

Functional Independence in Traumatic Spinal Cord Injury Patients with Neuropathic Pain: A Cross-Sectional Study

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^{1,4} Substantial contributions to the conception or design of the work for the acquisition, analysis or interpretation of data for the work. ^{2,3,5,6} Drafting the work or reviewing it critically for important intellectual content, Final approval of the version to be published, ¹⁻⁶ Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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A B S T R A C T

Background: Traumatic spinal cord injury is a severe neurological condition that cause the life-long disability. Impairments are associated with motor and sensory dysfunctions. Central neuropathic pain is a complication after spinal cord injury.

Objective: To find out the functional independence in traumatic spinal cord patients with neuropathic pain.

Methodology: This is descriptive cross-sectional study, which included the sample size of 65 by using WHO sample size calculator as a non-probability purposive sampling technique. The study included paraplegia patients with neuropathic pain after six month of traumatic spinal cord injury with age 25-50 years which included both male and female gender. Other neurological condition that causing the neuropathic pain were excluded from the study. Data analysis was done by using Statistical Package for Social Science.

Results: Out of 65 patients, 70.8% (n=46) were male and 29.2% (n=19) were females. The mean age of subject was 36.62 ± 11.819 years. Descriptive analysis of total score of Spinal Cord Independence Measure III showed with mean 47.77 ± 15.161 and the total score of Self Administrative Lead Assessment of Neuropathic Sign and Symptoms showed with mean 14.88 ± 5.045 years confirming the moderate functional dependence of patients.

Conclusion: The moderate functional independence was found in traumatic spinal cord injury patients with neuropathic pain.

Keywords: Functional Independence, Neuropathic pain, Traumatic spinal cord injury

Introduction

The Traumatic Spinal Cord Injury (SCI) is a severe neurological condition of damaging of tight bundles of cell and nerve, afferent and efferent neurons leading to motor

and sensory dysfunctions with life-long disability¹ SCI is more prevalent in developed and developing countries. The prevalence rate has also been recorded to be 906 per million in the United States of America, 250 per million in the Rhine-

Alpes region of France, and 280 per million Helsinki, Finland. There is also disparity in incidence of SCI across countries, with New Zealand recording the highest incidence of 49.1 per million population, and least incidence of 4.2 per million population in Fiji and Spain respectively. The worldwide impact of SCI is caused by road traffic accidents.^{2,3}

SCI further categorized as Complete SCI with no sensory and motor functions below the level of injury and incomplete SCI means sensory and motor functions are preserved below the level of injury with sacral sparing.⁴ Additionally Injury at the level of cervical spine cause Quadriplegia and at the level of thoracic and lumbar cause Paraplegia.^{1,5}

Among all, Neuropathic pain is due to injury of central and peripheral system. Central neuropathic pain is common in spinal cord injury and secondary complication of spinal cord injury. Pain like burning, tingling, sharp, stabbing, shooting sensations.^{6,7} Person with neuropathic pain is sensitive to touch. Neuropathic pain can occur below, above or at the level of spinal cord lesion. Pain highly alter the quality of life, restricts ADLs and functional independence.⁶ Neuropathic pain characterized by positive and negative phenomena. In positive phenomena includes abnormal painful sensation e.g. tingling, numbness. Negative phenomena means sensory response is deficits in painful area.⁸

The common symptom of neuropathic pain is Hyperesthesia which means increase sensitivity and painful sensation in response to any stimulus. The most common type of hyperesthesia are allodynia and hyperalgesia. Allodynia is a pain caused by a stimulus that does not show a painful response, for example pain in response of light touch.⁹ Hyperalgesia means exaggerated pain response to a stimulus and usually cause pain, for example pain in response of sharp touch. Pain interfere the daily activities and adversely affect the physical, psychological and social functioning.¹⁰

The functions of spinal cord are affected by trauma, inflammation and tumor. Traumatic spinal cord injuries are more common in men than women. SCI more common in young adults. People suffer from spinal cord injury due to road traffic accident, fall from height ,violence, gunshot and due to sports.¹¹ Functional Independence is ability of individual to perform activities of daily living include self-care, respiration management, mobility, transfer, social participation, bowel and bladder skills. Daily living activities are affected and interrupted according to the level of spinal cord injury. Individual with paraplegic have innervations and functions of upper extremity muscle include those for hand functions.^{12,13}

D.Burke et al. (2017) reported the overall prevalence of neuropathic pain was 53%, in acute injury 52%, in chronic injury 55%, at the level of injury 19%, below the level of injury 27%, in paraplegic 46%, in tetraplegia 52%.¹⁴ Additionally, D. Burke et al (2018) and Shoaib et al (2022) concluded the neuropathic pain type and severe pain negatively impact QOL among post SCI patients. However pain interference more than intensity or best type explain the variance in QOL reported.^{15,16} Renne et al. (2023) further supported persistent daily pain and prolonged hospital stays creates extensive risks of functional independence loss for trauma patients after admission.¹⁷ Furthermore, Noreau et al. (2021) found that spinal cord injury patients who reported neuropathic pain causing moderate activity limitations experienced reduced participation in five of twenty-six surveyed activities, whereas those reporting severe pain showed reduced participation in 23 of 26 activities.¹⁸

Most of the work about neuropathic pain in SCI has been done worldwide. But in Pakistan the previous literature not focused about the functional independence in traumatic spinal cord injury patients with neuropathic pain. Therefore, the current study design to help the Physical Therapists to modify the plan of care for SCI patients focusing on functional independency suffering from neuropathic pain.

Methodology

Descriptive cross-sectional study has been conducted after the approval of ethical committee of Lahore College of Physical Therapy (LMDC), **Ref. No. LCPT/ 403**. WHO calculator was used for collecting a sample size of 65 with 0.16 proportion,¹⁶ 0.95% confidence level and 0.03 absolute precision.¹⁹ Data from 65 spinal cord injury patients were collected from Ghurki Teaching and Trust hospital, General hospital, Lahore. Sample of 65 SCI patients were selected with non-probability purposive sampling.

Study included patients with age 25-50 year, who had sustained a traumatic spinal cord injury (paraplegia) within the past 6 months with both male and female participants.¹⁴ SCI patient with other condition that include Traumatic brain injuries, Diabetic neuropathic, Amputation, Multiple sclerosis, Infection and Other neurological diseases which cause the neuropathic pain were excluded.²⁰

After receiving the consent each patient was assessed through the questionnaire including demographic variables, Self-Administered Lead Assessment of Neuropathic Symptoms and Sign (S-LANSS) and Spinal Cord Independence Measure III (SCIM III). S-LANSS was used to identify the neuropathic pain through 7 steps. The total score was 24. Patients with score less than 12 considered with no neuropathic pain while score greater than 12 considered with

presence of neuropathic pain. A Questionnaire was filled by the patients on proper guidance and score will be calculated and result will be predicted. The AUC = 0.89, sensitivity = 88.7, specificity = 76.6 (21, 22)

Spinal Cord Independence Measure III (SCIM III) was used to assess the functional independence in daily life activities. The Questionnaire had 17 steps include the self-care ability, respiration management, sphincter management, balance control, transfer, functional mobility, wheelchair transfer with a total score range was 0-100. The lowest score indicates the high assistance or dependency of patient. The conclusion of study was that extend the clinical benefit and confirm the use of SCIM III among the rehabilitation professionals after they had been trained. The ICC>0.90, kappa values >0.80 and p<0.05 (23).

The statistical analysis of the data was performed based on descriptive statistics, including means, SD, frequencies (%) as the main aim of the study was to describe the characteristics of functional independence and neuropathic pains among the patients with injuries of the spinal cord. There was no inferential statistical test conducted, as the research was not intended to draw a comparison between groups or determine predictive relationships.

Results

The study included 65 patients who had spinal cord injury (SCI). The sample was male dominated, which means that SCI was more prevalent in men of the study group. The patient age distribution was mostly young-to-middle-aged adults who are aged productively and often affected with traumatic SCI Table 1.

The Spinal Cord Independence Measure III (SCIM III), was used to assess the level of functional independence to find differences between disabilities in various domains. On the whole, patients were moderately functionally independent. Self-care abilities were comparatively preserved using the SCIM III subscales when compared with mobility which was more limited. Respiration and sphincter control scores were significantly variable, which indicated that there was heterogeneity in autonomic and respiratory activities of SCI patients. The overall SCIM III score also verified moderate independence in the study group (Table 1).

The S-LANSS questionnaire evaluated neuropathic pain and indicated that neuropathic pain features were prevalent among the SCI patients. Most of the participants experienced sensory symptoms, including burning pain, tingling, prickling, touch sensitivities, which underlines the benefits of neuropathic pain in this group. Less often, patients mentioned such symptoms as changes in skin coloration or the emergence of electric shocks. The total S-LANSS scores

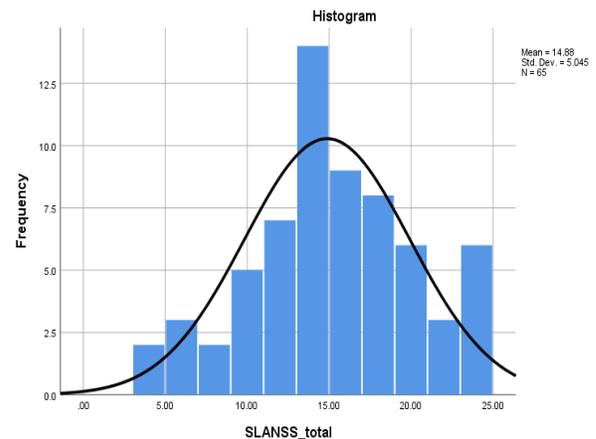
indicate that neuropathic pain is a prevalent and clinically important issue in people with SCI Table 2.

Table 1: Demographic characteristics of the SCI patients:

Variable	Mean ±S.d	Frequency (%)
Age	36.87 ± 8.49	-
Gender	Male	46 (70.8%)
	Female	19 (29.2%)
Self-care	16.45± 3.245	-
Respiration and sphincter management	19.28 ± 8.815	-
Mobility	12.05 ± 5.02	-
SCIM total	47.77 ±	-
	15.161	-

Table 2: Neuropathic pain identified in SCI patients with S-LANSS Questionnaire.

S-LANSS Components	Mean ± SD	Frequency (%)	
		Yes	No
Tingling and prickling sensation	-	51 (78.5%)	14 (21.5%)
Change in colour	-	20 (30.8%)	45 (69.2%)
Sensitive to touch	-	48 (73.8%)	17 (26.2%)
Jumping and bursting	-	20 (30.8%)	45 (69.2%)
Burning pain	-	57 (87.7%)	8 (12.3%)
Gentle rub and feel discomfort	-	50 (76.9%)	15 (23.1%)
Gentle press and feel numbness or tenderness	-	39 (60%)	26 (40%)
Total	14.88± 5.045	-	-



Discussion

The current cross-sectional research was done to identify the functional independence level of traumatic SCI patients with neuropathic pain. The results of this research show that traumatic SCI patients and neuropathic pain patients have moderate functional independence thus indicating that neuropathic pain contributes greatly to the limitation in daily functional functioning.

Post-traumatic neuropathic pain after SCI was identified as a result of malfunctioning of somatosensory pathways which caused abnormal neuronal excitability, central sensitization, and altered processing of sensory information. Such processes may lead to chronic pain, motor control change, muscle inhibition, fatigue, motion avoidance, which may decrease engagement of rehabilitation activities, and impair functional autonomy.²⁴ The chronic pain can also disrupt the concentration, motivation and sleep, which makes the patient even more unable to engage in self-care activities, mobility, and sphincter management.¹⁸ The results of the present study align with those of Burke (2018), who established that, in the absence of pain, patients had the best quality of life (QOL), and both nociceptive and neuropathic pain adversely affected QOL. It was found that neuropathic pain was most strongly related to the decreased QOL and as the severity of pain increased the worse the outcome was regardless of the type of pain.¹² These results indicate the mechanistic rationalization that chronic pain distorts physical and mental functioning, thus restricting autonomy and involvement in everyday operations.

Likewise, Muhammad Idrees et al. (2022) investigated neuropathic pain frequency and effects on rehabilitation outcomes, balance, and QOL of patients with paraplegic and tetraplegic SCI. The results of their study indicated that about two-thirds of SCI patients were affected by neuropathic pain that made a huge difference in terms of rehabilitation and QOL.²⁵ The authors hypothesized that the worse functional outcomes might be driven by pain related movement restriction and less involvement in rehabilitation-related activities. Contrarily, the current study particularly showed that neuropathic pain exerted significant impact on functional independence among paraplegic patients with chronic pain negatively affecting the execution of everyday life functions.

Concurring with these results, Andresen et al. (2016) found out that chronic pain was prevalent in the individuals with traumatic SCI and that the main symptoms were burning, tingling, pins-and-needles sensations, and numbness. The physical health scores of patients with pain were much lower than those with no pain, and a significant number of those with pain exhibited related muscle stiffness and spasms.²⁶ These neuro-muscular deficiencies could also restrain functional autonomy through augmented energy consumption, diminished motor efficiency, and disruption of the coordinated motor activities. Although the research in Andresen et al. involved both patients with paraplegia and tetraplegia, the current study involved paraplegic patients

only, but also showed moderate functional independence among people exposed to neuropathic pain.

A previous clinical trial study by Rita Lacerda et al. (2015) assessed the quality of life of patients with SCI induced neuropathic pain and discovered that the intensity of pain was correlated with impairments in physical functioning and overall QOL. Autonomic dysfunction patients, in this case fecal incontinence, were found to have poorer physical health outcomes, and the experience of pain was found to have an adverse impact on life.²⁷ The results uphold the idea that neuropathic pain interferes with several physiological systems, which leads to impaired independence and functional restrictions. Conversely, in the present study it was found that even with the prevalence of neuropathic pain patients exhibited moderate functional independence with possible differences in the level of injury, access to rehabilitation, or duration of injury.

Although it has clinical significance, this study has a number of limitations. The first limitation of the study is that it was done in one city in Pakistan with a very small sample size, thus limiting the applicability of the results. It needs to involve many centers and larger populations in future research. Second, it included only paraplegic patients, not the tetraplegic, which could be misleading to substantially represent the extent to which neuropathic pain affects functional independence. Third, all the participants were measured at minimum six months after injury however neuropathic pain can be developed or aggravated after 1 year. Hence, longitudinal research involving patients with prolonged injury length in the future is recommended to observe the long-term effects of neuropathic pain on functional independence. Lastly, the research utilized a non-inferential descriptive statistical analysis alone, so no measure was made of creating an association or causal relationship between the severity of neuropathic pain and functional independence. Therefore, a future study based on the inferential statistical test is recommended to establish the correlation between functional independence and neuropathic pain severity include.

Conclusion

The study concluded that the patients who had suffered traumatic spinal cord injury with neuropathic pain showed moderate functional independency on the basis of SCIM scores. The burning, tingling, and touch-sensitive pain have a high prevalence, marking the high sensory impairment of the daily functioning. The results highlight the importance of customized physical therapy programs aimed at the management of pain

and the development of functional capabilities in patients with SCI in order to increase their level of independence.

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