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SHORT-TERM EFFECT OF CHEST PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION COMBINED WITH BREATHING EXERCISE ON RESPIRATORY PARAMETERS IN AN ICU PATIENT WITH CHEMICAL PNEUMONITIS: A CASE REPORT

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Bhaswati Haloi PG Scholar, Department of Physiotherapy, Jorhat Medical College and Hospital, Assam, India

Kangkan Talukdar Lecturer of Physiotherapy, Srimanta Sankaradeva University of Health Sciences, Jorhat Medical College, Assam, India

B. K. P Rajlakshmi Borah PG Scholar, Department of Physiotherapy, Jorhat Medical College and Hospital, Assam, India

ABSTRACT

Background: Chemical pneumonitis is an acute inflammatory lung injury that may cause hypoxemia, dyspnea and increased work of breathing. Respiratory physiotherapy may support recovery in medically stable patients. Objective: To describe short-term changes in respiratory parameters following chest proprioceptive neuromuscular facilitation (PNF) combined with breathing exercise in an ICU patient with chemical pneumonitis. **Methods:** A 35-year-old male with chemical pneumonitis following diesel-fume exposure received chest PNF and deep breathing exercise twice daily for 7 consecutive days. Each session lasted 40 minutes. Inspiratory capacity, peripheral oxygen saturation (SpO_2), respiratory rate (RR) and heart rate (HR) were recorded after the second session each day. **Results:** Inspiratory capacity increased from 500 mL on Day 1 to 2200 mL on Day 7. SpO_2 increased from 93% to 100%, while RR decreased from 38 to 20 breaths/min and HR from 102 to 88 beats/min. All recorded respiratory parameters showed improvement during the 7-day period, with the greatest change observed in inspiratory capacity. **Conclusion:** Chest PNF combined with deep breathing exercise was associated with short-term improvement in respiratory parameters in this patient with chemical pneumonitis.

KEYWORDS

Chemical Pneumonitis; Chest PNF; Breathing Exercise; Respiratory Physiotherapy

INTRODUCTION

Chemical pneumonitis is an acute inflammatory lung injury caused by inhalation or aspiration of toxic or irritating substances. It may produce epithelial injury, pulmonary edema, impaired ventilation and hypoxemia, with dyspnea and rapid, shallow breathing in the acute phase (Gorguner & Akgun, 2010; Ware & Matthay, 2000). Respiratory physiotherapy may be considered in medically stable patients, with close monitoring of physiological responses and treatment tolerance (Gosselink et al., 2008; Schaller et al., 2024; Stiller, 2013). Respiratory proprioceptive neuromuscular facilitation (PNF) uses tactile, proprioceptive and stretch stimuli synchronized with breathing to facilitate thoracic movement and inspiratory muscle recruitment. Techniques such as intercostal stretch and basal facilitation have been associated with changes in respiratory parameters in selected populations (Adler et al., 2014; Gupta et al., 2014; Mohan et al., 2012). Evidence remains heterogeneous, and respiratory PNF has been studied more often in COPD and neurological populations than in chemical pneumonitis (Themistocleous et al., 2025).The present case describes the short-term response to a structured program of chest PNF combined with deep breathing exercise in a medically stable ICU patient with chemical pneumonitis. Inspiratory capacity, peripheral oxygen saturation (SpO_2), respiratory rate (RR) and heart rate (HR) were monitored over seven days to document changes in respiratory status.

Purpose of the Study

To evaluate the short-term effectiveness of Chest Proprioceptive Neuromuscular Facilitation (PNF) with breathing exercise on respiratory parameters in an ICU patient with chemical pneumonitis.

Case Description

A 35-year-old male industrial worker developed sudden shortness of breath, cough and chest discomfort following accidental exposure to diesel fumes while drawing fuel from a storage tank at his workplace. The reported exposure lasted approximately 20–25 minutes before the respiratory symptoms worsened. At admission, the patient was alert and oriented. Initial vital signs were HR 128 beats/min, RR 38 breaths/min, BP 148/96 mmHg and SpO_2 91% on room air. Respiratory examination revealed shallow breathing, increased use of accessory muscles and bilateral coarse crackles. Imaging demonstrated diffuse inflammatory infiltrates consistent with chemical pneumonitis, while arterial blood gas analysis indicated mild hypoxemia. The patient was managed conservatively with oxygen therapy. The baseline physiotherapy assessment documented reduced diaphragmatic excursion, weak inspiratory effort and decreased chest expansion. The patient was considered fit for respiratory physiotherapy aimed at improving lung expansion and preventing secondary pulmonary complications such as atelectatic changes. All treatment was to be performed with continuous clinical observation and modified or stopped if physiological instability or intolerance occurred (Gosselink et al., 2008; Schaller et al., 2024; Stiller, 2013). Chemical pneumonitis may resolve with appropriate medical management, but respiratory symptoms can persist during the early recovery period. Changes in inspiratory capacity, oxygen saturation, respiratory rate and heart rate can provide simple bedside indicators of respiratory status. Chest PNF may facilitate thoracic movement through tactile and proprioceptive stimulation, while deep breathing encourages active inspiratory expansion (Adler et al., 2014; Gupta et al., 2014; Mohan et al., 2012; Themistocleous et al., 2025). However, evidence describing this combined approach in chemical pneumonitis is limited, supporting the documentation of detailed clinical responses in individual cases.

Intervention

The structured respiratory physiotherapy intervention consisted of two components: (1) Chest PNF techniques and (2) Deep breathing exercise. The patient received two physiotherapy sessions per day (BD) for 7 consecutive days, resulting in a total of 14 sessions. Each session lasted approximately 40 minutes. Each session included 2 minutes of pre-treatment monitoring and positioning, 24 minutes of Chest PNF techniques, 3 minutes of rest between techniques, 8 minutes of deep breathing exercise, and 3 minutes of post-treatment observation and recording. RR, SpO_2 and respiratory comfort were monitored before and after the intervention, and the exercises were performed according to the patient's clinical tolerance.

Table 1. Intervention Schedule for the 40-minute Twice-daily Respiratory Physiotherapy Session.

Time/phase	Duration	Procedure	Frequency
Pre-treatment monitoring	2 min	RR, SpO_2, respiratory comfort, semi-Fowler's positioning and preparation.	Before each session
Bilateral intercostal stretch	6 min	3 sets × 10 repetitions; 5-second stretch with controlled inspiration; 30-second rest between sets.	BD
Anterior basal/lower-costal facilitation	6 min	3 sets × 10 repetitions; gentle lower-costal facilitation coordinated with inspiration; 30-second rest between sets.	BD

Posterior basal facilitation/lift	6 min	3 sets × 10 repetitions; facilitation coordinated with subsequent inspiration; 30-second rest between sets.	BD
Gentle vertebral/ upper-thoracic facilitation	6 min	3 sets × 10 repetitions; gentle tactile facilitation synchronized with breathing; 30-second rest between sets.	BD
Breathing exercise	8 min	3 sets × 10 repetitions; slow inspiration, comfortable inspiratory hold and relaxed expiration; 60-second rest between sets.	BD
Post-treatment observation/data recording	3 min	Rest, observe tolerance and record inspiratory capacity, SpO_2, RR after the second daily session.	Daily after 2nd session

RESULTS

The patient demonstrated an overall improvement in respiratory parameters over the seven-day physiotherapy intervention. Inspiratory capacity increased from 500 mL on Day 1 to 2200 mL on Day 7, representing an absolute increase of 1700 mL . SpO_2 increased from 93% to 100%, while respiratory rate decreased from 38 to 20 breaths/min . The daily values are presented in Table 2.

Table 2. Daily Respiratory Outcome Measurements

Day	Inspiratory capacity (mL)	SpO_2 (%)	RR (breaths/min)
1	500	93	38
2	750	94	34
3	1000	95	30
4	1350	95	32
5	1500	96	26
6	2000	98	22
7	2200	100	20

Comparative Day 1–Day 7 Statistical Analysis

As this was a single-patient case report, the comparison between Day 1 and Day 7 was performed descriptively. Absolute change and percentage change were calculated for each outcome measure. Inferential statistical testing and p-values were not applied because a single participant does not provide an appropriate estimate of between-subject variability.

The Day 1–Day 7 comparison demonstrated improvement in all four recorded outcomes. Inspiratory capacity increased from 500 mL to 2200 mL, an absolute increase of 1700 mL. SpO_2 increased from 93% to 100%, an absolute increase of 7 percentage points (7.53%). Respiratory rate decreased from 38 to 20 breaths/min, representing a reduction of 18 breaths/min (47.37%).

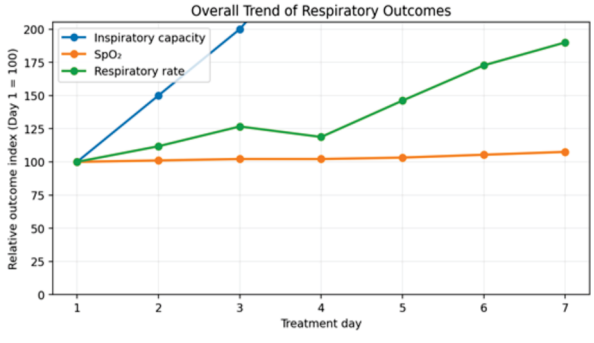


Figure 1. Overall Outcome Graph

DISCUSSION

Continuous monitoring of SpO_2, respiratory rate and respiratory comfort was maintained throughout treatment. The absence of deterioration in the recorded parameters suggests that the intervention was tolerated in this medically stable patient. Nevertheless, the single-case design, short follow-up and concurrent medical management limit interpretation and generalizability. Respiratory PNF has been investigated in other respiratory and neurological populations, but evidence specific to chemical pneumonitis remains limited. A recent systematic review reported improvements in several pulmonary outcomes following respiratory PNF in COPD, while also noting heterogeneity and co-interventions (Mendes et al., 2019). The present case therefore provides a detailed clinical description of a combined respiratory physiotherapy program in a less commonly studied condition. The improvement in SpO_2 may reflect better ventilation and recovery of the underlying pulmonary condition. Similarly, the reduction in respiratory rate may indicate a transition from rapid, shallow breathing toward a more efficient respiratory pattern. Deep breathing exercise may have complemented the manual facilitation by encouraging active, controlled inspiration (Themistocleous et al., 2025). However, these outcomes cannot be attributed to PNF or breathing exercise alone because both were delivered together and the patient was simultaneously recovering from chemical pneumonitis. The increase in inspiratory capacity may reflect improved thoracic expansion, respiratory coordination and inspiratory effort. Intercostal stretch and anterior/posterior basal facilitation provide tactile and proprioceptive stimulation to the thoracic cage and may facilitate deeper inspiration (Adler et al., 2014; Gupta et al., 2014; Mohan et al., 2012). Previous studies have reported changes in respiratory parameters following respiratory PNF techniques, including intercostal stretch and basal facilitation (Gupta et al., 2014; Mohan et al., 2012). The present case demonstrated improvement in respiratory parameters following a structured program of chest PNF combined with deep breathing exercise in a patient with chemical pneumonitis. Over seven days, inspiratory capacity increased from 500 to 2200 mL, SpO_2 increased from 93% to 100%, and respiratory rate decreased from 38 to 20 breaths/min. Heart rate also decreased from 102 to 88 beats/min. These changes indicate an overall favorable clinical trend, although natural recovery and concurrent medical management may also have contributed.

CONCLUSION

The seven-day program of chest PNF combined with deep breathing exercise was associated with improvement in inspiratory capacity, SpO_2, respiratory rate and heart rate in this patient with chemical pneumonitis. The findings should be interpreted cautiously because this single-patient case cannot separate treatment effects from natural recovery or concurrent medical management and has limited generalizability. Further controlled studies with larger samples and longer follow-up are recommended to evaluate the specific contribution of respiratory PNF.

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