Respiratory Physiotherapy in Patients with Spinal Cord Injury: A Systematic Review

Sakshi Patwa¹, Dr Sambhaji Gunjal²

¹(Intern), Dr APJ Abdul Kalam College of Physiotherapy, Loni Maharashtra, India
²Associate Professor, Dept. of cardiorespiratory Physiotherapy Dr APJ Abdul Kalam College of Physiotherapy, Loni Maharashtra, India.

ABSTRACT

Background: A spinal cord injury is a trauma or lesion to the spinal cord, which is made up of white matter (ascending and descending tracts) and grey matter (sensory neuron and motor neuron). It causes muscle paralysis and affects sensory abilities and other bodily processes below the level of the injury. Between 2,50,000 and 5,00,000 people worldwide experience spinal cord injuries each year, according to the WHO. In India, the prevalence of SCI is 0.15 million, with an average yearly incidence of 15,000 cases.

Objective- To study the effect of respiratory physiotherapy in spinal cord injury patients.

Method: A Systematic review according to PRISMA guidelines was conducted on 20 articles through different databases like PubMed, google scholar which were identified, sorted and screened according to the inclusion criteria and exclusion criteria post which the studies were assessed for quality.

Result: Data from the selected studies were extracted under the headings of title /author, type of study design, intervention /device /technique elaborated in the study, and key highlights of the study and was tabulated systematically.

Conclusion: This study concludes that respiratory physiotherapy improves respiratory muscle strength and function in SCI Patients.

Key words: respiratory physiotherapy, spinal cord injury

INTRODUCTION

A spinal cord injury is a trauma or lesion to the spinal cord, which is made up of white matter (ascending and descending tracts) and grey matter (sensory neuron and motor neuron). It causes muscle paralysis and affects sensory abilities and other bodily processes below the level of the injury¹. Spinal segments T4–T11 supply the principal muscle of active expiration, the abdominals, while the phrenic nerve (spinal segments C3–C5) supplies the primary muscle of inspiration, the diaphragm. Between 2,50,000 and 5,00,000 people worldwide experience spinal cord injuries each year, according to the WHO². In India, the prevalence of SCI is 0.15 million, with an average yearly incidence of 15,000 cases⁴. Individuals with cervical cord lesions have mortality rates that are 9–18 times greater, respectively, than those in the general population for the same age.¹⁵
When examining SCI from the perspective of respiratory dysfunction, it helps to think of the condition in two stages: (1) the acute phase that occurs right after the injury and lasts for a year, and (2) the chronic phase that lasts for the remainder of the affected person's life. Damage to the phrenic motor neurons (C3, 4, and 5) or above results in nearly total paralysis of the breathing muscles, necessitating phrenic nerve stimulation or artificial ventilation. People with long-term SCI frequently experience hypertension, and those who are paraplegic are more likely to experience it than those who are quadriplegic. Compared to individuals without spinal cord injuries, persons with SCI—particularly those who have paraplegia—had a higher prevalence of hypertension, according to earlier research. Following SCI, a sedentary lifestyle is linked to the development of hypertension. An increased risk of hypertension following SCI can also be caused by other risk factors, including age, smoking, diabetes, obesity, and high cholesterol.

The management techniques used in physiotherapy include postural drainage and secretion clearance procedure. Abdominal binders, positioning, deep breathing exercises, glossopharyngeal breathing, diaphragmatic breathing, thoracic expansion exercises, incentive spirometry, balloon blowing exercises, cough assisted techniques, and inspiratory muscle training are among the treatments used to improve ventilation.

MATERIALS AND METHODS

Study design: Systematic review

Study Setting: DR. APJ Abdul Kalam College of Physiotherapy

Study Duration: August 2022 to January 2024

Sample Size and Method: Approximately 40.

Participants: Spinal cord injury patients.

Selection Criteria

The Inclusion criteria of the study were -full text articles, articles which are referred from last 13 years, cross sectional study and observational study, Systematic review, Case studies, Randomize control trial, Metaanalysis.

The exclusion Criteria of the study were -Duplicate articles, Articles with only abstracts, Articles in other languages

Procedure: Several articles from pubmed google scholar databases were reviewed the following keywords: pulmonary function in obese female, impact of obesity on pulmonary function, lung function in obese female were used studies that were completed and published in english focusing on respiratory physiotherapy in SCI patients were selected.
**Data analysis and results**

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>STUDY DESIGN</th>
<th>TREATMENT STRATEGIES</th>
<th>OUTCOME MEASURES</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Xiao-Ying Zhang, Wei-Yong Yu et al.</td>
<td>Randomized controlled trial</td>
<td>Vocal respiratory training</td>
<td>Forced vital capacity, Peak expiratory flow, Respiratory neural plasticity, Dyspnea sores</td>
<td>This study indicated that VRT - MT can improve respiratory function and vocal function in patients with CSCI and that the neural regulation mechanisms of the respiratory center can be used as an effective basis for behavioral therapy.</td>
</tr>
<tr>
<td></td>
<td>Authors</td>
<td>Study Type</td>
<td>Intervention</td>
<td>Outcomes</td>
</tr>
<tr>
<td>---</td>
<td>---------</td>
<td>------------</td>
<td>--------------</td>
<td>----------</td>
</tr>
<tr>
<td>2.</td>
<td>Kang D, Park J, Eun SD et al.</td>
<td>Feasibility study</td>
<td>Game based respiratory muscle training</td>
<td>Respiratory muscle strength, Feasibility(adherence), Quality of life, Game engagement</td>
</tr>
<tr>
<td>3.</td>
<td>Kinjal Parmar, Sambhaji Gunjal et al.</td>
<td>Interventional study</td>
<td>Manually assisted cough technique</td>
<td>Baseline peak cough flow(PCF), Post-intervention PCF, Changes in PCF, Quality of life.</td>
</tr>
<tr>
<td>4.</td>
<td>Ramzi Alajam et al.</td>
<td>Systematic Review</td>
<td>Body Weight–Supported Treadmill Training</td>
<td>Vital capacity, Inspiratory capacity.</td>
</tr>
<tr>
<td>5.</td>
<td>A. William Sheel et al.</td>
<td>Systematic review</td>
<td>Exercise training, inspiratory muscle training</td>
<td>Respiratory function, Exercise capacity, Quality of life</td>
</tr>
<tr>
<td>6.</td>
<td>Gee CM, Williams AM et al.</td>
<td>Interventional study</td>
<td>Respiratory muscle training</td>
<td>Cardiopulmonary function, Exercise capacity.</td>
</tr>
</tbody>
</table>
### DISCUSSIONS

This systematic review is primarily aimed to provide an overview of effect of respiratory physiotherapy in SCI patients. The findings of this review has been drawn from the above summarized 10 articles, which had information on effect of respiratory physiotherapy in SCI patients.

<table>
<thead>
<tr>
<th>7. Berlowitz DJ, Wadsworth B, Ross J et al.</th>
<th>Observational study</th>
<th>Respiratory muscle training</th>
<th>Forced vital capacity, peak expiratory flow, Respiratory quality of life, pre-treatment versus post treatment values.</th>
<th>This study stated that use of RMT can improve respiratory muscle strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Daphne Balatsou, Ioannis S et al.</td>
<td>Observational study</td>
<td>Respiratory muscle training</td>
<td>Forced vital capacity, peak expiratory flow rate, respiratory muscle strength, quality of life.</td>
<td>This study shows that Respiratory muscle training is helpful in improving breathing and cough, preventing infections, and improving patients’ overall quality of life.</td>
</tr>
<tr>
<td>9. Karin Postma, Janneke A. Haisma et al.</td>
<td>Randomized controlled trial</td>
<td>Resistive inspiratory muscle training</td>
<td>Primary outcome- maximal inspiratory pressure Secondary outcome- borg scale, Forced vital capacity, peak expiratory flow rate</td>
<td>Resistive inspiratory muscle training has a positive short-term effect on inspiratory muscle function in people with SCI who have impaired pulmonary function during inpatient rehabilitation</td>
</tr>
<tr>
<td>10. J Romero-Ganuza, A García-Forcada, E Vargas and C Gambarrutta et al.</td>
<td>Retrospective study</td>
<td>Respiratory muscle strengthening</td>
<td>Primary outcome - Vital capacity, peak flow Secondary outcome- incidence of respiratory complications</td>
<td>An intermediate respiratory care unit (IRCU) can manage a substantial number of severe SCI patients who need MV, and an important number of them can be weaned from the respirator.</td>
</tr>
</tbody>
</table>
According to a study by S. Burney et al. examined the immediate respiratory management of cervical spinal cord injury and the efficacy of several treatment approaches for acute tetraplegia over the first six weeks following the injury. There were 21 studies found, totaling 1263 patients. Using a respiratory protocol resulted in a significant reduction in the frequency of respiratory problems and the need for a tracheostomy. It also decreased the length of stay in the ICU by 6-8 days, the duration of mechanical ventilation, and the cost of intubation.

According to a comparative study by Kyochul Seo et al examining the impact of balloon blowing exercise on the pulmonary function of twenty something female participants using a ball in the 90/90 bridge position. To improve lung function and respiratory system contractile activity, exercises such blowing balloons while in the bridge position with the knee and hip extended to ninety degrees and asking to hold a five-inch rubber ball between the knees are performed. The Controlled group remained in the same posture but underwent diaphragmatic exercises. The parameters were significantly changed for the experimental group. The controlled group's parameters remained unchanged.

Hyun Ji Jun et al carried out The study examined how breathing exercises and balloon-blowing training affected older smokers' lung function. After four weeks, the lung function of both groups greatly rose, and after six weeks, it significantly reduced. Ultimately, the benefits of FBT and BBT extend to pulmonary function.

A review of respiratory treatment for patients with spinal cord injuries was completed, according to Rita Galeiras Vázquez et al. In order to provide resistance during inspiration and permit expiration, it uses parts with spring-loaded valves. Based on expiratory muscle exercise, they concluded that early weaning and appropriate conservative treatment should be started.

An experimental study by Kinjal Parmar et al, the effectiveness of a manual coughing technique for maximum cough flow was examined in individuals with spinal cord injuries. The intervention involved two sessions every day for four weeks, with each subject doing three sets of three repetitions. The study concluded that the Manually Assisted Cough Method ought to be regarded as a baseline physiotherapy treatment regimen, given the noteworthy enhancement in peak cough flow that transpired after the intervention.

So we can say that inspiratory muscle training, expiratory muscle training, body weight supported treadmill training, vocal respiratory training, manually assisted cough technique, exercise training, abdominal bracing, abdominal muscle training, breathe training, electrical nerve stimulation, positioning, resistive inspiratory muscle training, respiratory muscle strengthening can be given to treat respiratory complications in spinal cord injury patients.

**CONCLUSION**

This study concluded that respiratory physiotherapy intervention improves the performance of respiratory, pulmonary and cough muscle function in individuals with SCI, which aids in removing excessive secretions from the lungs and improves muscle strength, henceforth respiratory physiotherapy can be added to routine physiotherapy intervention for spinal cord injury patients.

**FUNDING:** None
CONFLICT OF INTEREST: Author has no conflict of interest.

REFERENCES


