CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

SJIF Impact Factor: 7.187
http://doi.org/10.5281/zenodo.4073360

Available online at: http://www.iajps.com *Research Article*

STUDY OF VARIOUS MICROORGANISMS IN PATIENTS OF EMPYEMA THORACIS, DEVELOPING AS A COMPLICATION OF BACTERIAL PNEUMONIA

[1]Dr. Aizaz Rafiq Chaudhry, [2]Dr. Mariam Shah, [3]Dr. Rana Ali Assadullah
[1]Medical Officer, Bahawal Victoria Hospital, Bahawalpur
[2]Ex-house Officer, Bahawal Victoria Hospital, Bahawalpur
[3]Ex-house Officer, Bahawal Victoria Hospital, Bahawalpur

Article Received: August 2020 **Accepted:** September 2020 **Published:** October 2020

Abstract:

Objective: *To study the various microorganisms in patients of empyema thoracis developing as a complication of bacterial pneumonia.*

Material and methods: *This cross-sectional study was conducted at Bahawal Victoria Hospital, Bahawalpur form May 2019 to November 2019 over the period of 6 months. In this study, 102 patients with empyema thoracis were included. Aspirate from pleural cavity was sent for culture and sensitivity. The main outcome variable was frequency of microorganisms detected in culture and sensitivity reports which were described as frequency distribution tables.*

Results: *Out of 102 patients, growth was seen among 79 (77.5%) patients. Out of those 79 patients, the following were results: streptococcus milleri in 26 (32.9%) patients, Klebsiella pneumoniae in 19 (24.1%) patients and bacterioides in 12 (15.1%) patients.*

Conclusion: *Streptococcus milleri is the most common causative microorganism detected in patients with empyema throacis.*

Key Words: *Empyema thoracis, bacterial pneumonia, microorganisms*

Corresponding author:
Dr. Aizaz Rafiq Chaudhry,
Medical Officer,
Bahawal Victoria Hospital, Bahawalpur

QR code

Please cite this article in press Aizaz Rafiq Chaudhry et al, ***Study Of Various Microorganisms In Patients Of Empyema Thoracis, Developing As A Complication Of Bacterial Pneumonia.,*** *Indo Am. J. P. Sci, 2020; 07(10).*

INTRODUCTION:

Community-acquired pneumonia (CAP) is a common and serious illness with high morbidity and mortality, as approximately 20% of episodes result in hospitalization. Community-acquired pneumonia can be a source of both morbidity and mortality, particularly in patients who are hospitalized.[1] In a review article, mortality rates from CAP were reported as 5.1% for patients treated either as out-patients or in hospital and 36.5% for those admitted to intensive care units.[2]

Pneumonia can result in complicated parapneumonic effusion (CPE) and/or empyema thoracis (ET) in 44 to 57% of all pneumonia cases.[3, 4]

Empyema thoracis by definition is the collection of pus in the pleural cavity. [5] It was first described in the 5th century B.C. by Hippocrates in his aphorisms: "pleuritis that does not clear up in fourteen days results in empyema". Hippocrates proposed drainage as a treatment for it and for hundreds of years empyema was treated using open drainage.[6]

Empyema thoracis arises as a complication of pneumonia in most of the cases (incidence of empyema is 7.2% after bacterial pneumonia) and is associated with a significant mortality rate of 11-50%.[7, 8] Etiology of approximately 70 % of all cases is bacterial. [7] Other causes include iatrogenic, traumatic, and malignancies.[8]

Empyema thoracis presents commonly with fever (73%), cough (65%) and chest pain (60%).[8] Many risk factors have been defined for empyema thoracis which include age, pneumonia requiring hospitalization, and co-morbid diseases, such as bronchiectasis, alcoholism, diabetes and chronic obstructive pulmonary disease.[9] The symptoms of empyema thorac can be either acute or chronic. Weight loss and anemia are common with anaerobic infections. In patients with pneumonia, the clinical picture, such as the degree of leukocytosis or the incidence of chest pain, is very similar whether or not they have a parapneumonic effusion.[10]

Knowledge of the exact bacteriology is very important in treatment of the empyema.[11-13] In literature, many studies have been carried out to detect the causative infecting organisms in empyema. In a study by Ahmed RA, Streptococcus milleri (50% of all the isolates) emerged as the most common organism. [11] Tareen S, et al, reported gram negative enteric rods (91%) as the most common agents followed by Strept. pyogenes (5.4%) being the only other organism isolated from two samples.[12] The results of study by Tsang KY, the bacteriology are as follow; Streptococcus milleri (19%), Bacteroides (14%), Klebsiella pneumoniae (12%), Peptostreptococcus (7%), Streptococcus Pnemoniae (3.5%), E.Coli (7%), Staph aureus (7%)and Pseudomonas(3.5%) were the most common organisms. [13]

Antibiotics are started according to isolation of microorganism; drainage is mandatory which are most frequently achieved with tube thoracostomy. [11] The use of fibrinolytics remains controversial. Early thoracoscopy is an alternative to thrombolytics. Open surgical intervention is sometimes required to control pleural sepsis or to restore chest mechanics.[11]

As the empyema throacis is associated with adverse outcomes so the early and best possible treatment of the disease is very important. Initially, we give the empirical antibiotic therapy while waiting for culture and sensitivity report. Therefore the knowledge of various causative microorganisms of the disease is very important to offer the best possible empirical antibiotic treatment to the patients. Various studies have been done to know the exact causative organisms of empyema thoracis.[13]

Various authors have reported different causative organisms in their studies but no single microorganism could be found as the most common cause of the disease in different population. This has made it difficult to establish a single standard disease in different population. This has made it difficult to establish a single standard empirical antibiotic regimen.

In our study, we observed the frequency of various organisms involved in causing the empyema thoracis in complicated bacterial pneumonia in our community so that we may be able to establish a standard empirical antibiotic therapy in our population. This would help us to do the early and more effective management of the disease so that hospital stay of patients might be reduced and the risk of morbidity and mortality might reduce.

OPERATIONAL DEFINITIONS:

Bacterial pneumonia:

It was assigned to the patients who presented with high grade fever (101 ^{o}F) cough and chest pain and will be

confirmed on having radio opaque opacity on X-ray chest, PA view.

Empyema Thoracis:
It was assigned to the patients presenting with history of high-grade fever (101 ^{o}F), cough and chest pain having radioopaque opacity obliterating the costopheranic angle on X-ray chest PA view and pus on needle aspiration of pleural fluid.

Detection of microorganisms:
Pus was collected from pleural cavity of the patients with empyema throcis with 20 cc sterile syringe. Collected specimen was sent to the laboratory of the hospital where the identification of various microorganisms was made on growth pattern on the disc of routine bacterial culture media as follows: 'blood agar' for streptococcus milleri, 'blood agar' for bacteriodes, 'CLED (Cystine lactose electrolyte deficient) agar and 'blood agar' for klebsiella, 'blood agar' for peptostreptococcus, 'chocolate agar' for streptococcus pneumoniae, 'MacConkey' and 'CLED agar' for E-coli, 'blood agar' for staphylococcus aures and 'blood agar', MacConkey' and 'CLED agar' for Pseudomonas. The microorganisms were labeled as positive on culture if the growth of the microorganisms were detected on the particular media.

MATERIAL AND METHODS:

This cross-sectional study was conducted at Bahawal Victoria Hospital, Bahawalpur form May 2019 to November 2019 over the period of 6 months. In this study, 102 patients with empyema thoracis were included.

INCLUSION CRITERIA

1. Gender: Patients with either sex
2. Age: All patients above 15 years
3. All the patients admitted in Pulmonology Department with history of high grad fever, cough and chest pain, having radio opaque opacity obliterating the costophrenic angle on X-ray Chest, PA view and pus on aspiration of pleural fluid.
4. All the patients with good nutritional status assessed by Body Mass Index (BMI) ranging from 18 – 24 kg/m^2.

EXCLUSION CRITERIA

1. History of taking antibiotics for more than 2 weeks.
2. Patients who had any other associated medical disorder like diabetes mellitus, hepatic or renal insufficiency, connective tissue disease, lymphoma and HIV/ AIDS.
3. Patients who had structural lung damage like interstitial lung disease, bronchiectasis, COPD, bronchial asthma, pulmonary tuberculosis and malignant chest disease
4. Patients who had history of smoking, alcoholism, steroid intake or immunosuppressive drugs.
5. Patients with BMI < 18 kg/m^2 and > 24 kg/m^2

DATA COLLECTION

First 102 consecutive patients admitted in Bahawal Victoria Hospital, Bahawalpur, fulfilling the inclusion and exclusion criteria were included in the study after taking the informed written consent. Study was started after the approval from ethical committee of our institution. Needle aspiration of pleural fluid was done with 20 cc. sterile disposable syringe by researcher himself. Specimen was sent for culture on disc for routine bacterial culture media mentioned in operational definition to the hospital laboratory. Reports were collected after 3 days and the detected microorganisms on the culture report was documented by the consultant pathologist (who has more than 5 year post fellowship experience in the field of Pathology) duly stamped. A separate proforma was used for every patient to record the particulars and the documented report of culture.

DATA ANALYSIS

All the collected data was entered through SPSS version 13 and analyzed through its statistical package. The qualitative variables like sex and microorganisms on culture and sensitivity (streptococcus pneumonia, staphylococcus aures, E. Coli, streptococcus milleri, bcteriodeds, klebsiella pneumoniae, peptostreptococcus and pseudomonas were presented as frequency distribution. Quantitative data like age (in years) and nutritional status (BMI) were presented as means and standard deviations. The main outcome variable was frequency of microorganisms which were presented as frequency distribution tables. Patient's age, sex and nutritional status (BMI) were kept in mind and their effects on the causative microorganisms of empyema thoracis were noted to minimize the confounding factors.

RESULTS:

The total number of patients included in the study was 102 (including both males and females).

The mean age of the patients was 33.32 $\pm$ 13.62 years [range 18 - 67 years]. There were 25 (24.5%) patients

of age range of 15 - 20 years, 31 (30.4%) patients of age range of 21- 30 years, 19 (18.6%) patients of age range of 31-40 years, 17 (16.7 %) patients of age range of 41 - 50 years, 5 (4.9%) patients of age range of 51-60 years, 5 (4.9%) patients of age range ≥ 61 years. (Table)

Patients were also distributed according to sex. There were 54 (52.9%) male patients in the study, while 48 (47.1%) patients were female. (Figure 1)

Patients were also distributed according to growth pattern. In 79 (77.5%) patients, growth was detected on culture and sensitivity and in 23 (22.5%) patients no growth was found. (Figure 2)

Out of the 79 patients in whom microorganism was detected, Streptococcus milleri were found in 26 (33%) patients, bacterioides in 12 (15.1%) patiens, Klebsiella pneumoniae in 19 (24.1%) patients, peptostreptococci in 7 (8.9%) patients, Streptococcus pneumoniae in 4 (5.1%) patients, E. Coli in 5 (6.3%) patients, staphylococcus aures in 2 (2.5%) patients and pseudomonas in 4 (5.1%) patients. (Figure 3)

Table 1: Distribution of patients by age (n=102)

Age (Years)	No.	Percentage
15 – 20	25	24.5
21 – 30	31	30.4
31 – 40	19	18.6
41 – 50	17	16.7
51 - 60	5	4.9
≥ 61	5	4.9
Mean±SD	33.32 ± 13.62	
Range	18 - 67	

Figure 1: Distribution of patients by sex (n=102)

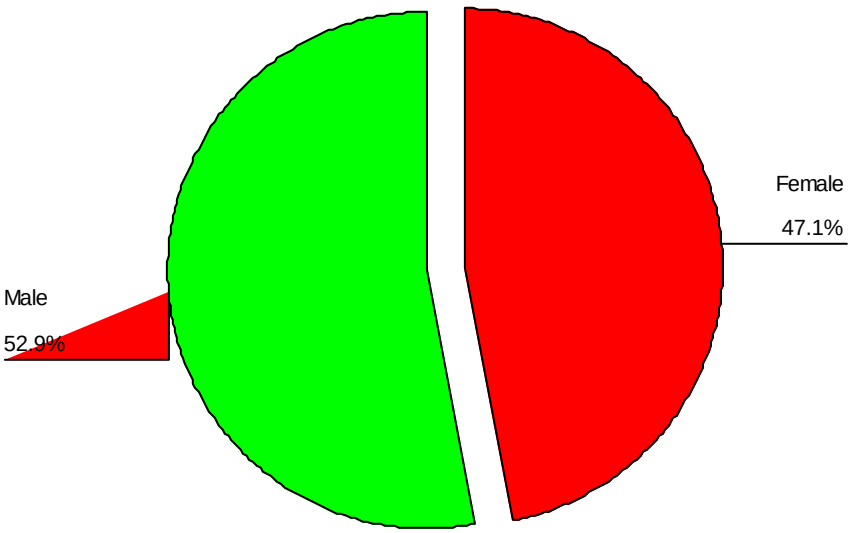


Figure 2: Distribution of patients by detection of Growth (n=102)

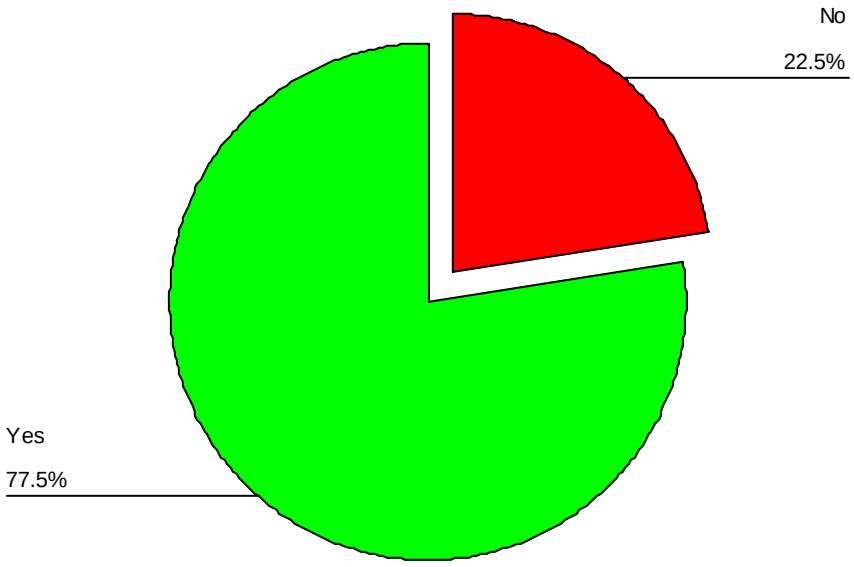
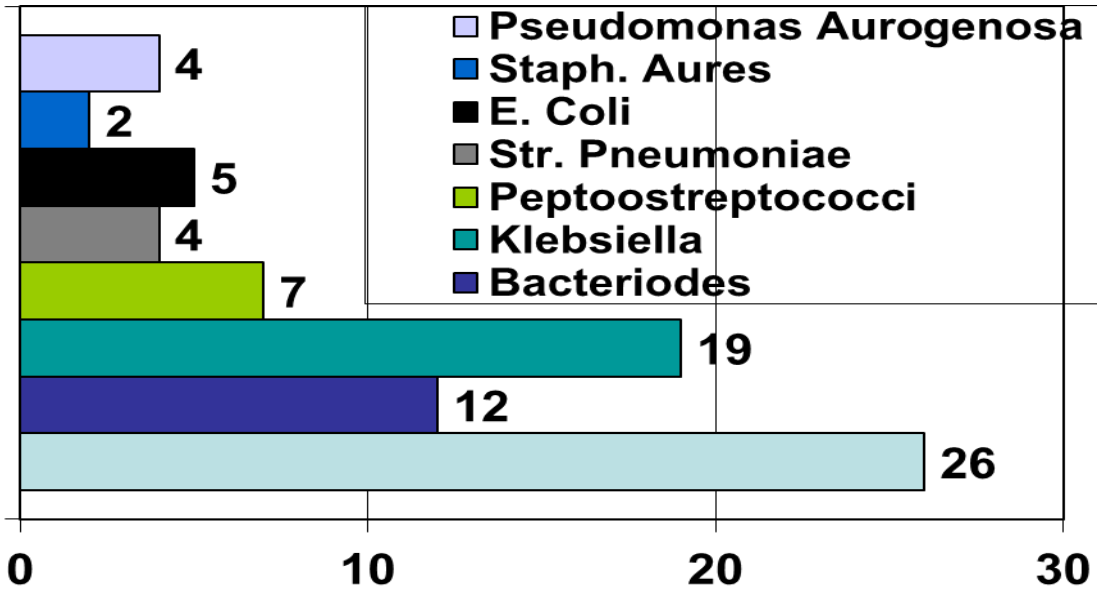


Figure 3: Distribution of patients by Microorganisms (n=79)



Key:
Staph. Staphylococcus
Str. Streptococcus
E. Escherichia

DISCUSSION:

In this series, we studied a total 102 patients with empyema thoracis and microbiology was done in every case to document he most common pathogens in the pus of empyema thoracis. This is one of the largest studies conducted in Pakistan which included 102 patients. The results of the study showed that among those patients, streptococcus milleri was the most common organism (found in 32.9% patients,), followed by Klebsiella pneumoniae (24.1%), and Bacteroides (15.1%) Peptostreptococcus in (8.9%), E. Coli (6.3%), Psudomonas (5.1%), Streptococcus pnemoniae (5.1%), and staph aures (2.5%) patients.

In our local settings, the studies on this topic are very few. In a study by Tareen S, et al, a total 42 patients with empyema thoracis were included. Among those, 81% patients were male and 19% were female. Mean age of subjects was 43 years. They concluded that gram negative enteric rods (91%) as the most common agents followed by Strept. pyogenes (5.4%) being the only other organism isolated from the samples of two patients.[12]

In another study by Tsang KY, et al, 63 patients with diagnosis of empyema thoracis were studied. The mean age of the patients was 64 years and a male-to-female ratio of 45:18. The pleural fluid culture positivity rate was 68%; Streptococcus milleri (19%), Bacteroides (14%), Klebsiella pneumoniae (12%), Peptostreptococcus (7%), Streptococcus Pnemoniae (3.5%), E.Coli (7%), Staph aureus (7%)and Pseudomonas(3.5%) were the most common organisms. Like our study, streptococcus milleri was the most common organism. However, this was followed by Klebsiella pneumoniae (24.1%) in our study while, bateroided (15.1%) in their study. Similarly, staph aures was the least commonly detected organism in both of the studies.[13]

In a study by Chen K, et al, a total of 163 microorganisms were isolated from the pleural fluid of 139 patients. These patients were classified according to the following types of isolates: aerobic or facultative Gram-positive (n = 47); aerobic Gram-negative (n = 59); anaerobic (n = 14); and mixed (n = 19). The most predominant aerobic or facultative bacteria were Klebsiella pneumoniae (24.4%), Streptococcus constellatus (10.0%), Streptococcus intermedius (8.6%), and S aureus (5.7%). The predominant anaerobes were Fusobacterium species (8.6%) and Peptostreptococcus species (7.9%). The isolates from the 139 culture-positive patients were categorized into the following four groups: aerobic and facultative Gram-positive (n = 47); aerobic Gram-negative (n = 59); anaerobic (n = 14); and mixed (n = 19). In the aerobic and facultative Gram-positive group, viridans streptococci and S. aureus were the predominant pathogens. In the aerobic Gram-negative group, K. pneumoniae and Escherichia coli were the most frequent isolates. In the anaerobic group, Peptostreptococcus species and Fusobacterium nucleatum were predominant as single pathogens. In the group of patients with more than one pathogen isolated, Peptostreptococcus species, S constellatus, Eikenella corrodens, Prevotella species, and Fusobacterium species were the major isolated organisms. The differences among isolated organisms in these four groups were not related to age or gender but were related to underlying condition. Patients in the aerobic Gram-negative bacilli group had the highest incidence of underlying disease (84%; p = 0.006). The results of this study are comparable to that of ours, with a little difference that Klebsilla was the most common organism their study while this was second moost common in ours study.[14]

In a study by Lin Y, et al, the most common pathogens in the medical ward were Streptococcus spp. (26%), Klebsiella pneumoniae (17%), S. aureus (14%), and Pseudomonas spp. (12%). Otherwise, in the MICU patients, the most common pathogens in the MICU were K. pneumoniae (24%), S. aureus (22%), Pseudomonas spp. (13%), and Streptococcus spp. (12%). When compared to our study, the results were quite comparable. In our study, the most common organism was streptococcus milleri followed by Klebsiella, while in their study, both of these organisms were the most common i.e. streptococcus in medical ward and klebsiella in MICU.[15]

The above discussion shows that the frequency of causative organisms varies greatly among different authors. This can be due to difference in age of the patients and culture kits available at the diagnostic center. There is also another observation that, streptococcus pneumoniae has become a less common aetiologic agent for empyema thoracis and other Gram-positive, Gram-negative, and anaerobic organisms are more commonly isolated now. Such a change in pattern may be attributed to the worldwide accessibility of patients to broad-spectrum antibiotics.

CONCLUSION:

Streptococcus milleri is the most common microorganism detected in cases of empyema thoracis,

developing as a complication of bacterial pneumonia. The other causative organisms are Klebsiella pneumoniae and bacteroides. Unlike other cases of pneumonia, staphylococcus aures is least common organism. However, it is recommended that culture and sensitivity should be performed in all the patients with empyema thoracis in every clinical setup so that antibiotics can be recommended according to the detection of the causative organism.

REFERENCES:

1. Mandell LA, Bartlett JG, Dowell SF. Update of practice guidelines for the management of community-acquired pneumonia in immunocompetent adults. Clin Infect Dis 2003; 37: 1405-33.
2. File TM. Community-acquired pneumonia. Lancet 2003; 362: 1991-2001.
3. Death rates for leading causes of death (based on ICD 10th version): 2001-2005. HKSAR Centre for Health Protection website: http://www.chp.gov.hk/data153b 2006.
4. Colice GL, Curtis A, Deslauriers J. Medical and surgical treatment of parapneumonic effusions: an evidence-based guideline. Chest 2000; 118: 1158-71.
5. Sahn SA. Diagnosis and management of parapneumonic effusions and empyema. Clin Infect Dis 2007; 45: 1480-1486.
6. Tassi GF, Marchetti GP. Pleural disease: historic perspective. In: Light RW, Gary Lee YC, eds. Textbook of pleural diseases, 2nd edition. London: Hodder Arnold ; 2008; 1-9.
7. Acharia PR, Shah KV. Empyema thoracis; a clinical study. Ann Thorac Med 2007; 2: 14-7.
8. Nadeem A, Bilal A, Shah SA. Presentation and management of Empyema Thoracis at Lady Reading Hospital Peshawar. J Ayub Med Coll Abottabad 2004; 16: 14-17.
9. Chalmers JD, Singanayagam A, Murray MP, Scally C, Fawzi A, Hill AT. Risk factors for complicated parapneumonic effusion and empyema on presentation to hospital with community-acquired pneumonia. Thorax 2009; 64: 592-597.
10. Light RW. Parapneumonic effusions and empyema. The Proceedings of the American Thoracic Society 2006; 3: 75-80.
11. Ahmed RA, Marrie TJ, Huang JQ. Thoracic empyema in patients with community-acquired pneumonia. Am J Med 2006; 119: 877-83.
12. Tareen S, Aman R, Hussain S, Masoom A, Zaman M, Massod MK. Bacteriology of acute thoracic empyema in a tertiary care hospital. Int J Pathol 2007; 5: 72-6.
13. Tsang KY, Leung WS, Chan VL, Lin AW, Chu CM. Complicated parapneumonic effusion and empyema thoracis: microbiology and predictors of adverse outcomes. Hong Kong Med J 2007; 13: 178-86.
14. Chen KY, Hsueh PR, Liaw YS, Yang PC, Luh KT. A 10-Year Experience with Bacteriology of Acute Thoracic Empyema; Emphasis on Klebsiella pneumoniae in Patients with Diabetes Mellitus. Chest 2000; 117: 1685-9.
15. Lin YC, Chen HJ, Liu YH, Shih CM, Hsu WH, Tu CY. A 30-Month Experience of Thoracic Empyema in a Tertiary Hospital: Emphasis on Differing Bacteriology and Outcome between the Medical Intensive Care Unit (MICU) and Medical Ward. Southern Medical Journal 2008: 101; 484-9.