Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 13, (2024)
https://www.jneonatalsurg.com

OPEN ACCESS

Comparative Efficacy of Amoxicillin vs. Azithromycin in the Treatment of Community-Acquired Pneumonia

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Cite this paper as: Saleh Saadat Afridi, Abdul Moiz Bhatti, Fahad Aman Khan, Said Malook, Imran Khan, Salman Khan, (2024) Comparative Efficacy of Amoxicillin vs. Azithromycin in the Treatment of Community-Acquired Pneumonia. *Journal of Neonatal Surgery*, 13, 469-474.

ABSTRACT

Background: Globally, community-acquired pneumonia (CAP) ranks high among the leading causes of death and disability. Antibiotics should be started as soon as possible. Although there is a growing availability of different pharmacological alternatives for CAP, there is sometimes insufficient information to directly compare the effectiveness of these treatments.

Objective: The primary goal of this research is to compare the effectiveness of azithromycin and amoxicillin in treating pneumonia in children.

Materials and Methods: In all, 152 individuals were found to be suffering from pneumonia. The patients were split into two categories. Six days of amoxicillin at 50 mg/kg/day, split into three doses, is administered to patients in group I. The dosage of azithromycin for patients in group II is 10 mg/kg on day one, followed by 5 mg/kg daily for four days. On days 2, 4, and 6, we looked for signs of improvement in overall health, such as a drop in temperature, less respiratory symptoms, and no longer feeling sick.

Results: There were majority males in both groups. Mean age of the cases in group I was 5.13±4.19 years and in group II mean age was 6.9±4.12 years.In terms of clinical improvement rates by Day 6, 92.1% for amoxicillin and 85.5% for azithromycin ($p = 0.51$) and radiographic recovery rates by Day 6, 68 (89.5%) for amoxicillin and 64 (84.1%) for azithromycin ($p = 0.40$), no statistically significant differences were found.

Conclusion: We found no statistically significant differences between amoxicillin and azithromycin in terms of clinical outcomes, microbiological eradication, or side effects; therefore, both antibiotics are safe and effective in treating pediatric community-acquired pneumonia.

Keywords: *Amoxicillin, azithromycin, Pediatric Pneumonia, Community-acquired pneumonia*

1. INTRODUCTION

There is a significant incidence of disease and mortality due to community-acquired pneumonia (CAP), an infection of the lower respiratory tract that is widespread. The World Health Organization reports that about three million people lose their lives each year to CAP.[1,2] The mortality rate for hospitalized patients ranges from around 6% to 20%, depending on the disease severity and treatment circumstances. A significant rate of antibiotic resistance among Streptococcus pneumoniae has increased the frequency of CAP-related hospitalizations and complicated the management of this disease [3].

According to the Infectious Disease Society of America (IDSA), in 2019, patients hospitalized with CAP are strongly encouraged to seek combination therapy. Monotherapy of fluoroquinolones or beta-lactams with macrolides is the standard treatment for mild to moderate inpatient CAP; a combination of these two medications is suggested for severe cases.[4,5] Due to the increasing pattern of resistance among CAP infections, several trials have demonstrated that combination therapies, rather than monotherapy, are superior in individuals with severe CAP. Efficacy of fluoroquinolone, beta-lactam, and macrolide combinations has been the subject of several research, some of which have also investigated these three methods separately [7]. The question of whether combination treatment is optimal remains unanswered, though. Intracellular azithromycin concentrations are 10- to 100-fold higher than serum values, and they frequently exceed minimum inhibitory concentrations (MICs) for a number of common respiratory infections [8].Due to the antibiotic's accumulation among phagocytes, which release it upon exposure to bacteria, prolonged tissue and intracellular concentrations of azithromycin can be achieved for up to four days after a prescription. [5-8]This makes azithromycin more convenient to take and leads to shorter treatment durations in comparison to other antibiotics, including other commercially available macrolides. The role of azithromycin in treating community-acquired infections of the lower respiratory tract is still unclear, despite the drug's many advantages. Its high price tag, which exceeds that of most antibiotics used in public health settings, is one possible downside that might reduce its utilization.

When compared to competing medications, the spectrum of effects exhibited by the macrolide antibiotic azithromycin is far broader. Chlamydophilapneumoniae and Mycoplasma pneumoniae are unusual infections that are being recognized as significant causes of pediatric CAP; it is effective against these illnesses. The shorter treatment duration and easiness of azithromycin's once-daily dosing can improve compliance, especially in younger patients [9].The public health and clinical components of children's community-acquired pneumonia (CAP) are closely related, and the healthcare systems are greatly affected by the disease's prevalence and the seriousness of its effects. Picking the right antibiotic treatment is critical for CAP management, complication prevention, and antibiotic resistance control. Two antibiotics that are often recommended to children with CAP are examined in this study for their efficacy in treating the condition. Amoxicillin and azithromycin are the meds that are being discussed. By disrupting the development of the bacterial cell wall, amoxicillin, an antibiotic from the β-lactam class, leads to cell lysis and ultimately death. Streptococcus pneumoniae is the most common bacterium that causes bacterial pneumonia in children, making it an excellent first-line treatment [11].

A clinical investigation was carried out on individuals with severe CAP class IV using the Pneumonia Severity Index (PSI). The results demonstrated that beta-lactam combination treatment with macrolides was more successful than beta-lactam monotherapy. Another difference between combination and monotherapy patients was the time it took for them to reach clinical stabilization.[12] Compared to ciprofloxacin alone, a combination of beta-lactam and macrolide was more efficacious in another cohort study included CAP patients with PSI class V. Multiple observational studies have shown that combining beta-lactam and macrolide antibiotics at the outset of treatment may reduce mortality and hospital stays.[12,13] Amoxicillin is a great choice for pediatric therapy due to its reasonable price and good safety profile. The emergence of resistant bacterial strains, however, poses a danger to its continuous efficacy, therefore constant surveillance and assessment are necessary [8].Azithromycin, on the other hand, is a macrolide antibiotic that blocks protein synthesis in bacteria by binding to the 50S ribosomal subunit. Mycoplasma pneumoniae and Chlamydophilapneumoniae are atypical pathogens that are being detected more and more in instances of pediatric pneumonia, and it is particularly effective against these infections [9]. Due to its pharmacokinetic properties, such as a longer half-life and higher tissue penetration, azithromycin can be recommended with a once-daily dosage and shorter treatment durations to promote adherence in young patients.Due to their distinct action methods and activity spectra, there are significant benefits and downsides to utilizing both antibiotics, despite the fact that they are effective [10]. Because of its extended tissue concentration and broad spectral range, azithromycin may be more prone to produce resistance than amoxicillin. In contrast, young patients' adherence to treatment is crucial to its success, and azithromycin's flexible dosing schedule can help with that [14].

This study primarily aims to assess the efficacy of azithromycin and amoxicillin in treating pediatric pneumonia.

2. MATERIALS AND METHOD

The study was conducted in Khyber Teaching Hospital, Peshawar from June 2022 to August 2023. In this comparative study 152 patients were presented.Age of the cases between 1 year-14 years, clinical diagnosis of CAP (fever, cough, tachypnea, and abnormal lung findings), radiographic confirmation of pneumonia.

This study did not include patients who had the following conditions: a known allergy to β-lactam or macrolide antibiotics; a recent hospital stay (within the last 30 days); chronic pulmonary diseases (such as cystic fibrosis or bronchiectasis); an immunocompromised state or the use of immunosuppressive therapy; a history of recent antibiotic use (within the last two weeks); or a severe case of CAP necessitating fast hospitalization.

Standardized forms and electronic medical records are used to gather and manage data on patient demographics, clinical presentations, treatment adherence, and results. There are two therapy groups to which patients are randomly assigned: Amoxicillin is in Group I. Azthromycin is in Group II. A course of amoxicillin treatment lasts six days and consists of three doses of 50 mg/kg/day. On day one, patients take 10 mg/kg of azithromycin; for the subsequent four days, they take 5 mg/kg

daily. On days 2, 4, and 6 of therapy, the goal is to see if the temperature goes down, the respiratory symptoms go down, and how you feel overall improves. Subsequent sputum cultures or nasopharyngeal swabs were used to ascertain microbial eradication rates. Throughout the course of therapy, we tracked any adverse effects. There was also a comparison of the rates of hospitalization after therapy started. To assess the safety and effectiveness of the two therapy groups, statistical analyses are carried out using SPSS v25. To be deemed statistically significant, a p-value must be less than 0.05.

3. RESULTS

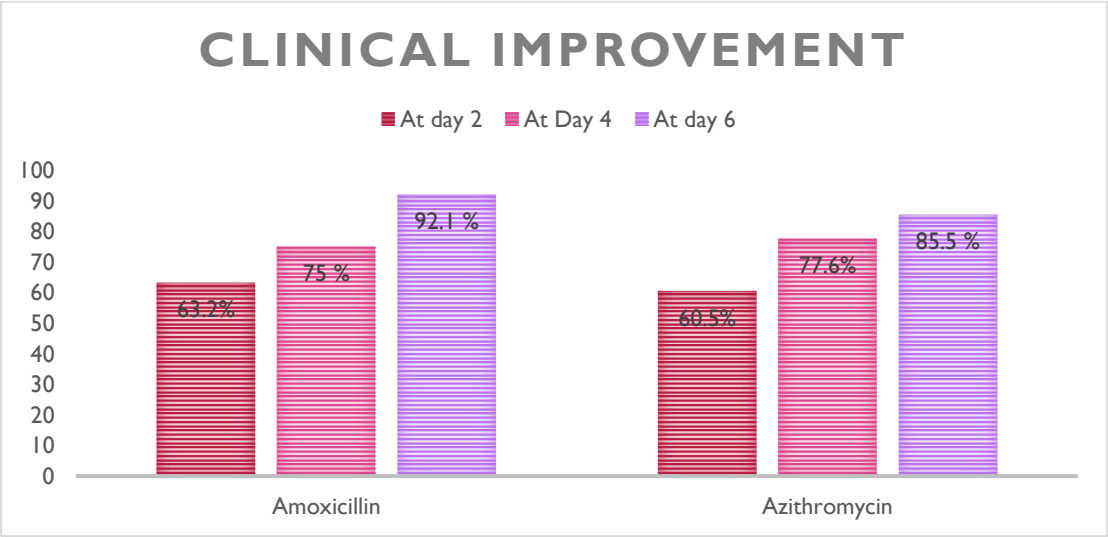
There were majority males in both groups. Mean age of the cases in group I was 5.13±4.19 years and in group II mean age was 6.9±4.12 years. Mean severity score in group I was 2.9±3.10 and in group II was 3.5±1.6. Most common symptoms among both groups were fever, chest pain, cough, shortness of breath, lung infection and consolidation (physically).(table 1)

Table-1: Demographics of the enrolled cases

Variables	Group I (76)	Group II (76)
Gender		
Male	44 (57.9%)	47 (61.8%)
Female	32 (42.1%)	29 (38.2%)
Mean age (years)	5.13±4.19	6.9±4.12
Mean severity score	2.9±3.10	3.5±1.6
Signs and symptoms		
fever	27 (35.5%)	16 (21.1%)
chest pain	20 (26.3%)	11 (14.5%)
cough	11 (14.5%)	14 (18.4%)
shortness of breath	10 (13.2%)	20 (26.3%)
lung infection	5 (6.6%)	10 (13.2%)
consolidation	3 (3.9%)	5 (6.6%)

We observed at day 2, 48 (63.2%) cases were improved in group I and 46 (60.5%) cases showed improvement in group II. At day 4, 57 (75%) in group I and 59 (77.6%) in group II showed good results. In terms of clinical improvement rates by Day 6, 92.1% for amoxicillin and 85.5% for azithromycin (p = 0.51).(figure 1)

Figure-1: Comparison of clinical improvements in both groups



The radiographic recovery rates by Day 6, 68 (89.5%) for amoxicillin and 64 (84.1%) for azithromycin (p = 0.40), no

statistically significant differences were found. There were also no any significant difference was observed between microbial eradication rates among both groups.(table 2).

Table-2: Comparison of radiographic recovery and eradication rates

Variables	Group I (76)	Group II (76)
Radiographic recovery		
Yes	68 (89.5%)	64 (84.1%)
No	8 (10.5%)	12 (15.9%)
Eradication		
Yes	65 (85.5%)	63 (82.9%)
No	11 (14.5%)	13 (17.1%)

Frequency of adverse effects in group I was 9 (11.8%) and in group II found in 7 (9.2%) cases. There was no any significant difference was observed in hospitalization of cases between both groups. Satisfaction rate among both groups were 70 (92.1%) and 67 (88.2%) in all cases.(table 3).

Table-3: Comparison of adverse events, hospital stay and satisfaction rate among both groups

Variables	Group I (76)	Group II (76)
Adverse events		
Yes	9 (11.8%)	7 (9.2%)
No	67 (88.2%)	69 (90.8%)
Hospitalization		
Yes	3 (3.9%)	4 (5.3%)
No	73 (96.1%)	72 (94.7%)
Satisfaction Rate		
Yes	70 (92.1%)	67 (88.2%)
No	6 (7.9%)	9 (11.8%)

4. DISCUSSION

There were no statistically significant differences between the two antibiotics in terms of clinical efficacy, radiographic clarity, microbial clearance, side effects, hospitalization rates, or adherence, suggesting that both are effective. By Day 6, both groups of patients treated with amoxicillin and azithromycin had significantly improved clinically, suggesting that the antibiotics are effective in alleviating CAP symptoms [15]. On Day 6, there were no statistically significant differences between the two antibiotics in terms of radiographic recovery rates: 68.5% for amoxicillin and 64.1% for azithromycin ($p = 0.40$). Since there is no discernible difference between the two antibiotics, either one can be used as a first line of defense against pediatric CAP[16].

In support of our findings that gatifloxacin had a 91% clinical success rate and clarithromycin-ceftriaxone has a 97% rate, we found results from a prospective study comparing the two drugs (n=99 and 106 participants, respectively).[17] A multicenter trial comparing moxifloxacin monotherapy (n=233) to clarithromycin-amoxicillin (n=134) found a high clinical success rate of 93.6% and 93.7%, respectively, 7 to 10 days after treatment ended. The vast majority of the patients who participated in that study (84%), with a class-a PSI score of I, II, or III.[18] in Antibiotics with a combination of a macrolide and beta-lactam were found to reduce 14 and 30-day mortality rates compared to fluroquinolone alone, suggesting that patients with a higher PSI score may benefit from a stronger therapy. Possible explanation for the high rate of clinical success.[19]

Several studies have looked at the clinical outcomes and effects on hospitalization when combinations of beta-lactam and

macrolide are used. Hospitalized individuals who took a macrolide antibiotic like erythromycin, clarithromycin, or azithromycin had better clinical results and spent less time in the hospital, according to these research.[20]With the addition of clarithromycin or erythromycin to either of the beta-lactams, a recent open-label randomized study compared ceftriaxone to ampicillin-sulbactam in patients with CAP. Day 7 efficacy rates in the ampicillin-sulbactam group were considerably higher than those in the ceftriaxone group in the validated per-protocol population ($p = 0.047$).[21] Combination treatment was preferable for several reasons. Two drugs with different modes of action can be used in combination treatment to target various aspects of bacterial metabolism; for instance, a beta-lactam that blocks the production of cell walls and a macrolide that blocks the production of proteins. Moreover, macrolides have anti-inflammatory effect by lowering the production of interleukin-8 and tumor necrosis factor-alpha, and they decrease the adherence of S. pneumoniae to respiratory epithelial cells.[22,23]

Other considerations, such as the specific pathogen (both suspected and verified), the patient's allergy history, and local resistance trends, may therefore influence the decision between amoxicillin and azithromycin. The two antibiotics azithromycin and amoxicillin had similar rates of moderate side effects, with 11.8% and 9.2% of patients reporting them, respectively, as described in the literature [24]. No statistically significant difference in the occurrence of side effects ($p = 0.64$), which were mostly gastrointestinal in nature and included symptoms including nausea and diarrhea, was seen between the two groups. This discovery emphasizes the safety profile of both antibiotics in the juvenile population, which is significant for therapeutic decision-making [25]. Both groups had relatively low rates of hospitalization following therapy beginning. Supporting their use as first-line therapies for outpatient therapy of pediatric CAP, this suggests that both antibiotics are helpful in avoiding illness development that would need hospitalization [26].

In clinical practice, this may be something to think about because it is so important to make sure patients follow their treatment plans. Numerous consequences for clinical practice stem from this study's findings [27,28]. Because amoxicillin and azithromycin have similar safety and effectiveness characteristics, the antibiotic that is prescribed to a patient depends on their unique circumstances as well as regional epidemiological statistics. When Streptococcus pneumoniae is the main infection, amoxicillin may be the best choice, but azithromycin could be the better choice when atypical infections are detected or when individuals have a history of β-lactam allergy.

5. CONCLUSION

We found no statistically significant differences between amoxicillin and azithromycin in terms of clinical outcomes, microbiological eradication, or side effects; therefore, both antibiotics are safe and effective in treating pediatric community-acquired pneumonia.

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