least 18 gms of fibre is required
 - ii. Osmotic laxatives such as lactulose
 - iii. Regular intake of fluids-500ml more than requirement of a normal person
 - iv. Pharmacological agents; Prokinetic drugs eg. Cisapride promote transit through GIT thereby decreasing the length of time for stool to pass through gastrointestinal tract. Indicated only if scheduled bowel care and constipation is unmanageable with modification of diet/fluid/activity.
 - v. Use of suppositories- glycerin suppository is a mild local stimulant and lubricating agent.

Spasticity and contractures: Muscles are flaccid during the spinal shock period. Exercises can be done more easily with flaccid muscles. Flaccidity is replaced with spasticity after the period of spinal shock. Despite the

positive effects of spasticity, it has negative effects on mobility, daily living activities and transferring [12]. The severity and type of the other complications of SCI affects spasticity and the precipitating factors should be eliminated for the treatment of spasticity. The ROM exercises should be done in a flaccid period at least once a day and at least 2-3 times a day in the presence of spasticity. Recent studies have shown that early mobilization plays an important role in prevention of pulmonary function decline and in the development of muscle strength. Stretching prevent contractures. Flexion contractures of the hip and knee may develop due to continuous lying on the side and sitting in the wheelchair. Flexor muscle tension can be reduced with a prone position at regular intervals and ROM exercises in all directions. The ankle ROM exercises are useful to prevent contractures of the foot as well as the proper positioning of the foot while sitting in a wheelchair. Patients should be asked to change position regularly.

Muscle weakness- it is managed in following ways. A) strengthening exercises to increase muscle power and prevent wasting. Strengthening exercises to be done in both upper and lower limbs. The most important is strengthening of upper extremities as it is needed for independent transfer from bed. Weight and resistance exercises can be applied with dumbbells in bed depending on patient's strength. Shoulder bandages are effective in reducing shoulder pain B) electrical stimulation therapy- electric stimulation is given in case of extreme fatigue while strengthening. The purpose of this rehabilitation period should focus on stability and strength education for sitting and transportation. Functional goals must prepare the patient for movements such sitting up in bed or a wheelchair, dressing and transfers. Initially, the goal is for successful bed movements. ROM and stretching exercises are used for functional activities. Exercises for sitting, balance and strengthening of the upper extremities should be done at the beginning. Patients who can tolerate sitting can begin to push up, with static and dynamic balance training to transfer to the wheelchair. Depending on patient profile wheelchairs, walkers and crutches are used for out of bed transferring of patients. Ideally wheelchair must allow for optimal mobility, protect skin integrity and maintain normal anatomical posture. For paraplegic a manual wheelchair is preferred. Wheelchair dimensions such as

height, width, seat length, back rest and arm support should be customized [13]. Pressure ulcers – pressure ulcer can be seen in both acute and chronic stage. During acute phase sacral and heel ulcers are common. In chronic cases ischial ulcer is common. Prevention strategy during acute stage – a) posture change 2 hourly, b) use of air beds, c) use of pillows and foam wedges to prevent pressure on bony prominences, d) electric stimulation. Once pressure sores develops it needs to be addressed as it can be a source of sepsis as well as impediment to further rehabilitation as well as psychological bearing. The principles of management are a) complete pressure relief, b) best possible nutrition, c) treatment of necrosis or sepsis, d) stimulation of wound granulation, e) surgery.

DVT thromboprophylaxis` 14:

- Compression hose or pneumatic devices should be applied to the legs of all SCI patients for the first 2 weeks: i. Knee or thigh length. ii. Single or sequential chamber compression iii. Effectiveness enhanced in combination with other antithrombotic agents
 - In patients whose thromboprophylaxis has been delayed > 72 hours, testing to exclude DVT should be performed prior to applying compression devices.
 - Active and Passive ROM
 - Elevation of legs
 - Gradient elastic stockings (TED)
 - Electrical Stimulation
 - External Pneumatic compression devices i. Thigh and calf ii. Calf iii. Foot only
 - IVC filter indicated for the following reasons: (note: not a substitute for thromboprophylaxis) i. Failed anticoagulant prophylaxis ii. Contraindication to anticoagulation (active or potential bleeding sites) iii. Complete motor paralysis due to lesions in the high cervical cord difference in Mortality rate (2.5%). 18
 - Use either LMWH or adjusted dose unfractionated heparin within 72 hours after SCI, if no active bleeding, evidence of TBI, or coagulopathy. Continue until discharge with incomplete injury, for 8 weeks in uncomplicated complete SCI, and for 12 weeks with complete SCI with other risk factors.
 - DVT prophylaxis should be instituted within 72 h post injury. (Single study but large difference; therefore suggest strong recommendation with weak data.)
 - LMWH should be held on the

morning of surgery and resumed within 24 h following surgery. (Balance of risks and benefits; strong recommendation, weak data.)

- Reinstitution of DVT Prophylaxis: I). Chronic SCI if they are immobilized with bed rest for a prolonged period of time. ii). Readmitted for medical illness or altered medical condition. iii). Undergoing surgical procedures.

- Education: Patients, family members and significant others should be educated to take prevent measures and to recognize DVTs. Postural hypertension – is seen due to deprivation of sympathetic response leading to venous pooling. The treatment options are –

- a)pharmacological- midodrine, fludrocortisone,
- b)nonpharmacological –regulating salt and water intake, abdominal binders, elastic stocking

Pain –pain causes disruption in daily activities, rehabilitation and return to work. Pain has negative impact on perceived quality of life.

- Pharmacological management- a)antiepileptics- gabapentin, Pregabalin, b)antidepressants-tricyclic antidepressants, selective noradrenaline reuptake inhibitors, c) opiod, d) local anesthetics, e) NMDA antagonist- ketamine

- Non pharmacological- TENS, acupuncture, exercise modalities decrease pain.

Occupational therapy-Occupational therapy

(OT) is a key rehabilitation discipline the goal of which is to assist persons in recovering function and facilitate a return to a productive and fulfilling life after spinal cord injury (SCI). Occupational therapists (OTs) evaluate a wide spectrum of life skills needed to function at home, at work, in school, in the community, and during leisure activities [15] They select specific interventions to address identified patient needs.

Orthosis –crutch, cane, walker etc are used. Gait training- proper gait training is needed to achieve balance. Following methods are used a)pre-ambulation MAT exercises such as rolling, prone on elbow, prone on hand, sitting, b)parallel bar exercises

Chronic rehabilitation period of paraplegia-independent mobilization is the ultimate goal. Wheel chairs, crutches and orthoses are important to provide chronic stage ambulation. House modifications is essential to have independent activities of daily living. Door width and door handles should be adequately modified. Carpets to be removed. There must be ramp at entrance to house. Psychological issues are more prevalent in paraplegics compared to able-bodied individuals. They should be readily identified and addressed. Suicide is the most common cause of death on paraplegics younger than 55 years.

Future options-

- a)exoskeletons – they are currently available and enable paraplegics to walk around. The robotic bodysuit took cues from the user's

brain activity to power his steps forward. It was developed by Brazilian doctor Miguel Nicolelis, , b) stem cell therapy- various studies are going on exploring the use of stem cell in paraplegic. Studies has shown the benefits of it , but most of the studies were poorly executed. c) ephothilone B represents a novel treatment option for spinal cord injuries. It is a anti-cancer drug and has demonstrated cell regeneration in rodents with spinal cord injuries, leading to improvements in motor skills such as balance and coordination [16].

Conclusions

as of now no curative treatment as available for traumatic paraplegia , the only reasonable option is proper rehabilitation. Rehabilitation program should be planned such that there is optimal reintegration in society as quickly and as efficiently as possible.

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