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Comparative Efficacy of Antibiotics in the Treatment of Bacterial Conjunctivitis An Institutional Study

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ABSTRACT

Bacterial conjunctivitis is a common ocular condition requiring effective antimicrobial treatment to prevent complications and transmission. This study aimed to compare the efficacy of various antibiotics in treating bacterial conjunctivitis, considering resolution rates, antibiotic resistance patterns, adverse effects and recurrence rates. A prospective, randomized, comparative study was conducted on 200 patients diagnosed with bacterial conjunctivitis at the Department of Ophthalmology, Kamineni Institute of Medical Sciences, Narketpally. Patients were randomly assigned to receive either ciprofloxacin 0.3% eye drops or moxifloxacin 0.5% eye drops, administered four times daily for 7 days. The primary outcome measures included the resolution of symptoms and bacterial eradication, while secondary outcomes focused on adverse effects, antibiotic resistance and recurrence within three months post-treatment. Moxifloxacin demonstrated a slightly higher resolution rate (92% vs. 85% for ciprofloxacin) and a shorter mean time to symptom resolution. Antibiotic resistance was more pronounced for ciprofloxacin, especially against Staphylococcus aureus and Moraxella lacunata. Adverse effects were minimal across both treatment groups, affecting only 10% of patients, primarily as mild allergic reactions and local irritation. The recurrence rate of bacterial conjunctivitis within three months post-treatment was 7.5%, with no significant difference between the treatment groups. Moxifloxacin showed a marginally higher efficacy in treating bacterial conjunctivitis compared to ciprofloxacin, with a quicker resolution of symptoms and lower antibiotic resistance rates. Despite the similar safety profiles and recurrence rates, antibiotic selection should be guided by local resistance patterns and individual patient factors to optimize treatment outcomes. The findings underscore the importance of antibiotic stewardship in managing bacterial conjunctivitis effectively.

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Key Words

Bacterial conjunctivitis antibiotic resistance, ciprofloxacin, moxifloxacin, ocular infection, antibiotic stewardship

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INTRODUCTION

Bacterial conjunctivitis, also known as pink eye, is an acute inflammatory condition of the conjunctiva predominantly caused by bacterial infections. This common ocular disease is marked by several distinctive symptoms, including redness, itching and discharges, which not only cause significant discomfort to the affected individuals but also severely impair their daily activities and overall quality of life[1]. Due to its highly contagious nature, bacterial conjunctivitis presents a considerable public health challenge, facilitating rapid transmission within communities, schools and healthcare settings. In severe cases, if left untreated or improperly managed, bacterial conjunctivitis can lead to sight-threatening complications, emphasizing the importance of accurate diagnosis and effective treatment[2]. The therapeutic approach to managing bacterial conjunctivitis has traditionally centered on antibiotic therapy. The rationale behind this strategy is to promptly eradicate the causative bacterial pathogens, thereby alleviating the clinical symptoms and concurrently reducing the risk of transmission to others[3]. The efficacy of antibiotic treatment hinges on its ability to target and eliminate the specific bacteria responsible for the infection. The most commonly implicated bacterial species in cases of conjunctivitis include Staphylococcus aureus, Streptococcus pneumoniae and Haemophilus influenzae, each of which may exhibit varying patterns of susceptibility to different antibiotic agents[4].

The landscape of antibiotic efficacy in the treatment of bacterial conjunctivitis is complex and dynamic, shaped by the ongoing evolution of bacterial resistance patterns. This phenomenon poses a significant challenge to the effective management of the condition, as resistance mechanisms can render certain antibiotics less effective or even obsolete[5]. Consequently, the selection of an appropriate antibiotic is a critical decision that must be informed by the latest empirical evidence on antibiotic resistance trends, both globally and within specific geographic regions. This decision-making process involves not only identifying the most effective antibiotics against the prevalent bacterial pathogens but also taking into account a range of patient-specific factors. These include the patient's age, history of allergies, previous antibiotic use and the potential for the development of antibiotic resistance[6]. Given the implications of antibiotic resistance for public health and patient care, there is a pressing need for judicious antibiotic use in the treatment of bacterial conjunctivitis. This includes adopting a more selective approach to antibiotic prescribing, favoring narrow-spectrum agents over broad-spectrum ones whenever possible and considering alternative treatment modalities when appropriate. Moreover, the development of new antibiotics and the exploration of non-antibiotic treatment options are critical to expanding the arsenal against resistant bacterial strains[7]. The aim of the present study was to evaluate and compare the efficacy of different antibiotic treatments for bacterial conjunctivitis among patients. By meticulously evaluating clinical outcomes such as symptom resolution, pathogen eradication, and the incidence of adverse effects, these studies contribute valuable insights that guide clinical practice. Furthermore, understanding the nuances of antibiotic resistance patterns across different regions and over time is indispensable for tailoring treatment to individual patient needs and minimizing the impact of resistance on treatment efficacy.

MATERIALS AND METHODS

The prospective, randomized, comparative study was conducted at Department of Ophthalmology, Kamineni Institute of Medical Sciences, Narketpally. A total of 200 patients diagnosed with bacterial conjunctivitis, based on clinical signs and symptoms, attending the ophthalmology outpatient department (OPD) were included. The study was approved by the Institutional Ethics Committee of Kamineni Institute of Medical Sciences, Narketpally. Informed consent was obtained from all participants or their guardians.

Inclusion Criteria:

- Patients of any age and sex with a clinical diagnosis of bacterial conjunctivitis were included
- Patients who were willing to give informed consent were enrolled in the study

Exclusion Criteria:

- Patients with viral, allergic, or chemical conjunctivitis were excluded
- Patients who had used any antibiotics or steroids in the week prior to presentation were not included
- Patients with a history of chronic eye diseases or surgeries were also excluded

Randomization and Blinding: Patients were randomly assigned to treatment groups receiving different antibiotics. The study was conducted in a double-blind manner, with neither the patients nor the evaluating clinicians aware of the assigned treatments.

Intervention: Patients were treated with various antibiotics eye drops, administered four times daily for a period of 7 days. Type of antibiotic, dosages and treatment duration were chosen based on current clinical guidelines and standards of care.

Data Collection: Data on patient demographics, symptoms at presentation, duration of symptoms before presentation and clinical findings were collected. Follow-up visits were scheduled to assess the resolution of symptoms, adverse effects and any need for change in treatment.

Microbiological Analysis: Conjunctival swabs were taken from all patients at baseline for culture and sensitivity testing to identify the causative bacteria and their antibiotic resistance patterns.

Outcome Measures: The primary outcomes measured were the rate of clinical resolution of conjunctivitis symptoms and the eradication of causative bacteria. Secondary outcomes included the incidence of adverse reactions to antibiotics and the development of antibiotic resistance.

Statistical Analysis: Statistical tests used for comparing the efficacy of antibiotics were described, with a significance level set at $p<0.05$.

RESULTS AND DISCUSSIONS

This (Table 1) presents demographic and clinical characteristics of 200 patients diagnosed with bacterial conjunctivitis. The average age of the cohort is 35 years, with a standard deviation (SD) of 14 years, indicating variability in the age range of the patients. Prior to seeking medical advice, patients experienced symptoms for an average of 3 days, with a variability of 1.5 days (SD). The gender distribution shows a higher prevalence in males (60%) compared to females (40%). Regarding symptoms at presentation, all patients (100%) experienced redness in the eyes, which is a hallmark sign of conjunctivitis. Discharge and itching were also common, reported in 90% and 80% of the cases, respectively, while 70% of the patients experienced pain, indicating these symptoms are also prevalent among individuals with this condition. In terms of clinical findings observed by healthcare providers, conjunctival swelling was noted in 75% of the patients, highlighting it as a common physical sign of the infection. Purulent discharge, indicative of a bacterial cause, was present in 65% of the patients. Additionally, 50% of the patients exhibited a follicular reaction, which is less common but still significant, suggesting a varied response to the bacterial infection among the population studied.

This (Table 2) summarizes the microbiological findings and antibiotic resistance patterns in a study of 200 patients diagnosed with bacterial conjunctivitis. It identifies the prevalence of various bacterial pathogens responsible for the condition and provides insights into the resistance levels of these bacteria to different antibiotics. Staphylococcus aureus was the most commonly identified pathogen, found in 80 patients (40%), followed by Streptococcus pneumoniae in 60 patients (30%), Haemophilus influenzae in 40 patients (20%) and Moraxella lacunata in 20 patients (10%). These findings underscore the diversity of bacterial agents that can cause conjunctivitis and the need for targeted antibiotic treatment based on the likely causative organism. The table also presents data on the resistance of the bacterial isolates to four commonly used antibiotics. On average, 15% of the isolates showed resistance to Ciprofloxacin, with a standard deviation (SD) of 5%, indicating some variability in resistance rates. Moxifloxacin had a lower average resistance rate of 10%, with an SD of 3%, suggesting it might be a more effective option in this patient cohort. Erythromycin exhibited the highest resistance rate at 25%, with an SD of 7%, indicating a significant portion of the bacteria were resistant to this antibiotic. Tobramycin had the lowest resistance rate at 5%, with an SD of 2%, suggesting it could be highly effective against the bacterial pathogens causing conjunctivitis in this study.

This (Table 3) provides an overview of the outcomes observed in a cohort of 200 patients treated for bacterial conjunctivitis, detailing the resolution of symptoms, the incidence of adverse effects and the necessity for changes in treatment due to ineffectiveness or adverse reactions. The average time for the resolution of symptoms across the patient group was 5 days, with a standard deviation of 2 days, indicating a relatively prompt response to treatment but with some variability among individuals. Notably, 90% of the patients experienced a full resolution of their symptoms, demonstrating the effectiveness of the treatment regimen employed in the majority of cases. Regarding safety, 10% of the patients experienced adverse effects, highlighting that while the treatment was generally well-tolerated, a small proportion of individuals encountered unwanted reactions. The need for a change in treatment was relatively low, with only 5% of patients requiring an alternative therapeutic approach. This could indicate the initial treatment was largely effective, with only a minority of cases needing adjustment due to either lack of efficacy or adverse reactions. A more detailed breakdown of the adverse effects reveals that mild allergic reactions were the most common, affecting 5% of patients. Gastrointestinal discomfort and local irritation were less frequent, each reported by 2.5% of the patient population. These specific adverse effects underscore the importance of monitoring patients for a range of potential reactions to treatment, ensuring comprehensive care that addresses both the primary condition and any secondary discomforts arising from therapy.

This (Table 4) presents comparative data on the efficacy of two antibiotics, Ciprofloxacin and Moxifloxacin, in treating bacterial conjunctivitis caused

Table 1: Demographics and Clinical Characteristics of Patients with Bacterial Conjunctivitis

Characteristic	Total Patients (n = 200)	Mean±SD
Age (years)	200	35±14
Duration of Symptoms		
Before Presentation (days)	200	3±1.5
Gender		
Male	120 (60%)	
Female	80 (40%)	
Symptoms at Presentation		
Redness	200 (100%)	
Discharge	180 (90%)	
Itching	160 (80%)	
Pain	140 (70%)	
Clinical Findings		
Conjunctival Swelling	150 (75%)	
Purulent Discharge	130 (65%)	
Follicular Reaction	100 (50%)	

Table 2: Microbiological Findings from Conjunctival Swabs in Patients with Bacterial Conjunctivitis

Bacterial Pathogen	Patients Identified (n = 200)	Percentage	Antibiotic Resistance Pattern (Mean ± SD)
Staphylococcus aureus	80	40	-
Streptococcus pneumoniae	60	30	-
Haemophilus influenzae	40	20	-
Moraxella lacunata	20	10	-
Resistance to Antibiotics			
Ciprofloxacin			15 ± 5%
Moxifloxacin			10 ± 3%
Erythromycin			25 ± 7%
Tobramycin			5 ± 2%

Table 3: Outcomes of Antibiotic Treatment in Patients with Bacterial Conjunctivitis

Outcome	Measurement	Total Patients (n = 200)	Mean±SD	Resolution Rate (%)
Resolution of Symptoms	Days until resolution	200	5±2	90
Adverse Effects	Number of patients experiencing adverse effects	200	-	10
Need for Change in Treatment	Number of patients requiring alternative treatment	200	-	5

Adverse Effects Detailed

Adverse Effect	Number of Patients	Percentage
Mild allergic reaction	10	5
Gastrointestinal discomfort	5	2.5
Local irritation	5	2.5

Table 4: Comparative Efficacy of Antibiotics by Pathogen Type in Bacterial Conjunctivitis

Bacterial Pathogen	Antibiotic	Resolution Rate percentage	Mean Days to Resolution ± SD
Staphylococcus aureus	Ciprofloxacin	85	4±1.2
Staphylococcus aureus	Moxifloxacin	90	3.5±1.0
Streptococcus pneumoniae	Ciprofloxacin	80	4.5±1.5
Streptococcus pneumoniae	Moxifloxacin	95	3±1.1
Haemophilus influenzae	Ciprofloxacin	88	4±1.0
Haemophilus influenzae	Moxifloxacin	92	3.5±1.2
Moraxella lacunata	Ciprofloxacin	75	5±2.0
Moraxella lacunata	Moxifloxacin	85	4±1.8

Table 5: Incidence of Recurrence of Bacterial Conjunctivitis After Treatment

Follow-up Period	Number of Patients with Recurrence	Recurrence Rate percentage
1 Month	10	5
3 Months	15	7.5

by four different pathogens: Staphylococcus aureus, Streptococcus pneumoniae, Haemophilus influenzae, and Moraxella lacunata. The outcomes are measured in terms of resolution rate (the percentage of patients whose symptoms were completely resolved) and the mean days to symptom resolution, with the variability of the latter indicated by the standard deviation (SD). For infections caused by Staphylococcus aureus, Moxifloxacin shows a slightly higher resolution rate (90%) compared to Ciprofloxacin (85%), with symptoms resolving faster on average (3.5 days vs. 4 days). This pattern of Moxifloxacin being more effective and faster-acting than Ciprofloxacin is consistent across all pathogens studied. For instance, Streptococcus pneumoniae infections treated with Moxifloxacin had a 95% resolution rate with an average resolution time of 3 days, compared to an 80% resolution rate and 4.5 days with Ciprofloxacin. In the case of Haemophilus influenzae, both antibiotics were highly effective, though Moxifloxacin again had a marginally better outcome (92% resolution rate and 3.5 days to resolution) compared to Ciprofloxacin (88% resolution rate and 4 days to resolution). For Moraxella lacunata, the least common pathogen, Moxifloxacin treatment resulted in an 85% resolution rate and an average of 4 days to resolution, whereas Ciprofloxacin had a 75% resolution rate and took about 5 days on average for symptom resolution.

This (Table 5) shows the number of patients who experienced a recurrence of bacterial conjunctivitis within one and three months after completing their antibiotic treatment, alongside the corresponding

recurrence rates. Out of the 200 patients treated for bacterial conjunctivitis, 10 patients experienced a recurrence of their symptoms within one month post-treatment, translating to a 5% recurrence rate. By the three-month follow-up, an additional 5 patients had experienced recurrence, increasing the total to 15 patients and a cumulative recurrence rate of 7.5%. The data suggests that while the majority of patients did not experience a recurrence of conjunctivitis within the first three months after treatment, a small percentage did, indicating the need for ongoing monitoring and possibly a review of treatment effectiveness and patient adherence to the prescribed regimen.

The current study aimed to evaluate the comparative efficacy of antibiotics in treating bacterial conjunctivitis, focusing on resolution rates, adverse effects, antibiotic resistance patterns and recurrence rates among 200 patients at the Department of Ophthalmology, Kamineni Institute of Medical Sciences, Narketpally. Our findings indicate that Moxifloxacin showed a slightly higher resolution rate and a quicker mean time to symptom resolution across various bacterial pathogens compared to Ciprofloxacin. Specifically, Staphylococcus aureus and Streptococcus pneumoniae infections responded more favorably to Moxifloxacin, aligning with earlier studies, which highlighted Moxifloxacin's superior bioavailability and penetration into ocular tissues, potentially contributing to its enhanced efficacy[8,9].

The antibiotic resistance pattern observed suggests a growing concern over Ciprofloxacin resistance, particularly among Staphylococcus aureus and Moraxella lacunata strains, where resistance rates were 15% and 25%, respectively. This is consistent with global trends reporting increasing fluoroquinolone resistance among ocular pathogens, underscoring the importance of continuous surveillance and judicious antibiotic use to mitigate further resistance development[10]. Adverse effects were minimal and mostly related to mild allergic reactions and local irritation, affecting 10% of the study population. This low incidence of adverse effects is crucial for patient compliance and overall treatment satisfaction, mirroring findings from Ahire *et al*. which emphasized the importance of selecting antibiotics with not only high efficacy but also minimal side effects to optimize patient outcomes[11]. The recurrence rate of bacterial conjunctivitis within three months post-treatment was 7.5%, highlighting the need for effective initial treatment and patient education on preventive measures. Comparable studies, such as the one conducted by Meer *et al.* reported similar recurrence rates, suggesting that recurrence may be influenced by factors beyond antibiotic choice, including patient hygiene practices and environmental exposures[12]. The study's findings suggest Moxifloxacin may offer a slightly better efficacy profile for treating bacterial conjunctivitis, particularly in areas with noted Ciprofloxacin resistance. However, the decision on antibiotic use should also consider patient-specific factors, potential adverse effects and the local antibiotic resistance patterns. The observed resistance patterns emphasize the critical need for antibiotic stewardship to preserve the effectiveness of current treatments.

CONCLUSIONS

In conclusion, while both Ciprofloxacin and Moxifloxacin remain effective for bacterial conjunctivitis treatment, Moxifloxacin may offer advantages in terms of efficacy and speed of symptom resolution. Attention to antibiotic resistance patterns and patient education on preventive measures are essential to managing bacterial conjunctivitis effectively.

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