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Wearable device-assisted physiotherapy in a case of left pleural effusion with clavicle fracture: A case report

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Abstract

Background: Pleural effusion compromises lung expansion, leading to dyspnea and reduced functional capacity. Physiotherapy plays a vital role in restoring pulmonary function post-drainage.

Case presentation: A 45-year-old male with type 2 diabetes mellitus and recent left clavicle fracture presented with chest heaviness, hiccups, anorexia, and breathlessness of 10 days' duration. Imaging confirmed left pleural effusion. Intercostal Chest Drain (ICD) insertion evacuated 1000 ml of blood. Pre-procedural physiotherapy evaluation using a wearable EMG device (Pheezee) showed reduced chest muscle activation (right intercostal 17 µV, left 11 µV) and poor inspiratory capacity (300 ml on incentive spirometry). Post-ICD, a structured program of diaphragmatic breathing, segmental expansion, and incentive spirometry was implemented. After 7 days, inspiratory capacity improved to 1200 ml (all 3 balls lifted), and EMG values increased (right 45 µV, left 40 µV).

Conclusion: This case demonstrates that physiotherapy, objectively monitored with wearable technology, enhances recovery following ICD for pleural effusion, even in the presence of comorbidities.

Keywords: Pleural effusion; Chest physiotherapy; Wearable EMG monitoring; Incentive spirometry.

Introduction

Pleural effusion, defined as excess fluid in the pleural cavity, impairs respiratory mechanics, leading to dyspnea and reduced functional capacity [1]. Intercostal Chest Drain (ICD) insertion remains the standard intervention for therapeutic evacuation.

However, post-drainage patients frequently exhibit restricted chest wall mobility and poor inspiratory effort [2].

Physiotherapy is critical in preventing complications such as atelectasis and in expediting recovery. Breathing retraining, chest expansion exercises, and incentive spirometry improve lung volumes and oxygenation [3]. Recent advancements in wearable technology enable objective monitoring of muscle activation and chest expansion during rehabilitation [4,5].

We report a case of pleural effusion with concurrent clavicle fracture and diabetes mellitus, where physiotherapy guided by

a wearable EMG device facilitated measurable improvement in lung function. The protocols emphasizing on strengthening respiratory muscles, enhancing pleural fluid clearance, and improving overall pulmonary efficiency, and highlighting the critical role of individualized physiotherapy have been shown to be efficacious in management of pleural effusion [6].

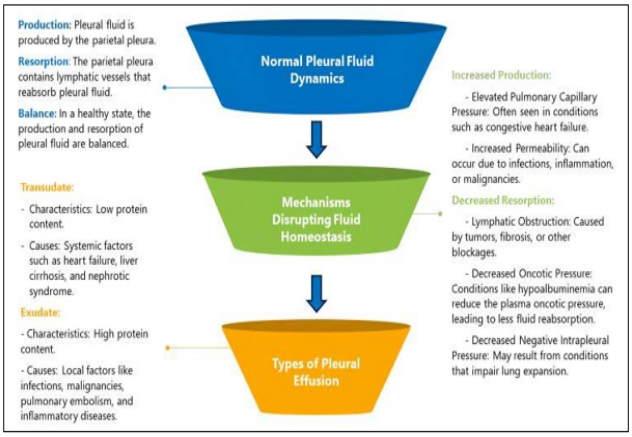

Figure 1: Flowchart of pathophysiology of pleural effusion. Copyright © 2024, Zunzunwala et al. [6].

Case presentation

A 45-year-old male was admitted to Jeevandan Health Hospital with complaints of left- sided chest heaviness, persistent hiccups, reduced appetite, and shortness of breath for 10 days.

History

- Known case of type 2 diabetes mellitus
- Recent road Traffic Accident (RTA) with left clavicle fracture, immobilized with a brace
- No history of prior surgeries, allergies, or significant social history

Investigations

Chest CT revealed left-sided pleural effusion as blunted costophrenic angle and the meniscus sign in left lung with a fluid-density collection within the pleural space.

Management

ICD tube insertion under local anesthesia drained 1000 ml of frank blood.

Physiotherapy assessment (Pre-procedure)

- **Pheezee EMG wearable:** right intercostal peak EMG 17 µV, left 11 µV
- **Incentive spirometry:** lifted only 1 ball (~300 ml inspiratory capacity)

Physiotherapy intervention

Following ICD insertion, the patient underwent daily sessions including:

- Diaphragmatic breathing
- Segmental chest expansion exercises
- Incentive spirometry practice
- Gradual progression of breathing load and duration
- Physiotherapy sessions were administered in dosages tailored to patient tolerance, comprising diaphragmatic breathing (10-15 repetitions, 4-6 times/day), segmental expansion (3-4 sets of 5-8 breaths, 3-4 times/day), incentive spirometry (10 breaths per set, 4-6 sets/day), and modified drainage positioning for 15-20 minutes, twice daily. Exercises were progressed gradually over the admission period.

Outcomes (After 7 days)

- **Incentive spirometry:** able to lift 3 balls (~1200 ml)
- **Pheezee EMG:** right intercostal 45 µV, left 40 µV
- **Subjectively:** reduced dyspnea, improved chest expansion, better tolerance to activity

The patient was discharged with advice on continuing home-based chest physiotherapy comprising of diaphragmatic and segmental breathing (10-15 repetitions, 3-4 times/day), incentive spirometry (10 breaths per set, 4-6 sets/day), thoracic mobility drills, and progressive ambulation. These were aimed at sustaining lung expansion, preventing recurrence of effusion-related complications, and improving overall pulmonary efficiency. All these exercises were asked to continue till 1 month.

Figure 2: Pheezee evaluation of lung expansion.

Figure 3: Pre physiotherapy patient lung capacity as measured by Incentive spirometry.

Figure 4: Taping for clavicle support.

Discussion

This case illustrates the role of structured physiotherapy in optimizing pulmonary recovery after pleural effusion management. Early initiation of diaphragmatic and segmental breathing exercises likely prevented atelectasis and accelerated lung re- expansion. Incentive spirometry provided motivation and progressive loading, while EMG monitoring quantified objective gains in intercostal activity.

Wearable devices such as Pheezee have growing utility in rehabilitation. By offering quantifiable data, they complement subjective assessment and enhance documentation of clinical outcomes [4,5]. Despite complicating factors like diabetes mellitus and concurrent clavicle fracture, the patient demonstrated significant improvement within a week.

To our knowledge, this may be among the first reports documenting physiotherapy progress in pleural effusion using wearable EMG monitoring in India.

Conclusion

Early physiotherapy following ICD insertion, supported by wearable device–based monitoring, can objectively demonstrate improved lung expansion and functional recovery. This approach has the potential to enhance clinical decision-making and patient outcomes in pleural effusion rehabilitation.

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