

## Original Research Article

# Clinical and microbiological characteristics of thoracic empyema: retrospective analysis in a tertiary care centre

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## ABSTRACT

**Background:** Clinicians should monitor characteristics of empyema to improve clinical decision making. The objective of this study was to evaluate the clinical and microbiological characteristics of patients of thoracic empyema in a tertiary hospital.

**Methods:** From 01 January 2016 to 31 December 2016, 110 patients with thoracic empyema were treated. An analysis of organisms cultured from empyema fluid and their antibiotic sensitivity patterns was done. The organism isolated from the pleural fluid, were classified into four groups: gram positive; gram negative; acid fast bacilli (AFB) and fungal. Observational, retrospective chart review design study conducted in Department of Pulmonary Medicine, Era's Lucknow Medical College and Hospital, a tertiary level health care centre.

**Results:** Cultures yielded 136 isolates from 96 patients (90.66%) whereas samples from 14 patients (09.34%) were sterile. The isolates were classified as gram positive (20), gram negative (110), AFB (4), fungal (2) and sterile (14). Gram negative bacteria were the most common organism. The prevalence of multi drug resistant *Pseudomonas aeruginosa* was 12%. 50% of all *Staphylococcus aureus* were Methicillin resistant.

**Conclusions:** There is high prevalence of gram-negative bacilli and the high rates of isolation of multi drug resistant *Pseudomonas aeruginosa* and Methicillin resistant *Staphylococcus aureus* in empyema. This indicates a need for judicious use of antibiotics at the referring centres and more aggressive antibiotic therapy at the referral centres. The practise of empirical broad spectrum antibiotic treatment of empyema must be reviewed.

**Keywords:** Clinical, College, Empyema, Medical, Microbiology

## INTRODUCTION

Empyema is defined as presence of pus in the pleural space.<sup>1</sup> The spectrum of organisms isolated from empyema has changed over recent decades.<sup>2</sup> Before the antibiotic era, *Streptococcus pneumoniae* or beta-

haemolytic streptococci were predominant organisms isolated. From 1955 to 1965, *Staphylococcus aureus* was the most commonly isolated organism. In the 1970s, anaerobic bacteria were isolated most commonly. In the 1990s, the majority of culture-positive effusions yielded aerobic organisms.<sup>2</sup>

Empyema develops in approximately 11% cases of pulmonary tuberculosis due to progression of a primary tuberculous pleural effusion, direct extension of infection into the pleural space from thoracic lymph nodes, vertebra, or sub diaphragmatic focus and haematogenous spread.<sup>3</sup> 1.3% cases of community acquired pneumonia develop empyema.<sup>4</sup>

Thoracic empyema continues to cause significant morbidity and mortality despite the improvement of antimicrobial therapy and the existence of multiple options for drainage. Approximately 15% of these patients die. Its incidence is rising in children and adults.<sup>5,6</sup> Since it is associated with high mortality, early drainage should be considered for empyema patients.<sup>7</sup>

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

A retrospective analysis of 110 cases of thoracic empyema is presented here. The 110 patients comprise all the cases of empyema thoracis admitted in the wards during a period of twelve months from 01 January 2016 to 31 December 2016.

### Inclusion criteria

Every patient of thoracic empyema

- Admitted for sufficient time till bacteriology and diagnosis of nature of empyema was determined
- Empyema was due to primarily pleuroparenchymal infection
- Gave informed consent for insertion of intercostal drain with underwater seal.

All the patients underwent diagnostic thoracentesis under aseptic precautions at admission. The empyema fluid samples were examined by Gram's staining and Ziehl Neelson (ZN) staining and were cultured for aerobic and fungal 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 tazobactam and Levofloxacin or Ciprofloxacin and Gentamicin or Amikacin.

## RESULTS

Among 110 patients of empyema, the age varied from 8 years to 74 years (Table 1). 86 (78.2%) of the patients were of 11-50 years, 16 (14.5%) were of more than 50 years and 8 (7.3%) were less than 10 years age. Male patients predominated over female patients with a male to female ratio of 9:1.

**Table 1: Age distribution of patients.**

Age (Years)	N (%)
<10	08 (07.3)
11-50	86 (78.2)
>50	16 (14.5)
Total	110

Empyema fluid smear/culture was positive in 96 (87.2%) patients and sterile in 14 (12.7%) (Table 2). Empyema fluid of 96 patients grew 130 types of bacteria and 2 fungi on culture and was AFB positive in 4 patients. Empyema fluid of 36 patients was polymicrobial yielding 2 isolates and in 40 patients yielded 1 isolate.

**Table 2: Isolates cultured.**

Organisms	150 (100%)
<b>Gram positive bacteria</b>	<b>20 (14.94%)</b>
<b>Staphylococcus</b>	
<i>Staph aureus</i> (Methicillin sensitive)	5
<i>Staph aureus</i> (Methicillin resistant)	5
Coagulase negative	2
<b>Streptococcus</b>	
<i>Enterococcus</i>	5
Alpha haemolytic <i>streptococcus</i>	3
<b>Gram negative bacteria</b>	<b>110 (73.33%)</b>
<b>Bacilli</b>	
<i>Pseudomonas aeruginosa</i>	66
<i>Klebsiella</i>	14
<i>E.coli</i>	12
<i>Proteus</i>	04
<i>Citrobacter</i>	04
<i>Enterobacter</i>	02
<b>Cocci</b>	
<i>Acinetobacter</i>	08
<b>Acid Fast Bacilli</b>	<b>04 (02.67%)</b>
<b>Candida</b>	<b>02 (01.33%)</b>
<b>Sterile</b>	<b>14 (09.33%)</b>

Gram positive bacteria was cultured in 20 (14.93%) isolates. 12 isolates were identified as *Staphylococcus* and 8 as *Streptococcus*. 5 of the 12 *Staph* isolates were MRSA. Among the 8 *Streptococcus* isolates, 5 were *Enterococci* and 3 were alpha haemolytic *Streptococci*.

The most predominant isolates were Gram negative bacteria (GNB) which was identified in 110 (80.8%) cultures. The Gram negative bacilli cultured were *Pseudomonas aeruginosa*-66 (60%), *Klebsiella* species-14

(12.7%), *E.coli*-12 (10.9%), *Proteus* species and *Citrobacter* species each-4 (3.6%) and *Enterobacter* species-2 (1.8%). *Acinetobacter* was cultured from 8 (7.2%) patients. Overall, *Pseudomonas aeruginosa* was the most common bacterial species cultured.

Ziehl Nielsen staining of empyema fluid revealed AFB (probably *Mycobacterium tuberculosis*) in 4 patients whereas *Candida* was cultured from 2 patients.

The antibiotic sensitivity pattern of gram negative bacilli is given in Table 3.

Among GNB isolates, the mean resistance to antibiotics was highest for ceftazidime (92%) and least for cefoperazone sulbactam (43%). 12% of the *Pseudomonas aeruginosa* isolates were MDR strains while 41% of the *Staphylococcus* isolates were MRSA strains.

**Table 3: Antibiotic susceptibility results of the isolates.**

Antibiotics	<i>Pseudomona aeruginosa</i>	<i>Klebsiella</i>	<i>E.coli</i>	<i>Acinetobacter</i>	<i>Proteus</i>	<i>Citrobacter</i>	Mean resistance
Piperacillin/ tazobactam	21.21%	80%	100%	0%	50%	-	50.24%
Ceftazidime	85.71%	75%	100%	100%	100%	-	92.14%
Cefoperazone sulbactam	42.8%	25%	50%	100%	0%	-	43.56%
Gentamicin	83.83%	80%	50%	66.66%	50%	100%	86.09%
Amikacin	66.66%	50%	50%	50%	50%	50%	52.77%
Levofloxacin	71.2%	50%	0%	66.66%	-	-	46.96%
Ciprofloxacin	76%	66.66%	60%	33.33%	50%	50%	55.99%
Pip/taz + genta/ami + levo/cipro	12.12%	-	-	-	-	-	

Pip/taz: Piperacillin tazobactam, Genta: Gentamicin, Ami: Amikacin, Levo: Levofloxacin, Cipro: Ciprofloxacin.

## DISCUSSION

Most of the patients were the young and middle-aged adults. These age groups represent the most productive years of life and the socio-economic impact is thus, tremendous. The high incidence in this age gender group is attributed to the predilection of pulmonary tuberculosis and community acquired pneumonia in this age- gender group.<sup>7,8</sup>

Culture of empyema fluid was sterile in 14 (12.7%) 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.

Gram negative bacteria were the most common isolates. Patients with empyema caused by Gram-negative bacteria have a significantly high mortality rate and poorer outcome. An early start to empirical antimicrobial therapy in such patients is known to improve outcomes.<sup>9,10</sup> The high prevalence of MDRPA empyema will necessitate a combination of antipseudomonal beta lactam and aminoglycoside /fluoroquinolone as empirical therapy. The other option would be the highly toxic and expensive antibiotic, colistin.<sup>11</sup> Antibiotics administered maybe modified after review of prior antibiotic use and individual sensitivity pattern in case of non-response to

empirical therapy. Measures need to be taken to limit horizontal spread of MDR-PA at tertiary care centres.<sup>12</sup>

Era's Lucknow Medical College serves as a tertiary care centre for referred and un referred patients from neighbouring areas of Awadh region and Central Uttar Pradesh.

The sentry antimicrobial surveillance program reported MDRPA rates of 1.6% in Asia-Pacific for 1997-1999. 13 All isolates of *E.coli*, *Acinetobacter* and *Proteus* were resistant to Ceftazidime. High mean levels of resistance to widely used anti-pseudomonal, Ceftazidime is a cause for concern. Antimicrobial therapy based on microbial sensitivity would result in shorter hospitalization, lesser cost of therapy and lesser mortality.

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

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