

## **Analysis of bacterial spectrum of Empyema Thoracis among patients with pleural effusion in low income country.**

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## **ABSTRACT**

### **Background**

Treatment of thoracic empyema in our country has been empirical with some assuming worst case scenario and treating it as extra-pulmonary TB and others treating with conventional broad spectrum antibiotics. With antibiotics resistance on the rise globally, this practice will worsen the condition by increasing drug resistance TB and other common microbes. The aim of the study is to analyze bacteria spectrum of pleural cavity in pleural empyema patients admitted at Muhimbili National Hospital(MNH) between March and December 2017.

### **Materials and Methods**

A hospital based prospective analytical study was conducted from March 2017 to December 2017; in the surgical and medical wards of MNH. It involved all patients who had pleural effusion. Data was collected using a structured tool and both the patient characteristics and clinical and laboratory diagnosis were recorded. Data analysis was done using SPSS version 22.0. Univariate analysis was used to analyze common causative organisms. The chi-square tests

were used to assess association between patterns of pleural empyema by patient characteristics. P- values of less than 0.05 was considered statistically significance.

## **Results**

A total of 86 patients were recruited he study period of March to December 2017,The isolated micro-organism among the 86 patients investigated were found in 29 patients, in which *Staphylococcal aureus* 10(33.3%) was the Commonest organism isolated, while the *Streptococcal species* 2(6.7%) was the least common.

## **Conclusion**

Empyema thoracis is still common in our setup as 29(33.7%) patients had bacterial isolates. The common organism identified was *Staphylococcal aureus* and *E.coli*, and it is common in middle age.

## **Background**

Thoracic empyema is a global problem with upto 65,000 cases reported each year in the US and UK alone.(1)Thoracic empyema incidence has been shown to be rising in both developed and developing countries, including in pediatric populations.(2)In Scotland, the incidence of empyema has risen 10 times in 1–4 yr old children, with similar reports from the USA, Canada and elsewhere in Europe, and the trend is mirrored in adults too.(1) The treatment of thoracic empyema normally require drainage of the pus plus antibiotics prescription appropriate to the causative organisms as well as addressing the underlying cause.

The exact bacterial spectrum responsible for the development of thoracic empyema in our set up is not well understood. This is due to lack of antibiotics stewardship culture with blind prescription. This pattern of antibiotics prescription amounts to irrational use and adds costs and antimicrobial resistance including multi drug resistance tuberculosis. Knowing the isolates will help the microbiology to perform routine sensitivity tests to target during the treatment of thoracic empyema. This study therefore aimed at addressing the pattern of isolate

The treatment of thoracis empyema will require the use of antibiotics specific to the causative organisms.. However, at MNH this practice is not routine and based on traditions with all non trauma related thoracic empyema treating as Extra pulmonary Tuberculosis. The findings from

this study will help in informing antibiotic choices thereby limiting development of antibiotic resistance and improving patient's outcomes. Targeted antibiotics also has the potential to foster quicker resolution of pleural infection and hence Empyema.

## **Methodology**

A hospital based prospective analytical study was conducted from March 2017 to December 2017 at Muhimbili National Hospital, a tertiary and largest teaching hospital for Muhimbili University of Health and Allied Sciences. It is located in the commercial capital of Dar es Salaam receiving patients from all over the country. It is one of the three that receives thoracic surgery cases in the whole country and microbiology laboratory for culture and sensitivity services, the study included all patients who had pleural effusion on admission. Ethical approval was obtained from MUHAS IRB.

All surgical aseptic techniques were observed in obtaining the pleural fluid. This included use of sterile instruments and hand washing techniques. The aspirate from intercoastal space was immediately placed in sterile specimen bottle (without EDTA) and sent to the laboratory within an hour of collection.

Data was collected using a structured tool and both the patient characteristics and clinical and laboratory diagnosis were recorded. Data analysis was done using SPSS version 22.0.

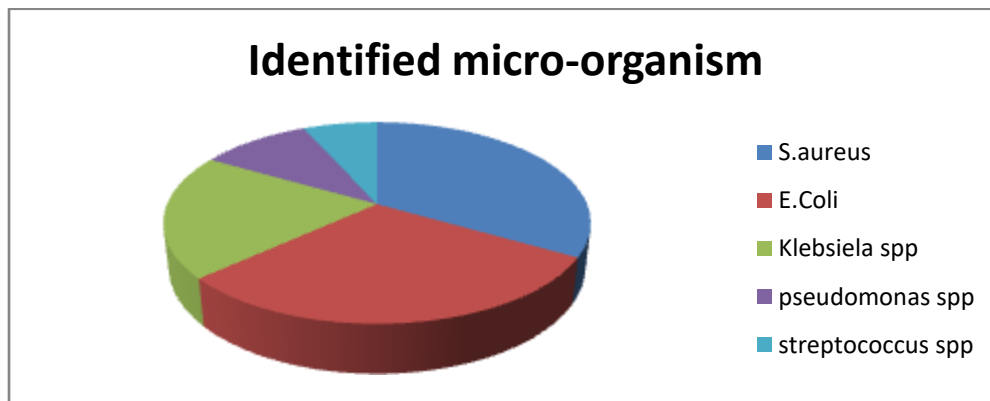
## **Results**

In this study 86 patients were recruited during the study period of March 2017 to December 2017, Most of the patients were in the age group of 31 -50 years at 43(50%) with patients less than 30 years above the age of 70 years at 11.6% and 9.3% respectively. In this study 86 patients were recruited during the study period of March to December 2017, Most of the patient were in the age group of 31 -50 years at 43(50%) with patients less than 30 years above the age of 70 years at 11.6% and 9.3% respectively. It was noted females predominated males by ratio of **2:1**, and large proportion of patients were peasants 68(79.1%) and less than 10% were employed. **(Table 1)**

**Table 1: Patients characteristics (n = 86)**

Variable	Frequency (%)
<b>Age(years)</b>	
0-30	10 (11.6%)
31-50	43 (50.0%)
50 -70	25(29.1%)
>70	8 (9.3%)
<b>Sex</b>	
Male	28 (32.6%)
Female	58 (67.4%)
<b>Occupation</b>	
Self employed	5 (5.8%)
Peasant	68 (79.1%)
Others	13 (15.1%)

The isolated micro-organism among the 86 patient investigated were found in 29 patients, in which *Staphylococcal aureus* 10(33.3%) was the commonest organism isolated, while the *Streptococcal species* 2(6.7%) was the least common. **(Figure 1)**

**Figure 1: The identified bacteria in the pleural effusion (n = 29)**

In this group of patients, multiple risk factors were identified as causative factor for empyema thoracis. Immunosuppression and malnutrition has no relationship with empyema thoracis, in which 34% patients respectively, but it was found that 31.7% patients with malignancy contributed to the patient with empyema thoracis and 33% of patients with chronic lung disease found to have empyema thoracis. (Table 2)

**Table 2: The comorbidity associated with empyema thoracis**

<b>CO-MORBIDITIES.</b>			
<b>Chronic lung disease</b>	YES	NO	P- value
Yes	3(33.3%)	6(66.7%)	1.000
No	26(33.8%)	51(66.2%)	
<b>Immunosuppression</b>			
Yes	0(0.0%)	3(100%)	0.548
No	29(34.9%)	54(65.1%)	
<b>Malnutrition</b>			
Yes	0(0.0%)	2(100%)	0.548
No	29(34.5%)	55(65.5%)	
<b>Malignancy</b>			
Yes	19(31.7%)	41(68.3%)	0.622
No	10(38.5%)	16(61.5%)	

## Discussion

Empyema thoracis is a serious complication of infection adjacent to or within the chest that rarely resolves without appropriate medical therapy and drainage procedures. In this study it was noted that one in three of the studied group had empyema thoracis and it was more common in the middle age group and in the lower social class which may explained their health seeking behavior and late presentation to the health facility. The study excluded pediatric patients and failed to estimate population prevalence hence could not measure the trend, but globally the trend has been shown to be increasing in both adults and children.(1,2)Our study unlike others reported female predominance.(4)The reasons for this observation could not be ascertained.

With regard to micro-organism isolates findings in this has shown that the commonest bacteria in pleural fluid was *Staphylococcal aureus* and *E. coli* at 33% and 30% respectively while less than 10% micro-organisms isolated were *Streptococcal species*. Different species were identified in a study done by Porcel *Jet al* to assess the pleural space infection and it was identified gram-positive organism (67%), specifically *Viridian streptococci*, *Streptococcus pneumoniae*, *Staphylococcus aureus* and few cases had gram negative aerobic pathogen mostly *Escherichia*

coli (7%)(5) study done by Yoshihiro Kobashi identified *Streptococcus milleri* bacteria as a main bacterial isolate(6).The differences in micro-organism isolates noted in the studies can be explained by host defence and may be a geographical distribution(6). A study in South Africa by Abramor and his colleagues reported single isolate- pyogenic cocci in 32 and gram negative enteric bacilli as common isolates.(7)

The bacteriology of pleural effusions is diverse; in the past, aerobic Gram-positive organisms (especially *Streptococcus species*) have been the most frequent isolates. However, commonly identified bacteria in the infected pleural effusion have changed over recent decades. Gram-negative aerobic bacteria are emerging as important pathogens in cases of parapneumonic effusion or empyema. The findings from this study will help set time trends among our patients presenting with pleural infection and offer reliable clue as to existence of any trend. With rampant usage of antibiotics in the society, and hierarchy of the hospital in the referral system, it was expected that most patients have already been on an antibiotics including the broad spectrum.

Globally, there is emerging isolation of *E. coli*, *Klebsiella*, *Pseudomonas*, and *Haemophilus influenzae* as most common microbes in thoracic empyema(8).Which is similar to our study findings of gram negative anaerobes, a hospital acquired organism,*E.coli*9(30.0%). How patients acquire these enterobacteria should be investigated well as in this error of blind treatment in the lower facilities, factors that would favor such bacterial colonization need to be studied. This will help with antibiotics selections in settings where routine culture and sensitivities are not being performed.

Several underlying conditions have been studied and shown to be related to the development of empyema thoracic. Some of these include: cigarette smokers, pneumonia, history of excessive alcohol intake, dental caries, chronic obstructive pulmonary diseases, diabetes mellitus and history of using oral contraceptives(6).This current study failed to identify any risk factor due to the small sample size in the studied variables. Only malignancy had the power to detect effect, but was also not statistically significant. Thoracic empyema should therefore be suspected in every patient with respiratory symptoms through regular and thorough physical examination.

## **Conclusion**

Thoracic empyema should be expected to occur in one third of patients with pleural effusion. There was mixed infection noted except for anaerobes which were not cultured in this study due to lack of handling containers. There is a need to have routine culture and sensitivity for all patients with pleural effusion and initiate early treatment before it turns to empyema.

## **Competing Interests**

The authors declare that they have no competing interest

## **Authors' contributions**

Both authors contributed equally towards the accomplishment of this work and have all read and approved the final version of the manuscript.

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## **REFERENCES**

1. Rosenstengel A. Pleural infection-current diagnosis and management. *J Thorac Dis.* 2012;4(2):186–93.
2. Brims FJH, Lansley SM, Waterer GW, Lee YCG. Empyema thoracis: New insights into an old disease. *Eur Respir Rev.* 2010;19(117):220–8.
3. M. P. Weinstein. *Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria That Grow Aerobically ; Approved Standard — Ninth Edition.* Vol. 32, *Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria That Grow Aerobically; Approved Standar- Ninth Edition.* 2012.
4. Jain A, Devadiya M, Mane S, Meena M. Clinico-etiological profile of Empyema Thoracis in children : A Descriptive Analysis. 2016;(11):23–9.
5. Porcel JM, Vázquez P, Vives M, Nogués A, Falguera M. Pleural Space Infections : Microbiologic And Fluid Characteristics In 84 Patients. internet *J Pulm Med.*

- 2002;3(1):1–5.
6. Kobashi Y, Mouri K, Yagi S, Obase Y, Oka M. Clinical analysis of cases of empyema due to *Streptococcus milleri* group. *Jpn J Infect Dis*. 2008;61(6):484–6.
  7. Abramor EJ, Baptista L, McHendry JA, Conlan AA. The microflora of chronic pleural empyema. An analysis of 89 patients. *S Afr Med J [Internet]*. 1985;68(2):80–2
  8. Sonali J, Banavaliker JN. EMPYEMA THORACIS : Bacteriological analysis of pleural fluid from the largest chest hospital in Delhi. 2013;3(6):46–51.