

Composition of Bacterial Isolates in Children with Thoracic Empyema : A Cross-sectional Study

Bacterial Isolates
in Children with
Thoracic
Empyema

Munawar Ali Siyal, Ameer Ali Jamali, Naseer Ahmad Memon, Azizullah Langah, Karam Khushik and Asghar Ali

ABSTRACT

Objective: To determine how often the University of Medical & Health Sciences Nawab Shah Department of Pediatrics receives bacterial isolates from children with thoracic empyema.

Study Design: A Cross-sectional Study

Place and Duration of Study: This study was conducted at the Department of Pediatrics, University of Medical Health Sciences Nawab Shah from March 2023 to August 2023.

Methods: All patients admitted to the University of Medical & Health Sciences Nawab Shah's paediatrics department who satisfied the study's inclusion requirements were enrolled. Informed consent was acquired after education regarding the procedure, its risks, and the benefits of the study. Chest X-rays were obtained of each patient at admission, throughout the insertion, removal, and discharge of the intercostal tube drain (ICTD). An ultrasonic CT scan of the chest was also carried out if needed. Pleural fluid was submitted for biochemical examination (total and differential leukocyte count, protein, sugar, and LDH) and morphological research (Gram staining, culture, and smear for AFB and Gen Expert) after a diagnostic thoracentesis. The outcome variable, or pattern of bacterial isolates, was assessed. All the data collected was input into the proforma, which was electronically used for research and appended at the end.

Results: The mean \pm SD age was 04.01 \pm 02.03 years. 25 (41.6%) women and 38 (58.4%) males totalled the total number of patients. Twelve patients (18.4%) had no bacterial isolate growth pattern, nine patients (12.6%) had staphylococcus aureus, eight patients (11.4%) had streptococcus pneumonia, four patients (6%) had Pseudomonas, five patients (3%) had Klebsiella pneumoniae, two patients (2.4%) had Proteus, two patients (2.6%) had E. coli, two patients (2.4%) had mixed, nine patients (12%) had tuberculosis, and twelve patients (18.4%) had no bacterial isolate growth pattern.

Conclusion: Staphylococcus aureus was our study's most common bacterial isolate, followed by Mycobacterium tuberculosis. More research is required to understand the factors related to the pattern of bacterial isolates in children with thoracic empyema.

Key Words: Pediatric, Empyema, Bacterial isolates, Thoracic

Citation of article: Siyal MA, Jamali AA, Memon NA, Langah A, Khushik K, Ali A. Composition of Bacterial Isolates in Children with Thoracic Empyema : A Cross-sectional Study. Med Forum 2024;35(2):74-77. doi:10.60110/medforum.350216.

INTRODUCTION

The treatment of empyema thoracis, a disorder marked by a buildup of pus in the pleural cavity, presents considerable difficulties for young patients¹. If not quickly detected and successfully handled, it may result in significant morbidity and death.

Department of Pediatrics, Peoples university of Medical Health Sciences NawabShah.

Correspondence: Asghar Ali, Assistant Prof Pediatrics, peoples University & Medical & Health Sciences For Woman Nawab Shah, Sindh

Contact No: 0308-3558887

Email: drasgharkerio66@gmail.com

Received: August, 2023

Accepted: September, 2023

Printed: February, 2024

It is a dangerous consequence of numerous respiratory diseases, including pneumonia². Comprehending the makeup of bacterial isolates in pediatric empyema patients is essential for directing suitable therapeutic approaches and enhancing clinical results. Clarifying the microbiological aetiology of pediatric empyema has garnered more attention in recent years, especially across various geographic locations and healthcare environments³. The Department of Pediatrics at the University of Medical & Health Sciences Nawab Shah initiated cross-sectional research to examine the distribution and incidence of bacterial isolates among pediatric patients with thoracic empyema⁴. The long-term goal of this research was to provide insightful information on the microbiology and epidemiology of empyema in this particular group. The cross-sectional research design that was used made it possible to include a variety of patients admitted to the paediatrics department during the allotted time frame. Strict

diagnostic techniques were used, including invasive operations like thoracentesis to extract pleural fluid for in-depth investigation and a range of imaging modalities, including ultrasonic CT scans and chest x-rays. To identify and characterize bacterial isolates, extensive morphological and biochemical investigations were conducted in addition to these diagnostic efforts⁵⁻⁶. These investigations included Gram staining, culture, and biochemical tests. The study's findings clarify the range of bacterial infections linked to pediatric empyema, providing essential information on the distribution and incidence of specific organisms, including *Mycobacterium tuberculosis* and *Staphylococcus aureus*⁷. To provide a comprehensive picture of the illness burden, the demographic features of the patient population, such as the distribution of age and gender, were also investigated⁸. The thoroughness with which the data were gathered—both clinical and microbiological parameters—highlights the importance of this research project in shaping evidence-based clinical practice and directing future research efforts toward the best possible management of pediatric empyema⁹.

METHODS

Children who met the study's inclusion requirements were admitted between March 2023 to August 2023 to the Peoples university of Medical Health Sciences Nawab Shah Department of Pediatrics. Guardians' informed consent was acquired. Chest x-rays, ultrasonic CT scans, and thoracentesis—the removal of pleural fluid for morphological and biochemical analysis—were performed as part of the diagnostic process. Techniques such as Gram staining, culture, AFB smear, Gen Expert, and biochemical tests were used to identify bacterial isolates and describe pleural fluid. For computerized analysis, the gathered data were input into a proforma. Statistical techniques were used to examine the distribution and frequency of bacterial isolates.

RESULTS

58.4% of the 63 pediatric patients in the research were male and had an average age of 4.01 ± 2.03 years. *Staphylococcus aureus* (16%) was the most common isolation among the microorganisms, followed by *Staphylococcus epidermidis* (12.6%) and *Streptococcus pneumoniae* (11.4%). *Pseudomonas* (6%), *Proteus* (2.4%), *Escherichia coli* (2.6%), *Klebsiella pneumoniae* (3%), and mixed (2.4%) were among the other isolates. In 12% of cases, *Mycobacterium tuberculosis* was found, while in 18.4% of cases, there was no bacterial growth. These results highlight the variety of bacterial infections causing pediatric empyema, which have consequences for antimicrobial treatment and clinical care.

Table No. 1: Demographic Characteristics of Pediatric Patients with Thoracic Empyema

Age (years)	Gender	Number of Patients
4.01 ± 2.03	Male	38
	Female	25

Table 2: Distribution of Bacterial Isolates in Pediatric Thoracic Empyema Cases

Bacterial Isolate	Frequency (%)
<i>Staphylococcus aureus</i>	16
<i>Staphylococcus epidermidis</i>	12.6
<i>Streptococcus pneumoniae</i>	11.4
<i>Pseudomonas</i>	6
<i>Klebsiella pneumoniae</i>	3
<i>Proteus</i>	2.4
<i>Escherichia coli</i>	2.6
Mixed	2.4
<i>Mycobacterium tuberculosis</i>	12
No bacterial growth	18.4

Table 4: Outcomes of Bacterial Isolates in Pediatric Thoracic Empyema Cases

Bacterial Isolate	Number of Patients	% of Total Patients
<i>Staphylococcus aureus</i>	11	16
<i>Staphylococcus epidermidis</i>	9	12.6
<i>Streptococcus pneumoniae</i>	8	11.4
<i>Pseudomonas</i>	4	6
<i>Klebsiella pneumoniae</i>	5	3
<i>Proteus</i>	2	2.4
<i>Escherichia coli</i>	2	2.6
Mixed	2	2.4
<i>Mycobacterium tuberculosis</i>	9	12
No bacterial growth	12	18.4

DISCUSSION

The results of this study provide critical new understandings of the epidemiology and microbiological aetiology of juvenile thoracic empyema, which may direct future research efforts and therapeutic care approaches¹⁰. The prevalence of bacterial isolates, including *Mycobacterium tuberculosis* and *Staphylococcus aureus*, highlights the need to consider local differences and antibiotic resistance patterns when treating pediatric empyema¹¹. According to earlier research, *Staphylococcus aureus*, a pathogen known to cause respiratory infections, was the most common bacterial isolate in this investigation¹². Its widespread use emphasizes how crucial it is to treat young patients with thoracic empyema with empirical antibiotic treatment targeting *Staphylococcal* species¹³. The high frequency of commensal bacteria *Staphylococcus epidermidis*, often linked to infections connected to medical devices, raises the possibility that nosocomial factors play a part in developing empyema in hospitalized children¹⁴. The discovery of

Streptococcus pneumoniae as a noteworthy bacterial strain highlights the value of pneumococcal immunization in shielding juvenile populations from respiratory illnesses and their related consequences¹⁵. The presence of Gram-negative bacteria like *Klebsiella pneumoniae* and *Pseudomonas* highlights the necessity for broad-spectrum antibiotic treatment in afflicted individuals and highlights the complex microbial landscape of empyema¹⁶. *Mycobacterium tuberculosis* has been found in a significant percentage of patients, indicating the importance of TB as an etiological factor in pediatric empyema, particularly in areas with high endemicity¹⁷. The significance of treating TB as a differential diagnosis in pediatric patients presenting with pleural effusions is highlighted by this study, especially in regions with high tuberculosis incidence. Since bacterial growth is often absent, more research is necessary to rule out viral, fungal, or non-infectious causes of empyema¹⁸. To pinpoint possible risk factors and develop focused preventive and therapeutic measures, it is also worthwhile to investigate the demographic and clinical characteristics of various bacterial isolates¹⁹. This work emphasizes the significance of customized diagnosis and treatment methods based on local epidemiology and microbial patterns and advances our knowledge of the microbial landscape of pediatric thoracic empyema²⁰. To fully understand the intricate interactions between microbial pathogens, host variables, and clinical outcomes in juvenile empyema patients, further study is required.

CONCLUSION

In pediatric thoracic empyema patients, *Staphylococcus aureus* was the most common bacterial isolate, followed by *Mycobacterium tuberculosis*. These results emphasize the value of individualized antibiotic treatment and the necessity for further investigation to determine the variables affecting the patterns of bacterial isolates in this group.

Future Finding: Future studies should clarify how host characteristics, such as immunological conditions and genetic predisposition, influence the patterns of bacterial isolates in pediatric thoracic empyema. Furthermore, studies on the efficacy of new treatment modalities and patterns in growing antibiotic resistance are necessary to maximize therapeutic outcomes for impacted children.

Acknowledgement: We thank the hospital administration and everyone who helped us complete this study.

Author's Contribution:

Concept & Design of Study: Munawar Ali Siyal
 Drafting: Ameer Ali Jamali,
 Naseer Ahmad Memon
 Data Analysis: Azizullah Langah,
 Karam Khushik,

Asgar Ali
 Munawar Ali Siyal,
 Ameer Ali Jamali
 Munawar Ali Siyal

Revisiting Critically:

Final Approval of version:

Conflict of Interest: The study has no conflict of interest to declare by any author.

Source of Funding: None

Ethical Approval: No. PUMHSW/SBA/ERB/557/PVC dated 22.03.2023

REFERENCES

- Lochindarat S, Teeratakulpisarn J, Warachit B, Chanta C, Thapa K, Gilbert GL, et al. Bacterial aetiology of empyema thoracis and parapneumonic pleural effusion in Thai children aged less than 16 years. *Southeast Asian J Tropical Med Public Health* 2014;45(2):442.
- Hegade S, Biradar S. The Clinical and Bacteriological Profile of Children with Empyema in a Tertiary Hospital. *Asian J Clin Pediatr Neonatol* 2019;7(3):50.
- Shiraishi Y, Kryukov K, Tomomatsu K, Sakamaki F, Inoue S, Nakagawa S, et al. Diagnosis of pleural empyema/parapneumonic effusion by next-generation sequencing. *Infectious Dis* 2021;53(6):450-9.
- Shankar G, Sahadev R, Santhanakrishnan R. Pediatric empyema thoracic management: should the consensus differ for developing countries? *J Pediatr Surg* 2020;55(3):513-7.
- Bobbio A, Bouam S, Frenkiel J, Zarca K, Fournel L, Canny E, et al. Epidemiology and prognostic factors of pleural empyema. *Thorax* 2021;76(11):1117-1123.
- Mohamed YG. Empyema necessitates in an infant due to *pseudomonas aeruginosa* at a referral hospital in Mogadishu, Somalia: A case report. *Radiology Case Reports* 2021;16(6):1485-8.
- Cura Yayla BC, Bedir Demirdag T, Akkuzu E, Kara N, Tezer H, Tapisiz A. A pediatric case series of invasive pneumococcal disease caused by *S. Pneumonia* serotype-19A despite complete dose vaccination. *Human Vaccines Immunotherapeutics* 2023;2219186.
- Muhyi A, Aswin A. *Sphingomonas paucimobilis* an unusual cause of subdural empyema in pediatric: A case report. *Pediatr Sciences J* 2021;2(1):1-3.
- Align D, Ameya G, Siraj M, Fenta F. Pleural Infections: Antimicrobial Susceptibility Patterns of Bacterial Isolates and Associated Factors in Suspected Hospitalized Patients at Arba Minch General Hospital, Southern Ethiopia. *Open Microbiol J* 2022;16(1).

10. Senger SS, Thompson III GR, Samanta P, Ahrens J, Clancy CJ, Nguyen MH. Candida empyema thoracic at two academic medical centres: new insights into treatment and outcomes. In Open forum infectious diseases. US: Oxford University Press;2021.p.ofaa656.
11. Nakamura T, Ishikawa K, Murata N, Sato K, Kitamura A, Mori N, et al. Empyema necessitans caused by methicillin-resistant Staphylococcus aureus: a case report and literature review. BMC Infectious Diseases 2024;24(1):157.
12. Yang HH, Li M, Yu Q, Liu Q, Liu M. Empyema caused by Streptococcus constellatus in a patient infected with HIV: a case report and literature review. AIDS Research and Therapy 2022;21(1):2.
13. Goussard P, Eber E, Rabie H, Nel P, Schubert P. Paediatric pulmonary actinomycosis: A forgotten disease. Paediatr Respiratory Reviews 2022;43: 2-10.
14. Sun Y, Dong H, Zhang N, Zhao P, Qi Y, Yang X, Wang L. Empyema caused by Fusobacterium nucleatum with squamous cell carcinoma of the lung: a case report and literature review. Frontiers Med 2023;10:1099040.
15. Sreedharan JK, Mirza YF, AlRabeeh SM, Alqahtani AS, Alqahtani JS, Alenezi M, et al. An Unusual Case of Thoracic Empyema Secondary to Streptococcus anginosus: A Case Report. Ind J Respiratory Care 2023;12(2):178-81.
16. Kobilov EE, Tukhtaev MK. Current treatment of acute bacterial destructive pneumonia in children. World Bulletin Public Health 2022;17:1-4.
17. Plut D, Winant AJ, Mahomed N, Sodhi KS, Kasznia-Brown J, Williams-Weekes T, et al. Unusual pediatric lung infections: imaging findings. Pediatr Radiol 2023;12:1-4.
18. Ojha SC, Chen K, Yuan Y, Ahmed S, Malik AA, Nisha M, et al. Clinical relevance of molecular testing methods in the diagnosis and guidance of therapy in patients with staphylococcal empyema: a systematic review and meta-analysis. Frontiers Cellular Infection Microbiol 2022;12:1079.
19. Singhal KK, Singh R. Chronic suppurative lung disease in children: a case-based approach. Ind J Pediatr 2023;90(9):920-6.
20. Shore D, Toth JW. Empyema thoracic. In Interventions in Pulmonary Medicine. Cham: Springer International Publishing; 2023.p.571-583.