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**ORIGINAL ARTICLE**

# Comparative Efficacy of Amoxicillin Versus Azithromycin in the Treatment of Pediatric Community-Acquired Pneumonia

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## ABSTRACT

**Background:** Community-acquired pneumonia is one of the leading causes of morbidity and mortality among children worldwide.

**Objective:** To compare the clinical efficacy, safety, and treatment outcomes of amoxicillin versus azithromycin in the management of pediatric community-acquired pneumonia.

**Methodology:** This comparative observational study was conducted at Department of Pediatric Medicine, Shahida Islam Medical & Dental College, Lodhran from 1st January 2023 to 30th June 2023 and included 355 children aged 6 months to 12 years diagnosed with community-acquired pneumonia. Patients were randomly divided into two equal groups: Group A received oral amoxicillin (50 mg/kg/day in three divided doses for seven days), while Group B received oral azithromycin (10 mg/kg on day one followed by 5 mg/kg once daily for four days). Clinical improvement was assessed on days 3 and 7 through resolution of fever, cough and tachypnea.

**Results:** The mean age of participants was 5.8±2.9 years, with a near-equal gender distribution. Clinical cure was achieved in 91.6% of the amoxicillin group and 87.6% of the azithromycin group (p=0.21). Fever resolution within 72 hours occurred in 83.1% and 78.5% of patients, respectively. Both groups demonstrated significant reductions in white blood cell count and C-reactive protein levels by day 7, with no statistically significant difference between them. Adverse effects were mild and comparable, with diarrhea and nausea being the most frequent. The mean duration of hospital stay was slightly shorter in the amoxicillin group (3.8±1.2 days) than in the azithromycin group (4.0±1.3 days), though not statistically significant (p = 0.17).

**Conclusion:** Both amoxicillin and azithromycin were effective and well-tolerated in the treatment of pediatric community-acquired pneumonia. Amoxicillin demonstrated a marginally faster clinical response and shorter hospital stay, reaffirming its role as the preferred first-line antibiotic for most pediatric CAP cases.

**Keywords:** Amoxicillin, Azithromycin, Community-acquired pneumonia, Pediatrics, Antibiotic efficacy, Respiratory infection

## INTRODUCTION

Community-acquired pneumonia (CAP) remains one of the leading causes of morbidity and mortality in children at the worldwide level and especially in the developing nations where access to healthcare, vaccinations, and adherence to antibiotic stewardship is unequal.[1] Even though there has been a drastic change in the preventive care system, including the introduction of conjugate vaccines and extended immunization efforts, the use of pneumonia in hospital admissions and deaths in pediatric care remains high. It presents a clinical issue but a threat to the economy and social of families and healthcare machinery.[2] Characteristics of the condition include inflammation of the lung parenchyma caused by bacterial, virus or in rare cases, fungi or atypical organism infection. Clinical manifestations include mild coughing and fever to severe respiratory distress and hypoxemia which necessitates hospitalization.[3]

The choice of antibiotic treatment in the case of pediatric CAP is very essential, as it determines the results of treatment directly, the dynamics of bacterial resistance, and the overall health of the population. The best antibiotic must be useful against the most prevalent causative organisms, cost effective, well-tolerated, and easy to administer.[4] Amoxicillin is a b-lactam antibiotic that has always been regarded as the foundation of bacterial pneumonia treatment among children mainly because of its excellent activity against Streptococcus pneumoniae the most common bacterial cause of pneumonia in children.[5]

The medical efficiency, cheapness, and security profile of it make it an effective first-line choice, particularly in under-resource districts. On the other hand, Azithromycin is a macro-lide antagonist and is reported to have a wide spectrum of activity which includes non-typical pathogens like Mycoplasma pneumoniae and Chlamydophila pneumonia.[6] It also has the advantage of a one-dose daily dose and a reduced treatment duration which enhances compliance especially in children who are not favorable with long-course treatment. Also, azithromycin possesses some anti-inflammatory effects which could lead to the quicker symptomatic recovery in respiratory tract infections.[7] Due to these reasons, the clinicians usually tend to use azithromycin particularly in older children and adolescents or when there is an allergy to penicillin. The other area of contention during clinical practice is the wide discrepancy between the guideline suggestions and the prescribing practices.[8] Numerous doctors still prefer azithromycin perhaps empirically even in the situations where the probable pathogen is b-lactam sensitive. This variation is an outcome of convenience, patient expectations, uncertain diagnosis and false beliefs about the scope of coverage.[9]

Parental demand and the availability of medications over the counter also affect antibiotic prescription patterns in many countries with the low and middle-income levels, making it even more difficult to follow evidence-based guidelines. Comparative research has attempted to establish the similarity in the effectiveness of amoxicillin and azithromycin in the treatment of CAP in children.[10] Results have been mixed. There are studies indicating that there is no clinical recovery difference between the two drugs whereas some studies argue that amoxicillin is somewhat more successful in treating typical bacterial infections especially in young children who are unvaccinated.[11] On the other hand, azithromycin might be an advantage over older children and adolescents in which unusual pathogens are also more probable.[12] Gastrointestinal discomfort and mild rash are the most frequent and common adverse events with both drugs, which are usually well-tolerated. They can be used in outpatient management of uncomplicated CAP because they do not have any significant side effects and they can be administered in oral and suspension forms.[13]

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## MATERIALS AND METHODS

This comparative observational study was conducted at Department of Pediatric Medicine, Shahida Islam Medical & Dental College, Lodhran from 1st January 2023 to 30th June 2023. A total of 355 pediatric patients were enrolled in the study. The sample size was calculated using the WHO sample size calculator, keeping a 95% confidence interval and a 5% margin of error, based on the expected difference in treatment response between the two antibiotic regimens. Non-probability consecutive sampling was used to recruit all eligible patients. All children aged 6 months to 12 years diagnosed with community-acquired pneumonia based on clinical and radiological findings, presenting with fever, cough, tachypnea, and radiographic evidence of pulmonary infiltrates, children who had not received antibiotics in the preceding 7 days and written informed consent obtained from parents or guardians were included. The children with hospital-acquired pneumonia or underlying chronic lung disease such as cystic fibrosis, bronchiectasis, or asthma, congenital heart disease, severe malnutrition, or immunodeficiency, known hypersensitivity to β-lactam antibiotics or macrolides and incomplete medical records or loss to follow-up were excluded.

The demographic details (age, gender, and weight), clinical symptoms (fever, cough, respiratory distress), baseline laboratory investigations, and radiological findings at admission were noted. Patients were randomly assigned into two equal groups using a computer-generated randomization method. Group A received Amoxicillin in an oral dose of 50 mg/kg/day divided into three doses for a duration of seven days and group B received Azithromycin in an oral dose of 10 mg/kg on the first day followed by 5 mg/kg once daily for the next four days. Both groups received supportive care including antipyretics, hydration, and oxygen supplementation when required according to standard hospital protocols. Follow-up evaluations were performed on day 3 and day 7 to assess treatment response, including fever resolution, improvement in respiratory symptoms, normalization of respiratory rate, and chest auscultation findings. Patients who showed incomplete improvement by day 7 were further evaluated for secondary infection or antibiotic resistance. The primary outcome of the study was clinical cure, defined as complete resolution of fever, cough, and tachypnea without the need to change the antibiotic within seven days of treatment. Secondary outcomes included the time required for fever resolution, improvement in respiratory rate, normalization of oxygen saturation, radiological improvement on follow-up chest X-rays, and the incidence of adverse drug reactions or hospital readmission within fourteen days. These parameters were selected to provide a comprehensive evaluation of therapeutic response and safety. Data were entered and analyzed using SPSS version 26. The Chi-square test was used to compare categorical variables, while the independent t-test was applied for continuous variables. A p-value of ≤ 0.05 was considered statistically significant.

## RESULTS

The mean age was 5.7±2.8 years in the amoxicillin group and 5.9±3.0 years in the azithromycin group. Males were slightly predominated (102 vs. 99), and mean body weight was similar (19.8±6.4 kg vs. 20.1±6.7 kg). The mean duration of symptoms before presentation was 4.2±1.5 days and 4.4±1.7 days, respectively. Fever was present in all children, cough in over 92%, and tachypnea in nearly 80%. Radiological infiltrates were confirmed in every case. There were no statistically significant baseline differences (p>0.05), indicating both groups were well matched (Table 1).

Both antibiotics achieved high clinical cure rates, with 91.6% of patients recovering in the amoxicillin group and 87.6% in the azithromycin group (p=0.21). Fever resolved within 72 hours in 83.1% and 78.5% of patients, respectively, with mean fever resolution times of 56.3±18.5 hours versus 59.8±20.1 hours (p=0.09). Improvement in respiratory rate was observed in 94.4% versus 92.1%, and radiological improvement in 86.5% versus 84.1% of cases. Treatment failure occurred in 8.4% of amoxicillin recipients and 12.4% of azithromycin recipients (Table 2).

Diarrhea occurred in 6.2% of the amoxicillin group and 7.3% of the azithromycin group (p=0.68). Nausea or vomiting affected 4.5% versus 5.1%, skin rash 2.2% versus 2.8%, and abdominal pain 3.4% versus 4.5%. Hospital readmission within 14 days was rare (1.7% vs. 2.8%; p=0.47). All adverse effects were mild and self-limiting, with no significant difference between regimens (Table 3).

Table 1: Baseline demographic and clinical characteristics of patients (N = 355)

| Variable | Amoxicillin Group (n = 178) | Azithromycin Group (n = 177) |
|---|---|---|
| Age (years) | 5.7±2.8 | 5.9±3.0 |
| Gender (Male/Female) | 102/76 | 99/78 |
| Weight (kg) | 19.8±6.4 | 20.1±6.7 |
| Duration of symptoms (days) | 4.2±1.5 | 4.4±1.7 |
| Fever | 178 (100%) | 177 (100%) |
| Cough | 165 (92.7%) | 163 (92.1%) |
| Tachypnea | 141 (79.2%) | 139 (78.5%) |
| Radiological infiltrates | 178 (100%) | 177 (100%) |

Table 2: Comparison of clinical outcomes between the two groups (N = 355)

| Clinical Outcome | Amoxicillin Group (n = 178) | Azithromycin Group (n = 177) | p-value |
|---|---|---|---|
| Clinical cure (Day 7) | 163 (91.6%) | 155 (87.6%) | 0.21 |
| Fever resolution within 72 hours | 148 (83.1%) | 139 (78.5%) | 0.27 |
| Mean time to fever resolution (hours) | 56.3±18.5 | 59.8±20.1 | 0.09 |
| Improvement in respiratory rate (Day 7) | 168 (94.4%) | 163 (92.1%) | 0.38 |
| Radiological improvement (follow-up) | 154 (86.5%) | 149 (84.1%) | 0.52 |
| Treatment failure | 15 (8.4%) | 22 (12.4%) | 0.21 |

Table 3: Adverse drug reactions and complications (N = 355)

| Adverse Event | Amoxicillin Group (n = 178) | Azithromycin Group (n = 177) | p-value |
|---|---|---|---|
| Diarrhea | 11 (6.2%) | 13 (7.3%) | 0.68 |
| Nausea/Vomiting | 8 (4.5%) | 9 (5.1%) | 0.81 |
| Skin rash | 4 (2.2%) | 5 (2.8%) | 0.73 |
| Abdominal pain | 6 (3.4%) | 8 (4.5%) | 0.59 |
| Hospital readmission (within 14 days) | 3 (1.7%) | 5 (2.8%) | 0.47 |

Table 4: Laboratory and inflammatory marker improvement after treatment (N = 355)

| Laboratory Parameter | Baseline | Day 7 | Mean Change | p-value |
|---|---|---|---|---|
| Amoxicillin Group | | | | |
| WBC Count (×$10^9$/L) | 13.2±3.8 | 8.4±2.5 | -4.8±1.3 | <0.001 |
| CRP (mg/L) | 42.6±11.4 | 12.1±6.5 | -30.5±9.8 | <0.001 |
| Azithromycin Group | | | | |
| WBC Count (×$10^9$/L) | 13.5±3.5 | 8.9±2.7 | -4.6±1.2 | <0.001 |
| CRP (mg/L) | 41.8±12.0 | 13.4±7.1 | -28.4±10.3 | <0.001 |

Table 5: Hospital stay duration and overall clinical outcome (N = 355)

| Parameter | Amoxicillin Group (n = 178) | Azithromycin Group (n = 177) | p-value |
|---|---|---|---|
| Mean hospital stay (days) | 3.8±1.2 | 4.0±1.3 | 0.17 |
| Early discharge (≤3 days) | 102 (57.3%) | 91 (51.4%) | 0.27 |
| Prolonged stay (>5 days) | 18 (10.1%) | 22 (12.4%) | 0.48 |
| Overall recovery (No relapse at 14 days) | 165 (92.7%) | 159 (89.8%) | 0.32 |

In the amoxicillin group, mean WBC count fell from 13.2±3.8 X$10^9$/L to 8.4±2.5 X$10^9$/L (p<0.001), and CRP decreased from

42.6±11.4 mg/L to 12.1±6.5 mg/L (p<0.001). Similar reductions were observed with azithromycin: WBC declined from 13.5±3.5 $X10^9$/L to 8.9±2.7 $X10^9$/L and CRP from 41.8±12.0 mg/L to 13.4±7.1 mg/L. Both antibiotics effectively normalized infection markers with no significant intergroup difference (Table 4).

The mean hospital stay was 3.8±1.2 days in the amoxicillin group and 4.0±1.3 days in the azithromycin group (p=0.17). Early discharge (≤3 days) occurred in 57.3% versus 51.4%, while prolonged stay (>5 days) was noted in 10.1% versus 12.4% of patients. Overall recovery without relapse at 14 days was achieved in 92.7% of children receiving amoxicillin and 89.8% of those on azithromycin (p=0.32) [Table 5].

## DISCUSSION

This study indicated that the two antibiotics were effective and high clinical cure rates, similar symptom improving, and minimal adverse effects were achieved. Though amoxicillin had a little increased rate of clinical improvement and quicker fever healing, the differences were not statistically significant meaning that both antibiotics can be deemed equal in most uncomplicated instances of CAP in children. The success of randomization in removing the baseline confounding was proven since the demographic distribution of both groups was nearly similar. The average age of the study members was around six years, which is the age group that is regularly impacted by the pneumonia community-acquired in children. The most common presenting symptoms were fever and cough accompanied by tachypnea and radiographic infiltrates subsequently which is in line with the common clinical presentation of pediatric lower respiratory tract infections. These results help to strengthen the external validity of the research and prove that the sample of the study was representative of real-life pediatric CAP cases.[14]

Over 90% of patients in the amoxicillin group and almost 88% of the patients in the azithromycin group responded to clinical cure. The difference though numerically larger with amoxicillin was not statistically significant. This finding corroborates the literature that both b-lactam and macrolide are highly effective in treating uncomplicated pneumonia in case the pathogen is vulnerable and treatment commences early. The marginally improved effect of amoxicillin can be explained by its high bactericidal effect on the Streptococcus pneumoniae which is the most common bacterial agent that causes CAP in the children.[15] Conversely, azithromycin which is mainly bacteriostatic relies on host immune systems in clearing the bacteria hence its relatively slower response rate. Side effects of the drugs used were also rare, mild and self-limiting in the two groups. Abdominal discomfort, diarrhea, and nausea were the most frequently reported. There were no serious allergic reactions, hepatic dysfunction or hospitalizations related to the treatment. This establishes the positive safety profiles of both medications in the children population.[16]

Notably, the frequency of adverse events did not differ significantly between the two groups, indicating that both the antibiotics are well tolerated provided they are administered within the recommended doses. With respect to hospital stay, patients under amoxicillin were discharged a little bit sooner than patients under azithromycin but the distinction was statistically irrelevant.[17] The faster resolution of fever in the amoxicillin group may be associated with this trend, which resulted in clinical stability earlier. In both regimens, the vast majority of the patients were fully recovered, and the rates of relapse were low during the follow-up. These findings derived that each of the two antibiotics may be used successfully based on clinical factors, patient preference and local resistance trends.[18-20] This study finding is in accordance with the overall literature of the pediatric CAP research which usually indicates the absence of significant difference in the cure rate between the b-lactam and the macrolide monotherapy as applied to typical bacterial pneumonia.[21]

Nonetheless, amoxicillin is still widely recommended as a first-line therapy in most international guidelines because it is highly effective against pneumococci, inexpensive and has a limited antibacterial spectrum coupled with providing advantages in antibiotic stewardship. Although as effective in mild cases, azithromycin should preferably be used in cases suspected in mycoplasma pneumoniae or chlamydophila pneumoniae infection, or where the patient is allergic to penicillin. Macrolides are prone to resistance when overused when their prevalence is low, which will compromise its use in the future.[22,23]

**Limitations:** However, certain limitations should be acknowledged. The study was conducted at a single center, which may limit the generalizability of results to other populations or regions with different bacterial resistance patterns. Microbiological confirmation of causative organisms was not performed due to resource constraints, and the diagnosis of CAP relied on clinical and radiological findings, which might have included some viral cases. Additionally, the short follow-up duration precluded assessment of late relapses or long-term resistance trends. Despite these limitations, the results remain valuable for guiding empiric therapy decisions in similar clinical settings.

## CONCLUSION

Both amoxicillin and azithromycin are highly effective and well-tolerated antibiotics in the management of pediatric community-acquired pneumonia. The clinical cure rates, symptomatic relief, and laboratory improvements were comparable between the two groups, with no statistically significant differences in treatment outcomes or adverse events. However, children treated with amoxicillin demonstrated slightly faster fever resolution, greater reduction in inflammatory markers, and shorter hospital stays, suggesting a modest clinical advantage.

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