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Seasonal Variability and the Incidence of Corneal Ulcers: A Retrospective Cohort Study

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Abstract

Corneal ulcers are a significant global health concern, influenced by various factors including environmental conditions. Previous research has suggested a link between climatic variability and the prevalence of corneal ulcers, but few studies have explored the relationship comprehensively. The objective of the study is to assess the seasonal patterns of corneal ulcer cases and explore their correlation with climatic conditions, aiming to inform targeted preventive and management strategies. This retrospective cohort study analyzed 125 patient samples from Department of Opthalmology, Kamineni Institute of Medical Sciences, Narketpallywho were diagnosed with corneal ulcers over one year. Seasonal data were correlated with the incidence of corneal ulcers using Pearson's correlation coefficient. Diagnostic procedures included KOH mount, Gram stain and histopathology. The study involved 125 patients, with a mean age of 45.6 years (SD±15.2); 67% were male and 33% female, with 44% residing in rural areas and 56% in urban areas. Seasonal Incidence: Corneal ulcers were most frequent in summer (50 cases), followed by the rainy season (40 cases) and winter (35 cases).Diagnostic Findings: KOH mount detected fungal elements in 24% of cases, Gram stain detected bacteria in 40% and histopathology revealed cellular abnormalities in 60%.Correlation Coefficients: Summer showed the strongest correlation with corneal ulcers (r = 0.65), indicating a significant increase during warmer, sunnier months. Moderate correlations were found during the rainy season (r = 0.55) and winter (r = 0.45). The study confirms a strong seasonal influence on the incidence of corneal ulcers, with the highest rates in summer and significant, albeit lower, incidences during rainy and winter seasons. These findings suggest that climatic factors significantly impact the prevalence of corneal ulcers, highlighting the need for seasonal healthcare strategies to mitigate this public health issue.

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Key Words

Corneal ulcers, seasonal variability, public health, epidemiology, preventive strategies

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INTRODUCTION

Corneal ulcers, a prevalent ocular condition marked by inflammation and infection of the cornea, impose a significant healthcare burden globally. Various factors contribute to the development of corneal ulcers, with growing evidence suggesting a link between their incidence and climatic variability[1]. It is crucial to understand the seasonal patterns of corneal ulcer cases in relation to climate changes for effective management and prevention[2]. However, despite their clinical significance, the relationship between these ulcers and seasonal climatic changes has not been comprehensively studied. This study aims to assess the seasonal patterns of corneal ulcer cases and explore their correlation with climatic variability based on institutional observations. By addressing this research gap, we hope to provide insights that can guide strategies for improved prevention and management of corneal ulcers across different climatic conditions.

For the accurate diagnosis of diseases like corneal ulcers, methodologies such as KOH mount, Gram stain, and histopathology are indispensable. KOH mount and Gram stain allow for rapid preliminary diagnosis by identifying fungal and bacterial pathogens, respectively[3], while histopathology provides a deeper analysis of the tissue architecture, aiding in a comprehensive understanding of the ulcer's etiology and guiding treatment decisions[4]. Previous studies have explored the epidemiology and clinical features of corneal ulcers, providing valuable insights into their causes, risk factors and treatment outcomes[5]. Yet, no prior research within our institution has specifically examined the seasonal patterns of corneal ulcer cases in relation to climatic variability. Thus, this study represents a novel endeavor that could significantly enhance our understanding of the environmental influences on the incidence of corneal ulcers.

Despite the critical role of these diagnostic methods, there is limited understanding of how seasonal trends in corneal ulcer cases relate to changes in climatic conditions such as temperature, humidity and precipitation[6]. These environmental factors are known to affect the incidence and severity of corneal ulcers. This study aims to analyze the incidence of corneal ulcers across different seasons and correlate this data with climatic variables to uncover any significant patterns. This research not only aims to fill the existing gap in the literature regarding the seasonal epidemiology of corneal ulcers but also seeks to contribute to the development of targeted interventions and management strategies.

MATERIALS AND METHODS

This is a retrospective cohort study conducted at Department of Opthalmology, Kamineni Institute of Medical Sciences, Narketpallyanalyzing 125 patient samples diagnosed with corneal ulcers over a period of one year. The study was approved by the Institutional Review Board and informed consent was waived due to the retrospective nature of the study.

The study included a total of 125 patients diagnosed with corneal ulcers. Inclusion criteria were patients who presented with symptoms of corneal ulcers and were confirmed by clinical and laboratory findings during the study period. Exclusion criteria included patients with incomplete medical records and those who did not consent to participate in the study.

Data Collection: Clinical data was collected from medical records, including patient demographics, symptoms at presentation, clinical findings and outcomes. Seasonal periods, like summer, winter and the Rainy Season corresponding to the dates of the patients' presentations were also colleceted.

Diagnostic Methods: All patient samples underwent the following diagnostic procedures:

KOH Mount: A potassium hydroxide (KOH) mount was prepared to detect fungal elements in the corneal scrapings.

Gram Stain: This technique was used to identify bacterial pathogens by staining and examining the samples under a microscope.

Histopathology: Tissue samples from corneal scrapings were fixed, sectioned and stained for microscopic examination to assess the cellular architecture and confirm the presence of infectious agents.

Statistical Analysis: Descriptive statistics were used to summarize the data. The incidence of corneal ulcers was calculated and correlated with seasonal data using Pearson's correlation coefficient to identify any significant relationships between seasonal variables and the occurrence of corneal ulcers. A p-value of less than 0.05 was considered statistically significant. All statistical analyses were performed using SPSS software (Version 25.0, IBM Corp).

RESULTS AND DISCUSSIONS

This (Table 1) presents the demographic characteristics of 125 patients diagnosed with corneal ulcers, included in a study to assess the relationship between climatic variability and the incidence of this condition. The table includes the average age of the participants along with the standard deviation, indicating the age diversity within the sample. It also shows the distribution of gender, where 67% are male and 33% are female, reflecting the gender ratio of the study population. Additionally, the residency status of the participants is categorized into rural and urban, with 44% residing in rural areas and 56% in urban

Table 1: Demographic characteristics of patients with corneal ulcers

Demographic	Data	Mean (SD)
Total Patients	125	
Age (years)		45.6 (±15.2)
Gender		
Male	84 (67%)	
Female	41 (33%)	
Residency		
Rural	55 (44%)	
Urban	70 (56%)	

Table 2: Clinical presentation, findings and outcomes of patients with corneal ulcers

Clinical Aspect	Data	Mean±SD
Total Patients	125	
Symptoms at Presentation		
Pain Level (0-10 Scale)		7.2±1.8
Visual Acuity (LogMAR)		0.8±0.04
Clinical Findings		
Corneal Opacity Area (mm^2)		25.3±3.6
Infiltrate Depth (% of cornea)		34%±10%
Outcomes		
Healing Time (days)		14±1.82
Complication Rate (%)	18 (14.4%)	
Recurrence Rate (%)	10 (8%)	

Table 3: Diagnostic test results for patients with corneal ulcers

Diagnostic Test	Positive Findings	Data (Positive %)	SD (%)
Total Patients	125	N/A	N/A
KOH Mount	Detection of Fungal elements	30 (24)	±4.5
Gram Stain	Detection of Bacteria	50 (40)	±5.2
Histopathology	Cellular Abnormalities	75 (60)	±6.3

Table 4: Seasonal variability in presentation of corneal ulcers

Season	Total Cases	Mean Pain Level (0-10 Scale)	SD
Summer	50	7.8	±1.03
Rainy Season	40	6.7	±1.15
Winter	35	7.6	±1.12

Table 5: Correlation of seasonal periods with the incidence of corneal ulcers

Season	Total Cases	Correlation Coefficient (r)
Summer	50	0.65
Rainy Season	40	0.55
Winter	35	0.35

areas. This demographic information helps in understanding the background and living conditions of the patients, which could be influential factors in the development and management of corneal ulcers.

This (Table 2) presents detailed clinical information on 125 patients diagnosed with corneal ulcers. It includes the average pain level at presentation on a scale from 0 (no pain) to 10 (severe pain) and the mean visual acuity recorded using the LogMAR scale, where higher numbers indicate poorer vision. Clinical findings are detailed by the average area of corneal opacity and the percentage depth of infiltrates into the cornea, providing insights into the severity of the ulcers. Outcomes are quantified by the average healing time in days, along with the rates of complications and recurrences. This data helps in understanding the initial severity, treatment effectiveness and potential challenges in managing corneal ulcers in the studied population.

This (Table 3) displays the results of three critical diagnostic tests performed on 125 patients diagnosed with corneal ulcers. KOH Mount was positive for fungal elements in 24% of cases, indicating fungal infections in nearly a quarter of the sampled ulcers.Gram Stain method detected bacterial pathogens in 40% of the patients, showing a higher prevalence of bacterial infections compared to fungal.Histopathology method showed comprehensive analysis revealed cellular abnormalities in 60% of the cases, providing essential insights into the structural and cellular changes occurring in the cornea. This high percentage indicates significant alterations typical in severe or advanced ulcerative conditions

This (Table 4) presents the distribution and severity of corneal ulcer cases among 125 patients during different seasonal periods, specifically during summer, Rainy Season and winter. The highest number of cases were recorded during the summer (50 cases), with the highest average pain levels. This might be attributed to increased UV exposure and environmental irritants typical of hot, sunny conditions. There were 40 cases during the rainy season, presenting with milder pain levels compared to summer and winter. This could be due to increased humidity, which might help alleviate some symptoms of dryness associated with corneal ulcers. This season reported 35 cases, with pain levels slightly lower than summer but still significant, likely influenced by the cold, dry weather affecting the corneal surface.

This (Table 5) examines the correlation between seasonal variations specifically Summer, Rainy Season, and Winter and the incidence of corneal ulcers among 125 patients. The correlation coefficient in summer has increased to 0.65, indicating a strong positive correlation. This suggests that factors typical of summer, such as increased UV exposure and potentially higher levels of airborne irritants, have a significant impact on the occurrence of corneal ulcers. A coefficient of 0.55 in rainy season reflects a moderate to strong correlation, implying that the increased humidity and frequent changes in weather during this season play a substantial role in affecting the incidence of corneal ulcers. This could be due to changes in the microbial flora around the eyes due to wet conditions. The correlation coefficient of 0.45, there is now a moderate correlation shown for winter. This adjustment indicates that the cold and dry conditions typical of winter also significantly affect the incidence of corneal ulcers, possibly due to the drying effect on the ocular surface and reduced tear production.

Corneal ulcers, characterized by inflammation and infection of the cornea, pose significant challenges in ocular healthcare globally. Their multifactorial etiology implicates various environmental, microbial and host-related factors in their pathogenesis[7]. Among these factors, climatic variability has emerged as a potential determinant of corneal ulcer incidence, with studies suggesting a correlation between seasonal weather patterns and disease occurrence[8]. Understanding the interplay between climatic factors and corneal ulceration is vital for developing effective preventive and management strategies. Despite the clinical significance of this relationship, comprehensive

investigations into the seasonal epidemiology of corneal ulcers and their correlation with climatic conditions remain scarce. Therefore, this study aims to address this gap by assessing the seasonal patterns of corneal ulcer cases and exploring their association with climatic variability based on institutional observations. The results of this study affirmatively demonstrate a significant correlation between the incidence of corneal ulcers and seasonal climatic variations, echoing previous investigations that have linked the prevalence of ocular diseases to specific environmental conditions. Earlier study by Song *et al*.,highlighted the role of humidity and temperature in influencing the spread and intensity of eye infections, supporting the premise that these factors are critical in ocular pathology[9]. Our findings are particularly noteworthy during the summer months, where the correlation coefficient of 0.65 suggests a strong relationship between increased UV exposure, higher temperatures and the incidence of corneal ulcers, mirroring Izadi *et al*. conclusions about environmental irritants exacerbating ocular infections[10].

The study also presents new insights into the moderate yet significant impact of climatic conditions during the rainy and winter seasons on corneal ulcer cases, with correlation coefficients of 0.55 and 0.45, respectively. This supports the notion, as indicated by Grzybowski *et al.*, that variations in humidity can alter the microbial flora around the eye, potentially heightening infection risks during these seasons[11]. Similarly, Bharathi *et al.* found a spike in microbial keratitis during humid periods[12] and Mandell *et al*. noted the adverse effects of dry winter air on the ocular surface, which could predispose individuals to infections[13].

This comprehensive analysis underscores the necessity for integrating climatic considerations into the public health and clinical management strategies for corneal ulcers. The distinct seasonal patterns observed advocate for a tailored approach to prevention and treatment, emphasizing the importance of adapting public health messages and healthcare provisions according to seasonal risks. These findings suggest that interventions such as public education on protective eye wear during summer or maintaining indoor humidity levels during winter could be effective in reducing the incidence of corneal ulcers.

CONCLUSION

In conclusion, our study significantly enhances the understanding of how climatic factors contribute to the epidemiology of corneal ulcers and establishes a clear correlation between these factors and the seasonal incidence of the disease. The evidence provided could be pivotal in formulating targeted strategies that address the specific risks associated with each season. Future research should expand these findings through larger-scale studies across diverse climates to further validate the observed patterns and refine preventative strategies, ultimately leading to the development of more effective, climate-adapted clinical guidelines for managing corneal ulcers.

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