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A PROSPECTIVE STUDY ON MANAGEMENT OF ANTIBIOTICS IN PEDIATRIC PNEUMONIA

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ABSTRACT

Aim: The aim of the study is to emphasize that the use of single therapy as an effective line of treatment when compared to combination therapies and to avoid unneccesary antibiotic exposure by limiting their irrational use. **Objective:** The main objective of the study is to evaluate the effectiveness of antibiotics given to paediatric pneumonia patients. To determine which antibiotic is most useful for treating paediatric pneumonia. To emphasise the effectiveness of single therapy as a course of treatment for simple CAP. **Methods:** It is a prospective study it includes inpatient, with the diagnosis of pneumonia. Using the Statistical Package for Social Sciences (SPSS) Software for Windows (version 29.0.1.0), the acquired data was categorized, compared, and statistical analysis was carried out. ANOVA and the Paired T-Test were both utilized in the analysis. Statistical significance was defined as a p-value of 0.05 or less.

Results: A total of 140 children with CAP were included in the study. Out of them, 86(64.1%) were males and 54(35.9%) were females. Among 140 subjects, 76(54.2%) were on Multiple Therapy and 64(45.7%) were on Single Therapy. Ceftriaxone was the most commonly used antibiotic, accounting for approximately (n=50), 78.1% of single antibiotic prescribing following the use of Amoxicillin accounting for(n=7) 10.9% was observed. **Conclusion:** This study concludes that Ceftriaxone has been proved to be more effective in both uncomplicated and complicated pneumonia. This study summarizes that single therapy samples are in significance and showed positive outcomes whereas multiple therapy samples were found to be insignificant.

KEYWORDS: Pediatric pneumonia, ceftriaxone, amoxicillin, community acquired pneumonia (CAP).

1. INTRODUCTION

Pneumonia is a form of acute respiratory infection that affects the lungs. Pneumonia is the lower respiratory infection caused by bacteria or viruses pneumonia occurs by inflammation of lungs in which alveoli are filled with fluids. Cough, breathing problems, a tightening of the lower chest wall, and nasal flare-ups are indications of severe pneumonia. Tachypnea is followed by a cough, fever, are the symptoms of non-severe pneumonia.[1] Globally, community-acquired pneumonia (CAP) is a significant source of morbidity and mortality. The eighth biggest cause of death in the USA is pneumonia and influenza.[2-4] Clinicians working in the emergency room and primary care settings frequently face pneumonia. In developing nations, childhood pneumonia continues to be a major source of morbidity and mortality, but new vaccines, antibiotics, and improvements in diagnostic and monitoring methods have led to a decline in mortality rates in industrialized nation.[5] For children, especially those who reside in third-world nations, pneumonia is a major hazard. There were over 120 million instances of pneumonia in the population of children under five.[6] An estimated 1.3 million kids that age died from pneumonia each year, according to estimates. 74% of pneumonia cases were found in south Asia and sub-Saharan regions, accounting for around 97% of cases worldwide.[6] Subgroups of children are further divided into the following categories:

Newborns and the first 28 days of life for neonates.

Infants: from 29 days to under 2 years

Children from 2 years old to under 12 years old

By age group and between developing and developed nations, pneumonia incidence varies. Globally, pneumonia affects 150 million to 156 million children under the age of 5 every year,[8-9] killing an estimated 2 million children each year, the majority of whom live in underdeveloped nations[10] Hospitalisation is necessary in 40% of patients.[11] In affluent nations, the annual incidence of pneumonia is thought to be 33 per 10,000 children under the age of 5 and 14.5 per 10,000 children between the ages of 0 and 16. According to estimates, pneumonia affects 2.6% of children under the age of 17 in the United States. Fortunately, less than 1 per 1000 people die each year in developed nations.[10] For children, especially those who reside in third-world nations, pneumonia is a major hazard. There were over 120

million instances of pneumonia in the population of children under five. An estimated 1.3 million kids that age died from pneumonia each year, according to estimates. 74% of pneumonia cases are found in south Asia and sub-Saharan regions, while about 97% of cases are found.[12-13]

The World Health Organisation (WHO) estimates that pneumonia kills 1.2 million children under the age of five every year, making it the top cause of mortality among children globally. 18% of all fatalities of children under the age of five occur due to this worldwide.[14-15]

Causes include Viruses, bacteria, and fungi are just a few of the infectious organisms that can cause pneumonia. The following are the most typical. The most typical cause of bacterial pneumonia in children is streptococcus pneumoniae. The second most frequent cause of bacterial pneumonia is Haemophilus influenzae type b (Hib). The most frequent viral cause of pneumonia is the respiratory syncytial virus. Pneumocystis jiroveci is one of the most typical causes of pneumonia in HIV-infected newborns, accounting for at least 25% of all pneumonia-related deaths.

Wheezing is common in infections which are viral. ill infants may be unable to drink and may also experience unconsciousness, hypothermia and convulsions. Acute symptoms and the presence of LRTI indications without any other clear causes are what define community-acquired pneumonia, however a new pulmonary infiltrate on a chest radiograph is required for a definitive diagnosis[16-19] Symptoms of severe pneumonia include cough, difficulty in breathing, lower chest wall indrawing, nasal flaring. Non severe pneumonia includes cough, fever, difficulty in breathing followed by tachypnoea.[20] For patients admitted with non-severe community-acquired pneumonia, the following tests are advised, complete blood count, Urea and electrolytes, Liver function tests(LFT), Sputum culture, Chest x ray ,Blood cultures.[21]

According to WHO for the treatment of "fast breathing pneumonia," oral amoxicillin is preferable to oral cotrimoxazole, and it is equivalent to injectable penicillin/ampicillin for the treatment of "chest in-drawing pneumonia." The new classification is streamlined to only include two types of pneumonia: "pneumonia" with fast breathing and/or chest tightness, which requires oral amoxicillin therapy at home, and "severe pneumonia," which is defined as pneumonia with any general danger sign and necessitates referral and injectable

therapy.[22]

As compared with the previous guidelines, the most important change in the recommended empirical antibiotic therapy for CAP is to start with 2nd or 3rd generation cephalosporin mono-therapy instead of combination therapy with amoxicillin or penicillin together with a quinolone or erythromycin in patients with severe CAP who are treated in a non-ICU ward. From an antibiotic stewardship perspective this is an important gain. The main reason for this change is the very low incidence of atypical pathogens in patients admitted to the ward with CURB-65 score ≥ 3 as outlined above. This is supported by the recent findings from the Dutch CAP-START study, involving more than 2000 patients with clinically suspected CAP admitted to non-ICU wards; in this study empirical treatment with beta-lactam monotherapy was non-inferior to strategies with a beta-lactam-macrolide combination or 4th generation fluoroquinolone monotherapy with regard to 90- day mortality.[23] Beta-lactam antibiotics (eg, amoxicillin, cefuroxime, cefdinir) are preferred for outpatient management. Macrolide antibiotics (eg,azithromycin, clarithromycin) are useful in most school- aged children to cover the atypical organisms and pneumococcus.[24]

3. MATERIALS AND METHODS

Study Design and Study Population

This was a prospective, population based, active surveillance of CAP hospitalizations among children (<12 years old). The total number of subjects enrolled in the study are 140 (n=140). The study was approved by Institutional Ethics Committee of St. Paul's College of Pharmacy.

Study Site and Period

The study was conducted in a multispecialty hospital, Hyderabad for a period of 6 months i.e., from October 2022 to March 2023.

Study instrument

In an especially created data collecting form, the information is gathered from the patient's case report files. Patients' age, gender, weight, date of admission, date of discharge, cause for admission, diagnosis, antibiotics prescribed, lab results like haemoglobin and white blood cell count, and radiology findings like chest x-ray and CT scan are all included in the data collection forms. Using the Statistical Package for Social Sciences (SPSS) Software for Windows (version 29.0.1.0), the acquired data was categorized, compared, and statistical

analysis was carried out. ANOVA and the Paired T-Test were both utilized in the analysis. Statistical significance was defined as a p-value of 0.05 or less.

Study criteria

a. Inclusion criteria

- Inpatients, Outpatients and Ambulatory patients of paediatric pneumonia.
- Age group: Below 12 years.
- Both genders.
- Patients with pneumonia.

b. Exclusion criteria

- All patients above 12years of age
- Patients with abnormal conditions like Autism, Bipolar and other psychiatric disorders.
- Patients with Renal insufficiency and liver disorders.
- Patients who expired during treatment.

4. RESULTS

A total of 140 children with CAP enrolled in the study. Out of them, 86(64.1%) were males and 54(35.9%) were females. Among 140 people, 76(54.2%) were on Multiple Therapy and 64(45.7%) were on Single Therapy.

Table I: Among 140 patients 76 patients were treated with multiple therapy and it is of 54.2% and 64 patients were treated with single therapy and it is 45.7%.

Type of therapy	No. of patients	Percentage
Single therapy	64	45.7%
Multiple therapy More then 1 antibiotic administered.	76	54.2%

Table II: Patients distributed according to age group.

Age stages defined according to National Institute of Child Health and Human Development (NICHD).

Stage	Age	No. of patients	Percentage
Neonatal	0 – 27 Days	2	1.42%
Infancy	28 days – 12 months	44	31.4%
Toddler	1 – 2 years	25	17.8%
Early childhood	2 – 5 years	45	32.1%
Middle childhood	6 – 11 years	22	15.7%
Adolescent	12 – 18 years	2	1.42%

Table III: Antibiotics prescribed in single therapy.

Antibiotics	No. of patients	Percentage
Ceftriaxone	50	78.1 %
Amoxicillin	7	10.9%
Piperacillin+tazobactum	4	6.25%
Azithromycin	1	1.5%
Linezolid	1	1.5%
Vancomycin	1	1.5%

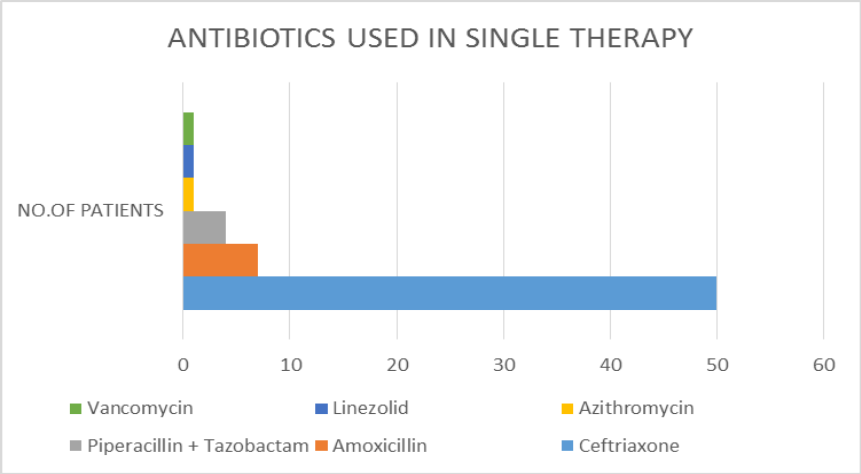

Fig. I: Antibiotics prescribed in the single therapy.

The above bar graph represents that ceftriaxone is mostly prescribed i.e., in 50 patients.

Table IV: Type of Therapy – Multiple therapy.

Antibiotics	No. of patients	Percentage	Comorbidities/no. of patients
Ceftriaxone + Azithromycin	19	25%	-
Ceftriaxone + linezolid	4	5.2%	-
Ceftriaxone + vancomycin	8	10.5%	-
Ceftriaxone + amoxicillin	2	2.6%	-
Amoxicillin + azithromycin	4	5.2%	-
Amoxicillin + vancomycin	6	7.8%	-
Amoxicillin + meropenem	4	5.2%	-
Ceftriaxone + azithromycin+ piperacillin	6	7.8%	-
Ceftriaxone + azithromycin+ vancomycin	4	5.2%	-
Ceftriaxone+ vancomycin+ piperacillin	6	7.8%	Stroke-1
Ceftriaxone + vancomycin + azithromycin+ meropenem	5	6.5%	Seizures-5
Ceftriaxone + linezolid + vancomycin + azithromycin	3	3.9%	Asthma -1, UTI-2
Ceftriaxone + linezolid+ vancomycin + piperacillin+ meropenem	5	6.5%	Myocarditis -2

Table V: Distribution of patients according to Typical and Atypical pneumonia.

	Typical pneumonia	Atypical pneumonia	Total
No.of single therapy patients	7	57	64
No.of multiple therapy patients	35	41	76
Total	42	98	140

Table VI: Length of stay of patients.

S.n0	Length of stay	Single therapy	Multiple therapy	Total
1.	(0 – 3) DAYS	25	18	43 (30.7%)
2.	(3 – 6) DAYS	33	42	75 (53.5%)
3.	(6 – 12) DAYS	5	11	16 (11.4%)
4.	(12 – 15) DAYS	1	2	3 (2.1%)
5.	(15 – 18) DAYS	-	1	1 (0.71%)
6.	(18 – 21) DAYS	-	1	1 (0.71%)
7.	More than 21 days	-	1	1 (0.71%)
	TOTAL	64	76	140 (100%)

Anova p = 0.009

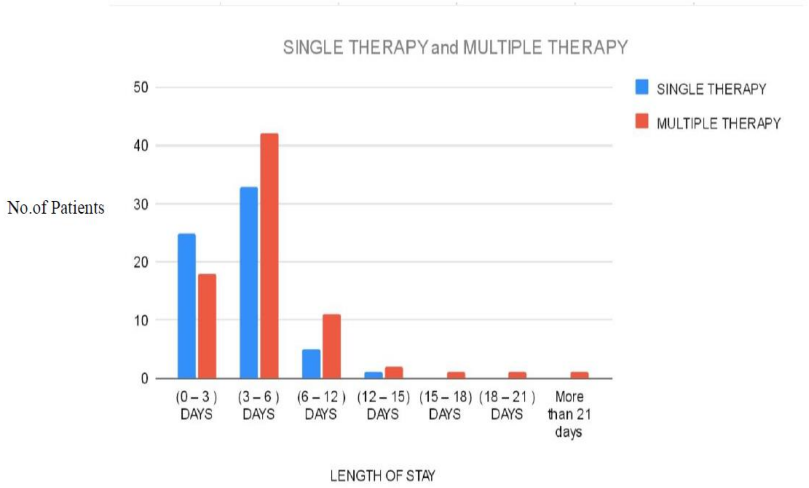

Fig. II: The above bar chart represents the length of stay in single therapy and multiple therapy patients.

Table VII: Use of antibiotics in management of pneumonia.

Antibiotics used	No. of patients
Ceftriaxone	107
Azithromycin	46
Vancomycin	40
Piperacillin+ Tazobactam	27
Linezolid	21
Amoxicillin	18
Meropenem	13
levofloxacin	2

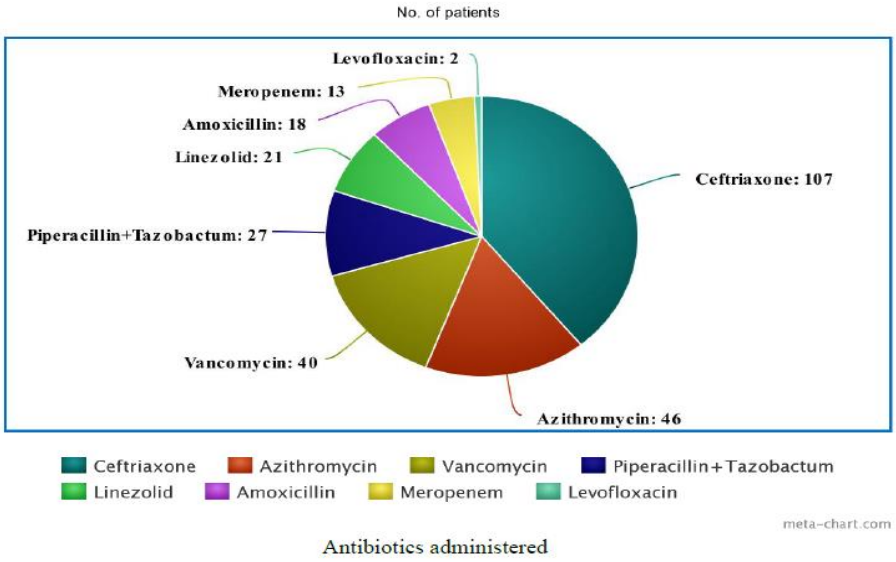

Fig. III: The above pie chart represents the administration of antibiotics among paediatric patients the most highly administered antibiotics were Ceftriaxone (70%) and Azithromycin (35%).

Table VIII: Single therapy – Patients with improved WBC count.

Total no. of patients for single therapy	No. of patients with improved WBC	Percentage
64	56	87.5%

Paired T – Test p = <0.001.

Table IX: Multiple therapy – Patients with improved WBC count.

Total no. of patients for multiple therapy	No of patients with improved WBC	Percentage
76	59	77.6%

Paired T – Test p = 0.148

5. DISCUSSION

This was a hospital based study conducted on a total of 140 children with CAP. Out of them, 86 were males, 54 were females and 76(54.2%) were on Multiple Therapy, 64(45.7%) were on Single Therapy.

Our study demonstrates that overall, use of third generation cephalosporins i.e., Ceftriaxone was the most commonly used antibiotic, accounting for approximately (n=50), 78.1% of single antibiotic prescribing following the use of Amoxicillin accounting for(n=7) 10.9%. In Multiple therapy, Macrolides were more commonly combined with third generation cephalosporin than with penicillin.

However the current study is concerned about the use of single therapy in uncomplicated pneumonia, we observed that single therapy is effective because it has shorter LOS compared with multiple therapy. The majority of the children had uncomplicated CAP (n=98) and the no. of single therapy patients were (n=64).Our study complements and expands on prospective assessments using administrative data by applying strict selection criteria to prospectively identify CAP hospitalisations and collecting detailed hospital-level information of dissemination efforts.

A multicenter study of children's hospitals showed that cephalosporins accounted for 45% of all empirical therapy for patients diagnosed with CAP but penicillins and aminopenicillins were rarely used.[25] JoAnna K et al. demonstrated that the comparative effectiveness ceftriaxone alone relative to ceftriaxone-macrolide combination therapy for pneumonia management, combination therapy did not appear to benefit preschool children, adjusted models revealed no significant difference in length of stay, with significantly higher costs in the combination therapy group.[26]

In one multicenter study of CAP, rates of penicillin use at tertiary care children's hospitals were as low as 5.5%.[27]Ambroggio et al.[28] conducted a single multicenter research in which they contrasted β-lactam monotherapy with β-lactam plus macrolide. 12% of the entire cohort in the sub analysis of patients receiving β-lactam monotherapy received an aminopenicillin, and the remaining patients received a second- or third-generation cephalosporin. Between the two groups, the readmission rates did not differ statistically. According to our study, Cephalosporins particularly in β-lactam antibiotics were the most prescribed antibiotic as single therapy.

In another multicenter study, Mary Ann Queen et al.[29] determines that only 33% of all CAP patients in this study received the advised narrow-spectrum penicillin or aminopenicillin medication. The most often given antibiotics were broad-spectrum cephalosporins, however there was significant variation in how they were used among the 4 participating institutions. As seen in our study, broad-spectrum Cephalosporins were the most effective antibiotic in uncomplicated CAP i.e., 78.1% followed by penicillins i.e., 10.9%.According to Julia A. Bielicki et al.[30] 3 days seemed inferior to 7 days in terms of the necessity for antibiotic re-treatment. In our research, we discovered that single therapy results in shorter los than multiple therapy.

We confirmed that there was a significant difference between both groups when we statistically analysed the improved wbc count in single therapy and multiple therapy using paired t-test. This significant difference illustrates 87.5% patients on single therapy improved wbc count after treatment whereas only 77.6% patients on multiple therapy improved wbc count after treatment. In our study, ANOVA was also performed for LOS in both groups, a p-value of <0.009 was obtained and we observed that 30.7% patients has a LOS of (0-3) days and 53.5% patients has a LOS of (3-6) days.

Comparative efficacy studies can be used to promote consensus recommendations, particularly when expensive or inconvenient randomised controlled trials are not an option. Our study adds to the corpus of research supporting the developing mainstream of consensus that uncomplicated CAP patients can be successfully treated with a single antibiotic and do not require multiple antibiotics for treatment.

6. CONCLUSION

Our study concludes that third generation cephalosporin are observed to be efficacious compared with other antibiotics. Ceftriaxone belonging to cephalosporins antibiotic has been proved to be more effective in both uncomplicated and complicated pneumonia. The effectiveness of single therapy was superior to multiple therapy for children hospitalized with uncomplicated CAP. Improvement of patient signs and symptoms was significantly associated with LOS (p=0.009). The majority of the patients had 3-6 days of los i.e., 53.5%. This study summarizes that single therapy samples are in significance and showed positive outcomes whereas multiple therapy samples were found to be insignificant, we reject the null hypothesis as our p-value is smaller i.e.,(p=<0.001) we have statistical evidence that the use of a single therapy as a successful course of treatment for CAP pneumonia. Additional research in a variety of settings are required to evaluate the long-term sustainability of these positive observations and to identify the most effective hospital based strategies, we need further evaluation with large sample size in the future.

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8. Glossary

CAP - Community-acquired pneumonia

PIDS - Pediatric Infectious Diseases Society

LOS - Length of stay

CDC - Centers for Disease Control and Prevention

WBC - White blood cell

ESPID - Europeon Society for Paediatric Infectious Diseases

IDSA - Infectious Diseases Society of America.

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