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CASE REPORT

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Remarkable improvement of symptoms and signs of severe dry eye treated by ocular immersion hydrotherapy

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Key Clinical Message

Traditional treatment options are often insufficient in treating severe dry eyes caused by systemic diseases. This case demonstrates that ocular immersion hydrotherapy significantly alleviated symptoms and ocular surface inflammation in ocular graft-versus-host disease. Based on these findings, we propose it as a promising option for managing severe dry eye disease.

Abstract

This case report investigates the efficacy of ocular immersion hydrotherapy (OIH) in treating severe dry eye secondary to ocular graft-versus-host disease (oGVHD). A 35-year-old female with a history of acute myeloid leukemia-M2 and subsequent hematopoietic stem cell transplantation (HSCT) developed high-intensity oGVHD unresponsive to conventional treatments, including topical corticosteroids and lubricants. We introduced OIH, utilizing sterilized swimming goggles filled with intraocular irrigating solutions, providing a moist microenvironment for the ocular surface. Symptoms were significantly relieved after treatment. Corneal filaments and epithelial defects were significantly reduced, and in vivo confocal microscopy (IVCM) demonstrated resolution of inflammation and reappearance of corneal nerves. This case indicates that OIH could be a promising therapeutic approach for severe dry eye conditions arising from oGVHD, particularly for patients refractory to traditional treatments. Further studies are warranted to elucidate the long-term benefits and mechanisms of OIH in oGVHD management.

KEYWORDS

corneal epithelial cell damage, dry eye disease, ocular graft-versus-host disease, ocular immersion hydrotherapy, ocular surface inflammation

1 | INTRODUCTION

In patients with severe dry eye due to systemic diseases such as Stevens-Johnson syndrome and ocular graft-versus-host disease (oGVHD), chronic ocular surface inflammation combined with remarkably reduced aqueous secretion usually lead to refractory damage of corneal epithelium and immense eye discomfort.[1,2] Moreover,

traditional treatments including eyedrops and ointments often find it difficult to achieve good results.[2–4] Here, we report the treatment effect of ocular immersion hydrotherapy (OIH) for a case of refractory and severe dry eye secondary to oGVHD.

2 | CASE HISTORY

A 35-year-old woman was referred to our service with a 16-month history of bilateral blurred vision, and dry, gritty, red, and painful eyes. She had a history of hematopoietic stem cell transplantation (HSCT) 2 years ago because of acute myeloid leukemia-M2. She developed acute graft versus host disease grade 1 with skin involvement which was controlled with initial daily intravenous methylprednisolone 60 mg for 5 days, and subsequent oral prednisolone 1 mg/kg, tapered gradually. At about 280 days after HSCT, she developed oGVHD which was of high intensity and initially managed with oral cyclosporin and topical corticosteroids and lubricants.

In the following time, she went to multiple hospitals and received a combination of intense topical treatments, including once per hour topical use of lubrication eyedrops such as 0.1% sodium hyaluronate in the daytime, recombinant bovine basic fibroblast growth factor eye-gel four times per day, 0.05% cyclosporin A eyedrops three times per day, topical use of eye ointment before sleep at night, and periocular injection of triamcinolone 20 mg every 3 months. However, despite of effort mentioned above, her symptoms including ocular foreign body sensation, photophobia, difficulty in opening the eyes and blurred vision aggravated gradually.

3 | INVESTIGATIONS AND TREATMENT

By this time, her best corrected visual acuity (BCVA) had reduced to 0.03 in the right eye and 0.05 in the left. Both eyes had a Schirmer's value <5 mm. Slit-lamp examination showed bilateral conjunctival hyperemia, corneal filaments, and epithelial defect. A pair of swimming goggles was sterilized with 75% medical alcohol, then both eye cups were filled with commercial intraocular irrigating solutions (Shike, Shenyang Xingqi Pharmaceutical Co., Ltd., Shenyang, China). According to the instructions, the main components of the irrigating solutions include sodium chloride, potassium chloride, magnesium sulfate, sodium bicarbonate, glucose, and calcium chloride. By securing the straps, the swimming goggles were fastened onto the head, ensuring that both eyes were immersed in the solutions.

4 | OUTCOME AND FOLLOW-UP

The patient underwent 8-h/day treatment of OIH for both eyes in the daytime. Eye ointment was given at night. At 6 days posttreatment, her BCVA increased to bilateral 0.4, and it was 0.8 from the 9 days posttreatment on. She felt more comfortable gradually with wide-open eyes and alleviated photophobia and ocular pain. Sodium fluorescein staining of the cornea showed that corneal filaments disappeared after 8 days of consistent OIH treatment with a few small punctate corneal staining with sodium fluorescein (Figure 1).

In vivo confocal microscopy (IVCM) of the corneas revealed the detailed changes of the corneal epithelial lesions and subbasal nerve density before and after treatment (Figure 2). During her initial visit, IVCM showed the epithelial erosion with inflammatory cell infiltration and loss of corneal nerves in her right eye (A1 and A2) and reduction of nerve density with high reflective dots were noted in her left eye (A3 and A4). After two-week OIH treatment, the inflammation of her right eye resolved remarkably and corneal nerves could be detected again by IVCM (B1 and B2). In her left eye, subbasal nerves became much clear and high reflective dot structures which might represent inflammation disappeared completely (B3 and B4).

5 | DISCUSSION

The corneal epithelial layer constitutes the outermost layer of the cornea. Although it is only 50 microns thick, it plays a crucial role in protecting the eye from external harm and helping to refract light, providing the necessary conditions for clear vision.[5] The manifestation of oGVHD include dry eye, meibomian gland dysfunction, keratitis, and conjunctivitis.[1,2] These pathological processes often result in damage to the corneal epithelium and inflammation of the ocular surface. Therefore, patients with oGVHD not only suffer physically, but their vision is often also affected.

During the healing process of corneal injury, the corneal epithelial layer has multiple strategies to achieve effective wound healing, including angiogenesis and immune privilege, as well as mechanotransduction, which is largely dependent on limbal stem cells and the remodeling of the basement membrane.[5,6] The presence of an adequate level of reactive oxygen species (ROS) during corneal epithelium wound healing is considered to be beneficial for accelerating cell proliferation. Conversely, excessive ROS can hinder the repair process of epithelial tissue by inhibiting cell migration and proliferation.[7] Patients with oGVHD often have difficulty healing their corneal epithelial injuries, which may

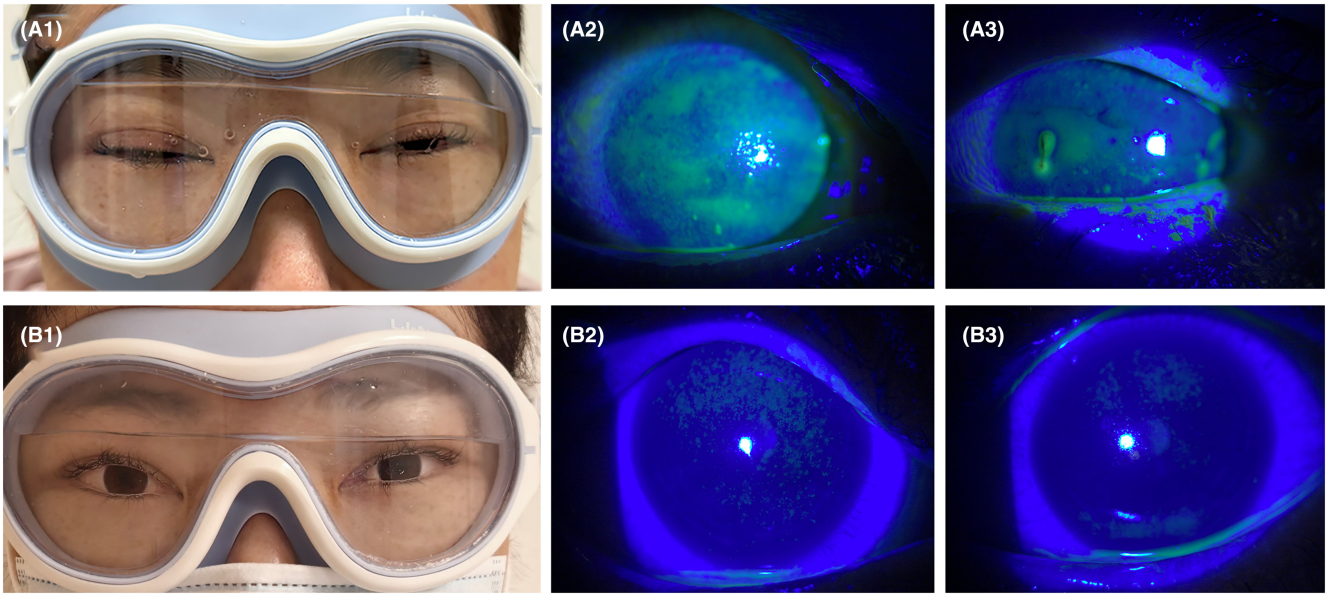

FIGURE 1 Photograph of the patient with swimming goggles filled with intraocular irrigating solutions at baseline (A1) and 8 days after OIH treatment (B1), and fluorescein staining of corneas of the patient at baseline (right eye: A2; and left eye: A3) and 8 days after OIH treatment (right eye: B2; and left eye: B3).

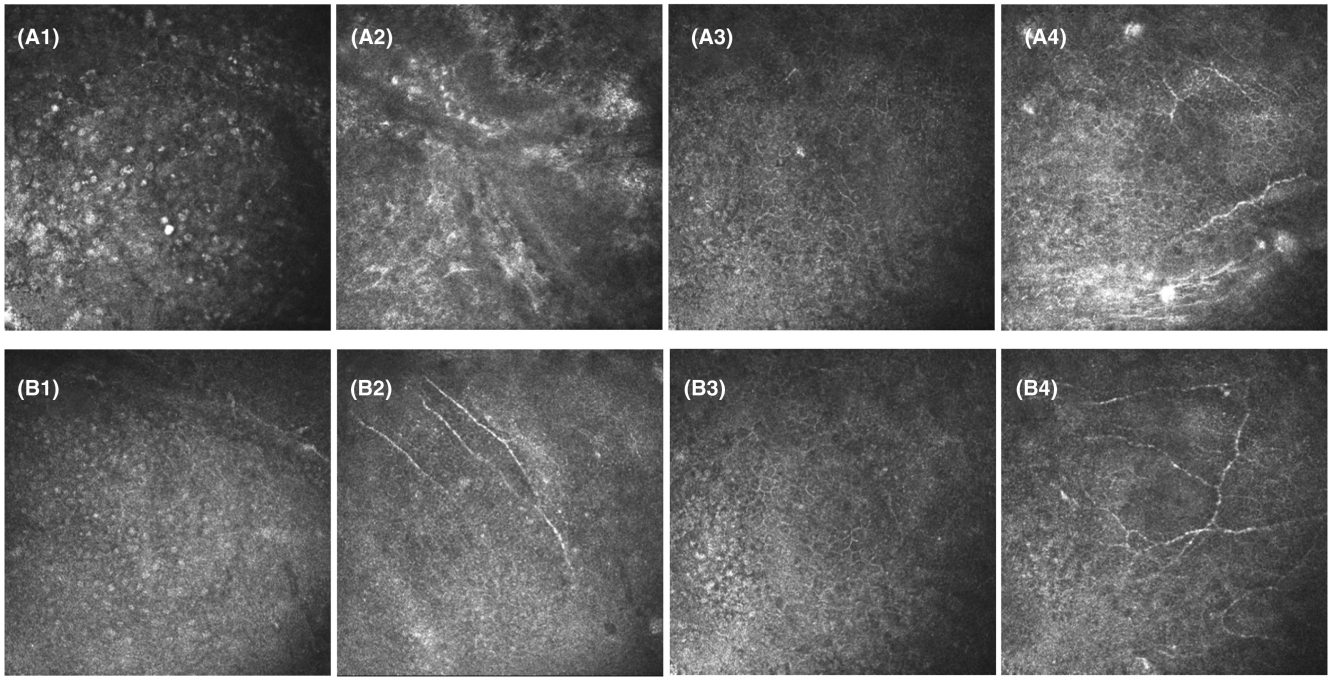

FIGURE 2 In vivo confocal microscopy of the corneas of the patient at baseline (right eye: A1 and A2; and left eye: A3 and A4) and 2 weeks after OIH treatment (right eye: B1 and B2; and left eye: B3 and B4).

be related to the excessvive ROS caused by dry ocular surface environment, continuous mechanical stimulation, and elevated inflammation levels.

In studies of skin healing, it was found that healing in a moist environment accelerates the epithelialization process.[8,9] This discovery inspired us to use OIH to treat corneal epithelial defect in severe oGVHD. In this case, ocular hydrotherapy provide the ocular surface with a mild microenvironment, including water, electrolytes, and glucose, which relieved the dry state of the ocular surface and make it possible for inflammatory factors to be diluted. And the aforementioned mechanism is postulated

to be the means through which OIH exerts its therapeutic efficacy.

Despite the fact that the patient did use eye ointment at night, OIH was the only treatment during the study in day time. We attributed the treatment effect to the OIH because the patient had been given ointment along with eye drops before OIH treatment, but her symptoms had not resolved. It was only after the initiation of OIH treatment that the patient experienced relief of symptoms.

Therefore, the remarkable improved short-term outcome of the present case showed that OIH swimming goggles may serve as a promising choice for the treatment of severe dry eye secondary to oGVHD, especially those patients who failed to get benefits from conventional treatments. Further studies are warranted to elucidate the long-term benefits and mechanisms of OIH in oGVHD management.

AUTHOR CONTRIBUTIONS

Yong Tao: Conceptualization; data curation; methodology; writing – original draft; writing – review and editing. **Haoran Cui:** Data curation; investigation. **Shuang Zhang:** Data curation; investigation. **Tao Zhang:** Writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors report there are no competing interests to declare.

DATA AVAILABILITY STATEMENT

Data available on request from the authors.

ETHICS STATEMENT

This study conformed to the provisions of the Declaration of Helsinki and was approved by Institute Review Board (IRB) and Ethnics Committee of Beijing Chaoyang Hospital, Capital Medical University. Written informed consent was obtained from the patient prior to the treatment of this case report.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

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