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Case Report

Role of Long Term Epidural Electrical Stimulation for Restoration of Neurological Functions in Patient with Spinal Cord Injury: A Case Report

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Abstract

Background: Spinal Cord Injury (SCI) is a neurological condition, leading to temporary or permanent deficits in sensory and/or motor function below the site of injury. Long Term Epidural Electrical Stimulation (LTEES) of spinal cord is one of the most promising clinical interventions for restoring useful function below to the level of spinal cord injury. We report the case of a patient with quadriplegia, and loss of sphincter function which was successfully restored of neurological functions followed LTEES of spinal cord intervention.

Case Presentation: A 64-year-old man involved in a Road Traffic Accident (RTA), presented with quadriparesis, spasticity, sphincters and sexual dysfunction due to spinal cord injury, decompression and internal fixation of the cervical spinal from C2-C6 were done, followed by rehabilitation and physiotherapy resulted in mild improvement of muscles power at the shoulder girdle mainly on the left side. After 9 months later patient received stem cells injection in India with no benefit. When we examine this patient, he had residual quadriparesis, loss of sphincters function and loss of all modalities sensation blow the level of T4. The patient unable: to control setting position without help, to move both of the upper and lower limbs individually, and to control urine. We performed surgical intervention for this patient and implanted electrode of LTEES of spinal cord around the area of the lesion followed by physiotherapy program. Three months later the patient showed considerable recovery of several functions, move both of the upper and lower limbs, maintain sitting position, control urine. Currently the patient was able to stand-alone without support.

Conclusions: The result of this report demonstrate that neurological functions may be able to restored in individuals SCI patients with surgically-implanted of LTEES.

Keywords: Spinal cord injury; Central Pattern generator; Long term epidural electrical stimulation

Abbreviations: SCI: Spinal Cord Injury; RTA: Road Traffic Accident; MRI: Magnetic Resonance Imaging; LTEES: Long Term Epidural Electrical Stimulation

Background

Spinal Cord Injury (SCI) is a common clinical neurological condition, leading to temporary or permanent deficits in sensory and/or motor function below the site of injury which often results in severe morbidity and disability [1]. It can be caused by direct injury to the spinal cord itself or from compression due to fractured vertebrae or masses such as epidural hematomas or abscesses; also, the spinal cord can be injured due to compromise of blood flow, inflammatory processes, metabolic derangements, or exposure to toxins [2]. More than 90% of SCI cases are traumatic and caused by incidences such as traffic accidents, violence, sports or falls, whereas non-traumatic SCI occurs when an acute or chronic disease process, such as a tumor, infection or degenerative diseases [3]. Another way to categorize SCI according to the extent of the damage to the spinal cord is 'complete' or 'incomplete.' A complete SCI causes permanent damage to the injured area, leading to a total lack of sensory and motor functions below the injury level, it causes paralysis. An incomplete spinal cord injury refers to partial damage to the spinal cord, where the patient has some sensation and motor below the injury level [4,5]. The clinical outcomes of SCI depend on the severity and section of the lesion [6]. Cervical injury account (50%) of SCI with the single most common level affected being C5 and can cause quadriplegia. Other injuries include the (35%) thoracic injury (11%) lumbar injury [7]. Potential treatments for SCI are categories into

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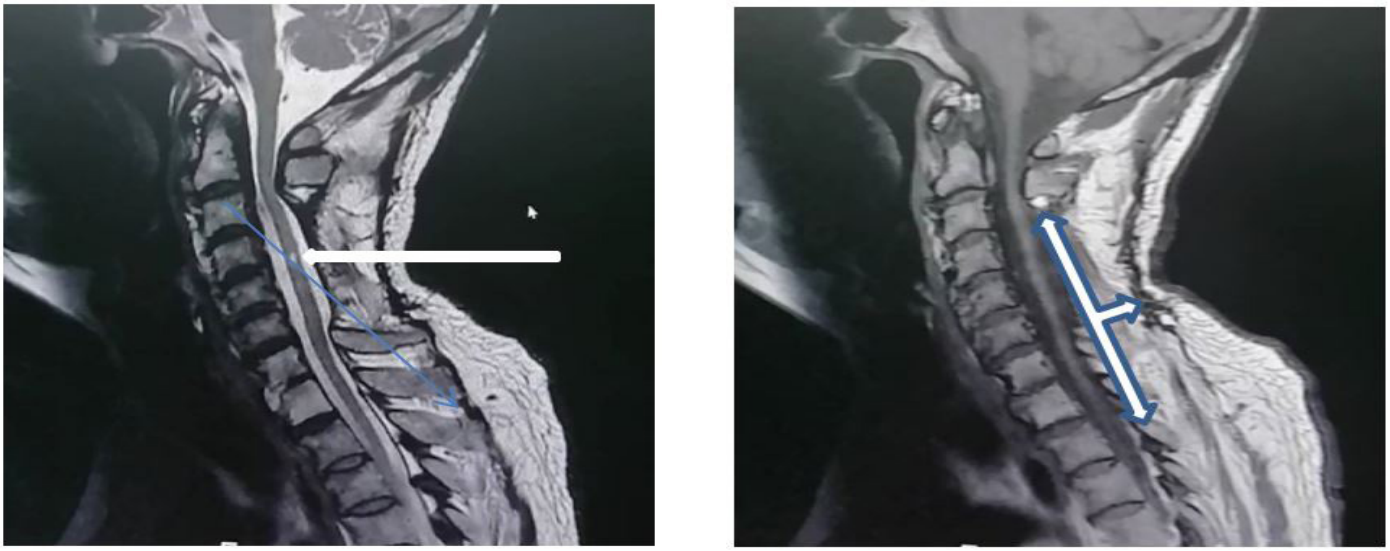

Figure 1: Magnetic resonance imaging of the spinal cord demonstrating.
(A) area of the lesion (myelomalacia) (B) area of the decompression (laminectomy)

three interventions (1) pharmacological agents that prevent the secondary damages and stabilize the injured spinal cord during the post-traumatic spinal shock, (2) gene and cell therapy to stimulate neurodegeneration at the site of lesion, and (3) electrical stimulations to reactivate central pattern generators and enhancement of the neuroplasticity [8]. Long Term Epidural Electrical Stimulation (LTEES) of spinal cord is one of the most promising clinical interventions for improving health and restoring useful functions below to the level of spinal cord injury [9,10]. In this report we demonstrate the role of long term epidural electrical stimulation of spinal cord for restoration of neurological function in patient with spinal cord injury.

Case Presentation

Patient's relevant demographic details and medical history

We report the case of a 64-year-old Sudanese man was admitted to our hospital with quadriparesis, spasticity, sphincters and sexual dysfunction. Patient had been involved in a Road Traffic Accident (RTA) on 27.04.2017 in Saudi Arabia, resulted in cervical injury due to spinal cord compression, quadriplegia, and loss of sphinctesr function. Magnetic Resonance Imaging (MRI) showed multiple disc prolapses from C2-C6 with spinal canal stenosis and myelopathy (figure 1). At that time decompression and internal fixation of the cervical spinal from C2-C6 was performed, after that patient had quadriplegia with spasticity, complete sensory loss blew the level of the lesion, sphincters and sexual dysfunction, flowed by rehabilitation and physiotherapy resulted in mild improvement of muscles power at the shoulder girdle mainly on the left side. Nine months later patient received stem cells injection in India with no benefit. After the accident the patient also underwent colostomy due to abdominal injury. When we examine this patient, he had residual quadriparesis with power of 3/5 in upper limbs, left leg power about 2/5, right leg power 0/5, he had loss of sphincters function and loss of all modalities sensation blow the level of T4. The patient unable to control setting position without help, unable to move both of the upper limbs individually, unable to move both of the lower limb individually and unable to roll his body individually. We performed surgical operation for this patient to implant electrode for LTEES around the area of the lesion followed by physiotherapy program. Three months later the patient showed considerable improvement of the power in his arms 4/5, patient can maintain sitting position for long period, patient can move both of the upper limbs voluntary and can raise both of them above 90 degrees, patient can roll himself from supine to prone position, stand with support (walker) and maintain his full body weight on his legs and control urine for a long period which could be 6 hours. Initially patient had a good sensation with all of his body except the sole of foot, stand-alone without support and gait training to regain balance and walking. We discussed this study with our patient and his family to avoid any ethical issues and he agreed to be enrolled in this study by verbal (video) and written informed consent.

Discussion

The possibility of restoring neurological functions after complete paralysis in patient with spinal cord injury becomes an important issue, because most of the cellular structure below the lesion remains intact and can actually control very complicated movements when this spinal network receives the appropriate sensory input, and stimulated with epidural placed electrodes [11]. To examine this issue, we performed this case report to evaluate the role of LTEES for restoration of neurological functions in patient with spinal cord injury. Prior to the stimulation treatment, the patient was unable to control setting position, to move both his upper and lowers limbs, and to roll his body individually. A series of observations were done to demonstrate the feasibility of using LTEES to facilitate the recovery of neurological functions, as well as other functions such as autonomic control after implanted an electrode for this patient. After the first three-month stimulation period recovery of several functions occurred (move both of the upper and lower limbs, maintain sitting position , control urine) in agreed with previous case reports , In 2011 a case report in England showed that a person with a clinically motor complete SCI could voluntarily move his legs again with surgically-implanted of EES [11], another case report in United States conducted in three patients with motor-complete SCI demonstrated that voluntary leg movement and standing was indeed achievable in the presence of EES [12,13]. In this patient the voluntary control of bladder function was recovered, in agreement with previous report showed the restoration of autonomic function after EES of spinal cord in patient with SCI [14]. Currently the patient was stand-alone without support similar to a case report also located in the United States, within two weeks of implanted electrode for EES the patient with SCI eventually was

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able to voluntarily walk [15]. Based on the outcomes of this report, it can be said that LTEES of spinal cord had the ability to produce positive changes in this patient, the underlying mechanism responsible for these changes that this intervention enhanced central pattern generation (neuronal networks located in the spinal cord) and enhancement of the neuroplasticity.

Conclusion

In conclusion, the result of this report demonstrate that neurological functions may be able to restored in individuals SCI patients with surgically-implanted of LLTEES, because it is a case report, this study is limited. Further studies involving larger numbers of cases should be conducted.

Acknowledgements:

Not applicable.

Consent:

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Competing Interests:

No competing interests.

Authors' Contributions

1. Khalid Mohammed Coco: examined the patient: performed clinical assessments and intervention, drafted manuscript
2. Halima Babikir Eltahir: performed an additional literature, edited and revised manuscript

All authors contributed to, read and approved the final version of the manuscript.

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