Programmed Post-Operative Physiotherapy May Improve Functional Outcomes in Pneumonectomy Patients of Rare Causes – Case Series

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Case Report

ABSTRACT

Physical therapy management for pneumonectomy has been long addressed in earlier literature. Post-operative pneumonectomy physiotherapy routinely administered in post-operative wards includes chest physiotherapy, positioning for ventilator perfusion (V/Q) matching, early in-bed and out of bed activities, early graded ambulation and ADL (activity of daily living) training. Though contrary results exist proving the post-operative pneumonectomy physiotherapy's effectiveness, routine post-operative physiotherapy regime is carried out in almost all the post pneumonectomy patients.

Post-pneumonectomy in-patient protocols vary with different institutions and hospitals across globe. This makes the study results generalization difficult and hence the negativeness in reviews analyzing the pooled results. But still in pneumonectomy, critical thinking and expertise therapeutic application still can give better results in post-operative pneumonectomy patients.

We present two pneumonectomy patients of unique causes whose outcomes encourage us to make a case series and may benefit the cardiopulmonary physical therapist in their clinical and practical appliances. A variety of modalities for pain, exercise techniques and early mobility are evidence-based and must be implemented depending on each post-operative day according to co-morbid conditions and cooperation of the patients. The physiotherapist should be responsible for implementing mobilization plans, exercise prescription and education to make recommendations in progression of patient's outcomes.

Protocol based post-operative physical therapy regime is effective in improving pneumonectomy patients of rare causes. These pneumonectomy cases recovered better and lesser hospital stay with protocol based post-operative physiotherapeutic management. We expect similar improvement in all post-operative pneumonectomy cases of any causes. This may be addressed through large randomized controlled trials comparing our protocols with others in near future.

Keywords: Pneumonectomy, Physical therapy, Castleman's disease, Destroyed lung

INTRODUCTION

Pneumonectomy is the dissection of unilateral lung with bronchial stump ligated. It may be due to numerous reasons not limiting to bronchial carcinoma, bronchiectasis, destroyed lung due to pulmonary tuberculosis, and so on [1]. Very rare causes such as Castleman's disease (pulmonary hemangiortoma), benign cyst (or) nodes affecting ventilator perfusion mismatch may lead to pneumonectomy [2]. In India, Castleman's disease has not been reported so far.

Physiotherapy management for pneumonectomy has been long addressed in earlier literature [3]. Post-operative pneumonectomy physiotherapy routinely administered in post-operative wards includes chest physiotherapy, positioning for ventilator perfusion (V/Q) matching, early in-bed and out of bed activities, early graded ambulation and ADL (activity of

daily living) training [4]. These are routine post-operative physiotherapy regime is carried out in almost all the post pneumonectomy patients [5], but contrary results exists about the effectiveness of physiotherapy in post-operative pneumonectomy patients. This warrants new studies to prove the effectiveness of routine physiotherapy in pneumonectomy patients. Post pneumonectomy in-patient protocols vary with different institutions and hospitals across globe. This makes the study results generalization difficult and hence the negativeness in reviews analyzing the pooled results. However, critical thinking and expertise therapeutic application can give better results in post-operative pneumonectomy patients [4].

Case reports in analyzing chest physiotherapy techniques in chronic and post-operative conditions are rare. We present two pneumonectomy patients of unique causes whose outcomes encourage us to make a case series and may benefit the cardiopulmonary physical therapist in their clinical and practical appliances.

CASE 1

A 20 year old female presented to emergency care department of our tertiary care hospital with complaints of moderate breathlessness, back pain, pain at the interscapular area, dry cough, and chest discomfort for one month and scanty hemoptysis for 3 months on 17th May 2014. A provisional diagnosis of hilar pulmonary nodule/lymphadenopathy was made confound with CT scan. She underwent left pneumonectomy on 20th May 2014. Pneumonectomy specimen showed a rare phenomenon of castle man's disease (pulmonary lymphangio hematoma).

Paradoxically she developed low grade fever, chills showing symptoms of sepsis on her 2nd post-operative day. She was stated on prophylactic antibiotics such as Tazomac 4.5 g intravenous (IV) 8th hourly and Comaxiclav 625 mg thrice daily for 5 days. Injections Tramodol 50 mg IV and Morphine 2 cc IV were administered two days for pain relief. Her conjugative symptoms were not subsided. On 21st May 2014, check x-ray revealed right lung collapse which was thought to be the cause for her constitutional symptoms. She was referred for vigorous chest physiotherapy for airway clearance and inpatient rehabilitation as per routine protocol as depicted in **Table 1**.

Table 1: Procedural post-operative protocol for pneumonectomy patients, (TENS: Transcutaneous Electrical Nervous Stimulation; ICD: Inter Costal Drainage; ACBT: Active Cycle of Breathing; FET: Forced Expiratory Techniques; PNF: Proprioceptive Neuromuscular Facilitation Techniques; IMT: Inspiratory Muscle Training; PEP: Positive Expiratory Pressure Therapy; ROM: Range of Motion; V/Q: Ventilation Perfusion Ratio; ADL: Activities of Daily Living).

Post-operative Day	Aim	Mean	Dosage
0th Day (Day of surgery) (a)	To decrease post-operative pain and anxiety	TENS around surgical site/Reassurance	TENS – Quadripolar, Burst, 0.5 mA, 80–110 Hz, minimal threshold (twice a day)
	To promote airway clearance	Chest vibration, modified postural drainage, splinted huff (NO PERCUSSION), if on ventilator - suction	Chest Physiotherapy 6th hourly, 20 min (pain free)
	To regulate V/Q matching	Position on pneumonectomy side	Position 5 min every 2 h
	Monitor HD changes	Real time monitor of HR, SpO_2, RR and BP	Monitor continuously
	To humidify artificial airways	Humidification – wick humidifier, steam inhalation	
1st Post-operative day (b)	To increase active ventilation as weaned from ventilator	Deep breathing exercises, incentive spirometer, costal expansion maneuvers	Twice a day, 20 min
	To increase shoulder ROM and decrease postural deficit (scoliosis) on pneumonectomy side	Active assisted wand and sheet activities	Assistive aid can be taken (walker, can)
	To promote airway clearance	Scoliotic correction on pneumonectomy exercises, Chair sitting, lateral reaches	Chest physiotherapy taught to the caregiver and reviewed twice a day
	To assure continuing pain relief	Stationary marches	Standing reach outs
	To improve intercostal drainage care	Active pain free huffing activities	Transfers – bed to chair, standing, based on minimal exertion
		Patient controlled burst TENS	

		ICD education – obstruction, activity care, fluid monitoring	
2nd post-operative day (c)	To increase ventilatory demands during increased activity	Incentive spirometer, deep breathing exercises, positioning to same side – PNF respiratory patterns, airway clearance	Thrice daily (if secretions in unaffected lung), 20 min/session
	To increase mobilisation status	Slow paced walking (minimal exertion pain free walking) – 50 ft max. level, transfers at increasing frequency	Pain free ROM
	To improve Activities of daily living and achieve functional independence	Out of bed – leisure walk, caregiver mobilisation allowed	Moderate exertion (Modified Borg exertion 5–6)
	To improve caregiver and patients attitude towards post pneumonectomy	Prehension and precision activities – functional reaches, pick up objects, lateral reach outs	Progressing at patient centered intensity of mobilisation
	To improve upper limb utilization	Wound remodeling and active exercises for the same	
	To educate about wound care		
3rd Post-operative day (d)	To increase ventilation (both lung and chest wall expansion) for growing needs of activities	Active airway clearance techniques – ACBT, FET, mechanical devices if willing and effective in introductory session	Thrice daily, 20 min
	To increase unsupervised mobilisation activities with the help of care giver	Adequate pain control – TENS, cryo (if no evidence of infection, fever, delayed wound healing)	Monitor for fever, unhealed lateral thoracotomy wound, pleurisy signs
	To improve ADL and other activities efficiency with unilateral lung	Incentive spirometer, chest mobility activities in sitting standing	Increase ambulatory periods with help of relatives, walking aids
	To monitor for signs of BP fistula, infection, wound healing	Free ROM in PNF respiratory patterns	
	To increase ambulatory status	Postural correction – bracing exercises, Latismus stretch (pain free), lateral bends	
	To increase postural awareness and scoliosis prevention	Increased paced walking – decrease rest periods – 100 ft minimal level	
4th post-operative day (e)	To improve ventilation and promote compensatory emphysema on unaffected lung	Airway clearance as stated in (d), incentive spirometer on affected side lying and sitting, balloon exercises (PEP maneuver) to initiate expiratory tolerance	Thrice daily
	Monitor for new infection, suture dehiscence, wound healing	Unaffected side costal expansion exercises	8 RM, 10 min 5 stations (Biceps, latismus, trapezius, triceps, pectoralis)
	To promote shoulder strength and ROM	Therabands, sand bag for affected shoulder, wall push up, partial squats	Lower limb – Squats, lateral leg raises, calf pumps (body weight supported)
	To strengthen trunk and Scoliotic correction	Diaphragm strengthening on affected and unaffected sides	Diaphragm strengthening (maximal 2 Kg)
	To increase mobilisation status to next higher grade	Walking ground 200 ft in patients own pace	
		Monitor safe transfers individually without support	
5th post-operative day (f)	To improve ventilatory status to meet the demands for stair climbing, ramp walking	Progressive spirometer (maximal 1200 cc for 2 min)	Max. 2 Kg for upper limb
	To progress mobilisation for challenged task – ramp and step climbing	Positioning skills of care giver review	Max. 3 Kg for lower limb

	To regulate balance – trunk, dynamic	Ground walking unsupervised – 500 ft	· Body supported, 8 RM, 20 minutes
	To increase awareness of job related skills – pull push and lifting	Ramp walking (uphill) and box – step up and down	Care giver education about vocational guidance
		Balance training – single leg stance, functional reach outs (sitting)	
		Hand dynamometer – grip strength (pulling pushing, lifting modification)	
		Strength training (therabands, hand cuffs)	
6th post-operative day (g)	To advance to more challenging chest expansion	Progressive inspiratory exercises with spirometer, inspiratory training with threshold IMT (<15 cm H_20)	Max. 3 Kg for upper limb
	To monitor late onset complications of pneumonectomy	Inspiratory load progressive during positioning maneuvers	Max. 4 Kg for lower limb
	To initiate gradual resisted training exercised	Resisted ventilatory PNF patterns	Body supported, 8 RM, 20 min
	To improve more progressive mobilisation	Classical strengthening exercises – Biceps, triceps, latismus, pectoralis, trapezius	Care giver education about vocational guidance
		Progressive balance training – tandem walk, ball throw during walking	
		3 steps of 10 inch stair climb, Ramp walking – 50 m	
7th post-operative day (h)	To prepare for home based rehabilitation	Assess for bronchial hygiene and adherence	Follow up plan
	To improve adherence to the rehab Performa	Assess lung expansion on unaffected side and review chest expansion exercises	Care giver and patient education about complications and follow up with the cardiothoracic surgeon
	To monitor for signs of post pneumonectomy delayed onset complications	Assess unsupervised mobility status and hemodynamic changes during progressive unsupervised ambulation (stair and uphill)	Warning signs of pleural effusion, BP fistula and cardiac tamponade
		Assess desaturation and about oxygen titration during ADL and walking	
		Two flights of stairs without breathlessness, palpitation, diaphoresis symptoms. Post climb BP >20 mm Hg	

She was started with 4th hourly modified high sidle lying postural drainage with forced expiratory breaths combined with chest mobility activities. Further left shoulder movements were encouraged as a part of thoracic mobility program. She was further started with expiratory exercises in incentive spirometer for hastening premature airway collapse and mediastinal drainage for 2 days. Splinted cough was administered and taught to caregiver for continuing the same during airway clearance maneuvers. After chest physiotherapy, lung expansion maneuvers (incentive spirometer) along with aerosol therapy with levolin were administered. She was started with graded mobility program both in intensive and step down wards with clamped chest drains. She was out of her drains on the 5th day of her post-operative stay. With the graded physiotherapy programme, she gradually improved in mobility status and functional independence status. Between 8^{th} to 13^{th} post-operative days she was started with graded stair climbing and ramp walking for increasing the intensity of exertional challenge. She tolerated well the whole physiotherapy protocol. Her check x-ray on 20^{th} post-operative day revealed a stable left granulation tissue and excellent right lung reserve and expanded volume. She was discharged with nutritional and pharmacological advice with systemic antihypertensive, analgesic and antibiotics (**Figure 1**).

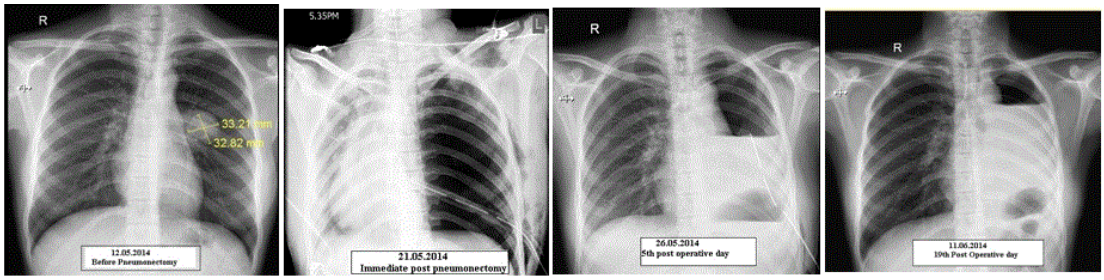

Figure 1. Case 1 x-ray.

CASE 2

A 46 year old male presenting with left lung cystic bronchiectasis due to post tubercular sequlae admitted to our tertiary care cardio thoracic surgery center on 09th July 2014 with dyspnea on exertion, productive cough, cachexia for 4-5 years, scanty hemoptysis and chest pain for a month. He was a known hypertensive for 2 years and was on Amlong 2.5 mg. He had history of tuberculosis and got treated completely 27 years back. He was diagnosed to have left destroyed lung underwent pneumonectomy on 24th July 2014.

The patient developed sepsis and referred to physiotherapy program with the aim of clearing airways and early mobilisation of the septic patient on the same day. On assessment, distress, pain on the surgical site with moderate intercostal drainage tubes. He was receiving antihypertensive, mucolytics drugs (mucolite SR) and antibiotics (Tazomac, Cebanex 1.5). He was administered with stringent post-operative physiotherapy protocol as mentioned in **Table 1**.

Patient was started with topical anesthetic with transcutaneous electrical nerve stimulation (burst TENS with patient controlled intensity and frequency) around the suture site with sterilized electrodes. With due pain reduction, he was started with gentle vibration in high side lying postures and active airway clearance techniques (Active cycle of breathing and forced expiration maneuvers). He was gradually started with early mobilization protocol with high sitting, functional reach outs, bed to chair transfers and stationary marching. Lung expansion maneuvers such as incentive spirometer and spinal mobility exercises were administered pertained to his pain tolerance. On the 2nd post-operative day his drains were removed and started ambulating gradually. His complete blood count and serum procolcitonin values started showing improvement in sepsis. Patient was started on exertional ambulation (stair and ramp walking) on the 3rd post-operative day. His x-ray showed significant right lung expansion and stable post-operative left granulation tissue on same day **(Figure 2)**. As patient was hemodynamically stable and functionally less dependent, he was discharged home with the advice of antihypertensive and analgesic (static) on the third postoperative day.

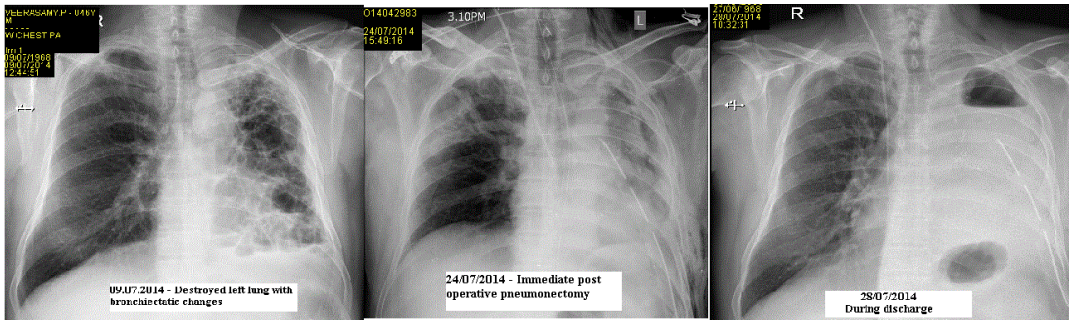

Figure 2. Case 2 x-ray.

DISCUSSION

We report two pneumonectomy cases of rare entities that showed better recovery and lesser hospital stay with protocol based post-operative physiotherapeutic management. We expect similar improvement in all post-operative pneumonectomy cases of any causes. This may be addressed through large randomized controlled trials comparing our protocols with others in near future.

Castleman's disease, post tuberculosis destroyed lung diseases are rare causes for pneumonectomy has been portrayed through our case report. Protocol based post-operative physiotherapy regime showed marked difference in the outcome measure when employed with therapeutic expertise. Earlier literature has portrayed the efficacy of post-operative and pre-operative physiotherapy regime in the improvement of the outcome measures (length of stay, mortality, post-operative pulmonary complications, cost and earlier return to normal capacity) [6] but rare causes such as tubercular

Leiden destroyed lung and Castleman's lymphagiomatoma has not been described elsewhere. There has been always a doubt in the administration of physiotherapy program or a protocol that can be employed for all pneumonectomy patients [7].

Post-operative physiotherapy includes airway clearance, mobilization, functional activity improvement and vocational guidance, community based rehabilitation in pneumonectomy patients has been depicted elsewhere [3-7]. But rare causes of pneumonectomy such as castleman's diseases, destroyed lung have not been portrayed.

We recommend further trials to follow our protocol in pneumonectomy of any causes. We expect the same recovery as that of what we have reaped in our patients.

CONCLUSION

Protocol based post-operative physical therapy regime is effective in improving pneumonectomy patients of rare causes. Our protocol is evidence-based and followed depending on each post-operative day according to co-morbid conditions and cooperation of the patients. These pneumonectomy cases recovered better and lesser hospital stay with protocol based post-operative physiotherapeutic management. The physiotherapist should be responsible for implementing mobilization plans, exercise prescription and education to make recommendations in progression of patient's outcomes. This may be addressed through large randomized controlled trials comparing our protocols with others in near future.

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