Journal of Pharmacology and Drug Delivery

Research Article

Lung Abscess: Causes and Therapeutic Approaches

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ABSTRACT

Background: Lung abscesses are considered one of the diseases that affect humans of all ages, which occur as a result of infection that affects the respiratory system, and it occurs in males more than female.

Methods: This cross-sectional study was conducted on 122 patients from Damascus Hospital where All patients with a lung abscess and divided into two groups: patients with primary lung abscess (81.1%) and patient with secondary lung abscess (18.9%) who met the exclusion and inclusion criteria were accepted.

Results: The sample included 122 patients, all of whom had lung abscess, (males 72.2%, females 27.9%), the percentage of patients between 40 and 50 years of age was 29.5%, which is the most age group in the study, most of patients were from Damascus countryside (39.3%), most of the patients were smoked cigarettes (57.4%). As for the type of lung abscess, the largest percentage of lung abscess was without surgical intervention, (81.1%), and the method of diagnosis was based mainly on R-xay (57.4%), and the treatment was based mainly on antibiotics (75.4%), right lower lung lobe mainly Infected (32.8%), anaerobes is mainly causative agent (54.1%), and deaths occurred in (11.5%) of patients.

Conclusion: The most important causative factor for a lung abscess is anaerobes. There is no statistically significant relationship between the duration and amount of smoking and the incidence of lung abscess. There is no statistically significant relationship mortality and method of treatment and type of causative agent.

Keywords: Lung abscess; Pulmonary disease; Etiology; Therapy diagnosis

INTRODUCTION

Lung abscess is defined as a circumscribed area of pus or necrotic debris in lung parenchyma, which leads to a cavity, and after formation of bronchopulmonary fistula, an airfluid level inside the cavity [1]. Lung abscess is in the group of lung infections such as lung gangrene and necrotizing pneumonia which is characterized with multiple abscesses [2]. The clinical signs and therapy of lung abscess was described for the first time by Hippocrates. In pre-antibiotic era, one third of patients with lung abscess would die, the other third of patients would recover fully, and the rest of them would survive with sequels such as chronic lung abscess, pleural empyema or bronchiectasis [3]. In that time, surgery was considered as the only effective therapy, and today most of the patients will be fully recovered only with antibiotic therapy. Hundred years ago, mortality from lung abscess was about 75% of patients [4]. Open drainage of lung abscess decreased mortality on 20%-35% and with antibiotic therapy mortality drop on about 8.7% [5]. At the same time, progress in oral and dental hygiene declined the incidence of lung abscesses. Today, aspiration from oral cavity is considered the major cause of lung abscesses as well as poor oral and dental hygiene [6]. In pre antibiotic era, lung abscess was caused by one type of bacteria, and today almost in all cases is caused by poly microbial flora [2]. Lung abscess can be divided on acute (less than 6 weeks) and chronic (more than 6 weeks). It can be called primary as a result of aspiration of oropharyngeal secretions (dental/periodontal infection, para nasal sinusitis, disturbance states of consciousness, swelling disorders, gastro-oesophageal reflux disease, frequent vomiting, necrotizing pneumonia's or in immunocompromised patients. Secondary lung abscesses occurred in bronchial obstructions (by tumor, foreign body or

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Received: Jul 08 2024, **Accepted:** Aug 10 2024; **Published:** Aug 19, 2024,DOI: 10.59462/jpdd.1.2.107

Citation: Al-Fawaris M, Mustafa N, Al-Masri L, Bardan H (2024) Lung Abscess: Causes and Therapeutic Approaches. Journal of Pharmacology and Drug Delivery,1(2):107.

enlarged lymph nodes), with coexisting lung diseases (bronchiectasis, bullous emphysema, cystic fibrosis, infected pulmonary infarcts, lung contusion), then spreading from extrapulmonary sites-hematogenous (abdominal sepsis, infective endocarditis, infected canula or central venous catheter, septic thromboembolisms) or by direct spreading (broncho-oesophageal fistula, subphrenic abscess) [6]. Based on way of spreading, lung abscess can be bronchogenic (aspiration, inhalation) and haematogenicdissemination from other infected sites.

METHODOLOGY

This study aims to describe lung abscesses and their treatment and diagnosis. It aims to study The relationship between Therapy and Mortbilty, study the relationship between Etiology and Mortbilty and The relationship between smoking and the type of lung abscess, as samples were collected in Damascus Hospital of the Syrian Ministry of Health between 2012 and 2021 during the official working hours of the hospital, and 122 samples were collected.

Inclusion and exclusion criteria

Inclusion criteria: All patients with a lung abscess were accepted and their files fulfilled all the information required for the study, Patients admitted to the emergency room, internal thoracic division, thoracic internal and thoracic surgery clinics.

Exclusion criteria: Patient files in which part of the requested information was available were excluded. Patients diagnosed with pulmonary abscesses but continued treatment outside Damascus Hospital were excluded and Patients who were discharged from the hospital were excluded at their own risk.

Instrumentation and procedure: The study was conducted in a prospective cross-sectional study design, between 2012 and 2021 after obtaining ethical approval. The medical and surgical files of all patients in our study sample were thoroughly studied. The researchers collected samples for the mentioned patients after obtaining the approval of the hospital director. The information required for the study was collected, then specially designed forms were filled out with the collected data.

Data analysis: The variables and data were entered and encoded in Excel, and then entered and decoded in SPSS-26 to analyze relationships, graphs, and statistical tables through it the relationship between qualitative and demographic variables was studied using chi-square test.

Ethical considerations: Ethical approval was obtained from the Institutional Review Board (IRB) Faculty of Medicine, Syrian Private University, and the Damascus Hospital Institutional Review Board (IRB). Verbal consent was obtained from each patient when contacting them for data collection purposes.

RESULTS

The sample included 122 patients who met the inclusion criteria age group most present in our study was from 40 to 50 years was 5.29%, and the least presence was within the study, the age group from 10 to 20 years was 2.8%, and thus the rest of the results are read as in Table 1.

As for gender, number of males was 88 (72.1%) and they are the most present in the sample, the number of females was 34 (27.9%) as shown in Table 2.

Speaking of the rate of patient acceptance over the years, the year in which patients were accepted the most was 2012, as the number of patients who were admitted to the hospital in 2012 were 42 patients (4.34%), and the number patients who were admitted in 2013 and 2014 were 28 patients (11.5%). the number of patients who were admitted in 2015 were 17 (13.9%) and the rest of the cases were distributed over the years as shown in Table 3.

Percentage of primary lung abscess in patients was (81.1%), while the percentage of secondary lung abscess was (18.9%), and the values here are not convergent at all, and there is a significant difference for as shown in Table 4.

Diagnosis was based primarily on X-ray (57.4%), followed CT scans were (29. 5%), and the rest of the surveys were distributed in varying proportions, as shown in Table 5.

Speaking of the size of lung abscess, the percentage of lung abscess that measures (4 cm × 5 cm) was (47.5%), while the percentage of lung abscess that measures (4 cm × 3 cm) was (46.7%), and the percentage of abscesses that measure (5 cm × 6 cm) was (4.1%) and the abscesses that measure (2 cm × 3 cm) and (2 cm × 4 cm) measuring were (0.8%) as shown in Table 6.

Percentage of patients diagnosed with anaerobes was (54.1%), while the percentage of patients diagnosed with gram-negative infection was (18%), and the percentage of patients diagnosed with gram-positive infections was (11.5%), while the percentage of patients diagnosed with more than one bacterial type of the above was (16.4%), as shown in Table 7.

Number of patients who were treated with chest drainage were 28 patients (23%) and were treated with specificity antibiotics of each pathogen diagnosed with bacterial cultures were 92 patients (75.4%), number of patients who were treated with surgical removal were 2 patients (1.6%), as shown in Table 8 and Figure 1.

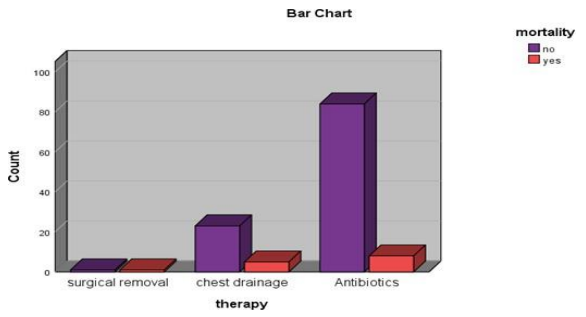

Figure 1: The relationship between pathogen and mortality.
Note: no ( ), yes ( )

Percentage of patients with primary lung abscess and non-smokers (35.2%), and patients with primary lung abscess and smokers for more than 10 years (39.3%), and so the rest of the statistical results is read as shown in Table 9.

Where death cases were significantly associated with patients with lung abscesses, the causative agent was anaerobes (4.9%), followed by gram-negative infection, followed by gram-positive infection by (3.3%) and (2.5%), respectively, and one death occurred when more than one pathogen was infected (0.8%) (Table 10).

When studying the relationship between the method of treating a lung abscess and the incidence of death, it was found that the percentage of patients who were treated with antibiotics and died (6.6%), and the percentage of patients were treated with chest blast and died (4.1%) and the percentage of patients who were treated with surgical excision and died (0.8%) (Table 11).

Age	Frequency	Percent
1-10 years	14	11.5
10-20 years	6	4.9
20-30 years	10	8.2
30-40 years	20	16.4
40-50 years	36	29.5
50-60 years	19	15.6
More 60 years	17	13.9
Total	122	100

Table 1: The relative distribution of the characteristics of the study sample according to age.

Gender	Frequency	Percent
Female	34	27.9
Male	88	72.1
Total	122	100

Table 2: The relative distribution of the characteristics of the study sample according to gender.

Year of admission	Frequency	Percent
2012	42	34.4
2013	14	11.5
2014	14	11.5
2015	17	13.9
2016	8	6.6
2017	5	4.1
2018	8	6.6
2019	2	1.6

2020	2	1.6
2021	10	8.2
Total	122	100

Table 3: The relative distribution of the characteristics of the study sample according to year of admission.

Type of abscesses	Frequency	Percent
Secondary	23	18.9
Primary	99	81.1
Total	122	100

Table 4: The relative distribution of the characteristics of the study sample according to type of abscesses.

Diagnosis	Frequency	Percent
More than a survey	11	9
Clinical history	3	2.5
microbial cultures	2	1.6
X-Ray	70	57.4
CT	36	29.5
Total	122	100

Table 5: The relative distribution of the characteristics of the study sample according to diagnosis.

Size of abscesses	Frequency	Percent
2 cm × 3 cm	1	0.8
2 cm × 4 cm	1	0.8
3 cm × 4 cm	57	46.7
4 cm × 5 cm	58	47.5
5 cm × 6 cm	5	4.1
Total	122	100

Table 6: The relative distribution of the characteristics of the study sample according to size of abscesses.

Etiology	Frequency	Percent
With more than one bacterial type	20	16.4
Gram-positive	14	11.5
Gram-negative	22	18
Anaerobes	66	54.1
Total	122	100

Table 7: The relative distribution of the characteristics of the study sample according to etiology.

Therapy	Frequency	Percent
Surgical removal	2	1.6
Chest drainage	28	23
Antibiotics	92	75.4
Total	122	100

Table 8: The relative distribution of the characteristics of the study sample according to therapy.

The relationship between smoking and the type of lung abscess			Type of abscesses		Total	P-value
			Secondary	Primary		
Time of smoking	Non-smoker	Count	9	43	52	0.456
		% of Total	7.40%	35.20%	42.60%	
	2-4 years	Count	3	4	7	
		% of Total	2.50%	3.30%	5.70%	
	4-6 years	Count	0	2	2	
		% of Total	0.00%	1.60%	1.60%	
	8-10 years	Count	0	2	2	
		% of Total	0.00%	1.60%	1.60%	
	More than 10 years	Count	11	48	59	
		% of Total	9.00%	39.30%	48.40%	
Total		Count	23	99	122	
		% of Total	18.90%	81.10%	100.00%	

Table 9: The relationship between smoking and the type of lung abscess.

The relationship between Etiology and Mortbilty			Mortbilty		Total	P-value
			No	Yes		
Etiology	With more than one bacterial type	Count	19	1	20	0.316
		% of Total	15.60%	0.80%	16.40%	
	Gram-positive	Count	11	3	14	

		% of Total	9.00%	2.50%	11.50%
	Gram-negative	Count	18	4	22
		% of Total	14.80%	3.30%	18.00%
	Anaerobes	Count	60	6	66
		% of Total	49.20%	4.90%	54.10%
Total		Count	108	14	122
		% of Total	88.50%	11.50%	100.00%

Table 10: The relationship between Etiology and Mortbilty.

The relationship between Therapy and Mortbilty			**Mortbilty**			
			No	**Yes**	**Total**	**P-value**
Therapy	Surgical removal	Count	1	1	2	0.093
		% of Total	0.80%	0.80%	1.60%	
	Chest drainage	Count	23	5	28	
		% of Total	18.90%	4.10%	23.00%	
	Antibiotics	Count	84	8	92	
		% of Total	68.90%	6.60%	75.40%	
Total		Count	108	14	122	
		% of Total	88.50%	11.50%	100.00%	

Table 11: The relationship between Therapy and Mortbilty.

DISCUSSION

The study showed a significant predominance of males in the group of those diagnosed with lung abscesses. Male predominance was also observed in another study conducted from 1968 to 2004, where lung abscesses were found in 252 consecutive cases of hospitalized patients, 209 of which were observed in males. The mean age in that study was 41.4 years [7]. Another study also showed the predominance of male patients and revealed values similar to our data with the mean age of 56.2 years (± 15.1) [8]. The latest study from India reported that the majority of patients with lung abscess were adults, with the mean age of 42.9 years and male to female ratio of 6.6: 1 [9]. Another report from Madagascar, based on cases of pulmonary abscess, showed the mean age of 38 years [10]. Male gender is a factor that can greatly affect the prevalence of the pulmonary abscess. However, it is worth noting that cigarette smoking is a risk factor for the occurrence of diseases that may increase the incidence of lung abscess, such as cardiovascular diseases and periodontal diseases. In a recent multicenter study from Poland, smoking history was reported in 92.6% of patients with stable chronic obstructive pulmonary disease [11]. Data from a large study on changes in the tobacco prevalence and use in the adult population of Poland in the period from 2003 to 2014 revealed that 30% of males and 21% of females were smokers [12]. A high rate of male smokers may indicate a significant influence of cigarette smoking on the occurrence of lung abscesses in Poland. This relationship seems to have been confirmed in other studies. A study based on 111 cases of pulmonary abscess in Madagascar showed that alcohol and tobacco abuse were observed in 32.2% of disease cases, whereby all patients were exposed to passive smoking [10]. In this subgroup, the male to female ratio, mean and median age were similar to those of the study group of all patients. Recent studies have provided limited data on gender and age of patients with mediastinum abscesses. Lack of oral cavity hygiene, abuse of alcohol and smoking were suggested to be causative agents for lung abscess [9]. Additionally, coronary artery bypass graft surgery may be a procedure increasing the risk of mediastinal abscess. A study from Poland reported the predominance of male patients among patients undergoing coronary artery bypass graft surgery [13]. One study involved an analysis of the data of 34 patients with descending necrotizing mediastinitis for the seven-year period from 2007 to 2013 and showed the mean age of 46.8 years, and the male to female ratio 3.25 [14]. In another study based on the data of 14 patients admitted to the surgical intensive care unit due to acute mediastinitis during the four-year period 2009–2012, the patients' mean age was 30 years and 8 months, and the male to female ratio was 1.33 [15]. In yet another study based on the data of patients treated surgically for mediastinitis, the outcome was satisfactory in 24 cases and 5 deaths were observed (mortality 17.2%) [16]. n our study, 14 patients (11.5%) were treated with surgery treatment and antipoetic, deaths patient with surgery treatment for lung abscesses have a significantly better prognosis than antipoetic with the same condition [17]. Additionally, in a study from Poland evaluating risk factors in children with community-acquired pneumonia, pneumococcal vaccination was reported to be significantly (p=0.03) associated with lower odds ratio for local complications [15]. In our study, 14 deaths (11.5% of all patients) were observed during the study

period all deaths were reported in finally-time hospitalized patients. All deaths were observed in adults. In another study focusing on patients hospitalized with lung abscess between 1968 and 2004, 4% of patients died [7]. A study from Madagascar based on 111 cases of pulmonary abscess reported 18 deaths (16.2%) [10]. Many factors can affect the mortality of patients with pulmonary or mediastinal abscess. Risk factors related to the increased mortality include smoking history and male gender [17]. Old age and associated multiple conditions have also been reported to be related to a worse prognosis [17]. Other negative prognostic factors are senility, neoplasms or bronchial obstruction [18]. When studying the relationship between mortality and the method of treatment, it was found that more deaths were associated with antibiotic treatment but without any statistical significance (P-value>0.05) this shows us that the surgical treatment is safe and associated with fewer deaths. When studying the relationship between the pathogen and mortality, it was found that the mortality rate was associated with more patients with anaerobes but without any statistical significance (P-value>0.05) this is evidence that anaerobes are an important virulence factor in causing death.

CONCLUSION

When studying the relationship between the duration of smoking and the type of lung abscess, it was found that the pulmonary abscess was significantly associated with patients with primary pulmonary abscess, but without statistical significance. The most important causative factor for a lung abscess is anaerobes. There is no statistically significant relationship between the duration and amount of smoking and the incidence of lung abscess. There is no statistically significant relationship mortality and method of treatment and type of causative agent.

DECLARATIONS

Ethics approval and consent to participate

The Research Ethics Committee in the Syrian Private University and the ethical committees in the concerned hospitals approved the study protocol. Verbal informed consent was obtained from every participant before participation. All procedures performed in studies involving human participants were by the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent for publication

Not applicable.

Availability of data and materials

All data related to this paper's conclusion are available and stored by the authors. All data are available from the corresponding author on a reasonable request.

Conflict of interest

The authors declare that they have no conflict of interest.

Funding

This research received no specific grant from SPU or any other funding agency in the public, commercial or non-profit sectors.

Authors' contributions

N.M. and H.B. conceptualized the study. N.M. and L.A. wrote the study protocol, performed the statistical analysis, participated in data collection, and did the literature search. M.A. participated in the literature search, interpret the results, wrote the main manuscript, and prepared the tables. H.B. revised the draft. All authors read and approved the final draft.

Acknowledgment

We are thankful to the management of the Syrian Private University and Damascus Hospital for their support in the field of medical training and research. We would also like to thank Dr. Husam Bardan for his help and supervision in the paper.

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