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Original Research Article

Infectious Keratitis Study: Update on Clinico-Microbiological Profile and Outcome of Infectious Keratitis

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Abstract:

This retrospective observational study conducted at Nalanda Medical College and Hospital, Patna, provides an updated clinical-microbiological profile and treatment outcomes of infectious keratitis from February 2020 to April 2023. Analyzing 450 cases, the study identified a high prevalence of bacterial infections, particularly *Staphylococcus aureus, Pseudomonas aeruginosa,* and *Streptococcus pneumoniae,* with significant resistance noted against fluoroquinolones. Fungal infections, predominantly caused by *Fusarium* species, were associated with worse visual outcomes and higher complication rates. The study highlights the necessity of tailored antimicrobial therapy based on precise microbial identification and resistance patterns to improve treatment efficacy and patient outcomes.

Keywords: Infectious Keratitis, Microbiological Profile, Antimicrobial Resistance, Treatment Outcomes.

Introduction

Infectious keratitis is a serious ocular condition characterized by the inflammation of the cornea due to microbial infections [1]. This condition can lead to significant visual impairment and, in severe cases, blindness if not promptly and effectively treated[2]. The pathogens responsible for infectious keratitis include bacteria, viruses, fungi, and parasites, each contributing differently based on geographical locations, environmental factors, and individual susceptibility [3].

Recent advances in microbiological techniques and a better understanding of ocular immunology have necessitated an updated review of the clinical-microbiological profiles associated with infectious keratitis[4]. This study aims to provide a comprehensive update on the microbial agents currently implicated in infectious keratitis, examining their patterns of antibiotic resistance, and detailing the clinical outcomes following various therapeutic interventions[5]. Through an examination of recent case studies and microbial surveillance reports, this research will also explore the evolving landscape of infectious keratitis. This includes shifts in pathogen prevalence due to changes in climate, antibiotic usage, and socio-economic factors. By integrating these findings with clinical outcomes, the study seeks to offer insights into more effective management strategies and preventative measures tailored to mitigate the burden of infectious keratitis globally [6,7].

Methodology

Study Design: This research was designed as a retrospective observational study to update the clinical-microbiological profile and outcomes of patients diagnosed with infectious keratitis.

Study Period: The data for this study were collected from records spanning February 2020 to April 2023.

Place of Study: The study was conducted at Nalanda Medical College and Hospital (NMCH), Patna, which serves as a major tertiary care center in the region.

Sample Size and Sampling Technique: The sample size was determined based on the number of recorded cases of infectious keratitis treated at

NMCH during the study period. A total of 450 cases were identified and included in the study. The cases were chosen through a purposive sampling technique, focusing on those with confirmed microbiological diagnosis to ensure that each case met the inclusion criteria for clinical and microbiological evaluation.

Data Collection: Data were extracted from medical records, including patient demographics, clinical presentation, laboratory results, and treatment outcomes. The following specific information was recorded:

- Demographics: Age, gender, occupation, and residential background.
- Clinical Data: Symptoms at presentation, duration of symptoms before presentation, visual acuity, and slit-lamp examination findings.
- Microbiological Data: Details of corneal scrapings, staining methods used, culture results, and sensitivity patterns.
- Treatment Data: Medications administered, duration of treatment, and any surgical interventions.
- Outcome Measures: Resolution of infection, improvement or deterioration of visual acuity, complications, and recurrence of keratitis.

Statistical Analysis: Descriptive statistics were used to summarize the data. Frequencies and percentages were calculated for categorical variables, and mean or median for continuous variables, depending on the distribution. The association between microbiological profiles and clinical outcomes was assessed using Chi-square tests for categorical variables and t-tests or Mann-Whitney U tests for continuous variables, as appropriate. All analyses were performed using SPSS version 25.

Results

The study included 450 patients diagnosed with infectious keratitis, with a nearly equal distribution of males (52%) and females (48%). The age range of the patients was from 18 to 85 years, with a median age of 47 years. The majority of patients were from rural areas (62%), which highlights a possible link between environmental exposure and infection rates.

Microbiological Profile

- **Bacterial Infections:** Bacterial pathogens were identified in 60% of the cases. The most common bacteria isolated were *Staphylococcus aureus* (22%), followed by *Pseudomonas aeruginosa* (18%) and *Streptococcus pneumoniae* (12%). Antibiotic sensitivity testing showed high resistance to fluoroquinolones but good sensitivity to fortified antibiotics like vancomycin and ceftazidime.
- **Fungal Infections:** Fungi were responsible for 30% of cases, predominantly caused by Fusarium species (50% of fungal cases), followed by *Aspergillus* (20%). Antifungal sensitivity testing indicated that natamycin was the most effective treatment, with some resistance observed to fluconazole.
- **Viral and Parasitic Infections:** Viral infections accounted for 8% of the cases, mainly due to herpes simplex virus. Acanthamoeba was identified in 2% of the cases, particularly challenging due to its mixed bacterial and amoebic infection nature.

Clinical Outcomes

- Resolution of Infection: Overall, 85% of patients showed complete resolution of infection after the initial treatment course.
- Visual Acuity: Improvement in visual acuity was noted in 70% of the patients at follow-up. However, 15% experienced a deterioration in vision, primarily those with fungal infections or with a delayed presentation to the hospital.
- Complications: Complications were observed in 20% of cases, including corneal scarring, perforation, and chronic eye pain.
- Recurrence: Recurrence of keratitis occurred in 5% of cases within six months after treatment completion, necessitating further intervention.

The relationship between microbial type and treatment outcome was statistically significant ($p < 0.05$), indicating that fungal infections were more likely to result in poorer outcomes compared to bacterial and viral infections.

There was also a significant association between late presentation and worsened visual outcomes ($p < 0.01$).

Table 1:

Variable	Total cases(n=450)	Details
Gender Distribution		Male: 52% (234)
		Female: 48% (216)
Age Range	18 to 85 years	Median Age: 47 years
Area of Residence		Rural: 62% (279)
		Urban: 38% (171)
Microbiological Profile		

Bacterial Infections	60% (270)	S. aureus (22%), P. aeruginosa (18%), S. pneumoniae (12%)
Fungal Infections	30% (135)	Fusarium spp. (50% of fungal), Aspergillus spp. (20% of fungal)
Viral Infections	8% (36)	Mostly herpes simplex virus
Parasitic Infections	2% (9)	Acanthamoeba
Outcomes		
Resolution of Infection	85% (383)	Complete resolution after initial treatment
Visual Acuity Improvement	70% (315)	Improved at follow-up
Visual Acuity Deterioration	15% (67)	Primarily in fungal cases or delayed presentation
Complications	20% (90)	Corneal scarring, perforation, chronic eye pain
Recurrence	5% (22)	Within six months post-treatment
Statistical Significance		Microbial type vs. outcome: $p < 0.05$
		Late presentation vs. visual outcome: $p < 0.01$

This table provides a structured overview of the demographic, clinical, and microbiological findings, as well as the treatment outcomes, associated with the study of infectious keratitis at NMCH, Patna.

Discussion

The study on infectious keratitis at Nalanda Medical College and Hospital, Patna, revealed significant insights into the clinico-microbiological profile and outcomes associated with this condition. The findings have critical implications for the diagnosis, management, and prevention of infectious keratitis, particularly in settings similar to that of the study [8,9].

Bacterial infections were predominant, accounting for 60% of cases, with *Staphylococcus aureus, Pseudomonas aeruginosa*, and *Streptococcus pneumoniae* being the most common pathogens [10]. This aligns with global trends where these organisms are frequently implicated in corneal infections due to their aggressive nature and ability to form biofilms. The high incidence of bacterial keratitis underscores the need for effective antibacterial strategies and highlights the importance of rapid and accurate microbial identification to guide therapy [11,12]. Fungal keratitis was significant but less common, noted in 30% of the cases. The prevalence of fungal infections, particularly due to *Fusarium* species, is notable and reflects regional differences in keratitis etiology, possibly influenced by agricultural practices and climatic conditions that favor fungal growth [13,14]. The treatment challenges posed by fungal infections, evident from the 15% deterioration in visual acuity, call for heightened awareness and prompt management strategies. The study results indicated that while 85% of infections resolved with initial treatment, the outcomes varied significantly depending on the infectious agent [15]. Bacterial infections responded better to treatment compared to fungal infections, which were associated with poorer visual outcomes and higher complication rates. These findings suggest that earlier diagnosis and tailored antimicrobial therapy are crucial in improving outcomes [16,17].

The resistance patterns observed—particularly the resistance to fluoroquinolones among bacterial isolates—emphasize the need for ongoing surveillance of antimicrobial susceptibility to guide empirical therapy effectively. The effectiveness of fortified antibiotics like vancomycin and ceftazidime presents a case for their consideration in severe infections or cases not responding to standard treatment.

Given the high rate of complications and the potential for significant visual impairment, preventive strategies are critical. Public health efforts should focus on educating at-risk populations, particularly those in rural or agricultural settings, about the importance of wearing protective eyewear and seeking prompt treatment for ocular injuries or infections [18-20].

The study's retrospective nature may limit the completeness of data, particularly regarding the exact timing of the onset of symptoms and initial treatment. Future research should aim to include prospective data collection to capture more detailed clinical timelines and treatment responses. Additionally, exploring the genetic makeup of the microbial isolates could provide deeper insights into the pathogenic mechanisms and resistance patterns, potentially leading to more targeted therapies.

This study provides a comprehensive update on the clinical-microbiological profile and outcomes of infectious keratitis at a major tertiary care center in Patna, highlighting the need for targeted microbial therapies, rapid diagnostic techniques, and robust preventive measures to effectively manage and control this vision-threatening condition.

Conclusion

This comprehensive study of infectious keratitis at Nalanda Medical College and Hospital, Patna, underscores the predominance of bacterial pathogens, particularly *Staphylococcus aureus, Pseudomonas aeruginosa, and Streptococcus pneumoniae, w*hich collectively account for the majority of cases. The high incidence of bacterial infections necessitates prompt and effective antibacterial treatment strategies, tailored to resistance patterns. Fungal keratitis, although less common, poses significant treatment challenges, often leading to poorer outcomes. The findings emphasize the importance of rapid and precise microbial diagnosis, appropriate antimicrobial therapy, and preventive measures, especially in settings similar to the study location. These measures are critical in enhancing patient outcomes, reducing complications, and ultimately preserving vision in patients affected by infectious keratitis.

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