

# Study of clinical profile of empyema thoracis

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## Abstract

**Background:** Empyema thoracis is still a relevant clinical problem in modern medicine practice. It has a complex microbiological profile. Most cases of empyema complicate community- or hospital-acquired pneumonia but a proportion results from iatrogenic causes or develops without pneumonia. Prompt treatment with appropriate systemic antibiotics and chest tube drainage are essential parts of management. In the present study we have attempted to present data on empyema thoracis from our local population. **Aim of the study:** To identify the risk factors, microbiological profile, various treatment modalities and treatment outcomes in patients with empyema thoracis. **Materials and Methods:** This was a prospective descriptive observational study conducted in a tertiary care hospital in southern India for a period of 24 months. A total of 82 patients with pus in the pleural cavity were included in the study. The age, gender, symptomatology, risk factors, hematological, biochemical and microbiological parameters were noted. The management, duration of intercostal drainage, antibiotics used and patient outcomes were noted. **Results:** Of the 82 patients of empyema thoracis, the male to female ratio was 5.3>1. Fever, cough, chest pain, intercostal tenderness was the most common presentation. Sputum culture was productive in 17 patients with *E. coli* being the most common culprit organism. Pleural fluid cultures were positive in 8 patients. Mean duration of ICD insertion was 14.9 days. Majority of the patients received 2 or more broad spectrum antibiotics and seven patients received ATT. Mortality was seen in 7 patients. **Conclusions:** Empyema thoracis commonly presents with fever, cough and chest pain. Neutrophilic leucocytosis and elevated ESR are common. Non tubercular empyema is more common than tubercular empyema. Common complications in our series were hepatitis, renal failure and septic shock. Management includes systemic antibiotics for 2-4 weeks and intercostal drainage.

**Key Word:** Empyema thoracis, Para-pneumonic effusion, Pleural fluid culture, Intercostal drainage

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## INTRODUCTION

Empyema thoracis is presence of pus in the pleural cavity. The diagnosis and treatment of empyema by surgical drainage was first described by Hippocrates in 600 BC.<sup>1</sup> Since then the management of this condition has posed a challenge to physicians and surgeons alike. From ancient times to the middle of last century, most empyemas were the result of pneumonic, traumatic or

tuberculosis processes. With thoracotomy becoming a commonly performed procedure, post-surgical empyema now constitutes 20% of all cases. Many surgical procedures are also used to treat empyema.<sup>2</sup> During World War I, an Empyema Commission was formed to address the high mortality rates in American soldiers. It stressed on the following principles:

1. The necessity to drain the pleural fluid and the need to avoid an open pneumothorax in the acute pneumonic phase.
2. The rapid sterilization and obliteration of the infected cavity in order to avoid a chronic empyema.
3. Proper nutrition of the patient. The same guidelines framed decades ago continue to provide the basis for the treatment of empyema even today.<sup>3</sup> Systemic antibiotics, intercostal drainage, intrapleural fibrinolytics, pleurodesis, fibrinolytics all have been used.

## AIMS AND OBJECTIVES

To study the clinical profile of empyema with respect to patient age, gender, risk factors, symptomatology, hematological, biochemical, microbiological study, management and patient outcome.

### Inclusion criteria

1. Patients in whom aspiration showed pus in pleural cavity.
2. Age more than 18 years

### Exclusion criteria

1. Post traumatic empyema
2. Post-surgical empyema

## MATERIALS AND METHODS

This was a prospective study performed in the department of General Medicine at Kasturba Hospital, Manipal, during September 2009 to June 2011. A total of 82 in-patients in our department who fulfilled the inclusion criteria were included in this study. A detailed clinical history and examination findings were obtained. The patient demographics, age and gender were noted. Presence of risk factors and patient symptomatology were noted. Routine investigations of complete blood picture, erythrocyte sedimentation rate (ESR), etc. were done and findings were recorded. Liver function tests and renal function tests were done. The pleural fluids and empyema were tapped and were sent for microbiological study. The sputum samples were also sent for microbiological examination. Chest X-Ray was done for all the cases and Computed tomography of chest was done in some of the cases. Patients were managed according to the nature of their disease and the outcome of treatment was noted. Statistical analysis was done using Windows-based SPSS statistical package (Version16).

## OBSERVATIONS AND RESULTS

In the present study, a total of 82 patients who were admitted to the hospital and who fit the selection criteria were included. The patient age ranged from 18 to 82 years. Age distribution: The 18-40 years age group had 30 (36.6%) cases of empyema, the 41-60 years age group had 31 (37.8 %) cases and patients >60 years were 21 (27.6 %). Gender distribution: There were 69 (84%) males and 13 (16%) females and the male to female ratio was 5.3:1. Risk factors: The commonest risk factor of smoking was observed in 34 (41.5%) patients. A history of COPD was observed in 24 (29.3%) patients, diabetes mellitus in 21 (25.6%) patients, past history of tuberculosis in 3 (3.7%) patients, past history of empyema in 3 (3.7%) patients, past history of lung abscess in 1 (1.2%) patient. Other comorbidities were seen in 9 (11%) patients that included carcinoma of esophagus in 2 patients, carcinoma of prostate in 1

patient, chronic kidney disease in 3 patients, chronic liver disease in 2 patients and interstitial lung disease in 1 patient. Symptomatology: The most common symptom in our study was fever and was observed in 63 patients (77%); cough in (49.6%), chest pain in 43 (52.5%), breathlessness in 31 (28%) and weight loss was seen in 16 (19.5%) cases. In addition, constitutional symptoms such as anorexia, malaise, abdominal pain, altered sensorium were noted in 9 (11%) patients. Among the 82 patients, majority had intercostal tenderness that was seen in 57 (69.5%) cases and clubbing was present in 12 (14.6%) cases.

**Laboratory Data:** Complete blood picture: The median haemoglobin on admission was <11 gm/dl in 45 (55%) patients, white cell count >10000 cells/cm<sup>2</sup> in 79 (96.5%) patients, ESR >50 mm/hour in 73 (89%) patients and among them ESR >100 in 51 (62%) patients was observed. Following biochemical lab parameters were observed in empyema patients at the time of admission. Random blood sugar >200 mg/dl observed in 29 (35.3%) patients.

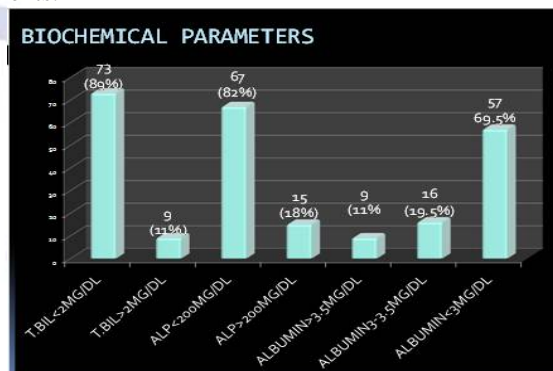


Figure 1: Biochemical parameters

**Liver function tests:** Total bilirubin >2 mg/dl was observed in 9 (11%) patients, <2 mg/dl in 73 (89%) patients. High alkaline phosphatase >200 was observed in 15 (18%) patients. AST >40 U was observed in 17 (20.2%) patients. ALT >40 U was observed in 12 (14.6%) patients. Hypoalbuminemia was observed in 73 (89%) patients, among them severe hypoalbuminemia was observed in 57 (69.5%) patients. Lowest value of serum albumin observed was 1.9 gm/dl.

**Renal Parameters:** Creatinine >1.6 mg/dl in 7 (8.5%) patients, <1.6 mg/dl observed in 75 (91.5%) patients.

**Imaging studies:** CXR was done in all the patients. Right sided effusion was observed in 45.1% patients, left sided effusion was seen in 47.6%, right sided hydropneumothorax was observed in 3.7% and left side hydropneumothorax in 3.7% of the patients respectively. CT thorax was done in 22 patients. Loculated effusion with air fluid level enhancing thick pleura with collapse

of lung was seen in 15 (68.2%) patients. Multiple loculated fluid collections enhancing parietal pleura were

seen in 3 (13.6%) patients. Thick walled cavity with internal septations was observed in 4 (18.2%) patients.



**Figure 2:** Loculated left sided empyema, **Figure 3:** Loculated effusion with air fluid level with enhancing thick pleura on computed tomography

**Sputum and pleural fluid examination:** Thoracocentesis was done in all the patients. Pleural fluid analysis was suggestive of frank pus. In 28 patients pleural fluid PH was analysed and in all cases it was < 7.2. Pleural fluid protein was < 2.4 mg/dl in 10 (9%) patients and > 2.4 mg/dl in 72 (91%) patients. Pleural fluid glucose was < 40 mg/dl in 75 (91.5%) patients and was > 40 mg/dl in 7 (8.5%) patients. LDH was > 1000 units in 68 (83%) patients and < 1000 units in 14 (17%) of patients. Adenosine deaminase (ADA) was > 40 units in 72 (91%), and < 40 units in 10 (9%) of the patients. Pleural fluid gram stain was positive in 14 (17%) patients. Gram stain was negative in 68 (83%) patients. Pleural fluid AFB was positive only in 1 patient. In the present study, sputum culture was done in 46 patients and pleural fluid culture was done in all the 82 cases.

**Table 1:** Microbiological culture study of sputum and pleural fluid specimens

Culture report	Sputum No. of cases (%)	Pleural fluid No. of cases (%)
Sterile	30 (38.0%)	74 (91%)
ESBL E.coli	6 (7.8%)	2 (2.4%)
Pseudomonas aeruginosa	4 (4.8%)	-
Staphylococcus aureus	2 (2.4%)	-
Acinetobacter	1 (2.0%)	1 (1.2%)
Cardiobacter	1 (2.0%)	-
Sphingomonas	1 (2.0%)	-
Aeromonas	1 (2.0%)	-
Alpha hemolytic streptococci	-	1(1.2%)
Streptococcus pneumoniae	-	1(1.2%)
Klebsiella and Morganella (mixed infection)	-	1(1.2%)
Enterobacter	-	1(1.2%)
Mycobacterium tuberculosis	-	1(1.2%)
Total	46 (100%)	82 (100%)

**Intercostal tube drainage:** Intercostal tube (ICD) insertion was required in all the 82 patients. Mean duration of ICD insertion was 14.9 days.

**Table 2:** Duration of intercostal tube drainage

ICD duration (in days)	No. of cases	Percentage (%)
Less than 10	12	14%
11-20	64	78%
21-30	3	4%
More than 30	3	4%
Total	82	100%

Mean duration of ICD insertion was 14.9 days. Maximum duration of ICD was 90 days and the patient recovered completely. The minimum duration of ICD was 2 days.

**Table 3:** Number of antibiotics used

No. of antibiotics used	No. of cases	Percentage (%)
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Single drug	15	18%
Two drugs	44	54%
Three or more drugs	16	20%
ATT	7	8%
Total	82	100%

Piperacillin-tazobactam was used in 7 (46.6%) patients. Cefoperazone-sulbactam was used in 4 (26.6%) patients, Aminoglycosides was used in 4 (26.6%) patients

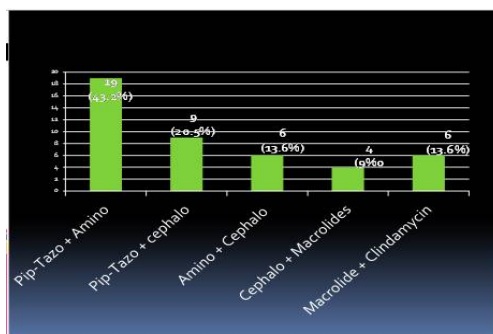


Figure 4: Drug regimen used

Piperacillin-tazobactam with Aminoglycosides was used in 19 (43.2%) patients. Piperacillin and cephalosporins was used in 9 (20.5%) patients. Aminoglycosides and cephalosporins were used in 6(13.6%) patients. Cephalosporins and Macrolides were used in 4(9%) patients. Macrolide with clindamycin were used in 6 (13.6%) patients. Out of 16 patients who received three or more drugs, the most common regimen used was Pip-Tazo+Aminoglycoside+Macrolide in 12(75%) patients. Duration of therapy for most of the patients was 2 weeks and maximum duration of antibiotic therapy in one patient was 28 days. ATT was used in 7 patients (4 out of 7 patients, in addition received Piperacillin-Tazobactam for 2 weeks) Pleurodesis and fibrinolytics were used in 1 (1.2%) patient. Decortication was done in 2 (3.2%) patients.

**Hospital stay:** Duration of hospital stay in patients of empyema was observed. Less than 10 days hospital stay was seen in 9 (11.0%) patients, 10-20 days in 65 (79.3%), 21-30 days in 6 (7.3%) patients, more than 30 days in 2 (2.4%) patients was observed The maximum duration of hospital stay was 90 days.

**Outcome:** A total of 72 (87.8%) patients recovered. However, death occurred in 6 (7.4%) patients. There were 4 (4.8%) patients who were lost to follow up and/or had taken discharge against medical advice. Among the deaths, 4 patients had developed septic shock and 2 patients had multi organ dysfunction. Among the deaths, one patient had pleural fluid culture that isolated mixed infection (Klebsiella and Morganella) and blood cultures were sterile. In one patient, pleural fluid culture had moderate growth of E.coli sensitive to amikacin, cefazolin, ceftriaxone, gentamycin, amoxicillin. The remaining 4 patients had sterile culture reports after 72

hours. Among the discharge against medical advice patients, in one patient, the pleural fluid was sterile and blood cultures had isolated Staphylococcus aureus. In one patient, pleural fluid culture isolated alpha haemolytic streptococcus and blood culture was sterile. In one patient, blood culture isolated Staphylococcus saprophyticus. In one patient pleural fluid had Gram positive bacilli and cultures were sterile. Among 72 patients, 56 (68.3%) patients came for follow up and 16 were lost to follow up. Among 56 patients, pleural fibrosis developed in 7 (12.5%) patients.

## DISCUSSION

The present study was conducted in tertiary care hospital in southern India with an aim to study the clinical profile of empyema thoracis. Even though multiple similar studies have been done in the past, this study is significant in view of increasing incidence of empyema with varied presentations and outcomes in last few years. A total of 82 proven empyema cases by pleural fluid analysis and imaging studies were analysed. In the present study, the male to female ratio was 5.3:1. This is comparable to the study done by Acharya *et al*<sup>4</sup> where 40 consecutive in-patients with empyema thoracis were studied and they observed a male to female ratio of 3.4:1. In their study there were 31 (77.5%) male patients and 9 (22.5%) female patients. In our study, the 40-60 year age group showed highest incidence of empyema which is similar to the findings of a study done by Geha <sup>[5]</sup> and Sherman *et al* <sup>[6]</sup> in Columbia. Higher incidence in males is thought to be due to the fact that in general males are more prone to mechanical stresses due to their tall stature and strenuous working styles. Also habitual smoking, tuberculosis and COPD are also contributing factors. The

clinical manifestations of 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 almost complete absence of symptoms to severe illness with systemic toxicity. In general, anaerobic and tubercular empyemas are usually present with a subacute illness, whereas aerobic bacterial infections of the pleural space present with acute illness.<sup>7</sup> In our study, the most common presenting symptom was fever followed by cough, chest pain, breathlessness and weight loss. In addition, constitutional symptoms anorexia, malaise and abdominal pain, were also noted. Kamat *et al*<sup>8</sup> in Mumbai reported cough (94%) to be the most common symptom. This was followed by fever (76%), chest pain (75%) and dyspnoea (53%). Acharya *et al*<sup>13</sup> in their study reported cough in 37 patients (92.5%), dyspnoea (37, 92.5%), followed by fever (35, 87.5%) and chest pain (32, 80%). Also in a study done in Pakistan by Nadeem *et al*<sup>9</sup> most common presentation was with fever (73%), cough (65%) and chest pain (60%) and these observations are consistent with our study. Out of 82 patients, majority had intercostal tenderness (57 patients, 69.5%) and clubbing was present in 12 (14.6%) patients. In present study median haemoglobin on admission was <11 gm/dl in 45 (55 %) patients, leucocytosis >10000 cells/cmm in 79 (96.5%) patients and ESR >100 mm/hour observed in 51 (62%) patients. Extremely elevated ESR (>100 mm/hour) has high specificity for infections, malignancies and arteritis. C-reactive protein (CRP) and procalcitonin are other acute phase reactants but these tests were not done in the present study.<sup>10</sup> In our study hypoalbuminemia was common which was observed in 73 (89%) patients, among them severe hypoalbuminemia was observed in 57 (69.5%) patients. Lowest value of serum albumin observed was 1.9 gm/dl and this is consistent with the observations of Ferguson *et al*.<sup>11</sup> In our study, 7 (8.5%) patients had renal failure. Out of these 7 patients, one patient's renal failure improved and six patients developed septic shock and MODS. Hepatitis was observed in 23 (28%) patients. Sepsis and 30-day mortality are high in cases of severe empyemas.<sup>12</sup> Imaging modalities used in our study were chest X-ray and CT thorax, but the basic methods of physical examination, (guided) tapping and analysis of the specimen are of utmost importance. Chest X-ray was done in all the patients. Right sided effusion was observed in 45.1% patients, left sided effusion was seen in 47.6%, right sided hydropneumothorax was observed in 3.7% and left side hydropneumothorax was seen in 3.7% of the patients respectively. CT thorax was done in 22 patients. Loculated effusion with air fluid level with enhancing thick pleura with collapse of lung was seen in 15(68.2%) patients. CT is also helpful in identifying

parenchymal lung lesions, masses, and enlarged mediastinal lymph nodes.<sup>13</sup> Thoracocentesis was done in all patients and pleural fluid analysis was done in all 82 cases. The results met the criteria of Empyema.<sup>14</sup> In our study pleural fluid from some of the patients could not be completely analyzed due to thick nature of pleural fluid. Pleural fluid glucose <40 mg/dl was observed in 75 (91.5%) patients. In a study by Vardhan *et al*<sup>15</sup> pleural fluid analysis, (n=40) showed glucose <39 mg /dl in 22 (44%), and 2 patients had LDH>1000 IU. Our results are consistent with this study. In our study pleural fluid cultures were sterile in 74 (91%) patients (Table 1). Acharya *et al*<sup>4</sup> reported sterile pleural fluid cultures in 55% cases. In their study, Staphylococcus aureus was isolated in 5 (12.5%) patients, Gram negative bacilli in 1 (2.5%), Mixed infection in 3 (7.5%), and Mycobacterial culture was positive in 8 (20%) of the patients. In our study, pleural fluid cultures were sterile in most of the patients. It could be attributed to the fact that patients would have already received antibiotics prior to being referred to our hospital which is a tertiary care centre. Kuan-Yu *et al*<sup>16</sup> in their study isolated a total of 163 microorganisms from the pleural fluids 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). Klebsiella pneumoniae was the most commonly isolated pathogen (24.4%) and was strongly associated with a diagnosis of diabetes mellitus. A less proportion of cases of tubercular empyema can be diagnosed by isolation of AFB in sputum and /or pleural pus. In the present study, sputum was positive for AFB in 3(6.4%) patients and mycobacterium tuberculosis was isolated from pleural fluid in one patient. In addition to 3 (6.4%) were diagnosed on basis of past history, symptomatology, radiological lesions and therapeutic response to antituberculous treatment.<sup>17</sup> There are two basic principles for the successful management of thoracic empyema-namely the control of infection with appropriate antimicrobial therapy and the adequate drainage of pus.<sup>4</sup> The initial choice of antibiotics depends on the clinical condition of the patient. In our study single drug antibiotic used in 5 (18%) patients. Two drugs used in 44 (54%) patients. Three or more drugs used in 16 (20%). ATT was used in 7 (8%) patients. Different drug regimens were used for the patients (Table 3, Figure 4). In a study by Mandal *et al*<sup>18</sup> 179 consecutive adult patients were seen with a diagnosis of primary bacterial thoracic empyema. A combination of clindamycin and gentamycin proved to be the most efficacious antibiotic regimen in this study when used either as the first-line or second-line therapy. Duration of the antibiotics in most of the patients was 2 weeks. In our study, ICD tube was

inserted in all 82 (100%) patients (Table 2). Maximum duration of ICD is 90 days and the patient recovered completely. The least duration of ICD was 2 days. Pleurodesis was used in 1 (1.2%) patient, intra pleural fibrinolytics used in 1 (1.2%) patient by using streptokinase 2.5 lakh IU. It was used because of very thick nature of pus. Decortication was done in 2 (3.2%) patients. These patients recovered completely. In the study done by Acharya *et al*<sup>4</sup> decortication was done in 2 (5%) patients, 1 (2.5%) patient was discharged against medical advice, 37 (92.5%) patients recovered and no deaths were reported. In the study by Mandal *et al*<sup>18</sup> over all, there were 12 deaths with a mortality rate of 6.7%, sepsis was the cause of death in 7 patients, and the organisms isolated in these patients included gram-negative bacilli (3 patients), Staphylococcus (1 patient), mixed aerobic and anaerobic bacteria (1 patient), pure anaerobic (1 patient), and 1 patient with none. In present study, death occurred in 6 (7.4%) patients. The lost to follow up or discharge against medical advice, was observed in 4 (4.8%) patients. Among the deaths, 4 patients developed septic shock and 2 patients developed multi organ dysfunction. Among the mortality patients, one patient had pleural fluid cultures with mixed infection (Klebsiella and Morganella) and sterile blood cultures. In one patient pleural fluid culture had isolated moderate growth of E.coli. The mortality from empyema is high and 20% of patients with empyema die. Approximately 20% require surgery to recover within 12 months of their infection.<sup>19</sup> A good outcome demands prompt recognition, appropriate antibiotic therapy and adequate pleural drainage. Pleural fluid of PH<7.2, glucose 40 mg/dl and LDH>1000 IU indicate a patient who requires pleural drainage. However, in practice such criteria may not always be readily available to guide treatment decisions. Hence, we propose that in addition to the size and thickness of the effusions; aspirated fluid may be used to guide the need for an ICD placement.

## CONCLUSIONS

Empyema thoracis commonly presents with fever, cough and chest pain. COPD, diabetes mellitus, smoking are most common risk factors associated with empyema. Neutrophilic leucocytosis is seen in almost all patients and also majority of patients have an ESR of >100. Non tubercular empyema is more common than tubercular empyema. Common complications in our series were hepatitis, renal failure and septic shock. Management includes systemic antibiotics for 2-4 weeks and intercostal drainage.

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