



## Ophthalmic complications associated with methamphetamine use disorder

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### ABSTRACT

**Purpose:** To describe the devastating ophthalmic sequelae of methamphetamine use disorder in two patients who developed vision loss from ocular complications, including keratitis and endophthalmitis.

**Observations:** Case 1 is a 26-year-old male with hepatitis C, poorly controlled type 1 diabetes, and chronic methamphetamine use who presented with a corneal ulcer in the left eye. Corneal culture grew *Staphylococcus aureus* and *Streptococcus viridans*, prompting antibiotic therapy. Follow-up exam showed peripheral corneal ulceration OD and diffusely vascularized and scarred cornea OS, although nonadherence was reported. Vision eventually worsened to hand motions OD and light perception OS.

Case 2 is a 44-year-old woman with hepatitis C, acute myeloid leukemia, dry eye syndrome secondary to chronic graft-versus-host disease (GVHD), and chronic methamphetamine use who presented with a diffuse corneal infiltrate and hypopyon. She underwent emergent corneal transplantation, vitrectomy, and broad-spectrum intravitreal and intravenous antibiotics. Vitreous cultures were positive for *Streptococcus pyogenes*. However, progressive disease eventually required enucleation despite initial globe salvaging measures.

**Conclusions and importance:** These two patient cases highlight the risk of vision loss or blindness due to the detrimental effects of chronic methamphetamine use on the eye, including the potential for keratitis and endophthalmitis. Given the increasing prevalence of methamphetamine use disorder in the United States, further understanding of these toxicities and preventive strategies are needed.

### 1. Introduction

Methamphetamine use approximated 1.6 million adults from 2015 to 2018, with 52.9% diagnosed with methamphetamine use disorder, including 25% self-reporting methamphetamine injection.<sup>1</sup> Sympathomimetic effects leading to vasoconstriction may be responsible for cardiac, pulmonary, and neurologic pathologies observed.<sup>2,3</sup> Ophthalmic manifestations, although infrequently described, include corneal ulcerations, keratitis, and endophthalmitis with resultant vision loss. In particular, smokeable meth, commonly referred to as “ice,” has been shown to increase the risk of corneal ulcer development.<sup>3,4</sup> Here, we describe two patients with methamphetamine-associated ophthalmic complications, including keratitis and endophthalmitis resulting in severe vision loss and blindness.

### 2. Findings

#### 2.1. Case 1

A 26-year-old male with a history of intravenous, smoked, and inhaled methamphetamine use presented with a 4 mm central non-suppurative corneal ulcer of the left eye. His most recent reported methamphetamine usage was via inhalation one month prior to this. Medical history was significant for hepatitis C, poorly controlled type 1 diabetes mellitus with multiple episodes of diabetic ketoacidosis, and self-epilation due to trichiasis in the left (OS) greater than right eye (OD) (Fig. 1A). His presenting visual acuities (VA) were 20/25 OD and hand motions (HM) at the face OS. Corneal culture showed *Staphylococcus aureus* and *Streptococcus viridans*, prompting fortified tobramycin and vancomycin therapy. He was lost to follow-up but presented five months later with an epithelial defect OD (Fig. 1B) and diffuse corneal opacification OS. Visual acuity was 20/400 OD and light perception (LP) OS.

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Slit-lamp examination revealed a 1 mm × 0.5 mm peripheral corneal ulceration OD and a diffusely vascularized and scarred cornea OS (Fig. 1C). Corneal sensation was found to be absent in both eyes with the corneal wisp test. Moxifloxacin every 2 hours, artificial tears QID and erythromycin ointment TID were prescribed, but the patient reported non-adherence to treatment, continuous eye rubbing, and worsening vision. One week later, his visual acuity had deteriorated to HM OD and LP OS. Slit-lamp exam showed a 2 mm × 3 mm neurotrophic-appearing epithelial defect and punctate epithelial erosions OD and corneal pannus OS. Artificial tears every 2 hours and ophthalmic ointment BID were prescribed with gradual improvement of the epithelial defect. Final visual acuities were HM OD and LP OS at 9-months follow-up.

## 2.2. Case 2

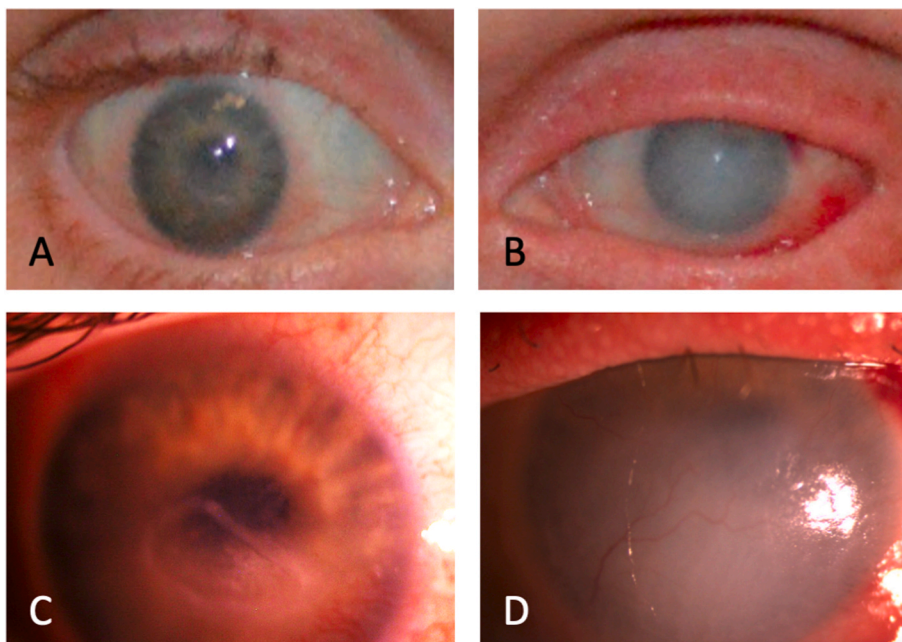
A 44-year-old homeless woman with a history of intravenous and smoked methamphetamine use presented for sudden vision loss and pain in the left eye. She had most recently smoked methamphetamine one day prior to presentation. Her medical history includes hepatitis C, acute myeloid leukemia in remission treated with chemotherapy and bone marrow transplant, and dry eye syndrome secondary to chronic graft-versus-host disease (GVHD). Ocular surgical history included cataract surgery in 2014 and 2018 of the left and right eyes, respectively. Her presenting visual acuities were 20/70 OD and LP OS. Ophthalmic examination OD showed a posterior chamber intraocular lens with moderate posterior capsular opacification and a chorioretinal scar. Ophthalmic examination OS revealed 4+ injection and a diffuse corneal infiltrate with iris plugging a central corneal defect, a shallow anterior chamber, and hypopyon (Fig. 2A). A gentle B-scan ultrasound showed a vitreous opacity and a small choroidal effusion temporally with overlying retinal debris. The patient underwent emergent corneal transplantation and anterior vitrectomy with intravitreal vancomycin and ceftazidime and was admitted for intravenous vancomycin and cefepime. Vitreous cultures grew *Streptococcus pyogenes*. Despite treatment, the infection continued to progress with increasing pain and redness (Fig. 2B), prompting evisceration. Two weeks later, she presented with panophthalmitis, orbital cellulitis, and a hematoma of the scleral shell. She underwent enucleation and was discharged with oral antibiotics. Follow-up visit two months later showed resolved periorbital edema, and the patient was participating in rehabilitation for

methamphetamine use.

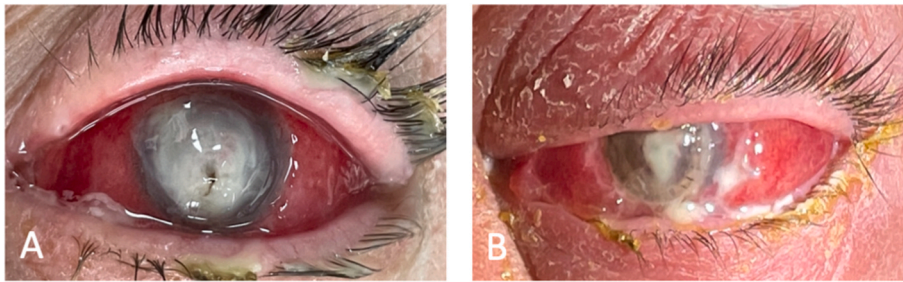
## 3. Discussion

This report describes two patients with methamphetamine use disorder who developed severe gram-positive keratitis, one of whom developed a concomitant endophthalmitis that ultimately required enucleation. In Case 1, diabetes could also contribute to the patient's keratopathy. The presentation of diffuse corneal opacification may represent limbal stem cell injury due to regional ischemia or the final stages of a severe ulcer. Methamphetamine intoxication can also lead to exacerbation of scratching and self-epilation, as seen in this patient. Furthermore, chronic methamphetamine usage has been observed to precede development of neurotrophic keratitis, as shown here, which decreases sensation and compromises healing, increasing susceptibility of the cornea to microbial infections.<sup>5</sup> In Case 2, the patient had a medical history significant for GVHD-associated dry eye but presented with infectious keratitis and endophthalmitis. Additional instances of concomitant ulcer infections and keratolysis have been reported in literature.<sup>2,6</sup> These cases emphasize the acuity and severity of methamphetamine-associated keratitis and secondary ocular complications.

Postulated explanations for the pathophysiology of methamphetamine-induced keratitis with superimposed infection include direct and route-related effects. Direct effects encompass phenomena such as catecholamine release, vasoconstriction, increased pain threshold, and decreased blink reflex.<sup>7</sup> Route-related effects include smoke-related eye irritation and hand-to-eye exposure.<sup>2</sup> While the presence of multiple underlying comorbidities could have contributed to the presentations described in this report, the temporal association between active methamphetamine use and acute corneal findings, along with the mechanism of action of methamphetamine, strengthens the concerning relationship between methamphetamine use and ophthalmic disease. As methamphetamine use disorder continues to become more widespread as a public health concern within the United States, further elucidation of the mechanisms behind these devastating ocular consequences as well as preventive and treatment strategies is needed.



**Fig. 1.** Case 1 on presentation and at follow-up. (A) External photograph of patient on presentation highlights hypotrichosis of the right eyelid. (B) External photograph showing madarosis of the left eyelid. There is erythema involving the superior and inferior eyelids and cicatricial ectropion of the lower eyelid. (C) At follow-up, slit-lamp photograph of the right eye shows conjunctival injection and a 3.5 mm epithelial defect with scarring. (D) At follow-up, slit-lamp photograph of the left eye shows a corneal opacity with scarring and neovascularization.



**Fig. 2.** Case 2 on presentation and following keratoplasty & vitrectomy.

(A) External photograph of the left eye shows diffuse conjunctival injection, diffuse necrotic-appearing corneal infiltrate with central ulceration, and a 2.5 mm central, curvilinear area of uveal exposure. The anterior chamber is poorly visible. The patient underwent a therapeutic penetrating keratoplasty and anterior vitrectomy with intravitreal antibiotics.

(B) Postoperatively, there is diffuse conjunctival injection and purulent material in the anterior chamber, along with diffuse periorbital edema. There is no view of the anterior chamber or posterior segment.

### Patient consent

The patients consented to publication of the case in writing.

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### Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

### CRediT authorship contribution statement

**Ye Huang:** Writing – original draft, Visualization. **Rao V. Chundury:** Investigation, Writing – review & editing. **Brent D. Timperley:** Investigation, Writing – review & editing. **Patricia A. Terp:** Investigation, Writing – review & editing. **Ronald R. Krueger:** Investigation,

Writing – review & editing, Funding acquisition. **Steven Yeh:** Conceptualization, Investigation, Supervision, Writing – review & editing, Project administration, Funding acquisition.

### Declaration of competing interest

The following authors have no financial disclosures: YH, RC, BT, PT, RK, SY.

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None.

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