

# Clinical and Radiological Features of Lung Abscesses and their Management: A Retrospective Observational Study

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## ABSTRACT

**Introduction:** A lung abscess is a localised area of destruction of lung parenchyma in which infection by pyogenic organisms results in tissue necrosis and suppuration. It is one of the common diagnosis in patients presenting to the respiratory Outpatient Department (OPD) and accounts for up to 4.0 to 5.5 per 10,000 hospital admissions each year.

**Aim:** To study the clinical profile, predisposing factors, anatomical location and response to medical treatment in patients with lung abscesses.

**Materials and Methods:** This was a retrospective observational study conducted on patients who had lung abscesses from the outpatient and inpatient departments of Respiratory Medicine at LG Hospital, Ahmedabad, Gujarat, India during January 2019 to December 2020. Parameters such as clinical profile, demographic profile, predisposing factors, radiological profile and response to medical treatment were assessed in all patients. All data were collected and analysed statistically using Statistical Package for Social Sciences (SPSS) Software version 21.0.

**Results:** In the study of 50 patients, 36 (72%) were in the 41-60 years age group, with a mean age of 47.56 years; the male-to-female ratio was 3.2:1. The most common symptom in the study was cough with expectoration, which was present in all the patients. Poor oral hygiene was a predisposing factor in the majority of patients, i.e., 22 (44%). Other factors included low Body Mass Index (BMI), alcohol use, diabetes, seizures and pre-existing lung disease. Mixed organisms were found in the sputum culture reports. Upper zone distribution was the most common radiological finding, observed in 29 (58%) cases. The majority of lung abscesses were located in the upper lobes of both lungs. A total of 48 (96%) cases showed clinical improvement and 42 (84%) cases showed radiological improvement after 28 days of broad-spectrum antibiotics.

**Conclusion:** The study found that lung abscesses are more common in males in the middle age group, particularly in individuals with addiction and co-morbidities such as diabetes, with upper lobe presentation being the most common. Most patients will improve if broad-spectrum antibiotics are started timely, at optimal doses and for the appropriate duration.

**Keywords:** Mycobacterium tuberculosis, Poor oral hygiene, Pyogenic organism

## INTRODUCTION

A lung abscess is a localised area of destruction of lung parenchyma in which infection by pyogenic organisms results in tissue necrosis and suppuration [1]. Lung abscesses may be single or multiple and they frequently contain air-fluid levels. The incidence of lung abscesses also declined in the late 1940s and 1950s, after the practice of performing oral surgery and tonsillectomy in the sitting position was abandoned, as it became clear that this could result in lung abscess formation [2]. Lung abscesses account for up to 4.0 to 5.5 per 10,000 hospital admissions each year in the US [3]. They occur at any age, but most frequently from the sixth to eighth decades and are predominantly seen in men [4,5]. A changing pattern of the disease has been reported in developed countries, where secondary lung abscesses due to underlying medical conditions, such as malignancy or immunosuppression, are becoming more common [5]. When multiple and small (less than 2 cm in diameter), they are sometimes referred to as necrotising or suppurative pneumonia, but they are an expression of the same pathological process and the distinction is arbitrary. It should not be forgotten that in addition to the more usual anaerobic and aerobic organisms, lung abscesses may also be found in tuberculosis and may be caused by non bacterial organisms, including fungi and protozoa. The most common cause of lung abscess is the aspiration of oropharyngeal contents [6].

Dr. David Smith postulated that the aspiration of oral bacteria was the mechanism of infection. He observed that the bacteria found in the walls of the lung abscesses at autopsy resembled the bacteria noted in the gingival crevice [7]. In recent times, there have been very limited studies available for the diagnosis and management of lung

abscesses [8]. Therefore, we aimed to fill this gap and create proper data for better management. The present study aimed to study the clinical profile of lung abscess patients, to examine the predisposing factors responsible for the development of lung abscesses, to determine the anatomical localisation of lung abscesses by chest X-ray and/or Computed Tomography (CT) scan and to evaluate the response to medical treatment.

## MATERIALS AND METHODS

It was a retrospective observational study conducted on patients who had lung abscesses from the outpatient and inpatient departments of Respiratory Medicine at LG Hospital, Ahmedabad, during the period from January 2019 to December 2020. Final interpretation and analysis of the data were done in April 2021. Ethical approval was obtained from the Ahmedabad Municipal Corporation Medical Education Trust (AMC MET) Institutional Review Board before starting the study.

**Inclusion and Exclusion criteria:** A total of 50 patients who were diagnosed with lung abscesses on an outpatient or inpatient basis, with or without co-morbidities and aged over 15 years, were included in the study. Patients with malignancy and those aged less than 15 years were excluded from the study.

## Study Procedure

A history regarding symptoms such as cough with expectoration, fever, chest pain, haemoptysis, dyspnoea and weight loss was collected, along with medical histories of Diabetes Mellitus (DM), Hypertension (HTN), Tuberculosis (TB), immunocompromised

conditions and any pre-existing lung diseases. Demographic data, including age, sex, weight, height and Body Mass Index (BMI), as well as investigation data like chest X-ray or CT thorax and clinical and radiological outcome details of all patients after receiving broad-spectrum antibiotics, were obtained from medical records. BMI is calculated by dividing an adult's weight in kilograms by their height in meters squared. A reading of less than 18.5 kg/m<sup>2</sup> is considered low BMI [9].

### STATISTICAL ANALYSIS

All data were collected and analysed statistically using Statistical Package for Social Sciences (SPSS) Software version 21.0.

### RESULTS

The mean age in the study [Table/Fig-1] was 47.56 years. The most common symptom in the study [Table/Fig-2] was cough with expectoration, which was present in all patients. Fever, varying from mild/low-grade (38.1-39°C/100.5-102.2°F) to moderate-grade (39.1-40°C/102.2-104.0°F) and high-grade (40.1-41.1°C/104.1-106.0°F), often associated with rigours was present in 48 (96%) patients.

Age	No. of cases (%)	Gender	No. of cases (%)
< 40 years	10 (20%)	Male	38 (76%)
> 40 years	40 (80%)	Female	12 (24%)

[Table/Fig-1]: Age and Gender of the patients.

Clinical features	No. of cases (%)
Cough with expectoration	50 (100%)
Fever	48 (96%)
Chest pain	25 (50%)
Weight loss	23 (46%)
Anorexia	22 (44%)
Dyspnoea	09 (18%)
Haemoptysis	04 (8%)

[Table/Fig-2]: Clinical features of the patients.

### Predisposing Factors

Poor oral hygiene was the major predisposing factor in the present study [Table/Fig-3]. In many patients, multiple predisposing factors were present.

Predisposing factors	No. of cases (%)
Poor oral hygiene*	22 (44%)
Low BMI (<18.5 kg/m <sup>2</sup> )	16 (32%)
Alcoholism	13 (26%)
Diabetes mellitus	07 (14%)
Seizure	02 (04%)
Pre-existing lung diseases**	08 (16%)
Unknown factor	06 (12%)

[Table/Fig-3]: Predisposing factors of the patient.

\*Poor oral hygiene include periodontal abscess, dental caries, gingivitis, recent dental extraction under General anaesthesia

\*\*Pre-existing lung disease like Chronic Obstructive Lung Disease (COPD), bronchiectasis, obstruction by foreign body, tumour or congenital anomaly

### Pathogenic Organisms Causing Lung Abscess

Mixed organisms were common, with Mycobacterium tuberculosis being the most prevalent [Table/Fig-4].

### Radiological Zonal Distribution

In the majority of cases, upper zone distribution was observed in 29 (56%) instances. Middle and lower zone distributions were seen in 4 (8%) and 14 (28%) cases, respectively. A total of 3 (6%) cases showed involvement of more than one zone.

Pathogenic organisms		No. of cases (%)
Gram positive organisms	<i>Staphylococcus aureus</i>	5 (10%)
	<i>Streptococcus pneumonia</i>	3 (06%)
Gram negative organisms	<i>Klebsiella pneumonia</i>	7 (14%)
	<i>Haemophilus influenza</i>	1 (02%)
	<i>Pseudomonas aeruginosa</i>	5 (10%)
	<i>E.coli</i>	3 (06%)
Mycobacterium tuberculosis		10 (20%)
No pathogen		15 (30%)

[Table/Fig-4]: Pathogenic organism grown in sputum.

### Radiological Distribution of Lung Abscess

Upper lobe involvement was the most common [Table/Fig-5].

Radiological sites	No. of cases (%)
<b>Right-side</b>	
Upper lobe	18 (36%)
Middle lobe	4 (8%)
Lower lobe	5 (10%)
More then 1 lobe	3 (06%)
<b>Left-side</b>	
Upper lobe	11 (22%)
Lower lobe	9 (18%)

[Table/Fig-5]: Radiological sites involved in lung abscess patients.

### Antimicrobial Drugs

Most of the patients with lung abscess were treated with amoxicillin + clavulanic acid (24%) and cefoperazone + sulbactam (36%), along with clindamycin (56%) or metronidazole (44%). Other patients were treated with piperacillin+tazobactam (20%), meropenem (16%) and amikacin (4%) [Table/Fig-6].

Antimicrobial Drugs	No. of cases (%)
Amoxicillin+clavulanic acid	12 (24%)
Clindamycin	28 (56%)
Metronidazole	22 (44%)
Cefoperazone+sulbactam	18 (36%)
Meropenem	08 (16%)
Amikacin	02 (04%)
Piperacillin+tazobactam	10 (20%)

[Table/Fig-6]: Antimicrobial drugs used to treat patients.

### Resolution of Lung Abscess

Responses were considered satisfactory when patients became asymptomatic both clinically and radiologically, either showing complete clearing or a stable residual lesion in the form of a linear or small thin-walled cystic lesion less than 2 cm in diameter [Table/Fig-7].

Duration of Treatment	Clinically n (%)	Radiologically n (%)
After 14 days	40 (80%)	30 (60%)
After 28 days	08 (16%)	12 (24%)
After 42 days	02 (04%)	08 (16%)

[Table/Fig-7]: Clinical and radiological resolution duration after treatment.

### DISCUSSION

The present study showed that the occurrence of lung abscesses was more common in males over 40 years of age, especially in patients with co-morbidities, addictions, or pre-existing lung conditions. Upper lobe involvement was the most common and most patients responded well to broad-spectrum antibiotics.

The occurrence of lung abscesses was higher (80%) in the age group over 40 years in the present study, which was similar to the

study by Mohapatra MM et al., which reported 32.6% [8]. Gupta A and Dutt N, Deng A et al., and Shafron RD and Tate CF observed a peak incidence in the age group of 41-50 years [10-12]. Gupta A and Dutt N noted that 75% of their patients were under 50 years of age [10]. In the present study, there were 38 male patients and 12 female patients out of 50 cases. The sex ratio was 3.2:1, which is similar to the study by Gupta A and Dutt N [10]. Mohapatra MM et al., showed a sex ratio of 6.6:1. Males and older age groups were affected more commonly than females in all studies [8].

Radiologically, the upper lobes of both lungs were most commonly involved. The studies by Mohapatra MM et al., Gupta A and Dutt N, Weiss W and Cherniack NS, and Takayanagi N et al., reported upper lobe involvement of the left lung in 13.05%, 8%, 8.4%, and 19% of cases, respectively [8,10,13,14]. Right upper lobe involvement was seen in 36% of cases, similar to the findings of Takayanagi N et al., [14]. In the studies by Mohapatra MM et al., and Gupta A and Dutt N, right upper lobe involvement was reported in 50% and 16% of cases, respectively [8,10]. The middle lobe of the right lung was involved in 8% of cases, which aligns with the findings of Gupta A and Dutt N [10]. The lower lobe of the right lung was involved in 10% of cases in this study. More than one lobe in the right lung was involved in 6% of cases. Mohapatra MM et al., and Takayanagi N et al., found this in 2.17% and 3.9% of cases, respectively [8,14]. Upper and lower lobe involvement of the left lung was observed in 22% and 18% of cases, respectively, in this study. Thus, dependent segments in a recumbent position, specifically the posterior segment of the upper lobe and the superior segment of the lower lobe, are more commonly involved, likely favoured by gravitational flow. In the present study, the major predisposing factor was poor oral hygiene, found in 44% of cases. In the studies by Mohapatra MM et al., Gupta A and Dutt N and Takayanagi N et al., the rates were 43%, 68% and 61%, respectively, for poor oral hygiene [8,10,14]. Poor oral hygiene increases the number of anaerobes in the oral cavity. Infected material from the mouth might be aspirated during sleep. Dental caries, periodontal infections, gingivitis and oral sepsis were considered criteria for poor oral hygiene in the present study. Dental decay was found in 11 (18%) cases in the study by Magalhaes L et al., [15]. Lung abscess is rare in edentulous persons; when present, it suggests the possibility of an associated bronchogenic carcinoma [16]. Alcoholism may have favoured aspiration due to altered sensorium and was present in 26% of cases in this study. Mohapatra MM et al., and Takayanagi N et al., reported alcoholism in 22% and 16.6% of their patients, respectively [8,14]. Another contributing factor in this study was diabetes mellitus (14%). Takayanagi N et al., showed 22.9% of cases, which was higher compared to the present study [14]. Mohapatra MM et al., and Gupta A and Dutt N detected diabetes in 8.7% and 4% of their patients, respectively [8, 10]. Seizures were found in 4% of cases in the present study. All the above studies show similarities in risk factors, indicating that poor oral hygiene, alcohol use and diabetes mellitus increase the risk of lung abscess.

Pre-existing lung diseases such as Chronic Obstructive Pulmonary Disease (COPD), bronchiectasis, obstruction by tumours, carcinoma and congenital anomalies were present in 16% of cases in the present study. COPD and bronchiectasis were the most commonly found conditions. Mohapatra MM et al., Gupta A and Dutt N and Takayanagi N et al., reported these conditions in 4.35%, 8% and 13.7% of cases, respectively [8, 10, 14]. In 12% of cases, no known predisposing factor was observed in the present study. Mohapatra MM et al., Gupta A and Dutt N and Takayanagi N et al., did not find any predisposing factors in 15.5%, 28% and 18.5% of their cases, respectively [8, 10, 14]. Thus, there is variation in the prevalence of pre-existing lung diseases across different studies.

The most common symptom in the present study was cough with expectoration, observed in all cases. Mohapatra MM et al., Gupta

A and Dutt N and Takayanagi N et al., found this symptom in 91%, 100% and 55.6% of cases, respectively [8, 10, 14]. Fever was the second most common symptom, present in 96% of cases in this study. Mohapatra MM et al., Gupta A and Dutt N and Takayanagi N et al., observed fever in 83%, 68% and 81.5% of cases, respectively [8, 10, 14]. Weight loss was noted in 46% of cases in the present study, while Mohapatra MM et al., Gupta A and Dutt N and Takayanagi N et al., reported it in 18%, 24% and 8.3% of cases, respectively [8, 10, 14]. Chest pain was present in 50% of cases in this study, compared to 21.7%, 42% and 37.1% in the studies by Mohapatra MM et al., Gupta A and Dutt N and Takayanagi N et al., respectively [8, 10, 14]. Haemoptysis was present in 8% of cases in this study, which was similar to the findings of Mohapatra MM et al., [8]. Dyspnoea was present in 18% of cases. Thus, cough with expectoration and fever were the most common symptoms in this and all other studies, while weight loss was less commonly reported.

Mycobacterium tuberculosis was detected in sputum microscopy using rhodamine and auramine stains in 20% of cases in this study, which was higher than other organisms, reflecting the greater prevalence of tuberculosis in our country. *Staphylococcus aureus* was found in 10% of cases in this study, which was similar to the study by Chidi CC and Mendelsohn HJ [3]. Gupta A and Dutt N and Deng A et al., observed it in 28% and 39.02% of cases, respectively [10, 11]. *Streptococcus pneumoniae* was observed in 6% of cases in this study, which was similar to Gupta A and Dutt N's findings, but higher (43%) in Deng A et al.'s study [11]. In the present study, *Klebsiella pneumoniae* was found in 14% of cases. Its presentation may be acute but not severe, often associated with multiple cavities and putrid sputum. *Haemophilus influenzae* was isolated in only 2% of cases. *Escherichia coli* was found in 6% of cases in this study. Chidi CC and Mendelsohn HJ, Gupta A and Dutt N and Deng A et al., observed it in 20%, 16% and 26.83% of cases, respectively [3, 10, 11]. No pathogen was found in 32% of cases in this study. Gupta A and Dutt N and Deng A et al., also did not find any pathogenic organisms in 16% and 18% of their cases, respectively [10, 11]. This could be due to prior antibiotic use by patients before coming to the hospital, which may have resulted in no pathogenic organism being detected in the sputum report. Therefore, the above findings suggest that tuberculosis is a more common cause of lung abscess in India and mixed organisms are commonly found in lung abscess patients rather than a single organism.

A total of 24% of cases were treated with amoxicillin+clavulanic acid in this study. In the study by Moreira JS et al., 74.6% of patients received amoxicillin + clavulanic acid [17]. Trials on antibiotic regimens for lung abscesses have reported that  $\beta$ -lactamase inhibitors/ $\beta$ -lactams are the mainstay for the treatment of aspiration pneumonia and lung abscesses [18, 19]. In this study, 56% of cases received clindamycin. In the studies by Mohapatra MM et al., and Moreira JS et al., 30.43% and 18.3% of cases received it, respectively [8, 17]. A total of 44% of cases were treated with metronidazole in this study. In the study by Mohapatra MM et al., 17.4% of cases were treated with it. Additionally, 36% of cases were treated with cefoperazone+sulbactam in the present study, while 21.7% of cases received it in Mohapatra MM et al.'s study [8]. Furthermore, 20% of cases were treated with piperacillin+tazobactam in the present study and 16% of cases received meropenem. In Mohapatra MM et al.'s study, 4.34% of cases were treated with it [8]. Four percent of cases received amikacin in this study, while 34.7% of cases were treated with it in Mohapatra MM et al.'s study [8]. A total of 10 (20%) cases were placed on antitubercular drugs in this study and showed improvement. Surgical intervention was not required in any case in this study. Therefore,  $\beta$ -lactam antibiotics combined with metronidazole or clindamycin are the most effective treatments for lung abscesses in all studies.

Patients were considered cured when they were asymptomatic and when chest roentgenograms were clear or showed a small stable residual lesion. In the present study, 40 (80%) cases were clinically improved and 30 (60%) patients showed radiological improvement after 14 days. The remaining cases improved both clinically and radiologically after 42 days. Out of 50 cases, 10 (20%) required six months of antitubercular treatment, with radiological resolution observed within 42 days. All cases responded well to treatment. In the study by Gupta A and Dutt N, all cases showed satisfactory improvement with medical treatment over a duration of 2 to 8 weeks, except for one case that had bronchogenic carcinoma [10]. In the study by Takayanagi N et al., the duration of antibiotic administration ranged from 28 to 48 days [14]. The three patients with nocardiosis and the three with actinomycosis required antibiotic treatment for 76 to 189 days. Cure rates of 85-90% have been reported by Gittens SA and Mihaly JP and Fox JR et al., [16, 20]. Therefore, the above studies suggest that most lung abscess patients respond well to four to six weeks of antibiotics.

### Limitation(s)

Anaerobic culture was not performed due to practical limitations, as specimens need to be obtained through transtracheal aspiration to prevent false results. Additionally, some patients had already received antibiotics beforehand, which may alter the culture results.

### CONCLUSION(S)

The present study showed that the occurrence of lung abscesses was more common in males over the age of 40, especially in patients with co-morbidities, addictions, or pre-existing lung conditions. Upper lobe involvement was the most common and most patients responded well within 4 to 6 weeks of receiving broad-spectrum antibiotics in the form of beta-lactamase with metronidazole or clindamycin. Mycobacterium tuberculosis was found to be more common in India. Early diagnosis, strict control of co-morbidities, cessation of addictions and optimal medical therapy are the mainstays for treating lung abscess patients.

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