Al-Azhar International Medical Journal

Volume 3 | Issue 6 Article 23

6-1-2022

Causes and clinical profile in children with severe recurrent pneumonia

Abdou Abdou
Department of pediatrics, Al-Azhar University, Faculty of Medicine for boys, Cairo, Egypt.,
abdoumohamed.206@azhar.edu.eg

Sameh Ahmed
Department of Pediatrics, Al-Azhar University, Faculty of Medicine for boys, Cairo, Egypt.,
samehmansour.206@azhar.edu.eg

How to Cite This Article

Abdou, Abdou and Ahmed, Sameh (2022) "Causes and clinical profile in children with severe recurrent pneumonia," *Al-Azhar International Medical Journal*: Vol. 3: Iss. 6, Article 23.
DOI: https://doi.org/10.21608/aimj.2022.132699.1911

OPEN AIMJ ORIGINAL ARTICLE

Pediatrics

Causes and Clinical Profile in Children with Severe Recurrent Pneumonia

Abdou Mohamed Abdou Mahmoud [1]*MD; Sameh Abdelaziz Ahmed [1]MD.

Corresponding Author:
Abdou Mohamed Abdou Mahmoud
abdoumohamed.206@azhar.edu.eg

Received *for publication May 21, 2022;* ***Accepted*** *June 24, 2022;* ***Published online*** *June 24,2022.*

doi: *10.21608/aimj.2022.132699.1911*

[1]Pediatrics Department, Faculty of Medicine, Al-Azhar University, Cairo , Egypt.

ABSTRACT

Background: Pneumonia is an acute lung inflammation caused by both infectious and non-infectious sources. Recurrent pneumonia is caused by weakened local or systemic host defenses, or by underlying lung diseases. Early diagnosis and treatment of the underlying cause should minimize pneumonia-related hospitalizations, morbidity, and death. Children hospitalized to the Pediatric Intensive Care Unit (PICU) with severe pneumonia have significant morbidity and death rate.
Aim of The Work: To identify the underlying causes and clinical profile of children with sRP admitted to the Pediatric Intensive Care Unit.
Patients and Methods: This research included 100 children with sRP hospitalized to PICU at Al-Hussein &Bab El-Shaarya University hospitals during the period from Feb. 2020 to Feb 2022. The research protocol was approved by the committee for research ethics at Al-Azhar faculty of medicine .All patients completed informed consent forms before the study began. We recruited all patients with severe recurrent pneumonia.
Results: The average age of sRP diagnosis was 14.8 months, the age of the first pneumonia episode was 12.1. Males were twice of females to be diagnosed with sRP. Wheezing was the most prevalent symptom with 99% of cases then wheezing (63%) and fever (60%). Respiratory abnormalities were the most prevalent (28%) as underlying causes of sRP patients, then Immune disorders (22%) and congenital heart diseases (16%). Pulmonary hemorrhagic syndrome was the least prevalent cause as it was observed in only 2 cases.
Conclusion: Severe recurrent pneumonia is common in pediatric critical care units. About ninety percent of individuals with recurrent severe pneumonia were also suffering from some other disease, including respiratory, immunological, congenital heart, and aspiration syndrome.

Keywords: *Recurrent pneumonia; Pediatricians; Underlying Causes, Children; Pediatric Intensive Care Unit.*

Disclosure: *The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.*
Authorship: *All authors have a substantial contribution to the article.*

INTRODUCTION

Both viral and non-infectious factors can contribute to the development of acute lung parenchymal inflammation, which is referred to as pneumonia. An estimated 156 million children were infected with pneumonia, according to the World Health Organization (WHO) (151 million in developing countries and 5 million in developed countries) [1]. 6.4–9.0 percent of the children with pneumonia who had at least two or more pneumonia episodes in a 1-year period, or more than three incidents at any time with radiographic clearance were identified with recurrent pneumonia (RP) [2].

There are several possible causes of recurrent pneumonia, including deficiencies in host defenses or underlying conditions altering lung defense. There is a lack of information on the underlying disorders that lead to a child's recurrent pneumonia. More research is needed on this issue in developing countries, where it has received less attention. RP has the potential to place a large financial burden on the healthcare system due to the frequency with which patients are hospitalized [3 & 4].

The amount of pneumonia-related hospitalizations, morbidity, and death will be reduced if the underlying cause is identified and treated early. Increased epidemiology studies of recurrent pneumonia, particularly in developing countries, will facilitate preventative and therapeutic approaches [5].

There is a significant mortality and morbidity rate among children with severe pneumonia who are hospitalized to the Pediatric Intensive Care Unit (PICU) [6]. However, to the best of our knowledge, data on cases hospitalized to the PICU with severe recurring pneumonia (sRP) remains scarce, particularly in developing countries like Egypt.

The purpose of this investigation was to determine the underlying reasons and clinical characteristics of children with sRP hospitalized to the Pediatric Intensive Care Units at Al-Hussein and Bab El-Shaarya University hospitals.

PATIENTS AND METHODS

This was a prospective and descriptive cohort investigation that investigated 100 cases who were administered to the PICU at Al-Hussein and Bab El-Shaarya University hospitals from February 2020 to February 2022. The ethical committee at the Intensive care department of the Faculty of Medicine reviewed and approved the study plan. All patients signed the informed consent form before the study could start. All patients who had severe recurrent pneumonia were chosen

Cough, chest wall in-drawing, and/or difficulty breathing, as well as tachypnea, fever, and evidence of lobar or bronchopneumonia infiltration on a chest X-ray, were used to diagnose pneumonia. Pediatric Infectious Diseases Society (PIDS) and Infectious Diseases Society of America (IDSA)-recognized criteria for diagnosing severe pneumonia included one major and two minor symptoms [7 & 8]. It was characterized as having two episodes of pneumonia within a year or three in any time period without any clinical sign [9]. The STROCSS criteria were followed for compiling this report [10].

Finding the root of the problem A thorough medical history, physical examination, and initial tests were conducted on all sRP cases hospitalized to the PICU. Medical record forms were used to collect data about sRP patients.

People who experienced recurrences or new lesions in different lobe were put into separate groups before undergoing tests to investigate the underlying cause. A chest CT scan and/or bronchoscopy, bronchoalveolar lavage, or lung biopsy were utilized to confirm pulmonary parenchymal or airway abnormalities.

Cardiovascular problems detected via echocardiography, computed tomography, or cardiac catheterization. Immune disorders identified by quantitative immunoglobulins, lymphocyte counting tests employing flow cytometry for T-CD3, T-CD4, and T-CD8, or particular illness standard (acute leukemia, hemophagocytic lympho-histiocytosis, etc.).

Aspiration syndrome was being diagnosed clinically, genetic disorders were being tested for via genetic analysis. A diagnosis of transitory recurrent wheeze was made in children under the age of 3, with three instances of wheezing, after which the child had no symptoms and was otherwise healthy. No particular underlying cause was discovered, and no risk of Asthma Predictive Index (API) classification was found [11].

Major criteria
Invasive mechanical ventilation
Fluid refractory shock
Acute need for NlPPV
Hypoxemia requiring FiO2 greater than inspired concentration or flow feasible in general care area
Minor criteria
Respiratory rate higher than WHO classification for age
Apnea
lncreased work of breathing (eg, retractions, dyspnea, nasal flaring, grunting)
PaO2/FiO2 ratio <250
M ultilobar infiltrates
PEWS score >6
Altered mental status
Hypotension
Presence of effusion
Comorbid conditions (eg, HgbSS, immunosuppression, immunodeficiency)
Unexplained metabolic acidosis

Table 1: Major and Minor criteria according to IDSA.

Statistical analysis:

IBM SPSS version 22.0 was used to analyses computer-generated data. To express quantitative data, percentages and numbers were employed. Before utilizing the median in nonparametric analysis or the interquartile range in parametric analysis, it was required to perform Kolmogorov-Smirnov tests to ensure that the data were normal. We used the (0.05) significance threshold to establish the significance of the findings. The Chi-Square test is used to compare two or more groups. The Monte Carlo test may be used to adjust for any number of cells with a count less than 5. Fischer Chi-Square adjustment was applied to tables demonstrating non continuous data.

RESULTS

This study included 240 patients that were subjected to renal transplantation.

Regarding the general characteristics of the patients, the mean age of the recipient was 41.62 years, while the mean age of the donor was 44.33 years. The male to female (M.F) ratio in the recipient was approximately 2:1, while in the donor was approximately 1.5:1. The Incidence of double graft artery was 13.3%, while the incidence of double graft vein was 8.3% (Table 1).

Urological complications occurred in 26.3% of patients. Bacterial infection was demonstrated to be the most common early complication (in the first postoperative month) (8.8%), followed by perinephric hematoma (1.7%), urinary leakage (1.7%), ureteral obstruction (1.7%) and urinary retention (1.3%). Lymphocele was demonstrated to be the most common late complication(7.9%), followed by erectile dysfunction (2.1%), vesicoureteral reflux (1.7%) and ureteral stricture (1.3%).

As regards the Graft function at the end of follow-up period in the studied sample, the majority of cases had functioning grafts (60.8%), while 33.3% and 4.5% of cases developed chronic kidney disease (CKD) and end stage kidney disease (ESKD) respectively (Table 2).

The mean Graft survival period in the current study was 37.05 ± 17.448 (median was 37 months) and ranging from 6 months to 70 months (Table 3).

Complication free cases demonstrated significant increase in survival in comparison with complicated ones (P<0.05) (Table 4).

The Kaplan Meier assessment of graft survival in the current study showed that the median complete success was 57 months and the median qualified success was more than 60 months (Table 5 and figure.)

The Univariate analysis for predictors of occurrence of urological complications showed that age of the recipient/ donor, gender of the recipient/ donor, diabetes, hypertension, chronic interstitial nephritis (CIN), lupus nephritis, double graft artery, double graft vein and operative duration were non-significant predictors (P>0.05) (Table 6).

Regarding the correlation between occurrence of urological complications and graft survival it was demonstrated that occurrence of urological complications significantly affects graft survival (P<0.05) (Table 7).

RESULTS

Characteristics	Value
Diagnostic age	
Admission age (month)	21.8 ± 23.5
Age of the 1st episode of pneumonia (month)	12.1 ± 28.9
Age of RP (month)	14.8 ± 9.7
Gender	
Male/Female	68 (68%) / 32 (32%)
M/F ratio	2.13/1
Residence	
Urban	23 (23 %)
Rural	77 (77 %)

Table 2: Demographic features of sRP patients.

The average age of sRP diagnosis was 14.8 months, the age of the first pneumonia episode was 12.1. Males were twice of females to be diagnosed with sRP. Rural patients were 2.3 times compared to urban cases.

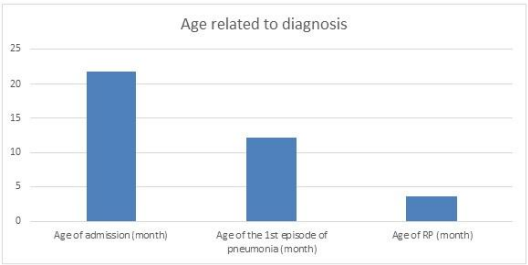

Fig. 1: Age related to diagnosis

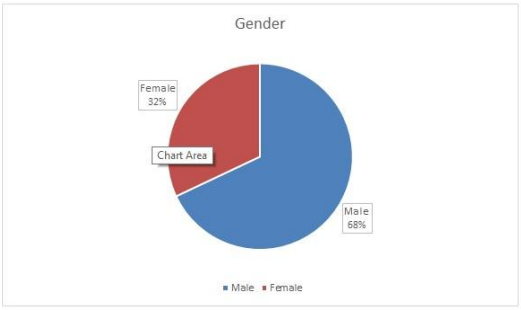

Fig. 2: Gender.

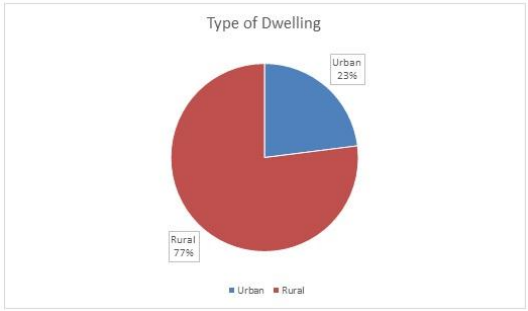

Fig. 3: Type of Dwelling.

Clinical symptoms	N	%
Major criteria		
mechanical ventilation (Invasive)	10	10
Shock (Fluid refractory)	7	7
Urgent NIPPV need	4	4
Hypoxemia requiring FiO2 greater than normal inspired concentration	13	13
Minor criteria		
High Respiratory rate	22	22
Apnea	20	20
Elevated breathing effort	83	83
PaO2/FiO2 ratio <250	15	15
Infiltrates (Multilobar)	7	7
Score of PEWS greater than 6	16	16
Changed mental status	26	26
Hypotension	23	23
Effusion	13	13
Comorbidities	31	31
Unexplained metabolic acidosis	11	11

Table 3: Severity criteria

Invasive mechanical ventilation was in 10% of cases and NIPPV in 4% of cases. Increased work of breathing was in 83% of cases, high RR was in 22% of cases and comorbid conditions in 31% of cases. Un-explained metabolic acidosis in 11% of cases.

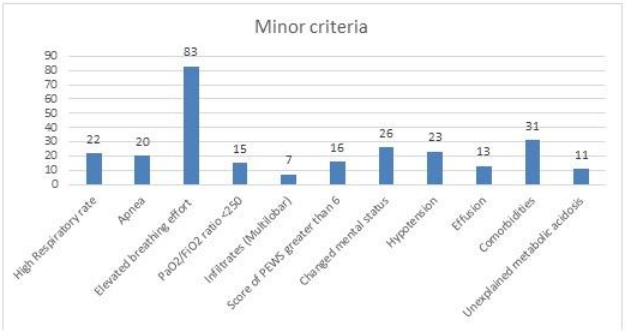

Fig. 4: Major criteria for clinical symptoms.

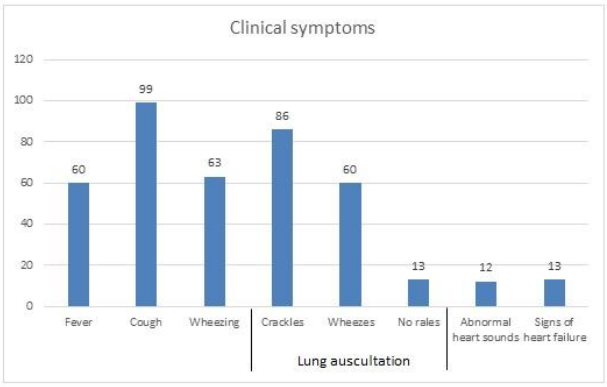

Fig. 5: Minor criteria for clinical symptoms.

Clinical symptoms	N	%
Fever	60	60
Cough	99	99
Wheezing	63	63
Lung auscultation		
Crackles	86	86
Wheezes	60	60
No rales	13	13
Abnormal heart sounds (murmur, gallop)	12	12
Signs of heart failure	13	13

Table 4: Clinical symptoms Signs of patients.

Cough was the most prevalent symptom with 99% of cases then wheezing (63%) and fever (60%). Regarding lung auscultation, crackles were the most observed finding in 86% of cases, then wheezes (60%). Abnormal heart sounds were found in 12% and signs of heart failure were found in 13% of cases.

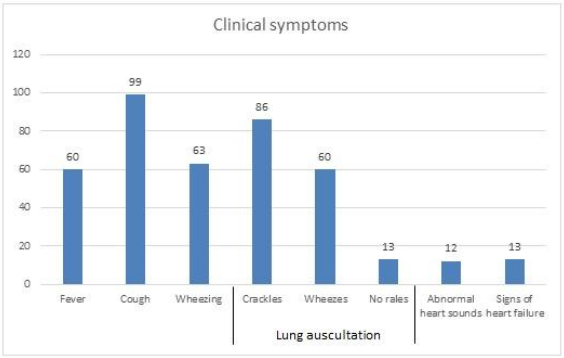

Fig. 6: Clinical symptoms Signs of patients.

Severe conditions on admission to ICU	N	%
Pre-ICU admission respiratory support		
Face masks or nasal prongs provided oxygen	24	24
Ventilation (Non-invasive) (N-PPV or CPAP)	2	2
Intubated and mechanical ventilated	75	75
Post-ICU admission Respiratory support by 24h		
Face masks or nasal prongs provided oxygen	4	4
Ventilation (Non-invasive) (N-PPV or CPAP)	4	4
Regular ventilation	80	80
High-frequency oscillatory ventilation (HFOV)	13	13
Type of respiratory failure		
Decrease of PaO_2	100	100
Increase of $PaCO_2$	64	64
Oxygenation Index (OI) 24 h after admission to ICU		
OI < 4	30	30
4 ≤ OI < 8	33	33
8 ≤ OI < 16	16	16
OI ≥ 16	16	16
Other conditions		
Shock	35	35
Multiple organ dysfunction syndrome	7	7
Vasoactive-Inotropic Score (VIS) 24 h after admission to ICU		
VIS< 10	1	1
10 ≤ VIS < 25	24	24
VIS ≥ 25	10	10
Death Occurrence	8	8

Table 5: Severe conditions on admission to PICU & respiratory support.

Intubated and mechanical ventilated was the most prevalent condition in respiratory support prior to admission to ICU. However, at respiratory support 24 h after admission to ICU Regular ventilation was the most prevalent condition. Decrease of PaO2 was found in all cases and Increase of PaCO2 was found in 64% of cases. Regarding Oxygenation Index (OI) 24 h after admission to ICU 44% of cases had OI more than 4 and less than 8. Shock was observed in 35% of cases and multiple organ dysfunction syndromes in 7% of cases. In many cases (24%) Vasoactive-Inotropic Score (VIS) 24 h after admission to ICU was more than 10 and less than 25. Mortality rate in recurrent pneumonia reached 8% of all cases.

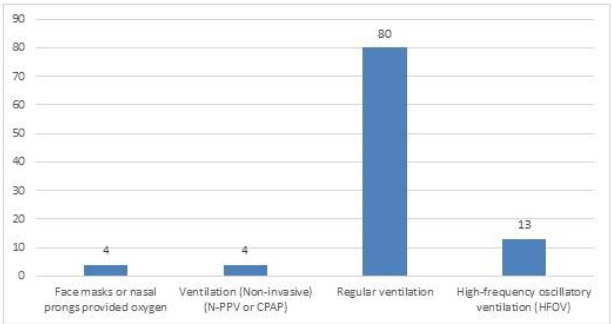

Fig. 7: Respiratory support prior to admission to ICU.

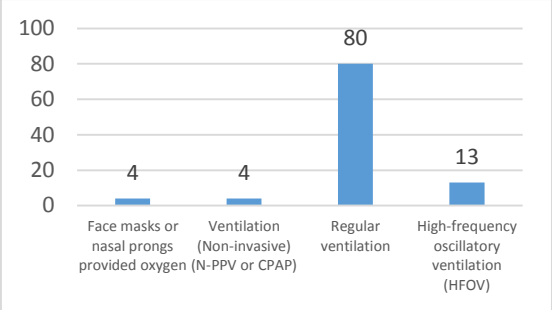

Fig. 8: Respiratory support 24 h after admission to ICU.

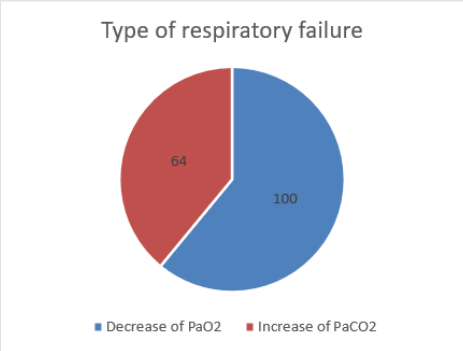

Fig. 9: Type of respiratory failure.

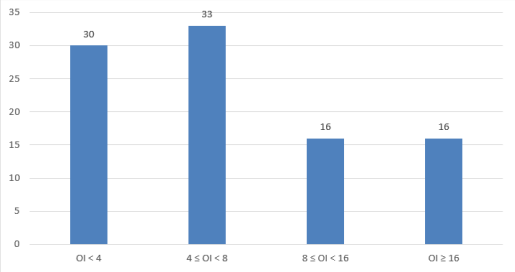

Fig. 10: Oxygenation Index (OI) 24 h after admission to ICU.

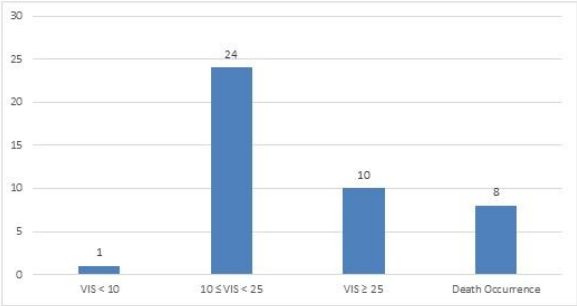

Fig. 11: Vasoactive-Inotropic Score (VIS) 24 h after admission to ICU

Chest X-rays	N	%
Same lobes Recurrent lesions	18	18
Lesions in different/multiple lobes	82	82

Table 6: Chest X-rays findings.

Regarding chest X-rays findings: the infiltrations in different/multiple lobes were found in most cases (82%) and recurrent lesions in the same lobes were found in only 18% of cases.

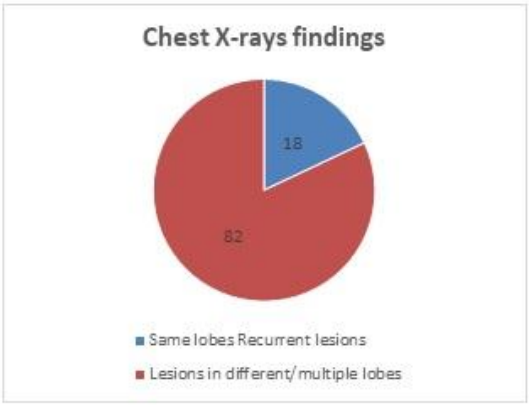

Fig. 12: Chest X-rays findings.

Underlying causes	N	%
Respiratory abnormalities	**28**	**28**
Immune disorders	22	22
Congenital heart diseases	**16**	**16**
Aspiration syndrome	11	11
Unknown	**8**	**8**
Post-infectious bronchiolitis obliterans (PIBO)	5	5
Neuromuscular disorders	**5**	**5**
Recurrent wheezing	4	4
Pulmonary hemorrhagic syndrome	**2**	**2**

Table 5: Underlying causes of sRP patients.

Respiratory abnormalities were the most prevalent (28%) as underlying causes of sRP patients, then Immune disorders (22%) and congenital heart diseases (16%). Pulmonary hemorrhagic syndrome was the least prevalent cause as it was observed in only 2 cases.

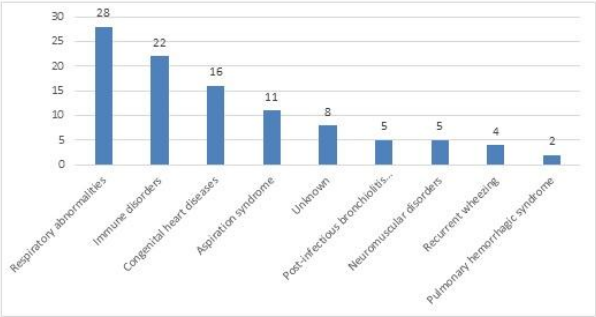

Fig. 13: Chest X-rays findings.

DISCUSSION

Pneumonia is the most frequent cause of morbidity and mortality in children worldwide [12]. As many as ten times as many children die from childhood pneumonia in developing countries, compared to developed countries [13].

According to our investigation, 75% of the paediatric patients with sRP admitted to the PICU had been previously intubated or ventilated. As a result, the death and morbidity rates of this group of children with severe pneumonia were significantly high. sRP had an average age of 14.8 months and a standard deviation of 9.7, which is similar to data given by Ciftci et al. [14] (23.6 months), Hoang & Ta [15] (20.8 months). There is a strong correlation between the lack of medical facilities in rural areas and the lesser awareness of parents in low-income areas, which may lead to a more serious condition for their children. Our results are supported by those reported with study of Hoang & Ta [15] findings.

In our study males were more than females with 2.13/1 ratio and cough was present in 99% of cases, along with our results, Hossain et al. [4] reported that males were more than females with 1.5/1 ratio. Cough was found in all cases of Hossain et al. [4] study. In our study the most prevalent cause was respiratory abnormalities (28%). However, in Hossain study Pulmonary TB was the most prevalent cause (23.3%) this may be due to low socioeconomic status and overcrowding of the selected patients in their study.

In our study Immune disorders were found in 22% of cases which is little more than previous studies that

demonstrated immune deficiency disorders in 7.7–17.75% of cases [16; 17; 18 & 19].

This difference in results between these studies and our work can be explained by difference in sample size, type of patients and methods of selection.

After conducting a series of tests and examinations, we found that the vast majority of instances of sRP were linked to an underlying condition. Investigation of past medical records was a significant and beneficial strategy in many cases of sRP. Psychomotor retardation in children with sRP may point to a neuropathy or inhalation syndrome. Respiratory and cardiovascular problems may be linked to a history of psychomotor impairment or starvation. Wheezing may indicate a variety of respiratory conditions, including respiratory disorders, PIBO, and recurrent wheezing. Inhalation syndrome, or neuropathy, has been linked to a history of meal-related coughing or choking. Another possible indicator of an underlying immunological problem is a history of severe or persistent/recurrent infection in an organ other than the lung, or a history of prolonged corticosteroid medication. Many procedures, such as chest CT scans, bronchoscopies, ECGs, ultrasounds, and blood tests, can be used to confirm the diagnosis after the clues for the causal status have been gathered. Despite this, we found that 8 percent of the instances in our study were undifferentiated.

Aspiration syndrome contribute to 11% of our cases it is along with previous studies' results as in Hossain et al., it affected 13.3% of patients. Aspiration syndrome was revealed to be the most common cause of recurrent/persistent pneumonia in the majority of investigations [16; 17; 18 & 19].

Respiratory abnormalities accounted for 28% of all cases of sRP, followed by immune system disorders (22%), congenital heart diseases (16%), and aspiration syndrome (11%).

According to Bolursaz et al. [18], aspiration syndrome was the most common cause of RP (51.75%), followed by recurrent wheeze (20.17%) and congenital heart disease (20.17%). However, Hossain found that congenital heart disease (16.6%) was second to pulmonary tuberculosis (23.3%), followed by cystic fibrosis (13.3%) and immune deficiency (10%) and finally bronchial asthma (10%).

The difference between our study and these data can be explained by the difference in the type of patients, difference in inclusion criteria as well as the difference of health awareness.

It may be difficult to determine underlying causes in our study because most of the children were brought to the PICU in an emergency. There are still no clinical criteria for determining the causative diagnosis in patients with severe recurrent pneumonia, making it challenging for clinicians to practise in this population. Because of this, certain tests had to be postponed and a wide variety of tests had to be done to cover all the probable reasons in those individuals without evidence of proper scheduling or ideal investigation sequences.

While this investigation revealed the related disorders in sRP patients, the impact of these conditions on pneumonia episodes, such as severity, PICU hospitalisation, intubation length, and recurrence prediction, had not been demonstrated. In this research, the majority of individuals with sRP had underlying conditions that may have triggered this episode or necessitated treatment at the same time. It's imperative that future research focuses on how each underlying issue affects diagnosis and treatment in each patient category, along with how it affects their care and prevention. In our study, the mortality rate in recurrent pneumonia patients was 8%. That's in line with the worldwide average of 5% to 10% [13].

CONCLUSION

One of the most common diagnoses in the pediatric intensive care unit (PICU) is severe recurrent pneumonia. Most individuals with severe recurrent pneumonia have an underlying condition, such as respiratory system abnormalities, immune system issues, congenital heart disease, and aspiration syndrome. Because of the significant mortality and risk of multi-organ failure in patients with severe recurrent pneumonia, a comprehensive approach is required.

REFERENCES

1. Torres, A., Catia, C., Niederman, M. S., Rosario, M., Chalmers, J. D., & Wunderink, R. G. Pneumonia (Primer). Nature Reviews: Disease Primers. 2021; 7(1). DOI:10.1038/s41572-021-00259-0

2. Al-Janabi, M. K., Nasir, N. A., Oleiwe, A. O., & Jaber, R. K. Recurrent Pneumonia in Children at a Tertiary–Pediatric Hospital in Baghdad. Iraqi Postgraduate Medical Journal. 2018; 17(4).

3. Ozdemir, O., Sari, S., Bakirtas, A., Zorlu, P., & Ertan, U. Underlying diseases of recurrent pneumonia in Turkish children. Turkish Journal of Medical Sciences. 2010; 40(1), 25-30. doi:10.3906/sag-0906-15

4. Hossain, N., Kamrul, K., Sultana, A. T., Rahman, M. S., & Amin, M. R. Recurrent and persistent pneumonia in dhaka shishu (children) hospital: clinical profile and etiology. Bangladesh Journal of Child Health. 2018; 42(3), 125-129. https://doi.org/10.3329/bjch.v42i3.39261

5. Rijal, P., Lama, L., Shrestha, S., Kakshapati, P., & Nayak, R. Study of children with recurrent pneumonia admitted in a tertiary hospital. Nepal Medical College Journal. 2019; 21(1), 65-69. https://doi.org/10.3126/nmcj.v21i1.24856

6. Eulmesekian, P. G., Alvarez, J. P., Ceriani Cernadas, J. M., Pérez, A., Berberis, S., & Kondratiuk, Y. The occurrence of adverse events is associated with increased morbidity and mortality in children admitted to a single pediatric intensive care unit.

European Journal Of Pediatrics. 2020; 179(3), 473-482. https://doi.org/10.1007/s00431-019-03528-z

7. Bradley, J. S., Byington, C. L., Shah, S. S., Alverson, B., Carter, E. R., Harrison, C. et al. Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. The management of community-acquired pneumonia in infants and children older than 3 months of age: clinical practice guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. Clin Infect Dis. 2011; 53(7), e25-e76. https://doi.org/10.1093/cid/cir531
8. Florin, T. A., Brokamp, C., Mantyla, R., DePaoli, B., Ruddy, R., Shah, S. S., et al. Validation of the pediatric infectious diseases society–infectious diseases society of america severity criteria in children with community-acquired pneumonia. Clinical Infectious Diseases. 2018; 67(1), 112-119. https://doi.org/10.1093/cid/ciy031
9. Jaffe, A., Doyle, K., & Belessis, Y. Investigation of the child with recurrent pneumonia. 2008.
10. Agha, R., Abdall-Razak, A., Crossley, E., Dowlut, N., Iosifidis, C., Mathew, G. et al. STROCSS 2019 Guideline: strengthening the reporting of cohort studies in surgery. International journal of surgery. 2019; 72, 156-165. https://doi.org/10.1016/j.ijsu.2019.11.002
11. Castro-Rodriguez, J. A. The Asthma Predictive Index: early diagnosis of asthma. Current opinion in allergy and clinical immunology. 2011; 11(3), 157-161. doi: 10.1097/ACI.0b013e3283464c4a
12. Yun, K. W., Wallihan, R., Juergensen, A., Mejias, A., & Ramilo, O. Community-acquired pneumonia in children: myths and facts. American journal of perinatology. 2019; 36(S 02), S54-S57. DOI: 10.1055/s-0039-1691801
13. McAllister, D. A., Liu, L., Shi, T., Chu, Y., Reed, C., Burrows, J. et al. Global, regional, and national estimates of pneumonia morbidity and mortality in children younger than 5 years between 2000 and 2015: a systematic analysis. The Lancet Global Health. 2019; 7(1), e47-e57. https://doi.org/10.1016/S2214-109X(18)30408-X
14. Ciftci, E., Gunes, M., Koksal, Y., Ince, E., & Dogru, U. Underlying causes of recurrent pneumonia in Turkish children in a university hospital. Journal of tropical pediatrics. 2003; 49(4), 212-215. https://doi.org/10.1093/tropej/49.4.212
15. Hoang, K. L., & Ta, A. T. Severe recurrent pneumonia in children: Underlying causes and clinical profile in Vietnam. Annals of Medicine and Surgery. 2021; 67, 102476. https://doi.org/10.1016/j.amsu.2021.102476
16. Owayed, A. F., Campbell, D. M., & Wang, E. E. Underlying causes of recurrent pneumonia in children. Archives of pediatrics & adolescent medicine. 2000; 154(2), 190-194. doi:10.1001/archpedi.154.2.190
17. Adam, K. A. R. Persistent or recurrent pneumonia in Saudi children seen at King Khalid University Hospital, Riyadh: clinical profile and some predisposing factors. Annals of tropical paediatrics. 1991; 11(2), 129-135. https://doi.org/10.1080/02724936.1991.11747491
18. Bolursaz, M. R., Lotfian, F., Ghaffaripour, H. A., & Hassanzad, M. Underlying causes of persistent and recurrent pneumonia in children at a pulmonary referral hospital in Tehran, Iran. Archives of Iranian medicine. 2017; 20(5), 266-269.
19. Hoving, M. P., & Brand, P. L. Causes of recurrent pneumonia in children in a general hospital. Journal of paediatrics and child health. 2013; 49(3), E208-E212. https://doi.org/10.1111/jpc.12114