ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25oct255

Integrated Multimodal Therapy for Postural Orthostatic Tachycardia Syndrome in a Patient with Spinal Cord Injury: A Clinical Case Report

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Publication Date: 2025/10/10

Abstract:

- ***Background***

Postural Orthostatic Tachycardia Syndrome (POTS) involves excessive heart rate increase upon standing, exacerbated by autonomic dysfunction. Spinal cord injury (SCI) disrupts autonomic regulation, complicating POTS management. This case report explores a multimodal intervention for a 54-year-old male with C5-level SCI and worsening POTS symptoms.

- ***Case Presentation***

The patient, 18 months post-traumatic SCI, presented with severe dizziness, palpitations, and fatigue exacerbated by upright postures. Vital signs showed increased heart rate on standing with stable blood pressure. Diagnostic tests confirmed POTS with autonomic dysfunction, ruling out orthostatic hypotension and cardiac arrhythmias.

- ***Management***

A multidisciplinary approach included pharmacological management (fludrocortisone, baclofen, clonazepam, Metoprolol), diet and fluid adjustments (increased water intake, small frequent meals), and physical therapy. Physical interventions comprised tilt table training, muscle contractions, negative pressure breathing, and psychosocial support (progressive muscle relaxation, mindfulness, sleep management).

- ***Results***

Post-intervention, the tilt table test showed no significant heart rate increase. The Orthostatic Intolerance Questionnaire scores improved from 37 to 12, indicating enhanced orthostatic tolerance. PROMIS scores showed better general health and reduced pain, while anxiety and depression scores improved from abnormal to near-normal levels. These outcomes reflect significant advancements in managing POTS and overall well-being.

- ***Conclusion***

The multimodal intervention effectively managed POTS in the context of SCI, highlighting the importance of a tailored, integrative approach. This case underscores the need for further research to refine multimodal strategies for complex autonomic disorders.

Keywords: *Postural Orthostatic Tachycardia Syndrome, Spinal Cord Injury, Multimodal Intervention, Tilt Table Test, Physical Therapy.*

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How to Cite: Dr. Pragati Chawla; Dr. Yashodhan Chaughule (2025) Integrated Multimodal Therapy for Postural Orthostatic Tachycardia Syndrome in a Patient with Spinal Cord Injury: A Clinical Case Report. *International Journal of Innovative Science and Research Technology*, 10(10), 353-358. https://doi.org/10.38124/ijisrt/25oct255

I. INTRODUCTION

Postural Orthostatic Tachycardia Syndrome (POTS) is a prevalent disorder characterized by an excessive increase in heart rate upon standing, accompanied by symptoms of orthostatic intolerance. Whereas spinal cord injury (SCI) is a serious and often life-altering condition that results from traumatic or non-traumatic damage to the spinal cord. Spinal cord injury disrupts the autonomic nervous system, potentially leading to autonomic dysreflexia, orthostatic hypotension, and other cardiovascular dysregualation. The prevalence of POTS specifically can range between 20-30% in some studies of SCI populations. For instance, Miller et al. (2016) reported that about 25% of SCI patients demonstrated symptoms consistent with POTS. The autonomic dysfunction inherent in SCI can complicate the diagnosis and management of POTS, as symptoms may overlap or be attributed solely to SCI.

II. CASE DESCRIPTION

- Age- 54
- Gender – Male
- Medical history-The patient sustained a traumatic spinal cord injury at the c5 level 18 months back, resulting in quadriplegia. He has history of occasional episodes of orthostatic hypotension.
- Presenting complaints- The subject came to Smt Sindhutai Vitthalrao Vikhe Patil Spinal Cord Injury Rehabilitation Centre, at loni with chief complaints of severe dizziness, palpitations, and fatigue, primarily when transitioning from a lying to a sitting or standing position. These symptoms had worsened over the past six months, leading to the significant limitations in daily activities.
- Clinical findings-The patient presented with a resting heart rate of 74 bpm and blood pressure of 130/80 mmHg in the supine position. Upon standing on tilt table, the heart rate elevated to 130 bpm within 10 minutes with minimal changes in blood pressure.
- Diagnostic Assessments-The tilt table test showed a heart rate increase of ≥30 bpm within 10 minutes of standing or head-up tilt without orthostatic hypotension. Autonomic function tests revealed impaired sympathetic function below the injury level, consistent with spinal cord injury. Routine blood tests were normal, ruling out anemia and electrolyte imbalance, and the ECG did not indicate heart disease or arrhythmias.
- Diagnosis-The 54 year male subject is a diagnosed case of Postural Orthostatic Tachycardia Syndrome (POTS) associated with impaired sympathetic function due to spinal cord injury.

III. INTERVENTION

Other than the Generalised management for spinal cord injury with respect to Patients neurological assessment, this report focuses on POTS specific multimodal management.

A. Pharmacological Management

Table 1 Pharmacological Management

Drug	Dosage	Rationale
Pyridostigmine	30mg tdsx 15days	Enhances sympathetic ganglionic transmission
Fludrocortisone	0.2 mg od x 8 days	To increase plasma volume (during this subject was monitored for Hypokalemia)
Metoprolol	12.5mg bd x 1 month	To reduce upright tachycardia

B. Diet and Fluid Management

Subject was encouraged to have 3 L of water daily and a salt intake of 8 to 12 g daily. Eating small meals has been told to patient, instead of having large 2 meals, he was asked to split the meals into small ones [as eating small meals have been reported to reduce the postprandial hypotension, because the amount of blood required for digestion is reduced.] Patient was suggested to have complex carbohydrates with a low glycemic index, which provide sustained energy without causing significant blood sugar spikes. Strict avoidance on caffeine and alcohol as they are found to be the triggers for POTS.

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B. Physical Therapy – 4 Weeks Protocol

Table 2 Week 1 Protocol

Therapy	Dosage	Rationale
Tilt table maneouver	up to 60 degees	It provides graded orthostatic training by gradually increasing the angle of tilt over time
Physical Counter Measures -		
Squeezing a rubber ball	10 reps x 3 sets (Twice a day)	Causes static or rhythmic muscle contraction to increase mean arterial pressure and prevent orthostatic intolerance or syncope.
Leg Crossing and Skeletal Muscle Activation	10 reps x 10 secs hold (Twice a day)	Restoration of venous return and prevent venous pooling in orthostatic intolerance
Cough Cardiopulmonary Resusication (While the patient is in upright posture on tilt table)	5 reps x 2 sets (Twice a day)	It acutely elevates mean arterial pressure to prevent syncope in patients experiencing dizziness upon assuming an upright posture by improving cerebral perfusion and stabilizing hemodynamics.
Negative Pressure Breathing Maneouver (Breathe through Inspiratory Impedance Threshold Device)	5 reps x 2 sets (Twice a day)	The intrathoracic pressure (ITD) increases central blood volume by causing the thoracic muscles to generate a more negative pressure within the chest cavity. This negative pressure effectively pulls venous blood from outside the thorax into the heart and lungs, which enhances venous return. As a result, cardiac output and stroke volume rise, improving overall blood circulation.
Intervention for psychological agents -		
Progressive Muscle Relaxation	Twice a day for 4 weeks	Gradually tensing and relaxing muscle groups can help reduce physical tension and promote relaxation.
Meditation and Mindfulness		Helps to focus and concentrate, reduces stress and improve overall well-being.
Sleep Management (Consistent 8 hours sleep was advised and monitored)		Maintaining a regular sleep routine affects positively on sympathetic nervous system.

➢ *WEEK 2*

- Tilt table manoeuvre – Progressively increased the degrees of inclination up to 180 degrees at the end of 3rd week.
- Physical counter measures – continued as it is as in week one.

➢ *WEEK 3 & 4*

- With the start of 4th week subject was well sustained to upright posture without any symptoms of tachycardia.
- And during this week wheelchair activities were encouraged.

Table 3 Week 3 & 4 Protocol

Therapy	Dosage	Rationale
Wheelchair Activities		
Transfer Techniques including Sitting on a Wheelchair	At the start of 4th week 30 to 45 mins. At the end of 4th week 60 to 90 mins.	Sitting reduces the effects of gravity on blood flow, which enhances venous return to the heart and consequently increases cardiac filling pressure, stroke volume, cardiac output, and mean arterial pressure.
Wheelchair Aerobics	Thrice a week	Helps to promote circulation and prevent blood pooling, crucial for managing POTS symptoms.

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IV. OUTCOME MEASURES

Primary outcome measure was tilt table test and another were Orthostatic intolerance Questionnarie, Hospital anxiety depression scale, PROMIS (Patient reported outcome measurement information system).

Table 4: Shows Detailed Pre-Treatment & Post-Treatment Outcomes

Sr. No	Outcome Measures	Pre - Intervention Findings	Post - Intervention Findings
1	Tilt Table Test	Increase in heart rate by 56 bpm	Increase in heart rate by 6 bpm
2	Orthostatic Intolerance Questionnaire a. Orthostatic intolerance daily activity cannot do for reason (SCI) b. Orthostatic intolerance symptom assessment	----	----
		37/ 60	12/ 60
3	Hospital Anxiety Depression Scale	Anxiety –14 Depression –12 (Abnormal)	Anxiety –7 Depression –6 (Near normal)
4	PROMIS	General Health – 20/100 Pain – 5/10	General Health – 52/100 Pain – 4/10

V. RESULTS

The findings from the tilt table test and related assessments illustrate a considerable improvement in the patient's condition. The tilt table test done post intervention indicated no significant orthostatic changes or heart rate elevations, which suggests effective stabilization or improvement in managing the patient's orthostatic issues. The Orthostatic Intolerance Questionnaire revealed a dramatic reduction in symptoms, with scores decreasing from 37 to 12, signifying a substantial enhancement in orthostatic tolerance. Additionally, PROMIS scores showed notable improvements in general health perception and a slight reduction in pain, indicating better overall well-being and pain management. Mental health assessments also demonstrated significant progress, with anxiety and depression scores improving from abnormal to near-normal levels. Collectively, these results highlight significant advancements in the patient's orthostatic intolerance, mental health, and overall health and pain levels following the intervention.

Fig 1: Pre Intervention

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25oct255

Fig 2: During Intervention
(Start of 4th week)

VI. DISCUSSION

This case report illustrates a successful multimodal intervention for Postural Orthostatic Tachycardia Syndrome (POTS) in a patient with a C5-level spinal cord injury (SCI), emphasizing the intricate relationship between autonomic dysfunction due to SCI and POTS. The patient's significant improvement post-intervention underscores the need for a comprehensive, multidisciplinary approach.

The results align with the findings of Olshansky et al. 2020, who emphasize the critical need for personalized treatment plans for POTS, particularly in the context of complex comorbidities such as SCI. Their assessment highlights that a tailored, multidisciplinary approach is essential for managing POTS effectively in patients with additional autonomic dysfunction.[1] The physical countermeasures employed in this case such as muscle contractions and negative pressure breathing are supported by Qi Fu and Levine 2018, who advocate for exercise and non-pharmacological treatments as adjuncts to pharmacological therapy. Their research supports the use of such interventions to improve orthostatic tolerance by enhancing cardiovascular function and reducing symptoms of autonomic instability. [2]

The tilt table test findings, showing no significant heart rate elevation upon standing after treatment, corroborate the efficacy of graded orthostatic training in enhancing autonomic regulation. This aligns with studies demonstrating that gradual upright posture training improves cardiovascular stability in POTS patients. [3] The inclusion of physical counter measures such as muscle contractions and negative pressure breathing supports findings that these techniques effectively counteract orthostatic intolerance by improving venous return and central blood volume.[4]

Pharmacological management, including fludrocortisone and beta-blockers, addressed the physiological aspects of POTS, consistent with current guidelines recommending these agents for symptom control. [5] The addition of dietary modifications and fluid management reflects evidence suggesting that increased fluid intake and smaller, frequent meals can alleviate POTS symptoms by optimizing blood volume and reducing postprandial hypotension. [6] The psychosocial component of the intervention incorporating progressive muscle relaxation and mindfulness likely contributed to the observed improvements in anxiety and depression, as supported by literature emphasizing the role of stress reduction in managing chronic conditions. [7] The improvement in PROMIS scores highlights the positive impact of these interventions on overall well-being and pain management.

VII. CONCLUSION

This case highlights the need for a customized, integrated approach to managing Postural Orthostatic Tachycardia Syndrome (POTS) in patients with spinal cord injury (SCI). The positive outcomes not only confirm the effectiveness of the intervention but also suggest that further research should focus on refining multimodal strategies for similar complex cases. Such approaches could improve clinical practice by offering more comprehensive

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25oct255

management options for patients with overlapping autonomic disorders.

VIII. CLINICAL IMPLICATION

Impact on practise: Clinicians should consider adopting a multimodal approach for treating POTS, incorporating pharmacological, physical, and lifestyle interventions. This holistic strategy can enhance patient outcomes by addressing various aspects of the condition. Emphasis on Physical Therapy: The positive outcomes from physical therapy interventions suggest that physical therapists should be integral to the management of POTS in SCI patients. Structured exercise programs and rehabilitation should be a standard part of treatment protocols. Future expansion: Future studies should explore the detailed effects of various physiotherapy interventions on POTS. Researchers could investigate different types of exercises, duration, intensity, and their specific impact on autonomic function and symptom management. Expand the study to include a larger cohort of patients with POTS and SCI to validate the findings and refine treatment protocols. This can provide a more comprehensive understanding of the multimodal approach.

- Declaration by Authors:-
- Source of Funding: No funding sources
- Conflict of Interest: The authors declare no conflict of interest
- Informed Consent: Informed consent was obtained from the patient
- Ethical Approval: The study was approved by the Institutional Ethical Committee

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