

Tailor-made Pulmonary Rehabilitation Program Aiding Return to Preinfection Fitness in Massive Cavitary Lung Abscess: A Case Report

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ABSTRACT

Lung abscess is a form of liquefactive necrosis of the lung tissue, that causes the formation of cavities (greater than 2 cm) which are filled with necrotic debris and fluid because of microbial infection. Aspiration, which may happen while the patient is not conscious and end in a pus-filled cavity. It is very rare to find out lung abscess with a complicated infection of *Streptococcus pneumoniae* serotype 6B. The authors, hereby present a case report of a 42-year-old male patient, who was referred to a tertiary care hospital with chief complaints of breathlessness of grade II on the Modified Borg Scale, cough with expectoration, and right-sided chest pain. Chest x-ray and High Resolution Computed Tomography (HRCT), High Resolution Computed Tomography (HRCT) scan of the thorax were done and the patient was diagnosed with right lower lobe lung abscess caused by *Streptococcus pneumoniae*. The patient was managed by bronchoscopy and bronchoalveolar lavage (washing). A complete plan of rehabilitation was designed to meet the patient's objectives, and it was executed and followed for one month. The patient showed considerable functional improvement in terms of aerobic capacity, endurance, and exercise tolerance ability. It was concluded that, medical care combined with pulmonary rehabilitation, together as a multidisciplinary approach result in improved outcomes related to the quality of life of the patients.

Keywords: Bronchoscopy, Bronchoalveolar lavage, Liquefactive necrosis, Pus-filled cavity

CASE REPORT

A 42-year-old male farmer reported to the Medicine Outpatient Department of a tertiary care hospital with the chief complaint of breathlessness, cough with expectoration and right-sided chest pain since one month. The patient was apparently well, one month ago, when he gradually started experiencing breathlessness accompanied by chest pain while walking for a mile and had to sit down and rest for a few seconds. After some weeks passed, the patient started coughing with expectoration and there was brown colour phlegm. He was a chronic alcoholic for 10 years and had stopped consuming alcohol for one month. The patient's wife also noticed a drastic change in the patient's weight. The patient reported a loss of appetite resulting in, approximately 7 kgs weight loss in one month. Thereafter, the patient had visited a nearby local hospital and underwent radiological investigations and was found to have consolidation in the right mid-zone along the costal margin. Following which, the patient was referred to the tertiary care hospital where the patient gave a history of fever (on and off), cough with mucoid brownish-coloured expectoration, breathlessness (Modified Borg grade: II that is, the patient walks slower than same age people because of breathlessness) [1], and was admitted to the Respiratory Medicine Ward.

On general examination, the respiratory rate was 24 breaths/min with the abdominothoracic type of breathing, heart rate was 89 beats/minute, and oxygen saturation was 97% on 6 litres of oxygen support via nasal cannula. Pallor was present while inspecting for the positive findings. Chest expansion revealed a difference of 2 cm, 2 cm, and 1 cm at axillary, nipple, and xiphisternum levels, respectively. On percussion, the dull note was present at the right lower zone and coarse inspiratory crackles, along with liver and cardiac dullness. Additionally, the dull note was present in the trapezoid space. Auscultation also revealed decreased air entry on the right side at inframammary and infrascapular levels.

Blood haemoglobin levels were constantly lower than normal

ranging between 8.5-9.3 gm/dL. Total red blood cells count was constantly low (i.e. below 3.07 cells/ μ L) whereas, the white blood cells count and platelet counts were 18,200/cumm and 1,36,000/cumm, respectively.

Several investigations such as blood tests including, Complete Blood Count (CBC), Kidney Function Test (KFT), Liver Function Test (LFT), and Optochin tests were carried out. Other diagnostic assessments such as sputum culture, and chest x-ray were also conducted. Sputum assessment revealed foul-smelling purulent brown-coloured thick phlegm. The Optochin test was performed revealed that the strains were sensitive. The patient was diagnosed with cavitary lung abscess.

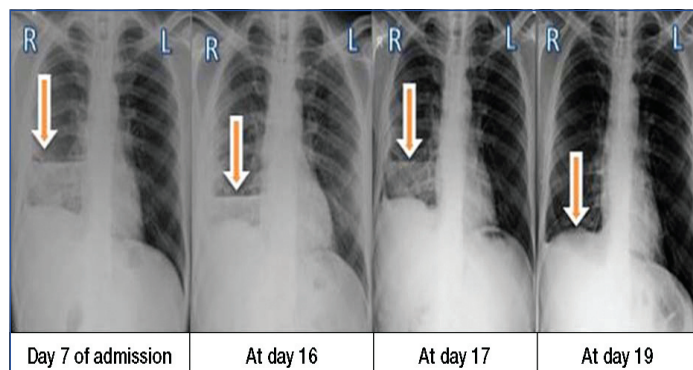
Bronchoscopy reports suggested mucopurulent secretions present in the right lower lobe. After the diagnosis confirmed the pharmaceutical medications was also started. Pharmacological management was done with Inj. piperacillin, tazobactam 4.5 gm intravenously (i.v.) (TDS), Inj. metronidazole 100 mL i.v. (TDS), tablet paracetamol 650 mg (OD), tablet levocetirizine and montelukast (HS), tablet pantoprazole 40 mg (OD), tablet acetylcysteine 600 mg (TDS), syrup ambroxol, guaifenesin, and terbutaline 10 mL (BD), nebulizer-salbutamol sulphate and ipratropium bromide (TDS) and budesonide (micronized) (BD), i.v. fluids-77 mEq/L sodium and 77 mEq/L chloride with multivitamin injection. Physiotherapeutic interventions were also started.

But when the patient's chest condition was deteriorating, then once again sputum culture was taken and an Optochin test was after 10 days. The optochin test was sensitive and thereafter, he was diagnosed with an infection of *Streptococcus pneumoniae*, which resulted in a complication of lung abscess on 12th day.

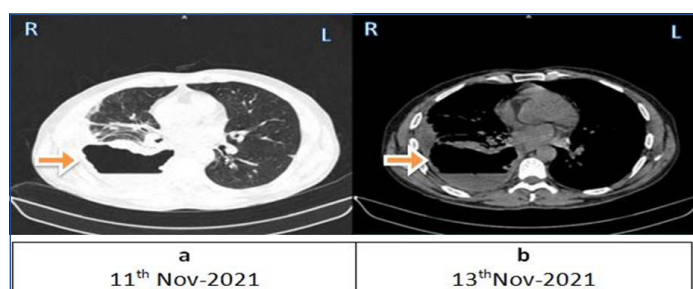
The bronchoalveolar lavage i.e. washing was done on 16th day. The bronchoalveolar lavage was done thrice in a span of 24 hours, the report suggested that the fluid collected was 43 mL of brownish, turbid material. The smear shows scattered acute inflammatory

cells, few lymphocytes, and macrophages. This was performed in respiratory medicine examination room.

All the x-ray findings are shown in [Table/Fig-1] showing the consolidation with the arrows. The High Resolution Computed Tomography (HRCT) scan impression is presented [Table/Fig-2].



[Table/Fig-1]: Series of chest x-rays showing improvement in cavitory lung abscess.



[Table/Fig-2]: High-resolution computed tomography scan of the thorax revealing a thick-walled cavitory lesion with an air-fluid level, in the right lower lobe with consolidation and centrilobular nodules, mild pleural thickening, and effusion.

Physiotherapy management: The physiotherapy rehabilitation was initiated after the diagnosis of right-side lower lung abscess was confirmed. The goal of the physiotherapy regimen was to improve ventilation and oxygenation, bronchial hygiene, and exercise tolerance. It comprised of myriad of separate interventions, like mobilization of secretions, breathing exercises, thoracic expansion exercises, and manual pressure at the left lower zones to maintain the expansion, physical mobility exercises, and posture retraining. All the brief introduction to goals, intervention, rationale, and dosage are given in [Table/Fig-3].

Goals	Intervention	Rationale	Dosage
To reduce dyspnoea while doing daily living activities	Pursed Lip Breathing (PLB)	Help the patient take shorter breaths and keep the airways open for longer.	10 repetitions 3-4 times/day for 4 weeks
To mobilise secretions	<ul style="list-style-type: none"> Postural drainage with manual chest percussions and vibrations. Acapella in sitting position. 	To aid in the mobilisation and drainage of pulmonary secretions away from the trachea by combining gravity with manual vibration and percussion. Acapella works on the principle of Positive Expiratory Pressure (PEP).	Every 4 hours for 4 weeks.
To improve ventilation and increase chest expansion	<ul style="list-style-type: none"> Posterolateral chest wall mobilisation. Thoracic expansion exercises. 	This helps to expectorate sputum output of more than 25-30 mL/day, this posture indicated assistance in clearing secretions. Mild improvement in the exercise tolerance capacity.	15-20 minutes twice a day for 4 weeks.
To reduce the respiratory rate and tidal volume	<ul style="list-style-type: none"> Breathing control Manual pressure 	Lowers blood pressure and heart rate. Increases the movement of ribs under pressure.	3-4 times/day, 10 repetitions for 4 weeks

Local relaxation techniques, and improving posture.	<ul style="list-style-type: none"> Progressive relaxation technique Postural training 	Reduce the patient's anxiety and stress. Increase work of breathing.	10 repetitions 3-4 times/day for 4 weeks
To reduce the work of breathing.	Energy conservation technique.	To reduce energy requirements and minimize muscle fatigue.	3-4 times/day, 10 repetitions for 4 weeks
To improve exercise tolerance and functional capacity.	Graded exercise program	To improve muscle strength and improve quality of life.	10 repetitions 3-4 times/day for 4 weeks

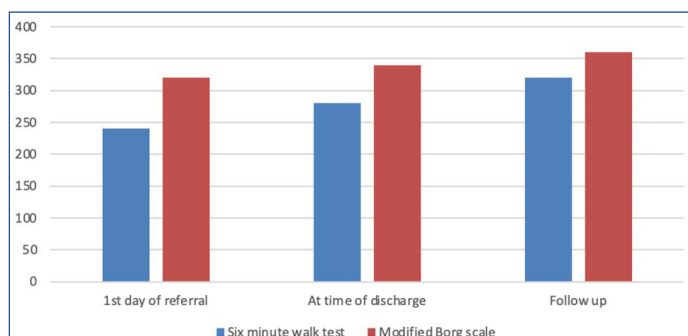
[Table/Fig-3]: Pulmonary rehabilitation given to the patient during the hospital stay [2].

Outcome measures: Sputum production quantity after airway clearance technique was 20 mL preintervention and 32 mL postintervention.

Progression of the overall physical condition of the patient was done by Six-Minute Walk Test [3] and Modified Borg Scale [1].

- Modified Borg Scale:
On 1st day of referral, it II
On the time of discharge, it was I
On follow-up (1 week after discharge), it was I
- Six-minute Walk Test:
On 1st day of referral was 220 m;
On the time of discharge, it was 260 m
On follow-up, it was 320 m.

Bar graph showing the progression of the overall physical condition of the patient by Six-Minute Walk Test [3] and Modified Borg Scale [1] [Table/Fig-4].



[Table/Fig-4]: Bar graph showing the progression of the overall physical condition of the patient.
X-axis: Time interval; Y-axis: distance (in metres)

DISCUSSION

Lung abscesses account for around 0.2% of all pneumonia cases requiring hospitalisation, according to Beth Israel Deaconess Medical Centre's experience, however, physiotherapy care is necessary to return the patient to their usual activities of daily living. Pulmonary rehabilitation aims to improve disease-related deficits by increasing exercise tolerance capacity, ventilation, and lowering labour of breathing [4-6].

The present case was diagnosed to have a right lower lobe lung abscess based on clinical results and investigations. Pulmonary rehabilitation was delivered focusing primarily on enhancing exercise tolerance capacity, ventilation, and reducing the work of breathing, thereby, improving the disease-induced impairments.

Lung abscess genesis, diagnosis, and treatment protocol have been described earlier. Antibiotics with a specific target and adequate drainage are essential for recovery. The mortality of lung abscesses has fallen to roughly 2-38.2% due to the widespread use of antibiotics [7]. The patient's age, malnutrition, co-morbidities, immunity, suitable and timely antibiotics, and supportive care all play essential roles. In up to 68% of cases, postbronchoscopy

fever occurs, with greater rates following bronchoalveolar lavage. Infectious problems after bronchoscopy are quite rare [8].

However, in the present case, there was no postbronchoscopy fever, and the patient was identified with a causative factor for cavitary lung abscess *Streptococcus pneumoniae*, which was treated by bronchoscopic drainage [9].

Long-term health effects of chronic respiratory disorders can be effectively combated with a thorough pulmonary rehabilitation program. The key interventions for rehabilitating patients with deteriorating health status due to respiratory problems include patient education, breathing methods, and graded exercise training programs. Disability results from pulmonary impairment caused by lung damage [10].

In the present case, a specialised rehabilitation program was developed and implemented. A regular exercise program reduced the number of exacerbations and hospital readmissions, resulting in improved functional capacity, and dyspnoea level.

Diaphragmatic breathing and pursed-lip breathing are two controlled breathing techniques, that increase psychological well-being by lowering anxiety and depression [10]. Six weeks of pulmonary rehabilitation on lung abscess has shown improvements in functional capacity, quality of life, and respiratory dysfunction-related outcomes, according to the study. Walking is utilised in an aerobic training program to focus on lower limb endurance [11].

On examination during follow-up, the patient showed improvement in Modified Borg scale from II-I and Six-Minute Walk Test was improved from 260 m at the time of discharge, to 320 m.

According to popular belief, pulmonary rehabilitation should last at least eight weeks to have a significant impact on exercise efficiency and quality of life [11,12]. In the present case, posture training and walking were offered as part of a supervised program, and after two weeks of unsupervised at-home instruction, telephonic follow-up was maintained.

The X-ray indicated a cavitary lung abscess. It can be challenging to diagnose the infectious pathogens at the time of confirmation of diagnosis. It is uncommon for *Streptococcus pneumoniae* to be the infectious cause of lung abscesses because *Staphylococcus aureus* typically causes them [13].

CONCLUSION(S)

The present case report, described an integrated plan for the rehabilitation of lung abscess. The patient's recovery occurred during

the rehabilitation program, the majority of the therapeutic objectives were met, including airway clearance to improve ventilation and saturation, improving the patient's exercise tolerance capacity, reducing work of breathing, and increasing functional capacity through energy conservation techniques. The patient received physiotherapy, which helped him to heal faster, lower his discomfort significantly, and enhance his day-to-day tasks, something he could not do, before starting physiotherapy.

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REFERENCES

- [1] Kendrick KR, Baxi SC, Smith RM. Usefulness of the modified 0-10 Borg scale in assessing the degree of dyspnea in patients with COPD and asthma. *J Emerg Nurs*. 2000;26(3):216-22.
- [2] Pryor JA, Ammani PS. *Physiotherapy for respiratory and cardiac problems: Adults and Paediatrics*. Edinburgh: Churchill Livingstone. 3rd ed. 2002.
- [3] Halliday SJ, Wang L, Yu C, Vickers BP, Newman JH, Fremont RD, et al. Six-minute walk distance in healthy young adults. *Respir Med*. 2020;165:105933.
- [4] Kuhajda I, Zarogoulidis K, Tsirgogianni K, Tsavlis D, Kioumis I, Kosmidis C, et al. Lung abscess-aetiology, diagnosis and treatment options. *Ann Transl Med*. 2015;3(13):183.
- [5] Beaucoté V, Plantefève G, Tirolien JA, Desaint P, Fraissé M, Contou D. Lung abscess in critically ill Coronavirus Disease 2019 patients with ventilator-associated pneumonia: A french monocenter retrospective study. *Crit Care Explor*. 2021;3(7):e0482.
- [6] Khoong CHL, Phua CK. Lung abscess and empyema following bronchoscopy: A case report and review of the literature. *Respir Med Case Rep*. 2020;30:101116.
- [7] Vatwani A, Margonis R. Energy conservation techniques to decrease fatigue. *Arch Phys Med Rehabil*. 2019;100(6):1193-96.
- [8] Hu L, Lin J, Li J, Cao Y, Lin L. Lung abscess secondary to lung cancer with *Eikenella corrodens* and *Streptococcus anginosus*: A case report. *BMC Infect Dis*. 2020;20(1):351.
- [9] Denu RA, Patel D, Becker BJ, Shiffler T, Kleinschmidt P. MRSA septicemia with septic arthritis and prostatic, intraretinal, periapical, and lung abscesses. *WMJ Off Publ State Med Soc Wis*. 2020;119(1):62-65.
- [10] Ainge-Allen HW, Lilburn PA, Moses D, Chen C, Thomas PS. Antibiotic instillation for a chronic lung abscess. *Respir Med Case Rep*. 2020;29:100991.
- [11] Rochester CL, Spruit MA, Holland AE. Pulmonary rehabilitation in 2021. *JAMA*. 2021;326(10):969-70.
- [12] Cascone R, Sica A, Sagnelli C, Carlucci A, Calogero A, Santini M, et al. Endoscopic treatment and pulmonary rehabilitation for management of lung abscess in elderly lymphoma patients. *Int J Environ Res Public Health*. 2020;17(3):997.
- [13] Ko Y, Tobino K, Yasuda Y, Sueyasu T, Nishizawa S, Yoshimine K, et al. A community-acquired lung abscess attributable to *Streptococcus pneumoniae* which extended directly into the chest wall. *Intern Med*. 2017;56(1):109-13.

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