"ELECTRICAL SHOCK INJURY BEYOND BURNS: NEUROLOGICAL INVOLVEMENT AND REHABILITATION INSIGHTS FROM A CASE REPORT"

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Abstract:

Electrical burns were among the most severe forms of trauma, often causing deep tissue destruction, multisystem involvement, and significant morbidity. This case report described the clinical presentation, diagnostic evaluation, and multidisciplinary management of a 35-year-old male who sustained a high-voltage electric shock followed by a fall from an electric post. The patient presented with second-degree burns (25% TBSA), respiratory distress, and bilateral limb weakness. Imaging revealed cervical spine injury with mild cord contusion. After emergency resuscitation and surgical stabilization, a structured physiotherapy regimen was initiated on Day 7, including respiratory rehabilitation, neuromuscular strengthening, postural re-education, and functional mobility training. After six days of intensive therapy, the patient showed marked improvements in respiratory function, motor coordination, balance, and hand function, along with progressive wound healing. This case highlighted the importance of early, individualized physiotherapy within a coordinated multidisciplinary framework to optimize functional recovery and reduce long-term disability in electrical burn injuries with associated spinal trauma.

Keywords: Electrical burn injury, cervical spine injury, physiotherapy rehabilitation, multidisciplinary management, deep tissue damage, neuromuscular recovery, case report.

Introduction

Electrical burns were considered among the most devastating forms of burn injury, often resulting in deep tissue destruction, significant morbidity, and delayed physiological and functional sequelae[1]. Unlike superficial thermal injuries, electrical trauma penetrated multiple tissue layers and had the potential to cause multisystem involvement, including cardiac, neurological, musculoskeletal, and visceral organ damage, with possible fatal outcomes [2].

The incidence of electrical burns varied internationally, ranging from approximately 0.04–5% of admissions to burn units in developed countries to up to 27% in developing regions [3]. These injuries predominantly affected adult males, were commonly occupational in nature, and constituted a major cause of work-related mortality [4].

Electrical burn injuries resulted in both short-term impairments and long-term functional disability[5] Early mortality was frequently linked to ventricular fibrillation, asystole, respiratory arrest due to neuromuscular paralysis, or secondary trauma such as spinal or head injuries sustained during falls[6].

Although advancements in emergency care and surgical intervention improved survival, electrical injuries still carried a substantial fatality risk. Preventive measures and strict workplace safety regulations remained the most effective strategies[7].

This case report described the clinical features, diagnostic findings, and multidisciplinary management of a 35-year-old male who sustained a high-voltage electric shock followed by a fall from height, resulting in second-degree burns and cervical spinal involvement.

Case report:

A 35-year-old male, Mr. Kumar, sustained a severe electric shock followed by a fall from an electric post. He presented to the Government Medical College Hospital, Pudukkottai, with:

- Sudden electric shock
- Injuries resulting from the fall, including significant neck trauma
- Second-degree burns to both upper and lower limbs
- Marked respiratory distress.

On admission to the Trauma Emergency Ward (TAEI), immediate resuscitation was initiated. Intravenous fluids were administered to manage acute shock. The patient regained hemodynamic stability following intervention. Capillary refill at the fingertips was normal. Sensation to touch and pressure was markedly reduced, and movements were painful. On

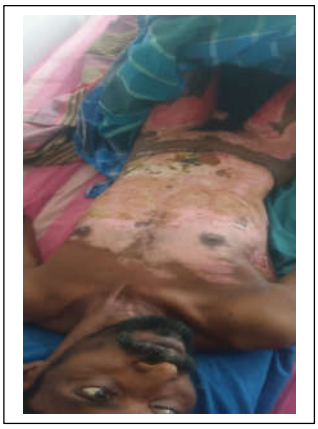
admission, the patient's vital signs indicated hypotension and mild hypoxia, with a blood pressure of 70/45 mmHg, pulse rate of 76 beats per minute, oxygen saturation of 89%, and a Glasgow Coma Scale score of 11/15.

Following stabilization, he was transferred to the Post-Burns Ward. The burns were confirmed as second-degree, involving 25% of TBSA, affecting both hands, hips, and the gluteal region. Wounds were managed with liquid paraffin dressings, and the patient was closely monitored.

Laboratory reports showed a markedly elevated creatine kinase level (12094 U/L). Troponin T was normal. ECG demonstrated sinus tachycardia.

During hospitalization, the patient reported bilateral limb weakness. Neurology and neurosurgery consultations were obtained. MRI and CT imaging confirmed a cervical spine injury with mild cord contusion. Motor strength was graded 3/5 in the upper limbs and 4/5 in the lower limbs, with preserved bladder and bowel control and mild numbness.

Figures of the patient.



Intervention and Rehabilitation Protocol

Daily wound care and medical management were administered. After one week of medical and surgical stabilization, the plastic surgery team referred the patient for physiotherapy and rehabilitation. Physiotherapy intervention commenced on Day 7 post-admission, beginning with a comprehensive assessment used to structure an individualized treatment plan.

Physiotherapy Management

The rehabilitation program focused on respiratory optimization, neuromuscular recovery, postural stability, and functional mobility. After one week of medical and surgical stabilization,

the patient was referred physiotherapy, which commenced on Day 7 post-admission. A comprehensive assessment guided the development of an individualized rehabilitation program that targeted respiratory optimization, neuromuscular strengthening, postural control, and functional mobility[8]. Respiratory exercises included diaphragmatic breathing, local chest expansion techniques, and incentive spirometry to improve lung capacity and prevent pulmonary complications[9]. Neuromuscular rehabilitation involved active upper and lower limb exercises along with progressive strengthening, while maintaining cervical spine stability using a hard collar. Postural and functional training encompassed supported sitting and standing balance exercises, gradual gait progression, and context-based mobility tasks to enhance coordination and independence in daily activities[10]. This integrated approach aimed to promote early mobilization, restore functional capacity, and prevent secondary complications such as contractures, muscle weakness, or deconditioning[11].

Outcome

After six consecutive days of daily physiotherapy:

- Hand function improved significantly
- Respiratory capacity enhanced
- Balance and coordination improved
- Progressive wound healing observed

Burn surfaces showed progressive healing, and the patient was discharged with home-exercise guidance and instructed to return for review after 15 days.

Discussion

Electrical burns differ from thermal burns due to deeper tissue destruction, neuromuscular disruption, and potential cardiac and respiratory complications. Physiotherapy plays a crucial role throughout the continuum of care.

Management of complex electrical burns with spinal involvement requires a coordinated, multidisciplinary approach. In our patient, prompt resuscitation, careful wound care, surgical/plastic-surgical management, neurologic assessment and imaging, along with nutritional and nursing support, stabilized the acute injury and prevented early complications. A comprehensive burn-care team — including surgeons, intensivists, nurses, and physiotherapists — remains essential to address the various aspects of electrical-burn trauma and associated

neuromuscular injury (e.g., deep tissue damage, spinal cord contusion, risk of contractures, respiratory compromise)[9].

Physiotherapy, initiated early in the hospitalization course, played a central role in our patient's recovery. Evidence supports that early physiotherapy (including mobilization, respiratory care, joint positioning, and range-of-motion exercises) reduces the risk of contractures, improves muscle strength and aerobic capacity, and enhances overall functional outcomes in burn survivors[12]. In particular, structured chest physiotherapy and early mobilization help preserve pulmonary function and prevent complications, while exercise-based interventions aid neuromuscular recovery and support return to function (mobility, hand function, ADLs) [11].

This case demonstrated that, despite severe burns and spinal involvement, early initiation of a tailored physiotherapy program — combining respiratory exercises, neuromuscular strengthening, posture management, and functional mobility training coincided with marked improvements in respiratory capacity, limb coordination, balance, hand function, and progressive wound healing. These outcomes echo findings in burn-rehabilitation literature that early and integrated physiotherapy supports physical recovery and reduces long-term disability[13].

In light of this, a multidisciplinary model including physiotherapy from the earliest possible stage should be considered standard in burn care, especially in complex electrical burns with neurological involvement. Early, individualized rehabilitation — embedded within acute wound care, surgical management, and neurological stabilization — is likely to optimize functional recovery and minimize long-term morbidity.

Studies emphasize that delayed or inadequate rehabilitation in electrical burn cases can lead to long-term disability, impaired hand function, chronic neuropathic pain, and reduced participation in daily activities. Therefore, structured, progressive, and individualized physiotherapy is essential in optimizing outcomes and preventing secondary complications.

Conclusion

This case illustrates coordinated multidisciplinary care, including emergency stabilization, accurate diagnostic evaluation, wound management, nursing care, nutritional support, and timely physiotherapy can significantly improve recovery trajectories in complex electrical burn injuries with spinal involvement. The patient achieved positive functional outcomes due to comprehensive and well-timed intervention.

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Authors' Contributions

All authors made substantial contributions to the study, including the conception or design of the research; the acquisition, analysis, and interpretation of data; and the drafting or critical revision of the manuscript for important intellectual content. All authors reviewed and approved the final version of the manuscript and agreed to take public responsibility for the accuracy and integrity of all aspects of the work.

Competing Interests

The authors declare no financial, legal, or political conflicts of interest involving any third parties (including government agencies, private companies, or foundations). This applies to all aspects of the submitted work, including but not limited to funding or grants, advisory roles, study design, data analysis, and manuscript preparation.

Ethical

This case report describes the clinical course and management of a single patient and does not involve any experimental intervention or prospective research. In accordance with the policies of our institution, formal Ethics Committee approval was not required for the publication of an individual case report. The study was conducted in compliance with the ethical principles outlined in the Declaration of Helsinki.

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