EMPYEMA THORACIS: BACTERIAL ISOLATES AND THEIR ANTIBIOTIC SENSITIVITY IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: empyema thoracis is defined as an accumulation of pus within the pleural space and has been associated with a high death rate. Clinicians should monitor characteristics of empyema to improve clinical decision making to reduce significant morbidity and mortality.

AIM AND OBJECTIVES: The aim of the study was to find out the Culture and sensitivity patterns of the causative organisms isolated from the patient of Empyema Thoracis in a tertiary hospital.

Methods: 50 patients with thoracic empyema were treated from 01 June 2023 to 30 june 2024. An analysis of organisms cultured and their antibiotic sensitivity patterns from empyema fluid was done. The organism isolated from the pleural fluid, were classified into three groups: gram positive; gram negative and acid fast bacilli (AFB). Observational, prospective design study conducted in Department of Pulmonary Medicine, Government Chest Diseases and Tuberculosis Hospital, a tertiary level health care centre.

Results: The peak age was in the range of 31-40 years, the male-to-female ratio was 2.57:1.0.Positive Cultures were isolated from 24 patients (48%) whereas samples from 26 patients (52%) were sterile. The isolates were classified as gram positive 6, gram negative 13, Sputum AFB Positive in 9 (18%). Gram negative bacteria were the most common organism. The prevalence of Pseudomonas aeruginosa was7(29.17%), among which 2 (8.33%) isolates were multi drug resistant.

Conclusions: There is high prevalence of gram-negative bacteria and the of isolation of multi drug resistant Pseudomonas aeruginosa in empyema. The key to successful outcome for patients with empyema lies in early diagnosis, treatment with appropriate antibiotics and adequate drainage. The knowledge of local antibiotic resistant organisms would help in making a judicious choice of antimicrobial agents for treatment of such cases.The practise of empirical broad spectrum antibiotic treatment of empyema must be reviewed.

Keywords: Empyema Thoracis, bacterial culture, antibiotic resistance.

INTRODUCTION

Empyema is defined as presence of pus in the pleural space.[1] The spectrum of organisms isolated from empyema has changed over recent decades.[2] Before the antibiotic era ,predominant organisms isolated were Streptococcus pneumoniae or beta-haemolytic streptococci. From 1955 to 1965,Staphylococcus aureus was the most common organism isolated. In the 1970s, anaerobic bacteria were isolated most commonly. In the 1990s, the majority of culture-positive effusions yielded aerobic organisms.[2]

Despite the improvement of antimicrobial therapy and the existence of multiple options for drainage Thoracic empyema continues to cause significant morbidity and mortality . Approximately 15% of these patients die due to empyema. Its incidence is rising in children and adults.[3,4] Since it is associated with high mortality, early drainage should be considered for empyema patients.[5]

Little is known about the microbiology and antibiotic susceptibility patterns of empyema patients in tertiary level institutions till now. Antibiotic choices based on organisms isolated and their sensitivity patterns provide a common-sense approach for management. Optimum medical therapy for empyema would thus include

intercostal tube drainage and selection of antibiotic to which the pleural fluid isolate is most   sensitive.

METHODS

It is Prospective observational study of 50 patients admitted and diagnosed with pleural effusion based on clinical history and chest radiograph conducted in the Department of Pulmonology,at Government Chest diseases and Tuberculosis Hospital, Hanamkonda, Telangana from June2023 to June 2024 a period of twelve months.

Inclusion criteria

Every patient of thoracic empyema

• Empyema was due to primarily pleuro-parenchymal infection

•Admitted for sufficient time till bacteriology and diagnosis of nature of empyema was determined

•Gave informed consent for thoracentesis or insertion of intercostal drain with underwater seal.

All the patients underwent diagnostic thoracentesis under aseptic precautions after admission. The empyema fluid samples were examined by Gram's staining and Ziehl Neelson (ZN) staining and were cultured for aerobic growth. Anaerobic bacteria couldn't be cultured because of lack of facilities in the Department of Microbiology. Antimicrobial sensitivity testing was done using disk diffusion method and NCCLS (National Committee for Clinical Laboratory Standards) guidelines were used to define sensitivity thresholds. MDR Pseudomonas aeruginosa (MDR PA) were defined as Pseudomonas aeruginosa isolates with resistance to all 3 antimicrobials in-vivo - Piperacillin tazobactum and Levofloxacin or Ciprofloxacin and Gentamicin or Amikacin

RESULTS

Among 50 patients of empyema, the age varied from 18 years to 70 years . 2 (4%) of the patients were of 11-20 years, 10 (20%) were of21-30years,18(36%) were of 31-40years,12(24%) were of 41-50 years,5(10%) were of 51-60 years,3(6%) were of 61-

70 years. Male patients predominated over female patients with a male to female ratio of 2.57:1.The mean age is 38.26, median is 36 (Table 1).

Table 1: Descriptive analysis

variable	Total (n)	Percentage(%)
Gender		
Male (M)	36	72%
Female (F)	14	28%
Total	50	100%
Age Group		
11 to 20	2	4%
21 to 30	10	20%
31 to 40	18	36%
41 to 50	12	24%
51 to 60	5	10%
61 to 70	3	6%
Total	50	100%
Mean-38.26, median-36, SD-12.38		

The commonest symptoms at presentation were dyspnea 46patients (92%),cough, seen in 44 patients (88%),fever (44, 88%); followed by chest pain (42,84%). In addition, constitutional symptoms, viz., anorexia, malaise and weight loss, were noted in 32 patients (64%).comordidities hypertension was seen in (8,16%) and diabetes was seen in (12, 24%) [Table 2].

Table 2: clinical presentation and comorbidities distrubution among study population

Symptoms	count	Percentage
Cough	44	88%
SOB	46	92%
Chest Pain	42	84%
Fever	44	88
Loss of weight	32	64
Loss of appetite	32	64

Comorbidities		
Alcohol	8	16
HTN	9	18
DM2	12	24

Empyema fluid culture was positive in 24 (48%) patients and sterile in 26 (52%) (Table 3). Empyema fluid of 24 patients grew 6 types of bacteria on culture and was AFB positive in (9, 18%), sputum CBNAAT positive in (12,24%)patients (Table 4). Empyema fluid of 2 patients was polymicrobial yielding 2 isolates and in 24 patients yielded 1 isolate.

TABLE NO.3 BACTERIAL GRAM STAINTING AND CULTURE FINDINGS AMONG STUDY POPULATION.

MICROBIOLOGICAL EXAMINATION		Count	Table N %
GRAM STAINING	Gram+	6	12%
	Gram-	13	26%
BACTERIAL CULTURE	Culture positive	24	48%
	Culture negative	26	52%

TABLE NO.4 SPUTUM AFB STAINTING AND CBNAAT FINDINGS AMONG STUDY POPULATION.

	Positive	Percentage	Negative	Percentage
SPUTUM AFB	9	18%	41	82%
SPUTUM CBNAAT	12	24%	38	76%

Gram positive bacteria was cultured in 6 (25%) isolates. 4 isolates were identified as Staphylococcus and 2 as Streptococcus. The most predominant isolates were Gram negative bacteria (GNB) which was identified in 18 (75%) cultures (Table 5). The Gram negative bacilli cultured were Pseudomonas aeruginosa-7 (29.17%), Klebsiella species-5(20.83%), *E.coli*-4 (16.67%), Acinetobacter was cultured from 2 (8.33%)

patients (Figure 1).Overall, Pseudomonas aeruginosa was the most common bacterial species cultured.

The antibiotic sensitivity pattern of gram negative bacilli is meropenem, piptaz, ciprofloxacin, and levofloxacin. Among GNB isolates, the mean resistance to antibiotics was highest for ceftazidime (92%) and least for cefoperazone sulbactum (43%). (2,8.33%) of the Pseudomonas aeruginosa isolates were MDR strains.

TABLE 5: BACTERIOLOGICAL PROFILE AMONG STUDY POPULATION

Culture	Organisms	Count	Percentage
Gram Positive	Staphylococcus	4	16.67%
	Streptococcus	2	8.33%
Gram Negative	Klebsiella	5	20.83%
	Pseudomonas	7	29.17%
	E. coli	4	16.67%
	Acinetobacter	2	8.33%

FIGURE 1: MICROBIOLOGICAL EXAMINATION FINDINGS AMONG CULTURE POSITIVE STUDY POPULATION.
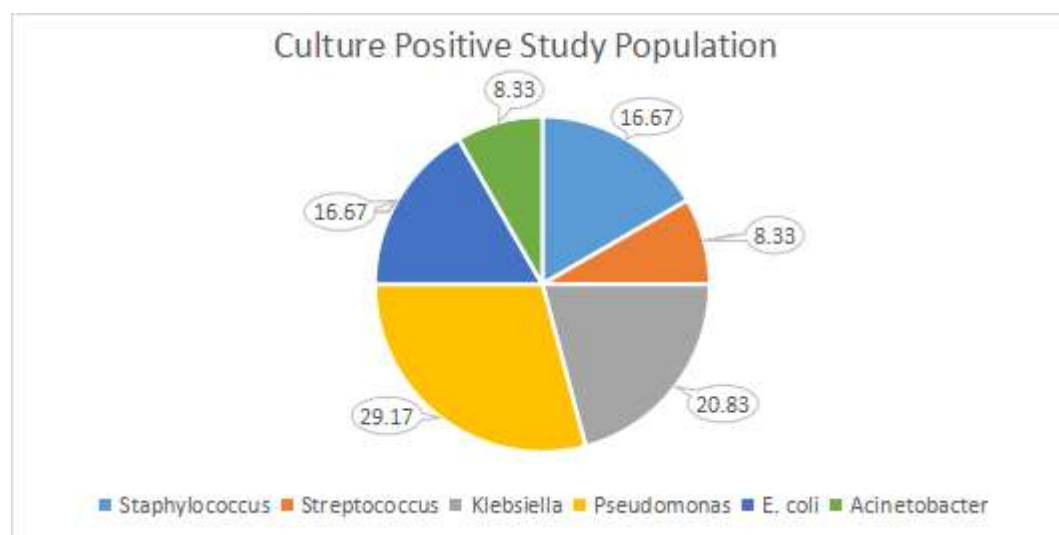
Discussion:

The high incidence of empyema in the productive age group of 21-40 years in this study is consistent with the findings in the earlier study by Acharya et al [7], Karmakar S et al [8]. The high incidence in this age gender group is attributed to thepredilection of pulmonary tuberculosis and community acquired pneumonia in this age- gender group.[5,6]These age groups represent the most productive years of life and the socio-economic impact is thus, tremendous.

In the present study, males outnumbered female patients in the ratio of 2.57:1 it matches with study by Acharya et al [7]. Males in general are more prone to mechanical stresses due to their tall stature and strenuous work. Smoking is a more frequent habit, and tuberculosis and COPD are more frequent in males.

The prevalence of cough (88%), chest pain (84%) matches with the study by Kamat et al [9], whereas dyspnea (92.%), fever (88%) and constitutional Symptomsviz., anorexia, malaise and weight loss (64%)matches withthe study by Acharya, *et al* [7].The clinical manifestations of an empyema can vary widely, depending on both the nature of the infecting organism and the competence of the patient's immune system.The spectrum ranges from an almost complete absence of symptoms to a severe illness with systemic toxicity.

In the past, aerobic Gram-positive organisms have been the most frequent isolates in acute thoracic empyema Mohanty S et al.[10] Gram-negative aerobic bacteria are emerging as important pathogens in cases of thoracic empyema.[6,7] A similar observation has been found in the current study. In this study, Gram-negative organisms accounted for 75% of culture-proven cases of empyema.as compared to study done by Mohanty S et al.[10] Though Staphylococcus aureus was the most common Gram-positive organism, it was only the fourth most common organism isolated.

In the present study, a positive culture was obtained in 24 patients (48%). Gram-negative organisms were cultured most frequently (75%) which is similar to the study done by Acharya, *et al.*[7] This is in concurrence with the reports of various workers who have emphasized the emergence of gram-negative bacilli as predominant pathogen.In our series pleural fluid was sterile in 52% cases similar to Acharya *et al.* [7].The most common organism isolated was Pseudomonas aeruginosa-7 (29.17%),

8.33% of the Pseudomonas aeruginosa isolates were MDR strains, which is similar to study by Karmakar S et al.[8]

Culture of empyema fluid was sterile in 26 (52%) patient's due to presence of anaerobic bacteria not picked up on routine aerobic culture or sterilizing effect of antibiotics given at previous centres. The performance of diagnostic aspiration in empyema can be improved by provision of facilities for anaerobic culture at referral centres on a routine basis.Karmakar S et al.[8]

Furthermore, most of the Gram-negative organisms in the current study demonstrated a high level of resistance to conventional antimicrobial agents tested. Beta-lactam/beta-lactamase inhibitor combinations and carbapenems appear to be promising agents for treatment of such infections.
High mean levels of resistance to widely used anti-pseudomonal, ceftriaxone, Ceftazidime, amikacin is a cause for concern. The drugs, meropenem, piptaz, ciprofloxacin, and levofloxacin each showed the highest degree of sensitivity . Antimicrobial therapy based on microbial sensitivity would result in shorter hospitalization, lesser cost of therapy and lesser mortality.

Conclusion:

Pleural space infection continues to be prevalent in our country particularly in the lower socioeconomic strata due to the delay in seeking medical care, inappropriate antibiotics and dosages and duration of antibiotic treatment.
Empyema fluid is diagnostic for pathogens if appropriate handling and early cultures but in the present scenario with prior antibiotic treatment, the fluid is sterile most of the times.So,Surveillance of antibiotic use and resistance patterns should be documented at every institute level to form appropriate antimicrobial stewardship programmes, which helps in rapid initiation of appropriate antimicrobial therapy. Application of logic in antibiotic selection for critically ill patients rather than a "tradition-based" approach for selecting treatment and Promotion of health care practices in health institutions.

Limitations:

There are various limitations of the current study.

1.although we collected data on age, sex, clinical symptoms, duration and aetiology of empyema, no correlational analysis or outcome analysis was done.

2.it was expensive and time-consuming, for mycobacterium tuberculosis and unusual microorganisms cultures we did not include them in the present study

3. many patients were already taking antibiotics that resulted in sterile cultures of empyema fluid in the present study.

References:

1. Fraser RS, Muller NL, Colman N, Pare PD. Pleural Effusion. In. Fraser and Pare's Diagnosis of Diseases of the Chest, 4th ed., Volume IV. Philadelphia, W.B. Saunders Company; 1999:2741- 2747.

2. Light RW. Pleural diseases. 3rd edn. Baltimore, Williams and Wilkins; 1995. In Hamm H, Light

RW. Parapneumonic effusion and empyema. Eur Respir J. 1997;10:1150-6.

3.Ahmed RA, Marrie TJ, Huang JQ. Thoracic empyema in patients with community-acquired

pneumonia. Am J Med. 2006:119:877-83.

4. Finley C, Clifton J, Fitzgerald JM. Empyema: an increasing concern in Canada. Can Respir J. 2008;15:85-9.

5. Brims FJH, Lansley SM, Waterer GW, Lee YCG. Empyema thoracic: new insights into an old disease.
Eur Respir Rev. 2010;19:117:220-8.

6. Lardinois D, Gock M, Pezzetta E, Buchli C, Rousson V, Furrer M, et al. Delayed referral and gram-negative organisms increase the conversion thoracotomy rate in patients undergoing video assisted thoracoscopic surgery for empyema. Ann Thorac Surg. 2005;79:1851-6.

7.Acharya PR, Shah KV. Empyema thoracis: a clinical study. Ann Thorac Med. 2007 Jan;2(1):14-7. doi: 10.4103/1817-1737.30356.PMID:19724669;PMCID:PMC2732064.

8.Karmakar, Saurabh & Karmakar, Shilpi & Prasad, Rajendra & Kant, Surya & Nath, Alok & Mahdi, Farzana. (2017). Clinical and microbiological characteristics of thoracic

empyema: retrospective analysis in a tertiary care centre. International Journal of Advances in Medicine.10.18203/2349-3933.ijam20174166.

9.Kamat. A prospective study of 100 cases of chronic empyema in Bombay. Lung India 1985;3:15-9.

10.Mohanty S, Kapil A, Das BK. Bacteriology of para-pneumonic pleural effusions in an Indian hospital.Trop Doct. 2007Oct;37(4):2289.doi:10.1258/004947507782333152. PMID: 17988487.