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Original Research Article

# Evaluation of Radiological and Clinical Findings in Patients with Empyema Thoracis

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**Abstract**

**Background:** Empyema thoracis (ET) is characterised by the presence of pus in the pleural cavity and is associated with considerable morbidity and mortality. This study was designed to evaluate the clinical and radiological outcomes of patients with empyema thoracis.

**Methods:** A total of 100 ET patients were evaluated, with a thorough history, physical examination, necessary imaging, pleural fluid/sputum gram and AFB staining, AFB and aerobic culture sensitivity followed by specific treatment.

**Results:** The majority of empyema thoracis patients were between the ages of 21 and 70, with a higher frequency in the early and middle ages and affecting mostly males (87%). No significant correlation between any hemithorax and tubercular empyemas was seen (Right 49%: Left 45%). However, in non-tubercular empyemas, involvement of the right hemithorax was much higher than that of the left (Right 63%: Left 26%).In 67% of cases, free ET was observed, 33% had encysted ET, and 62% had underlying lung parenchymal abnormalities. Gram staining of the pleural fluid showed no bacteria in 82% of the patients, although growth on aerobic culture was seen in 41% of the cases. In 73% of cases, tuberculosis was the main cause of empyema. *Staphylococcus aureus* (33.3%) was the most prevalent isolate in the 27% non-TB-ET group, followed by *Pseudomonas aeruginosa* (20%) and *Escherichia coli* (20%) on aerobic culture. Thoracocentesis was performed in 15% of the cases, ICTD in 84% of the cases, decortication in 4% of the cases, and open drainage in 1% of the cases, in addition to ATT and antibiotics.

**Conclusion:** Empyema thoracis is primarily caused by tubercular and bacterial infections with significant morbidity and mortality. Treatment involves specific antimicrobial agents, closed or open pus drainage, and surgical procedures. Early treatment helps cure the disease, while delay leads to complications and poorer living conditions.

**Keywords:** Empyema Thoracis, Tubercular Empyemas, Decortication, AFB Smear, Culture.



## Introduction

Empyema thoracis (ET), by definition, presence of pus in the pleural cavity. Different authors disagreed on the definition of empyema thoracis. Weese*et al* described it as a fluid having a specific gravity larger than 1.018, a white blood cell count greater than 500/cm, or a protein level greater than 2.5g% [1]. Vianna classified empyema thoracis as pleural fluid with a positive bacterial culture or a white blood cell count of more than 15,000 cells/cm and a protein level more than 3g% [2]. Many parapneumonic pleural effusions that satisfy these criteria resolve without requiring surgical intervention [3].Empyema thoracis has long been regarded as a significant condition with increased

morbidity and death. Around 500 B.C., Hippocrates was the first physician to describe the diagnosis and treatment of thoracic empyema through surgical draining [4-8]. In 1867, Hewett published the earliest documented description of a closed tube drainage apparatus for empyema drainage [9].

Because of the lack of a clear-cut definition, early empyema diagnosis is problematic in both clinical and laboratory settings in the current era.From ancient times to the present, the most common causes of ET have been discovered to be pneumonia, trauma, or tuberculosis. Empyema is still a typical concern in both the developed and developing worlds. In the former, surgical operations and thoracic trauma are common causes of pulmonary infections [10], whereas pulmonary infections, particularly tuberculosis, account for the vast majority of cases in the latter [11].Hence, present study was performed to evaluate the radiological and clinical findings in patients with empyema thoracis (ET).

## Materials and Methods

Over the period of two years, from 2012 to 2014, a prospective study of 100 ET patients admitted to the Dept. of Pulmonary Medicine at S.C.B. Medical College was conducted.

### Study Protocol

Demographic information and clinical characteristics were recorded at the time of admission in all cases, including age and sex and symptoms like fever, cough, expectoration, haemoptysis, chest discomfort, dyspnoea, loss of appetite and weight. Diabetes, alcoholism, hepatic diseases, heamatologic disorder, heart diseases and cancer were all listed as co-morbidities. In each case, a thorough physical examination and radiography of chest were performed. Pleural fluid/sputum gram and AFB staining were regularly conducted in all patients. In non-tubercular cases, a longer course of antibiotics was prescribed based on culture sensitivity. ICTD, fibrinolytic treatment, and surgical procedures were performed when needed.

### Inclusion Criteria

The study included all patients of pleural effusion with frank pus on thoracocentesis. All ages of patients were encountered.

### Exclusion Criteria

Patients with chylothorax and those not given their consent were excluded from the study.

### Statistical Analysis

Microsoft Excel was used for data entry and analysis of descriptive statistics. The Z test and Chi square test was performed to examine whether the two proportions differed statistically and whether there was an association between the qualitative characteristics/indicators. P value <0.05 was significant.

### Ethical Approval

The above study was approved by the ethical committee of the Department of Pulmonary Medicine, SCB Medical College, Cuttack, Odisha, India. Before the study, written informed consent was obtained from each patient.

## Results

The most common age group in our study having empyema thoracis was 41-50 yrs (21%), and an identical situation was also observed in the age group 21-30 yrs (20%) (Table 1).

**Table 1: Age and Sex Distribution in 100 Patients with Empyema Thoracis**

| Age groups | Male | Female | Number of cases | Percentage |
|---|---|---|---|---|
| 10-20 | 4 | 3 | 7 | 7 |
| 21-30 | 18 | 2 | 20 | 20 |
| 31-40 | 15 | 2 | 17 | 17 |
| 41-50 | 17 | 4 | 21 | 21 |
| 51-60 | 16 | 0 | 16 | 16 |
| 61-70 | 13 | 2 | 15 | 15 |
| 71-80 | 3 | 0 | 3 | 3 |
| 81-90 | 1 | 0 | 1 | 1 |
| Total | 87 | 13 | 100 | |

The most common medical conditions among ET patients at the time of admission included cough (83%), fever (78%), expectoration (78%), chest discomfort (62%), dyspnea (58%), malaise (41%), loss of appetite (39%), and hemoptysis (3%). Pallor, clubbing, and pedal oedema were the three most frequent physical indicators, each occurring in 47% of cases.Only 9% of cases exhibited superficial lymphadenopathy (cervical, axillary), 46% had intercostal discomfort with parietal oedema, and 33% had rib crowding. Bronchial breath sounds were detected in 7%, crackles in 17%, and wheezes in 5% of the patients (Figure 1).

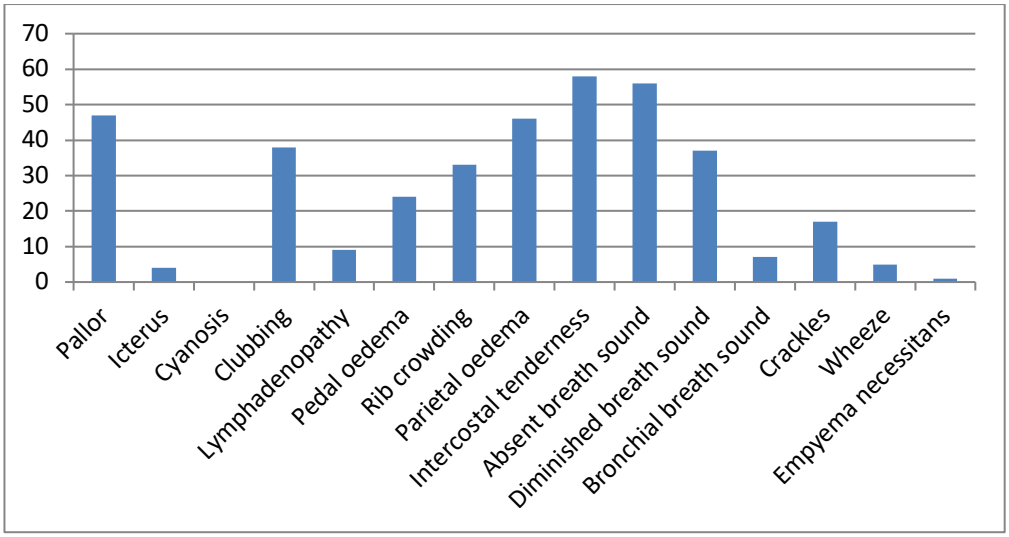


**Figure 1: Physical Signs in 100 Patients with Empyema Thorasis**

Among all cases, involvement of right side was in 55% patients, which was more common followed by 38% cases in left side and 7% bilateral. Tubercular involvement as a whole constituted 73% of cases in contrast to non-tubercular involvement in 27% of cases. Involvement of right side hemithorax was significantly greater in both tubercular and non-tubercular empyema ($p<0.05$). Among the non-tubercular empyema, pneumonia was the major cause, constituting 11% of cases (Table 2).

**Table 2: Aetiological Distributions in 100 Empyema Thoracis cases**

| Aetiology | Number of cases (%) | p-value |
|---|---|---|
| Tubercular | 73 (73%) | |
| Non-tubercular | 27 (27%) | |
| Lung abscess | 3 | |
| Pneumonia | 11 | |
| Liver abscess | 6 | |
| Post abdominal surgery | 2 | <0.05* |
| Secondary infection in a case of lung mass with effusion | 1 | |
| Undetermined cases responding to antibiotics | 3 | |
| Septicaemia | 1 | |
| Total | 100 | |

*Z test

Co-morbidities were found in 70% of patients, with alcoholism &diabetes being the greatest frequent morbidities (22% each). There was no statistically significant relationship between the above two morbidities in empyema patients (P=0.94, Yate's [chi square]=0.004) (Figure 2).

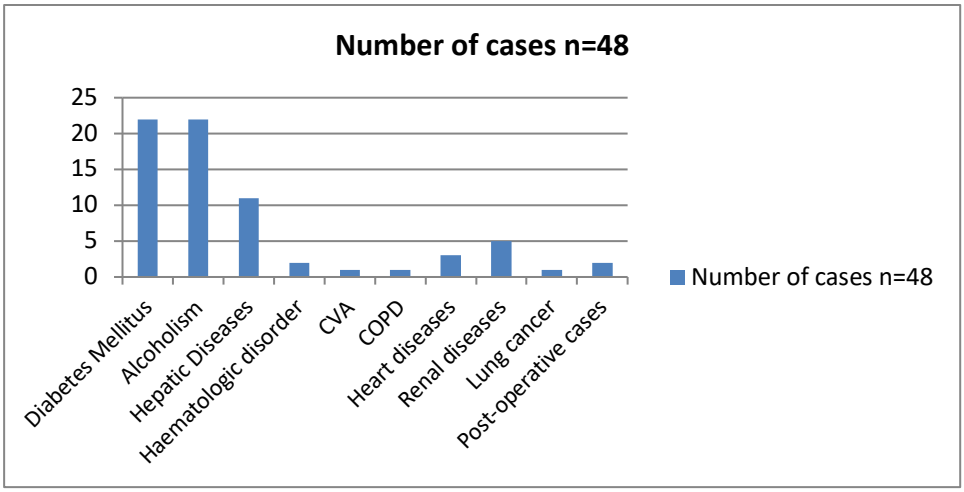


**Figure 2: Comorbidities in 100 cases with ET**

Radiologically, loculated empyema was only seen in 33 patients, while 67 cases had free empyema thoracis (free empyema highly significant with $p<0.05$). Similar findings were made with uniloculated empyema, which was determined to be highly significantly than multiloculated empyema (uniloculated: multiloculated = 25/33: 8/33 with $p<0.05$) (Figure 3).

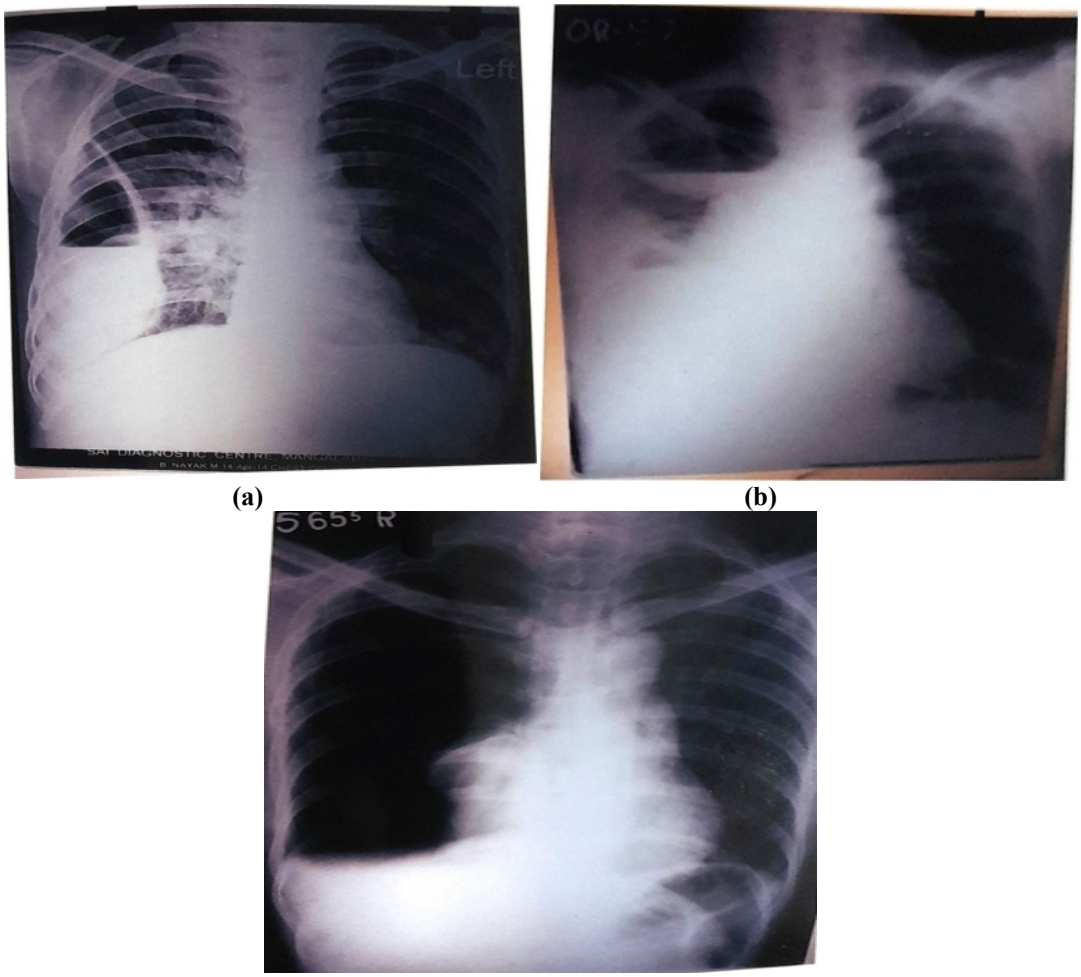


**Figure 3: Chest X-ray PA view of (a) Uniloculated, (b) Multiloculated and (c) Free moderate Pyopneumothorax with underlying lung disease**

Gram negative bacteria (29%) were found to be the most frequent organism in pleural fluid aerobic culture, followed by gram positive bacteria (12%). *Pseudomonas aeruginosa* was determined to be the most common pathogen involved (13%), followed by *Staphylococcus aureus* (11%) (Table 3). Regarding superinfection, gram negative bacilli were the most common species, with *Pseudomonas aeruginosa* being detected in the majority of cases. Regarding pleural fluid AFB smear and culture exhibiting definite TBET,out of 73 cases of TB-ET, 4 (5.47%) had both pleural fluid AFB smear and culture positive, while 7 (15.1%) had just pleural fluid culture positive, accounting for 15% (n=11) of total definite TB-ET. Sputum and imaging showed probable TB-ET.After sending all specimens for diagnosis, all patients were given empirical antibiotics. Following receipt of the culture and sensitivity data, the antibiotics were adjusted. Antibiotics were provided to non-tubercular patients for an average of 6 weeks. ATT was recommended in 73% of patients, while CAT I DOTS was recommended in 78%. In 19.1% of cases, CAT II was used, while in 2.7% of cases, CAT IV was used. In 15% of instances, simple thoracocentesis was performed. In 84% of cases, ICTD was administered, while open drainage was used in 1% of cases. Pleural fibrinolytics were administered in 6% of cases where expansion was not possible due to fluid thickness or drainage operations.Decortication was used as a last resort in 4% of patients following radiological confirmation when lung expansion could not be achieved using all medical procedures (Table 4 and Figure 4). The majority of cases in our study were tubercular in nature. In tubercular cases that required a lengthy course of treatment as well as closed drainage procedures, ATT was the mainstay of treatment in the forms of CAT I, CAT II, and CAT IV DOTS.

**Table 3: Organisms isolated in pleural fluid aerobic culture in 100 cases of ET**

| Microorganisms | Number of cases (%) | P value |
|---|---|---|
| Gram positive bacteria | 12 (12%) | |
| *Staphylococcus aureus* | 11 (11%) | |
| *Strep. pyogenes* | 1 | <0.05* |
| Gram negative bacteria | 29 (29%) | |
| *P. aeruginosa* | 13 (13%) | |
| *Kleb. Pneumonia* | 1 | |
| *Proteus* species | 2 | |
| *E. coli* | 5 | |
| *Citrobacter* species | 4 | <0.05* |
| *Acinetobacter* species | 3 | |
| *Morganella morgani* | 1 | |
| No growth | 59 (59%) | |

**Table 4**: **Treatment Modalities in 100 ET patients**

| Mode of treatment | Number of cases (%) |
|---|---|
| Closed drainage | 99 (99%) |
| Simple thoracentesis | 15 |
| ICTD | 84 |
| Open drainage | 1 (1%) |
| Decortication | 4 (4%) |
| Antibiotics | All cases |
| Anti-tubercular regimen | 73 (73%) |
| CAT I DOTS | 57 (78%) |
| CAT II DOTS | 14 (19.1%) |
| CAT IV DOTS | 2 (2.7%) |
| Pleural Fibrinolytics | 6 (6%) |
| Streptokinase | 3 |
| Hyaluronidase | 3 |

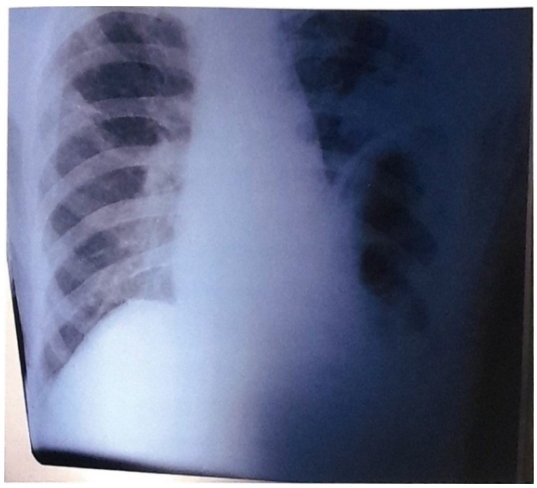

**Figure 4: Chest X-ray showing multiloculated pyopneumothorax with pleural fluid smear positivity (CAT II DOTS)**

## Discussion

One of the most important factors in the development of empyema is age. According to Nadeem *et al.* [12], most empyema cases are between the ages of 10 and 20. Ghaffar *et al.* [13] showed a comparable increase in the number of cases under the age of 20. In contrast, Malhotra *et al.* [11], Acharya *et al.* [14] and Vardhan *et al.* [15], observed the preponderance of cases in the age group 21-40 years. In our study, the age groups of 41–50 yrs (21%) and 21–30 yrs (20%) had bimodal peak incidence. The majority of tuberculosis cases were observed in both age groups, which may be related to the disease's prevalence in young adults and weakened host defences in middle-aged people. In the age range of 21 to 30 years, our finding agrees with Malhotra *et al.* [11], Acharya *et al.* [14], and Vardhan *et*

*al.*[15].Furthermore, our study also coincides with Geha[16] and Sherman *et al*[17] in age group of 1-50 years.Microorganisms have a critical part in the pathogenesis of empyema thoracis, which necessitates urgent antibiotic therapy, drainage of empyema fluid, and surgical intervention to manage the infection. Gram staining and subsequent cultures for particular aetiological treatment are used to isolate microorganisms during diagnostic thoracocentesis. In our investigation, Gram +ve cocci were identified in 11% of cases, Gram -ve bacilli in 7% of cases, and no bacteria were discovered in 82% of patients out of 100 ET patients.Kemper*et al.* [18] identified Gram positive organisms in 46.3% of cases, Gram negative organisms in 22.8% of cases, and anaerobes in 20.5% of instances with empyema thoracis, with mono-infection occurring in 56% of cases and multi-infection occurring in 44% of cases.

According to reports, a pleural fluid AFB smear in TB-ET is more positive than a TB effusion (5%). According to Vardhan *et al.*[15], Acharya *et al.* [14], and Malhotra *et al.* [11], pleural fluid AFB smear positivity was recorded in 27%, 46%, and 48% of cases of tuberculous empyema, respectively, while pleural fluid positivity was found in 18%, 23%, and 39% of cases. According to Kundu *et al.* [19], pleural fluid AFB smear was positive in 93.1% of cases of tubercular empyema, although pleural fluid AFB culture was not performed in those instances. However, in our analysis, 5% of instances of empyema thoracis had positive pleural fluid AFB smears, and 15% had positive pleural fluid cultures, regardless of the presence of 64% underlying PTB and 5% BPF.

In this study, ATT was used in 73% of TB-ET patients, compared to 35-65% in prior investigations[11,13-15,19]. Kundu *et al.* [19] used CAT I DOTS in 65.5% (n=19) of patients and CAT II DOTS in 34.5% (n=10) of cases in their study; we utilised CAT I DOTS in 78% (n=57) of cases, CAT II in 19.1% (n=14) of cases, CAT IV in 2.7% (n=2) of cases, and a lengthier course of antibiotics in 27% Non-TB-ET cases. In 7.6% of patients, Nadeem *et al.* [12] employed intrapleural fibrinolytics, whereas Malhotra *et al.* [11] used it in 17% of instances, however we used it as supportive therapy in 6% of patients.

## Conclusion

Empyema thoracis is primarily caused by tubercular and bacterial infections, with diabetes, alcoholism, hepatic, and renal diseases being common morbidities. Right thoracic involvement is more common in both tubercular and non-tubercular infections. Treatment involves specific antimicrobial agents, closed or open pus drainage, and surgical procedures like decortication is needed to recover normal lung function and resection surgery of the lung for removing the persistent lung lesions. Early treatment helps cure the disease, while delay leads

to complications and poorer living conditions. Emphasizing co-morbidities can help reduce mortality and morbidity in both peripheral and higher referral institutions.

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