Frozen corneas in the desert: a case report

Imran Ansari and Chris Canning

Moorfields Eye Hospital Dubai, PO Box 505054, Dubai, UAE

Corresponding address: Dr Imran Ansari, Moorfields Eye Hospital Dubai, PO Box 505054, Dubai, UAE.
Email: imran.ansari@moorfields.ae

Date accepted for publication 12 December 2011

Abstract

This is a rare case of freezing of the corneas in extremely cold conditions. A large proportion of the world's population inhabits areas where frequent exposure to subzero temperatures is common. Early recognition, appropriate referral and treatment of frozen corneas may help to minimize any potential complications that can develop later on, as well as reduce pain and suffering for the patient. A 39-year-old white man presented with a 48-h history of severe bilateral ocular pain, redness and photophobia. He denied any recollection of infection, trauma or foreign body entering the eyes, and his symptoms started after boarding a long-haul flight from Canada to the United Arab Emirates. During his stay in Canada the patient had frequently participated in winter sports, and right up until departure, had been exposed to an extremely cold outdoor environment. On examination he was found to have bilateral diffuse staining of the corneal epithelium. No other cause of such corneal injury could be found from the history or clinical examination, and his features were thought to be due to corneal freezing with subsequent thawing of tissue. He was started on intensive ocular lubricants, topical antibiotics, together with a mydriatic agent and topical non-steroidal anti-inflammatories. Subsequently his symptoms and visual acuity rapidly improved. After 1 week his unaided visual acuity was back to 6/6 and he was subsequently discharged. Freezing of the corneas is uncommon and occurs in individuals who have kept their eyes open in high-wind-chill and freezing temperatures without protective goggles. Soldiers, pilots, skiers, bicyclists, ice skaters, and snowmobilers and mountaineers are at particular risk. Treatment focuses on controlling inflammation and preventing secondary infection, and includes cycloplegia, eyelid closure with a dressing, topical lubricants, antibiotics and steroids. The prognosis is favourable provided there has been no damage deep to Bowman's layer. Severe keratitis may require lamellar and penetrating keratoplasty. Corneal freezing injuries should be kept in mind in emergency rooms particularly in areas where outside temperatures are extremely cold, and where members of the public are routinely exposed to high wind chill such as participants in winter sports and also military personnel. Educating these groups of people about potential injuries to cold is important for prevention of lasting permanent damage to the ocular structures and other tissues in the body.

Keywords

Cornea; injury; freezing.

This paper is available online at http://www.grandrounds-e-med.com. In the event of a change in the URL address, please use the DOI provided to locate the paper.
Introduction

Cold-related injuries exist on a spectrum of severity ranging from minor tissue injury to devastating injuries causing permanent damage to deep structures. Minor injury is often sustained as a result of prolonged exposure to cold conditions at non-freezing temperatures; it includes frostnip, chilblain and trench foot. Frostbite is caused by exposure to freezing conditions and implies severe damage to involved tissue[1].

Although temperature plays a key role in the severity of cold-related injuries, it is the duration of exposure to cold conditions that determines the extent of injury. In addition to temperature, other environmental factors contributing to cold-related injury include contact time, humidity, wind-chill factor, wind velocity, and wet skin. Host factors, such as lack of proper clothing, alcohol or drug intoxication, and malnutrition, also play a major role[1].

In addition to tissue injury of the extremities, other injuries associated with prolonged exposure to cold conditions need to be considered. Ophthalmologic injury such as corneal freezing and abrasions may occur in conditions of high wind chill and wind velocity. These injuries are more likely to occur in recreational sports such as snowmobiling and skiing[2]. Diagnosis requires adequate ophthalmologic evaluation with a slit lamp and fluorescein examination.

We highlight a case seen in Dubai, United Arab Emirates, where a patient suffered from severe bilateral corneal injury after prolonged exposure to extreme cold.

Case presentation

A 39-year-old white man presented to our clinic with a 48-h history of severe bilateral pain, redness and photophobia. He denied any recollection of infection, trauma or foreign body entering the eye, and his symptoms started soon after boarding a long-haul flight to Dubai where he resides.

There was a previous history of laser refractive surgery (LASIK) 7 years ago, but no other significant ocular history. Following LASIK he enjoyed excellent unaided visual acuity up until this episode. He denied the use of contact lenses. He was medically fit and well.

He was returning from a business trip in Canada at the end of which he spent 4 days on a winter sports holiday. Temperatures were extremely cold reaching −27°C, with very windy conditions. His activities including snow-mobiling and skiing, however he only used goggles occasionally when outdoors.

Before boarding his long-haul flight to Dubai, he had spent the morning snowboarding, again without the use of goggles. He made his way straight to the airport and his symptoms started soon after boarding. After a very uncomfortable flight he came straight to our clinic from the airport due to the severity of his symptoms.

On examination he was obviously uncomfortable and in distress. There was conjunctival injection and bilateral diffuse staining of the corneal epithelium, within the boundaries of the LASIK flaps (Figs. 1 and 2). The LASIK flaps were well aligned and centred and the interfaces were

Fig. 1. Epithelial defect in the left eye.
clear. There was no anterior chamber activity and the posterior segments were unremarkable. The upper lids were everted and no foreign body was visible. No other cause of such corneal injury could be found from the history or clinical examination, and it was thought to be due to corneal freezing with subsequent thawing of tissue leading to corneal epitheliopathy.

He was started on intensive ocular lubricants and topical antibiotics, together with a mydriatic agent and topical non-steroidal anti-inflammatories (NSAIDS). He was reviewed on a daily basis, and his symptoms and visual acuity rapidly improved. After 1 week his unaided visual acuity was back to 6/6 with no residual signs of corneal injury, and he was subsequently discharged.

**Discussion**

Freezing of the corneas is an uncommon injury reported to occur in individuals who have kept their eyes open in high-wind-chill situations and freezing temperatures without protective goggles. By the time most cold-damaged corneas are examined by an ophthalmologist the corneas, are no longer in a frozen state, and initial corneal flare and pain during rewarming are signs of this injury. Soldiers, pilots, skiers, bicyclists, ice skaters, and snowmobilers have all been observed with this condition. Other activities that are linked to this injury include mountaineering and snowboarding.

In addition to extreme environmental conditions, an impaired blinking reflex and incomplete closure of the eyelids during blinking due to a lowering of the surface temperature of the cornea are factors that are involved in corneal damage.

Treatment focuses on controlling inflammation and preventing secondary bacterial infection, and includes induced cycloplegia, eyelid closure with a dressing, topical lubricants, antibiotics and steroids/NSAIDS.

The overall prognosis is favourable as generally the injury is a superficial epithelial one, and as long as there has been no damage deep to Bowman’s layer, it almost universally heals with no scar within a week. Severe keratitis and corneal opacification however may require lamellar and penetrating keratoplasty depending on the amount of tissue destroyed.

It is not confirmed whether previous laser refractive surgery predisposes to this condition but other reviews have found corneal nerves are severed during the LASIK procedure producing an abnormal blink reflex. This may aggravate a pre-existing dry eye condition. It may therefore be prudent to warn patients undergoing refractive surgery, who reside in, or are regularly exposed to extreme cold and windy conditions to use adequate protective measures, such as goggles and suitable headgear when outside. Similarly, implications also arise for military personnel who operate in subzero conditions.

**Teaching points**

Corneal freezing injuries should be kept in mind in emergency rooms, particularly in areas with an extremely cold climate, and where members of the public or personnel are exposed to high
wind chill. Educating people who are exposed to extreme cold about potential injuries is important for prevention of lasting permanent damage to the eyes and other tissues in the body.

**Consent**

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

**Competing interests**

The authors declare that they have no competing interests.

**References**