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Original Article

Concordance of Organisms Between Blood and Tracheal Aspirate Cultures in Persistent Pneumonia Cases

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ABSTRACT

Introduction: *This study assessed the concordance between microorganisms isolated from blood and tracheal aspirate cultures in children with persistent pneumonia, emphasizing the need for targeted antibiotic treatment to improve outcomes.* ***Methods & Materials:*** *This cross-sectional observational study was conducted at PICU (Paediatric Intensive Care Unit) of Bangladesh Shishu (Children) Hospital & Institute, Dhaka from November 2019 to October 2020. Children aged 2 months to 5 years admitted with persistent pneumonia were considered as the study population. Data was analyzed using computer software SPSS (Statistical Package for Social Sciences) version 23.* ***Results:*** *The study included 49 pediatric patients with a median age of 8 months, predominantly male (75.5%), residing mainly in urban areas (53.1%). All patients exhibited fever, cough, and respiratory distress, with additional symptoms such as vomiting (14.3%) and convulsions (10.2%). Blood cultures revealed a high rate of negativity (81.6%) and Klebsiella pneumoniae was the most common pathogen detected (8.2%). In contrast, tracheal aspirate cultures showed a 50% positivity rate, identifying Acinetobacter (22.7%) and Pseudomonas (18.1%) as prevalent organisms. Similarly, posterior pharyngeal swabs*

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indicated a 46.6% positivity rate, with Pseudomonas (20%) and Klebsiella pneumoniae (13.3%) being notable isolates. ***Conclusion:*** *The findings conclude that while blood cultures may yield low positivity rates, tracheal aspirate cultures provide a more comprehensive insight into the respiratory pathogens involved, especially in cases of localized infections. Recognizing the differences in pathogen detection among various sample types is crucial for guiding targeted antimicrobial therapy and improving clinical outcomes in pediatric persistent pneumonia cases.*

Keywords: *Persistent Pneumonia, Causative organism, Blood C/S, Tracheal Aspirate*

INTRODUCTION

Pneumonia remains a leading cause of death in children under five years worldwide, with approximately 740,180 annual deaths reported in 2019[1]. This accounts for about 14% of all child deaths in this age group[1]. A subset of children with pneumonia develops persistent pneumonia, with approximately 1 in 10 affected children experiencing recurrent or persistent forms of the illness[2]. Persistent pneumonia is characterized by the continuation of symptoms and radiographic abnormalities for over a month, despite a 10-day course of antibiotic therapy[3]. Non-resolving or persistent pneumonia in children presents a significant challenge for pediatricians and respiratory specialists, as it often results from underlying conditions that contribute to its persistence[4]. Many affected children receive empirical anti-tubercular treatment, posing a risk for drug resistance. There is limited data on the underlying causes that contribute to pneumonia persistence in children, and some studies in the literature treat persistent and recurrent pneumonia as a single entity[5]. Recurrent pneumonia is defined as two or more pneumonia episodes within a single year or three or more episodes in a lifetime, with radiographic resolution between occurrences[2]. The presence of a symptom-free interval with radiographic clearance of infiltrates suggests recurrent, rather than persistent infection. At times, persistent infection may manifest as recurrent episodes due to inadequate or inappropriate therapy[6]. While the etiologies and outcomes differ between persistent and recurrent pneumonia, they may overlap. For example, a study in Iran found that the most common cause of persistent pneumonia was pulmonary tuberculosis, whereas recurrent pneumonia was frequently caused by recurrent aspiration[7]. However, few studies have explored this issue in developing countries[3,4,5,7,8]. In cases of persistent pneumonia, identifying the causative organisms is essential to guide effective treatment, particularly when empirical therapy has failed to resolve the infection. Blood-stream infections are one of the most important causes of morbidity and mortality in these patients. Early detection of causative microorganism from blood culture with determination of antibiotic susceptibility is very important for providing appropriate treatment to the patient and thus reducing mortality[9]. Concordance between blood culture and sensitivity (C/S) and tracheal aspirate C/S can provide valuable insight into the

responsible pathogens and their susceptibility patterns, supporting targeted antimicrobial therapy. Studies indicate that concordance between these two specimen types is variable, often influenced by factors such as the type of pathogen, the presence of polymicrobial infections, and the child's underlying immune status. For example, Gram-negative organisms like Klebsiella pneumoniae and Pseudomonas aeruginosa are frequently identified in tracheal aspirates of children with persistent pneumonia and may also be found in blood cultures if systemic infection has developed[10]. However, some pathogens may be confined to the respiratory tract, leading to discordance between blood and tracheal aspirate C/S results[11,12]. This study aimed to assess the concordance of organisms between blood C/S and tracheal aspirate C/S among persistent pneumonia cases.

METHODS & MATERIALS

This cross-sectional observational study was conducted at PICU (Paediatric Intensive Care Unit) of Bangladesh Shishu (Children) Hospital & Institute, Dhaka from November 2019 to October 2020. Children aged 2 months to 5 years admitted with persistent pneumonia were considered as the study population. Children who had a history of prolonged mechanical ventilation during the neonatal period were excluded. Data was collected using a structured questionnaire containing all the variables of interest. Complete blood count, serial CXR, blood culture and sensitivity, CRP, gastric lavage for AFB and gene Xpert, Mantoux Test and HIV screening were done in all patients. Tracheal aspirate culture and sensitivity was done in patients on mechanical ventilator. Posterior pharyngeal swab culture and sensitivity was done in patients who were not on mechanical ventilator. Samples were collected under sterile condition. Other investigations like echocardiography, CT scan of chest, sweat chloride test (Pilocarpine iontophoresis), primary immunodeficiency panel, contrast oesophagogram were individualized according to clinical suspicion. Data was analyzed using computer software SPSS (Statistical Package for Social Sciences) version 23. Simple statistics such as frequency, arithmetic mean, standard deviation, median, and interquartile range were used. Approval of the research protocol was taken from the ethical committee of Bangladesh Shishu (Children) Hospital & Institute. Informed written consent was taken from the guardians.

RESULTS

Table I shows that the median age of the patients was 8.0 months. Among the 49 patients, 26 (53.1%) were from urban residences. The median monthly family income of the patients was 20,000 taka.

Table – I: Distribution of Patients by Socio-demographic Status (*n*=49)

Socio-demographic Status	*n*	%
Age (in months)		
2-6	20	40.8
7-12	16	32.7
13-59	13	26.5
Median [IQR]	8.0 [3.7, 12.5]	
Residence		
Urban	26	53.1
Rural	23	46.9
Monthly family income (BDT)		
10,000-15,000	11	22.4
16,000-30,000	33	67.3
>30,000	5	10.2
Median [IQR]	20,000 [20,000, 25,000]	

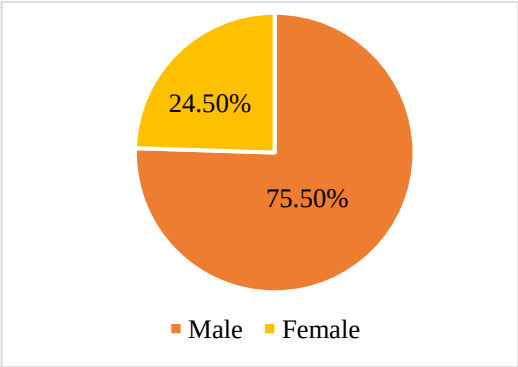

Figure – 1: Distribution of Patients by Gender (n=49)

Figure 1 shows that 37 (75.5%) patients were male child while 12 (24.5%) patients were female.

Table II shows that all patients had fever, cough, and respiratory distress. Besides these, 7 (14.3%) had vomiting and 5 (10.2%) had convulsions. Few had steatorrhoea (4.1%), hemoptysis (2.0%) and a history of weight loss (2.0%).

Table – II: Distribution of Patients by Symptoms (*n*=49)

Symptoms	*n*	%
Fever	49	100
Cough	49	100
Respiratory distress	49	100
Vomiting	7	14.3
Convulsion	5	10.2
Steatorrhoea	2	4.1
Hemoptysis	1	2.0
History of weight loss	1	2.0

Table III shows that bronchopneumonia was found in 31 (63.3%) patients and aspiration pneumonia was found in 5 (10.2%) patients. Beside these, 4 (8.2%) had lobar pneumonia, 4 (8.2%) had collapse and 2 (4.1%) had bronchopneumonia with pleural effusion. Few had bronchiectasis (2.0%), bronchopneumonia with pneumothorax (2.0%) and bronchopneumonia with cardiomegaly (2.0%).

Table – III: Distribution of Patients by Chest Radiograph (*n*=49)

Chest Radiograph	Frequency (n)	Percentage (%)
Bronchopneumonia	31	63.3
Aspiration pneumonia	5	10.2
Lobar pneumonia	4	8.2
Collapse	4	8.2
Bronchopneumonia with Pleural effusion	2	4.1
Bronchiectasis	1	2.0
Bronchopneumonia with pneumothorax	1	2.0
Bronchopneumonia with cardiomegaly	1	2.0

Table IV shows that 40 (81.6%) patients had negative blood culture while 9 (18.4%) patients had positive blood culture. Klebsiella pneumoniae was present in the blood culture of 4 (8.2%) patients.

Table – IV: Distribution of Patients by Organism in Blood Culture (*n*=49)

Blood culture	*n*	%
Negative	40	81.6
Positive	9	18.4
Klebsiella pneumoniae	4	8.2
Candida	1	2.0
Acinetobacter	1	2.0
Citrobacter freundii	1	2.0
Staphylococcus (coagulase-negative)	1	2.0
Staphylococcus (coagulase positive)	1	2.0

Table V shows that according to tracheal aspirate culture, 11(50%) patients had negative culture findings while 11(50%) patients had positive culture. Acinetobacter was present in 5(22.7%) culture, Pseudomonas was present in 4(18.1%), Klebsiella pneumoniae was present in 1(4.5%), Candida was found in 1(4.5%) and Staphylococcus aureus was found in 1(4.5%) tracheal aspirate culture. 1 patient had both Pseudomonas and Klebsiella pneumoniae in tracheal aspirate culture.

Table – V: Distribution of Patients by Tracheal Aspirate Culture (*n*=22)

Tracheal aspirate	*n*	%
Culture negative	11	50
Culture positive	11	50
Acinetobacter	5	22.7
Pseudomonas	4	18.1
Klebsiella pneumoniae	1	4.5
Candida	1	4.5
Staphylococcus aureus	1	4.5

Table VI shows that according to posterior pharyngeal swab culture, 8(53.3%) patients had negative culture findings while 7(46.6%) patients had positive culture. Pseudomonas was present in 3(20%) cultures, Klebsiella pneumoniae was present in 2(13.3%), Acinetobacter was present in 1(6.6%) and Candida was found in 1(6.6%) posterior pharyngeal swab culture.

Table – VI: **Distribution of Patients by Posterior Pharyngeal Swab Culture (n=15)**

Posterior pharyngeal swab	*n*	%
Culture negative	8	53.3
Culture positive	7	46.6
Pseudomonas	3	20
Klebsiella pneumoniae	2	13.3
Acinetobacter	1	6.6
Candida	1	6.6

DISCUSSION

Pneumonia, or inflammation of the lung parenchyma associated with consolidation of alveolar spaces, is a substantial cause of morbidity and mortality in childhood particularly among children below 5 years of age. It is one of the common causes of admission to the pediatric ward[13]. Persistent pneumonia implies chronic, non-resolving pneumonia with persistence of symptoms and radiographic abnormalities for more than 1 month despite a course of antibiotic therapy for 10 days[3]. This study aimed to assess the concordance of organisms between blood C/S and tracheal aspirate C/S among persistent pneumonia cases. The median age of the patients in the present study was 8 months where the majority (75.5%) was male and 53.1% were from urban residences. Male predominance was observed in other studies also[2-8]. As the study place was Dhaka city, the proportion of urban residents was comparatively more than the rural. In our study, blood cultures were mostly negative, with only 18.4% positivity, and Klebsiella pneumoniae was the most common organism isolated. This is consistent with findings in studies conducted by Jeena et al. and Rudan et al., which also noted a low yield of positive blood cultures in pediatric respiratory infections, especially in cases without systemic dissemination[11,14]. Comparatively, tracheal aspirate cultures in our cohort yielded more positivity rate (50%), with Acinetobacter and Pseudomonas being the most frequently isolated organisms. This higher positivity rate in respiratory cultures, compared to blood cultures has been observed in the study by Chisti et al., who reported similar findings, especially among cases with persistent or recurrent pneumonia[10]. Similar findings were also observed in the study by Caskurlu H et al where most (52.4%) of the tracheal aspirate samples were positive for bacterial growth, while only 29.2% of the blood cultures were positive[9]. Other studies also revealed the similar findings[15]. These studies noted that pathogens like *Pseudomonas* and *Acinetobacter* often colonize the respiratory tract in children with prolonged infections, suggesting that these organisms might evade systemic circulation, thus explaining their absence in blood cultures. In our study, the most common organism isolated in blood C/S is Klebsiella pneumoniae (8.2%) and in tracheal aspirate C/S are Acinetobacter (22.7%) and Pseudomonas (18.1%). Caskurlu H et al also identified separate organisms in blood and tracheal aspirate C/S[9]. In their study, among the culture-positive cases, blood C/S isolates were predominantly (57.9%) gram positive and tracheal C/S isolates were mostly

(89.7%) gram negative. Kotgire Santosh A found 25.88% case of bacteremia among which 14.11% with the same organism with tracheal aspirate and 11.76% with different organism which was considered as concomitant extrapulmonary infection[15]. In our study, only 1 patient had similar organism in blood and tracheal aspirate C/S who had growth of Candida in both. Studies indicate that concordance between these two specimen types is variable, often influenced by factors such as the type of pathogen, the presence of polymicrobial infections, and the child's underlying immune status. For example, Gram-negative organisms like Klebsiella pneumoniae and Pseudomonas aeruginosa are frequently identified in tracheal aspirates of children with persistent pneumonia and may also be found in blood cultures if systemic infection has developed[10]. However, some pathogens may be confined to the respiratory tract, leading to discordance between blood and tracheal aspirate C/S results[11,12]. Moreover, our findings show that posterior pharyngeal swab cultures had a lower yield (46.6%) than tracheal aspirates, which correlates with the study by Ranganathan and Sonnappa, where swab cultures were less effective in detecting respiratory pathogens compared to deeper respiratory samples like tracheal aspirates[12]. The variation in detection rates between tracheal aspirates and posterior pharyngeal swabs could also indicate that certain pathogens predominantly reside in the lower respiratory tract, making tracheal aspirates more representative of the true causative organisms in persistent pneumonia.

Limitations of the Study

The study was conducted in a PICU of a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion

The findings conclude that while blood cultures may yield low positivity rates, tracheal aspirate cultures provide a more comprehensive insight into the respiratory pathogens involved, especially in cases of localized infections. Recognizing the differences in pathogen detection among various sample types is crucial for guiding targeted antimicrobial therapy and improving clinical outcomes in pediatric persistent pneumonia cases.

Recommendation

It is recommended that clinicians adopt a multi-faceted diagnostic approach, utilizing not only blood cultures but also tracheal aspirates and posterior pharyngeal swabs, to accurately identify pathogens in cases of persistent pneumonia. This strategy is essential for guiding effective antimicrobial therapy, particularly in children where conventional treatments may fail due to the presence of specific respiratory pathogens like Pseudomonas and Acinetobacter.

Ethical Approval

The study was approved by the Institutional Ethics Committee

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