

Clinical, Radiological and Bacteriological Profile of Lung Abscess - An Observational Hospital Based Study

Madhusmita Mohanty Mohapatra^{*}, Manju Rajaram, Archana Mallick

Department of Pulmonary Medicine, JIPMER, Pondicherry, India

Abstract

Citation: Mohapatra MM, Rajaram M, Mallick A. Clinical, Radiological and Bacteriological Profile of Lung Abscess - An Observational Hospital Based Study. Open Access Maced J Med Sci. 2018 Sep 25; 6(9):1642-1646. <https://doi.org/10.3889/oamjms.2018.374>

Keywords: Cavity with fluid level; *Klebsiella pneumoniae*; Lung abscess

***Correspondence:** Madhusmita Mohanty Mohapatra, Department of Pulmonary Medicine, JIPMER, Pondicherry, India. E-mail: dmdhushmita1@gmail.com

Received: 27-Jun-2018; **Revised:** 20-Aug-2018; **Accepted:** 21-Aug-2018; **Online first:** 23-Sep-2018

Copyright: © 2018 Madhusmita Mohanty Mohapatra, Manju Rajaram, Archana Mallick. This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0)

Funding: This research did not receive any financial support

Competing Interests: The authors have declared that no competing interests exist

BACKGROUND: The incidence of lung abscess acquired in the community is unknown, but this is a common clinical problem encountered in developing countries. The incidence of lung abscess was high in the pre-antibiotic era but the advent of susceptible antibiotics it has reduced with an equal fall in mortality to 8.7%. With the emerging antibiotic resistance and change in the trends of bacteriological profile causing lung abscess, it is the need of time to reevaluate lung abscess.

AIM: The study aimed to determine the clinical, radiological and bacteriological profile of lung abscess.

MATERIAL AND METHOD: The study was a non-randomized prospective observational study conducted in the department of pulmonary medicine for 18 months. In the study, patients > 15 years of age with clinical features of lung abscess were recruited and were subjected to chest X-ray, routine blood test. Sputum gram stain and culture, as well as antibiotic sensitivity according to the organism, were evaluated. Reports of all investigations along with patient characteristics and risk factors were analysed statistically using SPSS 20.0.

RESULTS: Forty-six cases of lung abscess were included, and the majority of patients were found to be adults with a mean age of 42.9 years with a male to female ratio of 6.6:1. The most common predisposing factor was an unhygienic oral cavity in 28% of cases with alcohol ingestion being the most important risk factor in 22% of cases. The most common organism found in lung abscess cases was *Klebsiella pneumoniae*, and they were sensitive to ceftazidime.

CONCLUSION: Our study shows that *Klebsiella pneumoniae* should be considered an important pathogen in community-acquired lung abscesses.

Introduction

Lung abscess is defined as an area of necrosis of lung parenchyma leading to the cavity with air-fluid level due to the formation of a bronchopulmonary communication. One cm to two cm sized necrotising abscesses coalesce to become large lung abscess. These lung abscesses can be primary or secondary to underlying lung disease, acute or chronic based on the duration of the disease, community acquired or hospital acquired in nature. The mortality was higher for lung abscess in the pre-antibiotic era, but with the advent of antibiotic therapy, the mortality has reduced to 8.7% [1].

Many risk factors are associated with the formation of lung abscess. Based on aetiology, the type of causative organism for lung abscess also varies. With the advent of antibiotics, the etiological trend has changed, and a large chunk of cases needs to be still evaluated. Anaerobes from oropharyngeal secretion and gram-positive organisms were indicated as the main pathogenic organism in few small studies earlier [2]. But due to lack of skilled physicians for transtracheal and transthoracic lung aspiration, the etiological diagnosis of lung abscess has been rare.

The radiological picture of the cavity with air-fluid level can occur at any site of the lungs. Whether this radiological distribution of lung abscess has any association with the aetiology is still not clear in the literature. With the problem of antibiotic resistance,

clindamycin and penicillin used previously for the treatment of community-acquired lung abscess are no longer effective.

Since little data is available on the clinical correlation/ characterisation of lung abscess and their management, hence there is a need to describe the various risk factors as well as the radiological and bacteriological profile of lung abscess.

The objective of this study is to evaluate the clinical, radiological and bacteriological profile of lung abscess in a tertiary care centre in India

Methodology

This prospective observational study was approved by the Institute scientific and ethical committee. The study was carried out for 18 months, and 46 cases of lung abscess were included over a period of 18 months. Patients were selected from outpatient and inpatient of the department of pulmonary medicine. A detailed history of unconsciousness, alcohol intake, epilepsy and anaesthesia were taken. History of oral and dental infection, dental extraction, diabetes mellitus, pneumonia and sinusitis was also elicited. A detailed clinical examination for evaluating lung abscess was done. A routine investigation like hemogram, sputum for gram stain and acid-fast bacilli, blood culture, sputum culture and antibiotic sensitivity and chest X-ray PA view was done. Apart from the above investigations bronchoscopy, CT scan thorax with CT guided FNAC, serology and immunology tests were done where there was ambiguity. Patients are having chest X-ray PA view showing cavity, and air-fluid level with fever ($> 37.8^{\circ}\text{C}$), purulent sputum, cough were included in the study. Patients less than 15 years of age and with bronchiectasis, malignancy, pulmonary infarction was excluded from the study.

The data was prepared in excel sheet, and statistical analysis was done using SPSS version 20.0. The continuous variables were measured regarding the mean and standard deviation. The categorical variables were measured regarding percentage.

Results

In this study, the majority of the patients were above 40 years (58.7%) with a mean age of 42.9 years and an age range of 15 to 65 years. Out of 46 cases of lung abscess, 40 cases were males (87%) with a male to female ratio of 6.6:1 (Table 1).

Table 1: Demographic profile of lung abscess

Age	No. of cases	Percentage
> 40years	15	32.6%
< 40years	31	67.3%
Mean Age	42.9 years	
Sex	No. of cases	Ratio
Male	40	6.6:1
Female	6	

In our study, about 21 cases (45%) had predisposing factors and the most common predisposing factor was an unhygienic oral cavity in 13 cases (28%) followed by dental sepsis in 6 cases (13%). About 22 cases had associated risk factors and the most common risk factor found was alcohol ingestion in 10 cases (22%) and smoking in 8 cases (17%) (Table 2).

Table 2: Predisposing and risk factor for lung abscess

Predisposing factor	No. of cases	Percentage
Unhygienic oral cavity	13	28%
Dental sepsis	6	13%
Dental procedure	1	2%
Seizure	1	2%
Risk factor	No. of cases	Percentage
Alcoholic	10	22%
Smoker	8	17%
Diabetes	4	
COPD	2	

Amongst symptomatology, the most common symptom observed was a cough in 42 cases (91%). Fever was present in 38 cases (83%) (Table 3).

Table 3: Symptomatology of lung abscess

Symptomatology	No. of cases	Percentage
Fever	38	83%
Cough	42	91%
Expectoration	35	76%
Chest pain	10	21.7%
Hemoptysis	5	10.8%
Breathlessness	5	10.8%
Loss of appetite	8	17%

Radiologically majority of lung abscess was found to be located on the right side with the most common site being right upper lobe in 23 cases (52.17%) followed by right lower lobe in 9 cases (19.56%). Lung abscess was also present on left lung with the most common site being left upper lobe in 6 cases (13.10%). Majority of lung abscess presented radiologically with a cavity and fluid level. 34 cases (74%) represented a cavity radiologically with a fluid level while 8 cases (17%) were empty cavity (Table 4).

Table 4: Radiological site and characteristic of lung abscess

Radiological sites	No. of cases	Percentage
Right side		
Upper lobe	23	52.17%
Middle lobe	4	8.7%
Lower lobe	9	19.56%
Combined	1	2.17%
Left side		
Upper lobe	6	13.1%
Lower lobe	3	6.52%
Radiological Characteristic		
Cavity with fluid level	34	74%
Empty cavity	8	17%
Cavity with consolidation	4	9%

All lung abscess patients underwent sputum gram stain, and 35 cases (76.09%) were found to have a gram-negative organism. Two cases (4.35%) of lung abscess grew gram-positive organisms (Table 5).

Table 5: Sputum gram stain for lung abscess

Sputum Gram Stain	No. of cases	Percentage
Gram-positive	2	4.35%
Gram-negative	35	76.09%
Mixed	NIL	0%
No organism	9	19.56%

Sputum culture was done for cases which had gram stain results and the most common organism observed in lung abscess was gram negative *Klebsiella pneumoniae* in 23 cases (50%) followed by *Escherichia. Coli* in 12 cases (26%) cases (Table 6).

Table 6: Sputum culture for lung abscess

Organism	No. of cases	Percentage
<i>Klebsiella</i>	23	50%
<i>E.coli</i>	12	26.08%
<i>Streptococcus. pneumoniae</i>	2	4.35%
Mixed growth	8	17.4%
No growth	9	19.6%

The antibiotic to which the bacteria was sensitive was cefazidime and amikacin (Table 7).

Table 7: Antibiotic sensitivity of sputum in lung abscess

Antibiotic Sensitivity	No. of cases	Percentage
Ceftriaxone	12	26%
Cefoperazone	10	21.7%
Ceftazidime	25	54.34%
Amikacin	16	34.7%
Streptomycin	5	10.86%
Metronidazole	8	17.4%
Clindamycin	14	30.43%
Meropenam	2	4.34%

Discussion

Although the incidence of developing lung abscess has decreased with the advent of antibiotics still its presence is marked by the presence of risk factors. The incidence of lung abscess found in our study was more in adult males with a mean age of 42.9 years. This finding was similar to the findings of JS. Moriera et al. where the majority of lung abscess was in adult males more than 40 years of age with an age range of 15 to 65 years [3].

The most common symptom observed in lung abscess cases was a cough followed by fever. Cough was present as the main symptom in 42 cases (91%), and fever was present in 38 cases (83%). The initial symptom of lung abscess is a cough for a few days followed by expectoration once a bronchopulmonary communication was established. The findings of our study were in accordance to what was observed by all

studies [4] [5]. Several predisposing factors are associated with the causation of lung abscess. The unhygienic oral cavity was found to be the most important causative agent for a lung abscess. About 28% of lung abscess cases had an unhygienic oral cavity which was represented in a few studies [1] a [2] [3] [4] [5] [6]. The oral cavity is an abode for many organisms which stays in the gingival crevices and cause lung abscess when aspirated and hence unhygienic oral cavity leads to lung abscess. Dental sepsis was also noted in 6 cases (13%) of lung abscess cases. Alcohol ingestion and smoking were found to be two important risk factors in our study. About 10 cases (22%) gave a history of alcohol ingestion in our study while 8 cases (17%) were smokers. Our study had similar findings as was observed for risk factors in studies done by Takayanagi N and Magalhaes L [6] [7]. Loss of consciousness due to alcohol ingestion, epilepsy leading aspiration of oral secretion was found to be the main cause. Gastroesophageal pathology like oesophageal malignancy, oesophageal stenosis or gastric outlet obstruction due to tumours leading to aspiration of oral secretion has also been found to be an important contributor to lung abscess. In patients on ventilators, lung abscess has been seen due to microaspiration of oral secretions as well as due to hematogenous spread of organism leading to single or multiple lung abscesses.

Radiology plays an important role in identifying lung abscess. Chest X-ray not only helps in identifying lung abscess but also determines the location of the abscess. Plain CT scan thorax is sometimes done where there is confusion in differentiating lung abscess from loculated hydropneumothorax [8]. In our study the majority of the lung, the abscess was found to be located on the right side compared to the left side. Very few lung abscesses were present in bilateral lung fields. The most common location in our study was the right upper lobe followed by right lower lobe. This was because the majority of our patients were alcoholic and might have aspirated the oral secretion when unconscious under the influence of alcohol. Since anatomically the right main bronchus is straighter than left, the majority of our lung abscess was found on the right side. Majority of our lung abscess were represented by a cavity with fluid level, but few cases had an only empty cavity. Our study had similar finding as was observed by studies done by few authors where lung abscess was found most commonly on the right side and in the upper lobe [6] [8] [9].

All lung abscess cases were subjected to investigation by examination of their sputum for acid-fast staining and gram staining and culture sensitivity. In our study, sputum of all lung abscesses was sent for gram stain. Out of 46 cases of lung abscess, only 37 cases had an organism. In the remaining 9 cases, there was no growth of the organism. The most

common organism detected was *Klebsiella pneumoniae* in 23 cases which were followed by *E. coli* in 12 cases. Nine cases did not yield any organism. Two cases had gram-positive *Streptococcus pneumoniae* organism. Our findings did not show any other Streptococcus species except *Streptococcus pneumoniae* though *Streptococcus viridans* was found to be a cause of lung abscess in a study done by Jerng JS et al., [10] while other studies showed *Streptococcus pneumoniae* as a common gram-positive organism for lung abscess [11] [12]. In our study, the most common organism observed was *Klebsiella pneumoniae* and was similar to findings observed by Wang JL et al., [13]. Few studies on the bacteriology of lung abscess have been done due to the low incidence of the disease, and *K. pneumoniae* was reported in small studies during the 1970s. There have been few case reports of *K. pneumoniae* lung abscess occurring as concurrent infection at other sites [14] [15] [16]. In our study, all the *K. pneumoniae* lung abscess was not secondary to bacteremia or other foci of infection. Studies have shown that there is pharyngeal colonisation of gram-negative organisms and in alcoholics may contribute gram-negative pneumonia and lung abscess formation due to the aspiration to lower respiratory tract. In children, most studies showed that a common organism causing lung abscess was *Staphylococcus aureus* and *Streptococcus pneumoniae* [17]. There has been a noted difference in the organism causing lung abscess in immunocompetent and immunocompromised patients. It was found that aerobic organisms are mainly responsible for causing lung abscess in immunocompromised patients while lung abscess caused in immunocompetent patients was caused by anaerobic organism [18]. With the upcoming resistance pattern of antibiotics and immunomodulation due to environmental effect, a lot of gram-negative organism as well as gram-positive organisms are involved in the causation of lung abscess instead the conventional anaerobes. Studies done shows that these causes may be important for the pathogenesis of lung abscess due to *K. pneumoniae*.

Culture sensitivity of an organism with sputum gram stain for lung abscess was evaluated, and most of these cases were sensitive to ceftazidime and amikacin suggesting most of the organisms were gram negative. Trails on antibiotics regimen in lung abscess reported that β -lactamase inhibitors/ β -lactams are the mainstay for the treatment of aspiration pneumonia and lung abscess [19] [20]. Since there may be a mixed pattern of the organism which was either not detected or present as commensal, it is better to treat these cases with a combination of cephalosporins, aminoglycosides and anaerobic coverage with metronidazole or clindamycin.

The limitation of our study is that the majority of lung abscess cases who presented to us had used

antibiotics from a local hospital for a fever. Main bacteria like anaerobes could not be isolated effectively due to the prior use of antibiotics.

K. pneumoniae should be considered as an important pathogen in community-acquired lung abscess in addition to anaerobes. Their presentation may be acute but not severe with the presentation of multiple cavities and putrid sputum. With the increased number of *K. pneumoniae* infection and antibiotic resistance, it is safe to give third-generation cephalosporin and metronidazole or clindamycin.

Currently, there is lack of consensus on the best approach to the management of lung abscess, and controversies still surround medical and surgical approaches. Large prospective studies are required to evaluate better factors predicting clinical outcome of pyogenic lung infections. Protected lung specimen by bronchoscopy method or by transthoracic/transtracheal lung aspiration should be done to evaluate the common etiological agent so that an antibiotic protocol can be framed for treatment of lung abscess.

References

1. Kuhajda I, Zarogoulidis K, Tsigogianni K, Tsavlis D, Kioumis I, Kosmidis C, Tsakiridis K, Mpakas A, Zarogoulidis P, Zissimopoulos A, Baloukas D, Kuhajda D. Lung abscess-etiology, diagnostic and treatment options. *Ann Transl Med.* 2015; 3(13):183. PMID:26366400 PMCid:PMC4543327
2. Bartlett JG. The role of anaerobic bacteria in lung abscess. *Clin Infect Dis.* 2005; 40(7):923-5. <https://doi.org/10.1086/428586> PMID:15824980
3. Moreira Jda S, Camargo Jde J, Felicetti JC, Goldenfun PR, Moreira AL, Porto Nda S. Lung abscess: analysis of 252 consecutive cases diagnosed between 1968 and 2004. *J Bras Pneumol.* 2006; 32(2):136-43. <https://doi.org/10.1590/S1806-37132006000200009> PMID:17273583
4. Yen CC, Tang RB, Chen SJ, Chin TW. Pediatric lung abscess: a retrospective review of 23 cases. *J Microbiol Immunol Infect.* 2004; 37(1):45-9. PMID:15060687
5. Schiza S, Siafakas NM. Clinical presentation and management of empyema, lung abscess and pleural effusion. *Curr Opin Pulm Med.* 2006; 12(3):205-11. PMID:16582676
6. Takayanagi N, Kagiyama N, Ishiguro T, Tokunaga D, Sugita Y. Etiology and outcome of community-acquired lung abscess. *Respiration.* 2010; 80(2):98-105. <https://doi.org/10.1159/000312404> PMID:20389050
7. Magalhães L, Valadares D, Oliveira JR, Reis E. Lung abscesses: review of 60 cases. *Rev Port Pneumol.* 2009; 15(2):165-78. [https://doi.org/10.1016/S0873-2159\(15\)30125-2](https://doi.org/10.1016/S0873-2159(15)30125-2)
8. Stark DD, Federle MP, Goodman PC, Podrasky AE, Webb WR. Differentiating lung abscess and empyema: radiography and computed tomography. *AJR Am J Roentgenol.* 1983; 141(1):163-7. <https://doi.org/10.2214/ajr.141.1.163> PMID:6602513
9. Mansharamani NG, Koziel H. Chronic lung sepsis: lung abscess, bronchiectasis, and empyema. *Curr Opin Pulm Med.* 2003; 9(3):181-5. <https://doi.org/10.1097/00063198-200305000-00005>
10. Jerng JS, Hsueh PR, Teng LJ, Lee LN, Yang PC, Luh KT. Empyema thoracis and lung abscess caused by viridans

- streptococci. *Am J Respir Crit Care Med*. 1997; 156(5):1508-14. <https://doi.org/10.1164/ajrccm.156.5.97-03006> PMID:9372668
11. Nicolini A, Cilloniz C, Senarega R, et al. Lung abscess due to *Streptococcus pneumoniae*: a case series and brief review of the literature. *Pneumonol Alergol Pol*. 2014; 82:276-85. <https://doi.org/10.5603/PiAP.2014.0033> PMID:24793153
12. Ito Y, Toyoshima H, Suzuki T, Iwamoto K, Sasano H, Itani H, Kondo S, Tanigawa M. Lung abscess caused by *Streptococcus pneumoniae* serotype 6B. *Respir Med Case Rep*. 2017; 23:71-73. PMID:29487787 PMCid:PMC5805848
13. Wang JL, Chen KY, Fang CT, Hsueh PR, Yang PC, Chang SC. Changing bacteriology of adult community-acquired lung abscess in Taiwan: *Klebsiella pneumoniae* versus anaerobes. *Clin Infect Dis*. 2005; 40(7):915-22. <https://doi.org/10.1086/428574> PMID:15824979
14. Bhat KS, Hedge N, Pais CC. *Klebsiella pneumoniae* with lung abscess. *J Assoc Physicians India*. 1990; 38(5):378-9. PMID:2387832
15. Ko WC, Paterson DL, Sagnimeni AJ, Hansen DS, Von Gottberg A, Mohapatra S, Casellas JM, Goossens H, Mulazimoglu L, Trenholme G, Klugman KP, McCormack JG, Yu VL. Community-acquired *Klebsiella pneumoniae* bacteremia: global differences in clinical patterns. *Emerg Infect Dis*. 2002; 8(2):160-6. <https://doi.org/10.3201/eid0802.010025> PMID:11897067 PMCid:PMC2732457
16. Seo H, Cha SI, Shin KM, Lim J, Yoo SS, Lee J, Lee SY, Kim CH, Park JY. Focal necrotizing pneumonia is a distinct entity from lung abscess. *Respirology*. 2013; 18(7):1095-100. <https://doi.org/10.1111/resp.12124>
17. Chan PC, Huang LM, Wu PS, Chang PY, Yang TT, Lu CY, Lee PI, Chen JM, Lee CY, Chang LY. Clinical management and outcome of childhood lung abscess: a 16-year experience. *J Microbiol Immunol Infect*. 2005; 38(3):183-8. PMID:15986068
18. Mansharamani N, Balachandran D, Delaney D, Zibrak JD, Silvestri RC, Koziel H. Lung abscess in adults: clinical comparison of immunocompromised to non-immunocompromised patients. *Respir Med*. 2002; 96(3):178-85. <https://doi.org/10.1053/rmed.2001.1247> PMID:11905552
19. Yazbeck MF, Dahdel M, Kalra A, Browne AS, Pratter MR. Lung abscess: update on microbiology and management. *Am J Ther*. 2014; 21(3):217-21. <https://doi.org/10.1097/MJT.0b013e3182383c9b> PMID:22248872
20. Mandell LA, Wunderink RG, Anzueto A, et al. Infectious Diseases Society of America/American Thoracic Society consensus guidelines on the management of community acquired pneumonia in adults. *Clin Infect Dis*. 2007; 44(Suppl 2): S27-72. <https://doi.org/10.1086/511159> PMID:17278083