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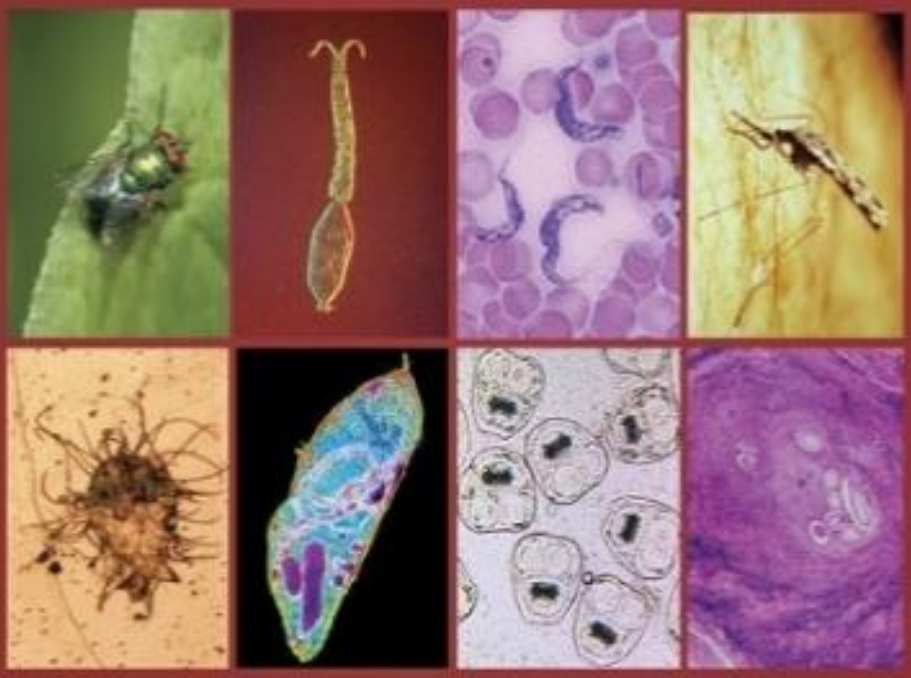

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Vision-Threatening Ulcerative Infectious Keratitis in Diabetic Patients: A Retrospective Case Series

Jawaher M. Alshehri
Optometry Department, Faculty of Applied Medical Sciences, Al-Baha University, Al-Baha, Saudi Arabia
***Email :** j.alshehri@bu.edu.sa

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ABSTRACT

Purpose: This retrospective case series investigates the clinical manifestations, microbiological profiles, and therapeutic responses of ulcerative infectious keratitis in patients with diabetes mellitus (DM), aiming to highlight the challenges diabetes imposes on disease progression, treatment efficacy, and corneal healing.**Materials and Methods:** Three adult patients with confirmed DM presented between August 2022 and April 2023 with unilateral ulcerative infectious keratitis following ocular trauma. Data were collected from medical records, including systemic and ocular history, clinical findings, microbiological results, treatments, and follow-up outcomes. All patients underwent standardized ophthalmic and microbiological evaluations. Broad-spectrum empiric antimicrobial therapy was initiated and subsequently adjusted based on culture results. Concurrent glycemic optimization was maintained throughout the treatment course due to its impact on healing and infection control. **Results**: Two patients were diagnosed with fungal keratitis (Case 1: *Fusarium solani*, Case 2: *Aspergillus spp.*), and one with bacterial keratitis (Case 3: *Staphylococcus aureus*). Case 1, with poorly controlled type 2 DM, had the most aggressive disease course, requiring therapeutic penetrating keratoplasty (TPK) and resulting in poor visual outcome. Case 2 showed partial clinical improvement with prolonged antifungal therapy but residual stromal scarring. Case 3 demonstrated resolution of infection with targeted antibiotics; however, visual recovery was limited despite clinical stabilization.**Conclusion**: Ulcerative keratitis in diabetic patients presents a multifactorial clinical challenge. Managing such infections requires early diagnosis, prompt initiation of targeted antimicrobial therapy, and strict glycemic control. Addressing these factors collectively is essential for improving prognosis and preserving vision in this high-risk population.

INTRODUCTION

Infectious keratitis is a major global ophthalmic concern and remains a leading cause of corneal blindness worldwide. The condition may be caused by a wide range of pathogens, including bacteria, fungi, viruses, and parasites. Its clinical severity and outcomes are highly influenced by host-related factors such as ocular surface integrity, immune function, and underlying systemic comorbidities (Alshehri, 2024, Cabrera-Aguas et al., 2022, Sereda et al., 2022). Among the various clinical forms of infectious keratitis, ulcerative keratitis represents the most severe manifestation, characterized by corneal epithelial defects, underlying stromal infiltration, intense inflammatory responses and hypopyon formation (Roongpoovapatr et al., 2019).

The pathogenesis typically begins with a disruption of the corneal epithelium, most often due to trauma, inappropriate contact lens use, or ocular surface disease, which facilitates microbial entry into the stroma. Once within the corneal tissue, the pathogens trigger a robust inflammatory cascade, potentially leading to progressive tissue necrosis, stromal melting, and ultimately corneal perforation if not promptly and appropriately managed (Cabrera-Aguas *et al.,* 2022, Das *et al.,* 2015, Sereda *et al.,* 2022).

Diabetes mellitus (DM) is a chronic metabolic disorder caused by insufficient insulin production or impaired insulin utilization. It is among the most prevalent systemic diseases globally and continues to rise in prevalence (Markoulli *et al.,* 2018). Individuals with DM are particularly susceptible to ulcerative infectious keratitis due to multiple diabetes-related ocular surface abnormalities. These include impaired epithelial barrier function, delayed wound healing, reduced tear film stability, and diminished corneal sensation. Collectively, these alterations increase vulnerability to microbial invasion and exacerbate the severity and persistence of keratitis (Zhou *et al.,* 2022, Sereda *et al.,* 2022, Zavoloka *et al.,* 2021, Zhao *et al.,* 2019, Markoulli *et al.,* 2018, Shih *et al.,* 2017, Misra *et al.,* 2016).

Numerous studies have identified diabetes as an independent risk factor for corneal ulceration, even after adjusting for other systemic diseases. Diabetic patients with keratitis frequently present with more extensive and deeper ulcers, experience prolonged healing durations, and exhibit a higher risk of complications such as corneal perforation or treatment failure. Management is often complicated by the isolation of multidrug-resistant organisms and the presence of atypical clinical signs that may delay accurate diagnosis and appropriate therapy (Naryati, 2025, Paul and Jyothi, 2023, Chang *et al.,* 2020, Dan *et al.,* 2018, Shih *et al.,* 2017, Manikandan *et al.,* 2008).

Managing ulcerative keratitis in diabetic patients presents distinct clinical challenges. Poor glycemic control has been strongly associated with worse prognoses, reduced responsiveness to antimicrobial agents, and an increased risk of therapeutic failure. Despite advancements in antimicrobial therapies and diagnostic technologies, diabetic individuals continue to experience disproportionately high rates of vision impairment following corneal infections (Naryati, 2025, Paul and Jyothi, 2023, Chang *et al.,* 2020, Shi *et al.,* 2013).

In light of these challenges, there remains a pressing need for detailed clinical data on ulcerative infectious keratitis in diabetic populations. This case series aims to present three such cases, highlighting their clinical presentations, microbiological findings, and therapeutic responses, to support ongoing documentation of disease patterns in this high-risk group.

MATERIALS AND METHODS

This retrospective case series describes three adult patients with a confirmed history of diabetes mellitus who presented with unilateral ocular infections to the Ophthalmology Department between August 2022 and April 2023, and were subsequently diagnosed with ulcerative infectious keratitis. Ethical approval for the study was obtained from the Scientific Research Ethics Committee at the Deanship of Innovation and Scientific Research, Al-Baha University. The study was conducted in accordance with the ethical standards outlined in the Declaration of Helsinki and its subsequent amendments.

Patient medical records were thoroughly reviewed to extract comprehensive data on systemic health status, medical and ocular histories, exposure details, potential risk factors, clinical characteristics, diagnostic ocular and microbiological evaluations, therapeutic interventions, and other relevant clinical findings.

The first case involved a 57-year-old male, employed in gardening and tree pruning, who had a 12-year history of

poorly controlled type 2 diabetes mellitus, with irregular insulin use and inadequate dietary management. His medical history included prostatitis, and he was a long-term smoker. The patient had no prior ocular diseases, surgical interventions, or use of corrective lenses. He sustained trauma to the right eye from a tree branch but delayed seeking medical attention, expecting spontaneous resolution of symptoms. He eventually presented nine days post-injury with complaints of ocular pain, redness, photophobia, foreign body sensation, and blurred vision.

The second case involved a 72-year-old female housewife with a 16-year history of type 2 diabetes mellitus, well controlled with oral hypoglycemic agents. Her systemic comorbidities included hypertension, osteoporosis, and peptic ulcer disease. She had a documented history of non-proliferative diabetic retinopathy, as well as prior bilateral cataract surgery. She routinely used reading glasses for near vision. The patient sustained a traumatic injury to the left eye with a wooden spoon while cooking and delayed seeking medical attention for 13 days. She presented with symptoms of eye irritation, moderate pain, redness, tearing, photophobia, and visual decline.

The third case involved a 38-year-old female preschool teacher with a longstanding history of type 1 diabetes mellitus, managed with insulin therapy since childhood. Her medical history included bronchial asthma, and her ocular history was notable for recurrent episodes of allergic conjunctivitis, although she had no history of ocular surgery. She also reported occasional use of cosmetic contact lenses. The corneal injury occurred following an accidental scratch to the right eye by a child's fingernail during play. She presented four days post-injury with complaints of severe ocular pain, redness, discharge, and rapid deterioration of vision.

At presentation, all patients underwent a standardized ophthalmologic evaluation, which included uncorrected and pinhole visual acuity testing, intraocular pressure (IOP) measurement, slit-lamp biomicroscopy, and fluorescein staining to assess epithelial integrity. A microbiological evaluation was also performed, involving corneal scrapings obtained under aseptic conditions from the base and margins of the ulcer. Samples were subjected to potassium hydroxide (KOH) wet mount preparation and Gram staining, and inoculated onto appropriate culture media, including chocolate agar and Sabouraud dextrose agar (SDA). Table 1, provides a summary of the demographic characteristics, ocular and medical histories, exposure details, identified risk factors, clinical presentations, and diagnostic evaluations of the three diabetic patients.

Immediately following specimen collection, empiric therapy was initiated using broad-spectrum topical antibiotics along with cycloplegic agents, aimed at reducing inflammation and preventing disease progression during the interim period while awaiting culture results. Case 1 and Case 2 were treated with topical ciprofloxacin 0.3% administered hourly along with atropine 1% three times daily. Case 3 was started on topical moxifloxacin 0.5% hourly and cyclopentolate 1% three times daily. Once microbiological results were available, antimicrobial therapy was adjusted accordingly based on the sensitivity profile of the isolated pathogen. Concurrently, systemic diabetic management was optimised in all cases to enhance corneal healing and improve infection resolution. Case 1, who had poorly controlled type 2 diabetes, was referred to endocrinology for insulin regimen revision and dietary counselling. Case 2 maintained adequate glycemic control on oral hypoglycemics, while Case 3 continued insulin therapy for type 1 diabetes mellitus under routine monitoring. Follow-up evaluations were conducted within three to five days after initial presentation and continued thereafter as clinically indicated.

Table 1: Summary of Demographic, Medical, Ocular, and Clinical Features of Diabetic Patients with Ulcerative Infectious Keratitis

	Case 1	**Case 2**	**Case 3**
Gender	Male	Female	Female
Age	57 years	72 years	38 years
Occupation	Tree pruning and gardening	Housewife	Preschool teacher
Diabetes Mellitus	- Type 2 DM - Duration: 12 years - Poorly controlled	- Type 2 DM - Duration: 16 years - Well controlled with oral medications	- Type 1 DM - Duration: since childhood - Controlled with insulin therapy
Medical History	Prostatitis	Hypertension Osteoporosis Peptic ulcer disease	Bronchial asthma
Ocular History	None	Diabetic retinopathy	Recurrent allergic conjunctivitis
Previous Ocular Surgery	None	Bilateral cataract surgery	None
Use of Eyeglasses or Contact Lenses	None	Reading glasses	Occasional use of cosmetic contact lenses
Affected Eye	Right eye	Left eye	Right eye
Exposure History	Ocular trauma caused by a tree branch during gardening activities	Accidental traumatic injury to the eye from a wooden kitchen spoon during cooking	Accidental corneal scratch by a child's fingernail during play
Suspected Risk Factors	History of smoking	None	Frequent eye rubbing
Presenting Symptoms	Eye pain, Redness, Photophobia, Foreign body sensation and Blurred vision	Eye irritation, Pain, Redness, Tearing, Photophobia, and Decrease in visual acuity	Severe pain, Redness, Discharge, and Rapid visual deterioration
Time to Presentation	9 days	13 days	4 days
Diagnostic Ocular Examinations	- Visual Acuity Test - Slit-Lamp Biomicroscopy - Fluorescein Staining - IOP Measurement	- Visual Acuity Test - Slit-Lamp Biomicroscopy - Fluorescein Staining - IOP Measurement	- Visual Acuity Test - Slit-Lamp Biomicroscopy - Fluorescein Staining - IOP Measurement
Type of Scraping	Corneal Scrapping	Corneal Scrapping	Corneal Scrapping
Diagnostic Microbiological Examinations	KOH wet mount; culture on chocolate agar and Sabouraud dextrose agar (SDA)	KOH wet mount; culture on chocolate agar and Sabouraud dextrose agar (SDA)	KOH wet mount; culture on chocolate agar and Sabouraud dextrose agar (SDA)

RESULTS

This retrospective case series evaluated three patients diagnosed with ulcerative infectious keratitis, all of whom had a documented history of diabetes mellitus with varying disease durations and degrees of glycemic control. Each patient presented with unilateral corneal involvement following distinct traumatic events and exhibited variable delays in seeking medical attention. The clinical manifestations, microbiological findings,

and therapeutic responses differed among the cases and appeared to be influenced by both systemic diabetic status and individual ocular risk factors.

Ophthalmic Findings and Clinical Features at Presentation:

At initial presentation, all three patients exhibited classical signs of ulcerative keratitis, including ocular pain, conjunctival injection, and photophobia. Visual acuity assessments revealed moderate to severe impairment in the affected eye across all cases. Case 1 had right eye involvement with an uncorrected visual acuity (UCVA) of 20/100 and no improvement with pinhole testing. Case 2 presented with profound visual decline in the left eye, with UCVA of 20/400 and no improvement on pinhole testing. In contrast, Case 3 showed moderate vision loss in the right eye, with UCVA of 20/80, improving to 20/60 with pinhole correction. Intraocular pressure was within normal limits in all cases.

Slit-lamp biomicroscopy revealed corneal ulcers measuring between 3.5 mm and 6.5 mm in diameter, with corresponding corneal infiltrates ranging from 3 mm to 7 mm and involving varying stromal depths. Case 1 exhibited a large, centrally located ulcer with feathery margins measuring 6.5 mm in diameter, accompanied by a dense stromal infiltrate approximately 6–7 mm in size, extending into the deep stroma, and associated with a marked hypopyon of ≥2 mm. Case 2 showed a paracentral ulcer with relatively defined borders measuring 4.0 mm, accompanied by a 4–5 mm stromal infiltrate reaching mid-to-deep stromal layers, without hypopyon. Case 3 demonstrated a smaller, round paracentral ulcer measuring 3.5 mm, with an associated 3–4 mm infiltrate confined to the mid-stroma and no hypopyon formation. Ophthalmic findings, including visual acuity and detailed clinical characteristics of the ulcers and infiltrates at presentation, are summarized in Table 2.

Table 2: Baseline Ophthalmic Examination Findings and Clinical Characteristics of Corneal Ulcers and Infiltrates in Diabetic Patients with Ulcerative Keratitis

	Case 1	**Case 2**	**Case 3**
Ophthalmic Examination Findings at Presentation			
UCVA	Right Eye = 20/100 Left Eye = 20/25	Right Eye = 20/100 Left Eye = 20/400	Right Eye = 20/80 Left Eye =20/20
VA with Pinhole	Right Eye = 20/100 (No improvement) Left Eye = 20/20	Right Eye = 20/80 (Limited improvement due to diabetic retinopathy) Left Eye = 20/400 (No improvement)	Right Eye = 20/60 Left Eye =20/20
IOP Measurement	Within normal range	Within normal range	Within normal range
Clinical Features			
Infiltrate size	6–7 mm	4–5 mm	3–4 mm
Infiltrate Depth	Deep stromal involvement	Mid-to-deep stromal involvement	Mid stromal depth
Hypopyon	Marked hypopyon (≥2 mm)	Absent	Absent
Ulcer Location	Central	Paracentral	Paracentral
Ulcer Size	6.5 mm with feathery edges	4.0 mm with relatively defined margins	3.5 mm round ulcer with dense borders

Microbiological Confirmation and Targeted Therapy*:*

Positive microbial cultures were obtained in all three cases, as detailed in **Table 3.** *Fusarium solani* and *Aspergillus spp*. were isolated in Cases 1 and 2, respectively, confirming fungal keratitis. In Case 3, culture results revealed Gram-positive *Staphylococcus aureus*, consistent with bacterial keratitis.

The initial follow-up occurred 3 to 5 days after presentation. At that point, both fungal cases demonstrated clinical deterioration. Case 1 showed progression of the ulcer with increased size and worsening hypopyon, necessitating a modification in the antimicrobial regimen. Case 2 developed a mild hypopyon and exhibited a persistent, non-resolving ulcer. In contrast, Case 3 showed mild symptomatic improvement, with reduced discharge and pain, although the corneal infiltrate remained stable.

Following microbiological confirmation, antimicrobial therapy was tailored to the identified pathogens. In Case 1, treatment was escalated to include topical natamycin 5% hourly, topical voriconazole 1% every two hours, and oral voriconazole 200 mg twice daily. Case 2 was managed with a dual-antifungal regimen consisting of natamycin 5% administered hourly and amphotericin B 0.15% every two hours. For Case 3, the antibiotic regimen was adjusted to fortified vancomycin 5% and gentamicin 1.5% eye drops, administered alternately every hour, along with oral ciprofloxacin 500 mg twice daily.

Second Follow-Up Findings and Subsequent Clinical Outcomes:

The second follow-up took place between 13 and 18 days after the initial post-treatment review. Despite culture-directed antifungal therapy, Case 1 exhibited no meaningful clinical improvement. The ulcer remained dense and deep, with a persistent epithelial defect and progressive corneal thinning. In response, treatment was intensified to include a triple topical antifungal regimen of natamycin 5%, amphotericin B 0.15%, and voriconazole 1%, along with systemic voriconazole 200 mg twice daily. Due to ongoing deterioration and the imminent risk of corneal perforation, therapeutic penetrating keratoplasty (TPK) was scheduled and subsequently performed. The final visual outcome was poor, with persistent epithelial defect, dense central stromal scarring, and severely reduced visual acuity (Best-Corrected Visual Acuity [BCVA]: counting fingers at 2 meters).

In Case 2, partial clinical improvement (~40%) was observed, characterised by reduced stromal edema and gradual epithelial recovery. The corneal ulcer showed signs of stabilisation, and surgical intervention was not required. A prolonged course of topical antifungal therapy was planned for at least six weeks. However, the final visual outcome remained suboptimal, with a BCVA of counting fingers at 3m in the affected left eye, primarily due to residual stromal scarring.

Case 3 demonstrated moderate improvement (~60%) by the second follow-up, with significant reduction in the epithelial defect and a marked decrease in inflammation. Given the stable clinical course, topical corticosteroids were cautiously introduced to control residual inflammation and minimise stromal haze. The final outcome was favourable, with resolution of the active infection, healing of the paracentral ulcer with residual scarring, and preservation of baseline visual acuity (BCVA: 20/60 partial in the affected right eye). Post-treatment outcomes, clinical progression, and final visual acuity for all three cases are summarised in Table 3.

Table 3: Microbiological Findings, Therapeutic Adjustments, and Clinical Outcomes in Three Diabetic Patients with Ulcerative Infectious Keratitis.

	Case 1	**Case 2**	**Case 3**
Microbiological Findings			
Microbiological Culture Results	Positive Growth	Positive Growth	Positive Growth
Diagnosis	Fungal Keratitis	Fungal Keratitis	Bacterial Keratitis
Identified Pathogen	*Fusarium Solani*	*Aspergillus spp.*	Gram-positive *Staphylococcus aureus*
Follow-Up Assessments and Therapeutic Adjustments			
First Follow-Up: Timing (Days from Presentation)	4 days	5 days	3 days
Clinical Response to Empiric Therapy	Progressive worsening: ulcer enlarged, hypopyon increased	Non-resolving: ulcer remained active, and mild hypopyon noted	Mild symptomatic improvement; discharge reduced, infiltrate stable
Therapeutic Plan after First Follow-Up	Modified to antifungal regimen following fungal culture results	Modified to antifungal regimen following fungal culture results	Adjusted to targeted antibiotic therapy
Definitive Targeted Antimicrobial Therapy	Topical natamycin 5% (hourly), Topical voriconazole 1% (every 2 hours), Oral voriconazole 200 mg BID	Topical natamycin 5% hourly + Topical amphotericin B 0.15% every 2 hours	Fortified vancomycin 5% and gentamicin 1.5% eye drops alternated hourly + Oral ciprofloxacin 500 mg BID
Second Follow-Up: Timing (Days from First Follow-Up)	13 days	18 days	14 days
Clinical Response to Targeted Therapy	No significant improvement: dense infiltrate, persistent epithelial defect, worsening corneal thinning	Partial improvement (~40%): slow epithelial healing, mild edema	Moderate improvement (~60%): epithelial defect reduced, symptoms relieved
Management Plan after Second Follow-Up	Escalated to triple antifungal therapy, TPK scheduled due to thinning and perforation risk	Continued current antifungal therapy for a prolonged course	Continued current therapy, topical corticosteroids introduced cautiously
Surgical Intervention	Therapeutic penetrating keratoplasty (TPK)	None	None
Final Clinical Outcomes			
Outcomes and Complications	Persistent epithelial defect, dense central corneal opacity, poor visual prognosis	Moderate stromal scarring, poor visual recovery	Resolved infection: healed with paracentral scar, stable functional vision without significant visual gain
BCVA	Right Eye = Counting Fingers at 2m Left Eye = 20/20	Right Eye = 20/80 Left Eye = Counting Fingers at 3m	Right Eye = 20/60 (partial) Left Eye =20/20

DISCUSSION

This case series highlights the complex interplay between diabetes mellitus (DM) and the clinical outcomes of ulcerative infectious keratitis. All three patients were diabetic and presented with unilateral keratitis following ocular trauma, an established global risk factor for infectious keratitis (Paul and Jyothi, 2023, Ting *et al.,* 2021, Keay *et al.,* 2006). These

cases emphasize how systemic metabolic dysfunction, local ocular risk factors, and microbial virulence collectively influence disease progression and therapeutic response.

DM is a well-recognized risk factor for severe keratitis due to its adverse effects on corneal barrier integrity, immune competence, and wound healing capacity. Chronic hyperglycemia promotes epithelial fragility, delays re-epithelialization, and impairs corneal innervation, making diabetic individuals more susceptible to infection (Paul and Jyothi, 2023, Zhou *et al.,* 2022, Zhao *et al.,* 2019, Markoulli *et al.,* 2018, Shih *et al.,* 2017, Misra *et al.,* 2016). These pathophysiological mechanisms were evident in current series, particularly in Case 1, where a 12-year history of poorly controlled type 2 DM coincided with the most aggressive clinical course. This aligns with existing evidence linking prolonged disease duration and poor glycemic control to delayed epithelial healing, stromal melting, and a heightened risk of corneal perforation (Qu *et al.,* 2018, Bettahi et al., 2014, Xu and Fu-Shin, 2011). A large-scale retrospective cohort study further supports this association, showing that diabetes mellitus independently increases the risk of developing corneal ulcers by 1.31 times, even after adjusting for other systemic comorbidities (Chang *et al.,* 2020).

Ocular trauma served as the inciting event in all cases, reaffirming the protective role of the corneal epithelium and its heightened vulnerability in diabetic eyes. In this context, diabetic-associated changes, such as reduced tear film stability, microvascular compromise, and diminished corneal sensitivity, further impair epithelial repair (Zavoloka e*t al.,* 2021, Markoulli *et al.,* 2018, Ljubimov, 2017, Lv *et al.,* 2014, Yoon *et al.,* 2004). In addition to increased incidence, diabetic patients have been shown to experience more severe presentations of corneal ulcers, with a higher frequency of antibiotic resistance and a greater need for systemic antimicrobial therapy (Paul and Jyothi, 2023).

At initial presentation, all patients received empiric broad-spectrum antimicrobial therapy, which remains standard practice when microbial etiology is not immediately confirmed (Daniell, 2003). Subsequent microbiological identification allowed for targeted therapy adjustments, contributing to partial clinical stabilization in Cases 2 and 3.

Fungal keratitis was diagnosed in Cases 1 and 2, with *Fusarium solani* and *Aspergillus spp*. isolated, respectively. These filamentous fungi are known for their deep stromal invasion and poor response to conventional antifungal agents, particularly in diabetic corneas, where impaired neutrophil function and altered cytokine expression hinder effective immune clearance (Mpakosi and Kaliouli-Antonopoulou, 2024, Abbondante *et al.,* 2023, Ratitong and Pearlman, 2021). *Fusarium* species, in particular, are associated with rapid disease progression and resistance to monotherapy (Tupaki-Sreepurna et al., 2017, Edelstein *et al.,* 2012), as demonstrated in Case 1. In this case, the failure of dual antifungal therapy necessitated escalation to triple antifungal agents and ultimately therapeutic penetrating keratoplasty (TPK) due to progressive stromal thinning and non-responsiveness to intensive medical therapy. Although TPK remains a critical salvage option in advanced fungal keratitis, outcomes in diabetic patients are often suboptimal (Kengpunpanich *et al.,* 2023, Chatterjee and Agrawal, 2020). In Case 1, despite halting active disease, postoperative epithelial healing remained poor, and final visual acuity was limited to counting fingers, with persistent epithelial defects. This case exemplifies the challenges of treating fungal keratitis in immunocompromised corneas and the limited efficacy of pharmacologic intervention in the context of delayed presentation and poor metabolic control (Paul and Jyothi, 2023, Dan *et al.,* 2018).

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Conversely, Case 2 benefited from early initiation of topical antifungal therapy, which contributed to infection containment and obviated the need for surgical intervention. However, treatment duration was prolonged, and visual recovery was limited due to residual stromal scarring. Despite a longer duration of diabetes, this patient maintained well-controlled blood glucose levels. Nevertheless, epithelial healing was significantly delayed, likely due to subclinical neuropathy and chronic microvascular alterations, factors known to impede wound healing even in metabolically stable patients. This case consistent with literature suggesting that even well-managed diabetes does not fully reverse underlying microvascular and neurotrophic dysfunction (Jan et al., 2024, Skljarevski and Veves, 2005). Case 3 presented with bacterial keratitis in a patient with type 1 DM and demonstrated a relatively milder clinical course with a more favorable therapeutic response. However, the underlying diabetes likely contributed to the disease trajectory, as evidenced by the persistence of corneal haze and a lack of meaningful visual improvement despite infection control.

Importantly, systemic glycemic control was addressed in all cases as part of the integrated treatment approach. Literature consistently supports the role of metabolic optimization in enhancing antimicrobial efficacy and promoting epithelial repair (Zhao *et al.,* 2019, Shih *et al.,* 2017, Nakamura *et al.,* 2003). The divergent responses observed in Cases 1 and 2, despite similar infectious etiologies, further highlight the influence of systemic diabetic status on ocular healing capacity.

Behavioural and environmental risk factors also contributed to disease progression. In Case 1, chronic smoking likely impaired epithelial turnover and increased inflammatory stress, compounding the effects of hyperglycemia and infection. Diabetic retinopathy in Case 2 may have further limited visual potential due to its cumulative impact on ocular microcirculation and retinal integrity. Meanwhile, in Case 3, habitual eye rubbing and chronic allergic conjunctivitis further compromised epithelial defences and heightened infection susceptibility (Azari and Arabi, 2020, Wang and Lo, 2018, Jetton *et al.,* 2014).

Conclusion

This case series reaffirms the multifactorial complexity of ulcerative keratitis in diabetic patients, where glycemic control, ocular trauma, and behavioral risk factors collectively influence disease severity, treatment response, and visual outcomes. Optimal management requires an integrated approach encompassing strict systemic glycemic control, prompt microbiological diagnosis, and early initiation of targeted antimicrobial therapy to minimize visual morbidity in the diabetic population.

Education and awareness are vital, particularly among high-risk diabetic individuals, to promote early care-seeking behavior in the presence of ocular symptoms. Furthermore, diabetic patients warrant close and prolonged follow-up due to their propensity for delayed epithelial recovery, atypical clinical presentations, and heightened risk of complications.

Declarations:

Ethical Approval: This research was approved by the Scientific Research Ethics Committee at the Deanship of Innovation and Scientific Research, Al-Baha University (Approval No. 45130359).

Competing interests: The author declares no competing interests.

Author's Contributions: This manuscript was solely written and prepared by the author.

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Availability of Data and Materials: All data analyzed in this study were obtained from patient medical records and include anonymized clinical, microbiological, and therapeutic information. In accordance with patient confidentiality protocols and institutional regulations, the raw data are

not publicly available. However, additional details may be provided by the corresponding author upon reasonable request and subject to appropriate ethical approval.

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