

The Pattern of Bacterial Isolates in Cases of Empyema Thoracic in Children

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ABSTRACT

Objective: To determine the frequency of pattern of bacterial isolates in children with thoracic empyema visiting to Children Hospital Larkana, Sindh.

Study Design: Cross sectional Descriptive Study

Place and Duration of Study: This study was conducted at the Department of Paediatric Medicine, Children Hospital CMC (H), SMBBMU, Larkana, Sindh, Pakistan from September, 2020 to March, 2021 for a period of six months.

Materials and Methods: All patients who implemented the inclusion criteria and admitted in Children Hospital CMC (H), Larkana were taken in the study. The procedure, its risks and benefits of the study enlightened and then informed consent was received. Chest x-rays were taken in all patients at the time of admission, after intercostal tube drain (ICTD) introduction, its removal and at discharge, while ultrasound CT of chest were done when needed. Diagnostic thoracentesis was performed and pleural fluid was submitted for biochemical analysis (total and differential leukocyte count, protein, sugar, and LDH) and microscopic analysis (Gram staining, culture, and smear for AFB and Gen Expert). Outcome variable i.e. pattern of bacterial isolates was assessed. All the collected data were recorded into the proforma added towards the end and used electronically for research purpose.

Results: Mean \pm SD of age was 5.1 ± 2.3 years. Out of 128 patients, 77 (60.2%) were male while 51 (39.8%) were female. In distribution for pattern of bacterial isolates, staphylococcus aureus were noted in 23 (18%) patients, staphylococcus epidermidis was noted in 17 (13.5%), streptococcus pneumoniae was noted in 14 (10.9%), 09 (7%) had pseudomonas, 09 (7%) had Klebsiella pneumoniae, proteus in 5 (3.9%), E.coli in 4 (3.1%), 4 (3.1%) had mixed, tuberculosis was noted in 18 (14%) while 25 (19.5%) patients had no growth pattern of bacterial isolates.

Conclusion: It is to be concluded that staphylococcus aureus was the commonest organisms of bacterial isolates followed by mycobacterium tuberculosis in our study. Further research is required to better understand the factors associated with pattern of bacterial isolates in children with thoracic empyema.

Key Words: Bacterial Isolates, Thoracic Empyema, Staphylococcus Aureus

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INTRODUCTION

Pleural effusion (PE) is an excessive collection of fluid in the pleural space. It results from excessive formation or decrease fluid removal by the lymphatics. PE may be transudate or exudate in nature ^[1]. Para-pneumonic effusions are associated with bacterial pneumonia, bronchiectasis or lung abscess and are probably the most frequent source of exudative variety of pleural effusion ^[2].

The term Thoracic Empyema (ET) refers to accumulation of pus in the pleural space ^[3], which is

related with morbidity and mortality in Pakistan. Even globally, PE is related with considerable amount of morbidity, although there is availability of rapid diagnostic tools, great coverage of immunization and extended antibiotics.^[4] Incidence of pediatric empyema has risen over the last decade while pediatric pneumonia causing to ET accounts for 0.6%, affecting about 3.3 per 100,000 children ^[5]. Though, there is lack of literature on the topic of pediatric empyema incidence and prevalence in Pakistan ^[6]. Globally studies shown that the incidence of thoracic empyema is increasing, due to drug resistant bacteria, emergent non-vaccine replacement serotypes, specially serotype 19A after the introduction of PCV7, late diagnosis, failure to introduce appropriate antimicrobial therapy, malnutrition, co-morbidities, non-compliance attitude and costly treatment ^[1,6-13]. The characteristic bacterial pattern for diagnosis of thoracic empyema is direct a pleural fluid analysis and standard bacterial culture ^[14]. Pleural fluid analysis should be done with the detailed clinical manifestation and Chest x-ray to find out the etiology of a PE. Culture is crucial to verify antibacterial susceptibility. ^[15] The frequent organisms

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of thoracic empyema in pediatric group are Mycobacterium tuberculosis, Pneumococcus, Staphylococcus aureus and other gram negative bacteria^[4,6]. Tuberculosis is commonest culprit of exudative pleural effusion followed by parapneumonic effusion in Pakistan and other developing countries^[15, 16]. It is also assumed that pneumonia caused by fatal organisms like S.pneumoniae often presents with prominent symptoms at early phase of the disease. Thus, it is frequently treated in advance as the progression to PE is decreasing^[17].

MATERIALS AND METHODS

Operational Definitions:

Empyema: It is defined as, if pleural effusion will fulfill as a minimum one of the following criteria:

- (1) The aspiration of frank pus on pleural tap;
- (2) Positive Gram staining of pleural effusion;
- (3) Existence of bacteria on culture pleural effusion;
- (4) The presence of polymorph nuclear leukocytes $\geq 10,000/\text{dl}$, LDH more than 200 U/L, glucose $\leq 40\text{mg}/\text{dl}$ and protein less than 3 g/dl in a pleural effusion^[10, 11, 15].

Tuberculous Empyema: Tuberculous empyema is described as empyema with one of the following criteria:

- (1) Acid fast bacilli (AFB) are present on pleural fluid smear;
- (2) AFB is present in sputum and with sign of active parenchyma TB on chest x-ray/CT scan of thorax (nodular consolidation with or without cavity in apex, tree in bud appearance)^[11].

Pattern of bacterial Isolates

Staining Reaction	Shape	Catalase	Coagulase	Oxidase	Additional Properties	Organism
Gram+ve	Cocci	+ve	+ve	-ve	DNase +ve	Sta. Aureus
Gram+ve	Cocci	+ve	-ve	-ve	DNase -ve	Coagulase -ve Staphylococci
Gram+ve	Cocci	-ve		-ve	Non motile, Nonsperforming CAMP +ve	GBS
Gram+ve	Rods	+ve	-ve	-ve	Motile, facultative Anaerobe	Listeria monocytogens
Gram+ve	Cocci	-ve	-ve	-ve	Esculine hemolysis +ve	Enterococci
Gram-ve	rods	+ve	-ve	-ve	Motile, glucose and lactose fermenter, indole +ve	E-coli
Gram-ve	rods	+ve	-ve	-ve	Non motile, glucose and lactose fermenter, ureas test +ve	Klebsiella species
Gram-ve	rods	+ve	-ve	-ve	Glucose fermenter, ureas test +ve, Swarming motility	Proteus species
Gram-ve	rods	+ve	-ve	+ve	Motile, glucose, lactose fermentation -ve	Pseudomonas aeruginosa

Data Collection: This study was carried out after approval of synopsis from Research Department of SMBBMU. All patients visited to department of Pediatrics Medicine, Children Hospital CMC (H) Larkana and fulfilling the inclusion criteria (Children below 15 years of age of either gender, presented with thoracic empyema in accordance with operational definition) were took in the study. A written informed consent was received from parents / guardian of patients. Empyema which was secondary to chest trauma or surgical procedure, excluded. Chest x-rays were taken in all patients at the time of admission, after intercostal tube drain (ICTD) introduction, its removal and at discharge, while ultrasound and CT of chest were done when needed. Diagnostic thoracentesis was performed and pleural fluid was submitted for biochemical analysis (total and differential leukocyte count, protein, sugar, and LDH) and microscopic analysis (Gram staining, culture, and smear for AFB

and Gen Expert). Outcome variable i.e. pattern of bacterial isolates was assessed in accordance with operational definition. All information was recorded into the predesigned proforma (attached). Biasness and confounders of the study were managed by firmly following the inclusion and exclusion criteria.

Data Analysis: Data was analyzed on SPSS version 23.0. Mean \pm standard deviation was calculated for quantitative variables like age, weight. Frequency and percentage were calculated for gender, site of chest and outcome variable i.e. pattern of bacterial isolates. Effect modifiers were controlled through stratification of age, gender and site of chest. Post stratification, Chi-square/Fisher's exact test as appropriate was applied using $P \leq 0.05$ as criteria of statistical significance.

RESULTS

In this study 128 patients were included to assess the pattern of bacterial isolates in children with thoracic

empyema. Mean age was 5.1±2.3 years; these were of all age from 1 year to 15 years.

Table No.1: Frequency for Pattern of Bacterial Isolates n=128

Bacterial isolates	Frequency	% age
Staphylococcus Aureus	23	18%
Tuberculosis	18	14%
Staphylococcus Epidermidis	17	13.5%
Streptococcus pneumoniae	14	10.9%
Klebsiella pneumoniae	9	7%
Pseudomonas	9	7%
Proteus	5	3.9%
E. Coli	4	3.1%
Mixed	4	3.1%
No Growth	25	19.5%

Table No.2: Stratification for Age Group with Pattern of Bacterial Isolates n=128

Pattern of Bacterial Isolates	Age group [in years]		P-Value
	1 – 5	>5	
Staphylococcus Aureus	11(8.6%)	12(9.4%)	0.002
Tuberculosis	12(9.4%)	6(4.7%)	
Staphylococcus Epidermidis	14(10.9%)	3(2.3%)	
Streptococcus pneumoniae	11(8.6%)	3(2.3%)	
Klebsiella pneumoniae	1(0.8%)	8(6.3%)	
Pseudomonas	8 (6.3%)	1(0.8%)	
Proteus	3(2.3%)	2(1.6%)	
E. Coli	4(3.1%)	0(0.0%)	
Mixed	2(1.6%)	2(1.6%)	
No Growth	12(9.4%)	13(10.1%)	

Table No.3: Stratification for Gender with Pattern of Bacterial Isolates n=128

Pattern of Bacterial Isolates	Gender		P-Value
	Male	Female	
Staphylococcus Aureus	14(10.9%)	9(7.0%)	0.704
Tuberculosis	12(9.4%)	6(4.7%)	
Staphylococcus Epidermis	7(5.5%)	10(7.8%)	
Streptococcus pneumoniae	8(6.3%)	6(4.7%)	
Klebsiella pneumoniae	5(3.9%)	4(3.1%)	
Pseudomonas	6(4.7%)	3(2.3%)	
Proteus	2(1.6%)	3(2.3%)	
E. Coli	4(3.1%)	0(0.0%)	
Mixed	3(2.3%)	1(0.8%)	
No Growth	16(12.5%)	9(7%)	

Applied Chi-Square test

Table No.4: Stratification for Site of Chest Pain with Pattern of Bacterial Isolates n=128

Pattern of Bacterial Isolates	Site of Chest Pain		P-Value
	Right	Left	
Staphylococcus Aureus	16(12.5%)	7(5.5%)	0.955
Tuberculosis	14(10.9%)	4(3.1%)	
Staphylococcus Epidermidis	11(8.6%)	6(4.7%)	
Streptococcus pneumoniae	11(8.6%)	3(2.3%)	
Klebsiella pneumoniae	6(4.7%)	3(2.3%)	
Pseudomonas	5(3.9%)	4(3.1%)	
Proteus	4(3.1%)	1(0.8%)	
E. Coli	3(2.3%)	1(0.8%)	
Mixed	3(2.3%)	1(0.8%)	
No Growth	15(11.7%)	10(7.8%)	

61% of children were below 5 years where 39% of above 5 years. Male were n=77 (60.2%) and number of female was 51(39.8%). Right side of chest was affected in 68.8% (n=88) whereas left side was involve in 31.3% (n=40) no one has bilateral involvement. In distribution for pattern of bacterial isolates staphylococcus aureus were noted in 23 (18%) patients, staphylococcus epidermidis was noted in 17 (13.5%), streptococcus pneumoniae was noted in 14 (10.9%), 09 (7%) had pseudomonas, 09 (7%) had Klebsiella pneumoniae, proteus in 5 (3.9%), E.coli in 4 (3.1%), 4 (3.1%) had mixed, tuberculosis was noted in 18 (14%) while 25 (19.5%) patients had no growth pattern of bacterial isolates as shown in TABLE 1. Stratification of age, gender, and site of chest was done with respect to patterns of bacterial isolates as shown from Table [2-4].

DISCUSSION

Quite a lot of studies from developed countries showed that the prevalence of ET and PE is increasing^[18-22]. In these countries, childhood ET is frequently and rapidly recognized and managed quickly with drugs or surgical procedure^[23,24]. Our study shows same results of ET in children that observed elsewhere in Asia^[25, 26].

The mean age, in this study was 5.1±2.3 years, whereas Nyambat B, et al^[12] noted age as 5.1 years. Another study noted as 7.9 years^[27].

In present study, out of 128 patients, 77 (60.2%) were male while 51 (39.8%) were female, where Baranwal AK, et al^[28] noted 70% male patients.

Our study reported the distribution of site of chest as 88 (68.8%) patients had right chest pain while 40 (31.3%) were involved with left site. Hardie W, et al^[10] noted patients have 64% ET with right chest pain and 36% with left chest pain.

Current study reported the pattern of bacterial isolates as staphylococcus aureus was noted in 23 (18%) patients, staphylococcus epidermidis was noted in 17

(13.5%), *Streptococcus pneumoniae* was noted in 14 (10.9%), 09 (7%) had *Klebsiella*, 09 (7%) had *Pseudomonas*, *proteus* in 5 (3.9%), *E.coli* in 4 (3.1%), 4 (3.1%) had mixed, tuberculosis was noted in 18 (14%) while 25 (19.5%) patients had no growth pattern of bacterial isolates. Nyambat B, et al^[12] further reported the pattern of bacterial isolates as *Staphylococcus Aureus* in 126 (9.1%), *E.coli* 13 (0.9%), *Klebsiella* 35 (2.5%), *pseudomonas* 37 (2.7%) and *staphylococcus epidermidis* 01 (0.1%) Chonmaitree T, et al^[27] noted *S. Aureus* as 35% whereas Baranwal AK, et al^[28] reported to have 162 (67%) prevalence of *staphylococcus*.

In recent study, stratification of confounders / effect modifiers with respect to pattern of bacterial isolates, significant difference was noted in age group ($P=0.002$) whereas insignificant difference was found in gender ($P=0.704$), body mass index ($P=1.000$) and site of chest pain ($P=0.955$).

CONCLUSION

It is to be concluded that *Staphylococcus Aureus* was the most frequent organism of causing empyema thoracic followed by *mycobacterium tuberculosis* in our study. Further research is needed to better understand the factors related with pattern of bacterial isolates in children with thoracic empyema. As the study was used only on single hospital, so results may not reveal the scenario of whole country. Epidemiological and research data on this problem should be expanded by further studies in multiple centers in Pakistan with larger sample in order to validate the findings of current study.

Author's Contribution:

Concept & Design of Study: Raheel Ahmed
 Drafting: Saifullah Jamro, Deli Jan Mugheri
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Conflict of Interest: The study has no conflict of interest to declare by any author.

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