Optometry & Contact Lenses · Vol. 5, No. 1, pp. 12-15, 2025
https://doi.org/10.54352/dozv.EDPD1996
Published online in English as Open Access: 30.12.2024

Moxifloxacin induced corneal edema

Naida Jakirlic[1,2], Philip Kwok[1,2]

[1] OD, FAAO • [2] Western University of Health Sciences, College of Optometry, Pomona, CA, USA

Received 14 September 2024; accepted 23 October 2024

Abstract

Purpose. This case report describes a case of acute unilateral central corneal edema in a patient undergoing treatment with topical moxifloxacin 0.5% ophthalmic solution for bacterial keratitis secondary to contact lens wear.

Material and Methods. During a problem-focused exam of an acute red eye, clinical examination with a Haag Streit slit lamp and sodium fluorescein dye revealed a 3×3 mm corneal ulcer and associated anterior chamber reaction in the left eye. The patient was started on moxifloxacin 0.5% ophthalmic solution q1h OS and cyclopentolate 1% TID OS. On day 3, there was 95% re-epithelialization of the corneal ulcer and significant improvement in symptoms. Unexpectedly, the patient's best corrected visual acuity in the left eye deteriorated from baseline due to new onset central corneal edema. Moxifloxacin was discontinued and the patient was started on ciprofloxacin 0.3% ophthalmic solution QID OS and instructed to return to office in 2 days for follow-up.

Results. On day 5, there was complete epithelialization of the corneal ulcer with a resolving subepithelial infiltrate. The central stromal edema and anterior chamber reaction were completely resolved.

Conclusion. Acute corneal stromal edema is a possible side-effect of topical moxifloxacin use. Eye care providers must be aware of this potential side-effect when making therapeutic decisions for bacterial keratitis treatment.

Keywords

corneal edema, corneal ulcer, moxifloxacin, keratitis, contact lenses

Introduction

A 26 year old female patient presented with acute onset of ocular pain, redness, photophobia, and tearing in the left eye. The patient reported onset of symptoms 1 day prior to presentation. She denied history of ocular trauma. She reported wearing her habitual soft contact lenses prior to onset of symptoms. She reported good contact lens hygiene and denied sleeping in the contact lenses. She denied any prior history of similar symptoms. The patient's overall systemic health was unremarkable, and she denied taking any systemic medications.

Results

On Day 1, Snellen distance visual acuity with the patient's habitual spectacle prescription (−6.25 −1.00 × 008 OD, −6.25 −0.50 × 180 OS) was 20/20 OD and OS. Pupils were round and briskly reactive to light in both eyes with a negative afferent pupillary defect (APD). Extraocular motilities were full in all fields of gaze. Slit lamp examination of the right eye was unremarkable. Slit lamp examination of the left eye revealed grade 3 diffuse conjunctival injection, a 3 × 3 mm corneal epithelial defect that stained intensely with sodium fluorescein dye with an underlying dense subepithelial infiltrate (**Figure 1**), and a grade 3 anterior chamber reaction. The patient was extremely photophobic at this visit, therefore Goldmann Applanation Tonometry was deferred. The patient was diagnosed with bacterial keratitis secondary to contact lens wear. The patient was started on moxifloxacin 0.5% ophthalmic solution every hour in the left eye and cyclopentolate 1% ophthalmic solution three times a day in the left eye. She was advised to throw away her contact lenses and contact lens case and was advised not to use contact lenses until her corneal ulcer resolved.

On Day 3, the patient presented with significant improvement in symptoms. Slit lamp examination revealed 95% epithelialization and a persistent subepithelial infiltrate. There was a grade 1 anterior chamber reaction, demonstrating significant improvement in inflammation with topical antibiotic use. However, slit lamp examination revealed a new 2 × 2 mm round area of corneal stromal haze and endothelial folds on the patient's visual axis in the left eye, which explained the patient's drop in best corrected visual acuity at this visit (which was 20/30 OS). Goldmann Applanation Tonometry was 12 mmHg OS. Moxifloxacin 0.5% was discontinued, and Ciprofloxacin 0.3% ophthalmic solution was started QID in the left eye. The patient was advised to continue cyclopentolate TID OS and was scheduled to return to office in 3 days.

On Day 5, the patient's Snellen distance visual acuity in the left eye returned to its baseline of 20/20 with her habitual spectacle correction. Slit lamp examination revealed complete epithelialization of the left cornea. There was a persistent but significantly fainter subepithelial infiltrate present. The central stromal edema and anterior chamber reaction were completely resolved. Ciprofloxacin and cyclopentolate were discontinued at this visit and the patient was advised to return to office in 1 week.

On Day 13, the patient was completely asymptomatic. Snellen distance visual acuity using the patient's habitual spectacle prescription was 20/20 OD and OS. Slit lamp examination in the left eye revealed a faint 3 × 3 mm subepithelial scar (**Figure 2**). There was no sodium fluorescein staining of the cornea and the anterior chamber was clear of cells and flare. Goldmann Applanation Tonometry was 12 mmHg OD and 11 mmHg OS. The patient was advised to return to office at her convenience for a contact lens re-fitting to ensure optimal corneal health.

Discussion

Fourth generation fluoroquinolones are broad-spectrum bactericidal antibiotics that interfere with bacterial DNA gyrase and topoisomerase IV, preventing bacterial DNA repli-

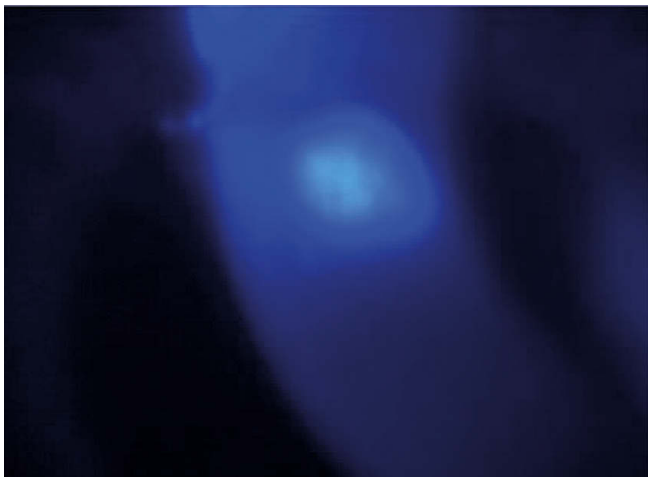

Figure 1: On Day 1, there was a 3 × 3 mm dense corneal subepithelial infiltrate with an overlying epithelial defect that stained intensely with fluorescein sodium dye.

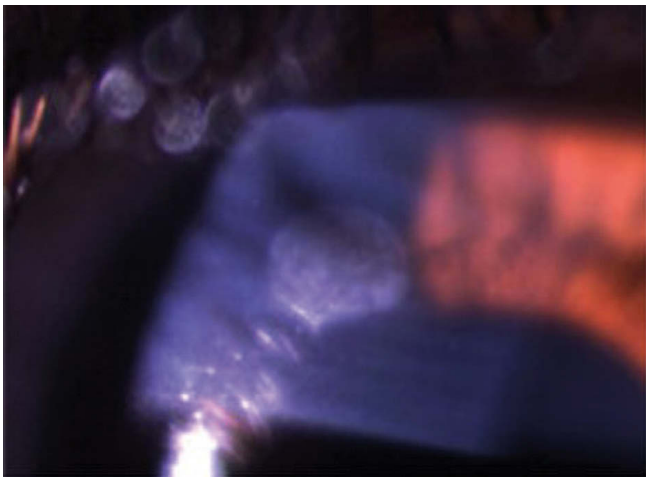

Figure 2: On Day 13 there was a 3 × 3 mm faint subepithelial scar and fully intact epithelium without sodium fluorescein staining present.

cation and subsequent death.[1-4] Treatment of uncomplicated non-central corneal bacterial ulcers with fluoroquinolones is the current standard of care and is preferred over combination of fortified cefazolin sodium 5% and tobramycin sulfate 1.3%.[5] Third generation fluoroquinolones like ciprofloxacin and ofloxacin were found to be equally effective in bacterial keratitis management compared to fourth-generation fluoroquinolones.[5]

Although topical and intracameral applications of fluoroquinolones have shown to be minimally disruptive to corneal tissue, several in-vivo and in-vitro studies have demonstrated cytotoxicity to corneal epithelial and endothelial cells. Kaufman and colleagues demonstrated that moxifloxacin 0.5% had greater degree of corneal epithelial cell dropout compared to gatifloxacin 0.3% despite being preservative-free.[6] They postulated that increased cytotoxicity may be caused by the higher concentration of fluoroquinolone molecules, leading to decreased collagen type IV expression and epithelial tight junction loss.[6] Similar findings were reported by Stern and colleagues.[7] Matsumoto also reported that at higher concentrations, moxifloxacin was a stronger inhibitor of corneal epithelial cell migration compared to other fluoroquinolones.[2]

While there is limited literature on the effects of topical moxifloxacin on corneal epithelial health, there exist even fewer publications on its effects on corneal endothelial function. Vignesh and colleagues described a case report of severe corneal edema in a 10-year old patient after a 3-day course of topical 0.5% moxifloxacin therapy for bacterial conjunctivitis that resolved after discontinuation of the medication.[8] They postulated that the corneal edema may have been caused by the medication's inhibition of collagen IV synthesis and damage to Descemet's membrane.[8] Similarly, Akal and colleagues reported a study that demonstrated in-vitro cytotoxicity to corneal endothelial cells, resulting in Descemet's folds and stromal edema.[9] Park and colleagues demonstrated that the cytotoxicity of moxifloxacin on human corneal endothelial cells is concentration-dependent.[3] They reported that moxifloxacin resulted in damage of endothelial cell membranes and led to apoptosis and necrotic cell death.[3] Janti reported that the toxicity of moxifloxacin may be due to inhibition of collagen IV synthesis, leading to damaged Descemet's membrane and breaks in corneal epithelial tight junctions.[10] Walter and colleagues reported a case of acute Descemet's membrane folds and stromal edema with initiation of moxifloxacin which resolved after discontinuation of medication.[11]

In the case report described by the present authors, frequent use of topical 0.5% moxifloxacin did not inhibit corneal epithelial healing as the patient demonstrated 95% re-epithelialization two days after initiating 0.5% moxifloxacin q1h in the left eye. However, the patient did develop acute central corneal stromal edema resulting in a noticeable drop in visual acuity despite improving symptoms and clinical presentation of the bacterial ulcer. Because the patient did not report any prior history of herpes simplex disease manifestation and had intact and symmetric corneal sensation, there was very little suspicion for an underlaying herpetic etiology of the acute corneal edema. Toxic effects of moxifloxacin 0.5% on the corneal endothelium were essentially proven after there was rapid and complete resolution of corneal stromal edema with discontinuation of the medication. This case adds to the limited literature on the possible cytotoxic side-effects of topical moxifloxacin on corneal endothelial health in a very substantial way.

Conclusions

Bacterial keratitis is an ocular emergency that must be treated with aggressive topical antimicrobial therapy. For low-risk ulcers, frequent application of fourth-generation fluoroquinolones is sufficient therapy that has demonstrated good patient outcomes. Microbial keratitis is unlikely to cause acute stromal edema in a corneal location that is not immediately adjacent to the ulcer, therefore one must consider the possibility of toxic medicamentosa as a possible etiology. This case report demonstrates rapid resolution of stromal edema after discontinuation of topical moxifloxacin therapy, which gives additional evidence to previously published literature on this possible side-effect of topical moxifloxacin that all eyecare providers should be aware of. The authors suggest adding this side-effect to moxifloxacin drug labels for increased awareness.

Conflict of interest

The authors declare that there is no conflict of interests regarding the methods and devices mentioned in the article.

Corresponding Author

Dr. Naida Jakirlic

E-Mail:
njakirlic@westernu.edu

References

1 Alshamrani, A. A., Alharbi, S. S. (2019). Corneal deposits following topical moxifloxacin use. Saudi J. Ophthalmol., 33, 163-164.

2 Matsumoto, S., Way, W., Tarlo, K., Short, B. (2006). Comparative Toxicity of Fluoroquinolone Antibiotics on Corneal Cells in Vitro. Cornea, 25, S1-S7.

3 Park, J. H., Kim, M., Chuck, R. S., Park, C. Y. (2021). Evaluation of moxifloxacin-induced cytotoxicity on human corneal endothelial cells. Sci. Rep., 11, 6250.

4 Tsai, T. H., Chen, W. L., Hu, F. R. (2010). Comparison of fluoroquinolones: cytotoxicity on human corneal epithelial cells. Eye, 24, 909-917.

5 Sharma, N., Goel, M., Bansal, S., Agarwal, P., Titiyal, J. S., Upadhyaya, A. D., Vajpayee, R. B. (2013). Evaluation of Moxifloxacin 0.5% in Treatment of Nonperforated Bacterial Corneal Ulcers. Ophthalmology, 120, 1173-1178.

6 Kaufman, S. C., Rusinek, C., Salahuddin, A., Ahee, J., Prasad, A. (2006). Comparison of the Biocompatibility of Gatifloxacin 0.3% and Moxifloxacin 0.5%. Cornea, 25, S31-S34.

7 Stern, M. E., Gao, J., Beuerman, R. W., Farley, W., Zhuo, L., McDonnell, P. J., Pflugfelder, S. C. (2006). Effects of Fourth-Generation Fluoroquinolones on the Ocular Surface, Epithelium, and Wound Healing. Cornea, 25, S12-S24.

8 Vignesh, A. P., Srinivasan, R., Karanth, S. (2015). A Case Report of Severe Corneal Toxicity following 0.5% Topical Moxifloxacin Use. Case Rep. Ophthalmol., 6, 63-65.

9 Akal, A., Ulas, T., Goncu, T., Guldur, M. E., Kocarslan, S., Taksin, A., Savik, E., Ozkan, U., Karakas, E. Y., Koksal, M., Aksoy, N. (2015). Does moxifloxacin alter oxidant status in the cornea? An experimental study. Cutan. Ocul. Toxicol., 34(2), 139-143.

10 Janti, S. S., Shinisha, D. P., Sudhakar, S. K. (2021). Moxifloxacin induced keratopathy. Indian J. Clin. Exp. Ophthalmol., 7(3), 594-595.

11 Walter, K., Tyler, M.E. (2006). Severe Corneal Toxicity After Topical Fluoroquinolone Therapy. Cornea, 25, 855-857.