Comparison of anterior segment optical coherence tomography findings in acanthamoeba keratitis and herpetic epithelial keratitis

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Abstract

This study is to investigate the characteristic features of Acanthamoeba keratitis (AK) that differentiating it from herpetic epithelial keratitis (HEK) using anterior segment optical coherence tomography (AS-OCT). Medical records of three eyes of each AK and herpetic keratitis who had AS-OCT examination were reviewed in this study. Slit-lamp biomicroscopy and AS-OCT was performed on the initial visit and on every follow-up visits in all patients. In all three AK cases, reflective bands in the corneal stroma that correspond to the area of radial keratoneuritis were observed. The depth of the reflective bands varied in each case. After AK treatment, slit-lamp biomicroscopy confirmed that radial keratoneuritis had resolved and AS-OCT confirmed that reflective bands in the corneal stroma had also disappeared in all patients. Unlike the AS-OCT results found in AK, highly reflective HEK lesions were observed only in the subepithelial area, not in the stroma. AS-OCT seems to be helpful analyzing the specific depth of the lesion which enables to distinguish AK from HEK.

KEYWORDS: acanthamoeba; optical coherence tomography; herpes; herpetic keratitis

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INTRODUCTION

Although acanthamoeba keratitis (AK) is relatively uncommon, when its diagnosis is delayed or incorrect, it can cause severe ocular damage. Recently, it was found that the main cause of AK is the improper use of contact lenses, including soft contact, hard contact, and orthokeratology lenses[1-2]. The clinical manifestations of AK include severe pain, corneal epithelial defect, corneal haze, and the most characteristic manifestation, radial keratoneuritis[3]. Although AK presents with characteristic signs, it is known to mimic herpetic epithelial keratitis (HEK)[4]. A definitive AK diagnosis is made by confirming its cytopathology using specific staining or culturing, a time-intensive process[4].

High-resolution anterior-segment optical coherence tomography (AS-OCT) allows the non-contact measurement and non-invasive imaging of microscopic structures, including the epithelium, Bowman layer, stroma, Descemet membrane, and endothelium[5-11]. Yamazaki et al[3] reported that AS-OCT provides novel and detailed visual information about radial keratoneuritis in patients with early-stage AK.

The purpose of this study was to investigate the characteristic features of AK that differentiating it from HEK using AS-OCT.

SUBJECTS AND METHODS

This study adheres to the tenets of the Declaration of Helsinki. Written informed consent was obtained from all patients. The medical records of three patients with AK and three with herpetic keratitis were reviewed in this study, such that each group was composed of three eyes. All patients were examined using AS-OCT (Spectralis; Heidelberg Engineering, Heidelberg, Germany) with an anterior segment module that uses raster and single-scan with high-resolution acquisition at a speed of 40 000 A-scans per second, an axial resolution of 3.9 to 7 μm, and a transverse resolution of 1 μm. Slit-lamp biomicroscopy and AS-OCT was performed on all patients during the initial and every subsequent follow-up visit.
RESULTS

Acanthamoeba Keratitis Patients Table 1 summarizes the characteristics, clinical ocular histories, and treatments for all AK patients. The use of soft contact lenses was the cause of AK for all the patients. A definitive diagnosis of AK was confirmed by plate culturing tissue obtained by corneal scraping. The corneal tissue was placed onto the center of a 1.5% non-nutrient agar plate covered with a lawn of *Escherichia coli*. Plates were sealed with parafilm, incubated at 30°C, and screened by inverted phase contrast microscopy.

In all cases, patients were initially treated with 100 mg of oral itraconazole, topical 0.02% polyhexamethylene biguanide (PHMB) and 0.02% chlorhexidine. Clinical outcomes were fair with visual recovery in all AK cases.

In all three AK cases, we observed reflective bands in the corneal stroma that corresponded to the area of radial keratoneuritis. Figures 1A, 2A, and 3A demonstrate these reflective bands in AS-OCT images. After AK treatment, radial keratoneuritis disappeared in slit-lamp biomicroscopy, and reflective bands in the corneal stroma disappeared in AS-OCT.

### Table 1 Characteristics, clinical ocular histories and treatments of AK patients

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex/age</th>
<th>Laterality</th>
<th>Risk factor</th>
<th>Slit lamp exam</th>
<th>Culture</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F/15</td>
<td>OS</td>
<td>SCL</td>
<td>Pseudodenrites, radial keratoneuritis, subepithelial infiltration, conjunctival injection</td>
<td>Cyst</td>
<td>Epithelial debridement, topical 0.02% hexamedine, topical 0.02% PHMB, oral itraconazole</td>
<td>Good</td>
</tr>
<tr>
<td>2</td>
<td>F/18</td>
<td>OD</td>
<td>Cosmetic SCL</td>
<td>Pseudodenrites, radial keratoneuritis, subepithelial infiltration, conjunctival injection</td>
<td>Cyst</td>
<td>Epithelial debridement, topical 0.02% hexamedine, topical 0.02% PHMB, oral itraconazole</td>
<td>Good</td>
</tr>
<tr>
<td>3</td>
<td>F/18</td>
<td>OS</td>
<td>SCL</td>
<td>Pseudodenrites, radial keratoneuritis, subepithelial infiltration, conjunctival injection</td>
<td>Cyst</td>
<td>Epithelial debridement, topical 0.02% hexamedine, topical 0.02% PHMB, oral itraconazole</td>
<td>Good</td>
</tr>
</tbody>
</table>

SCL: Soft contact lenses; PHMB: Polyhexamethylene biguanide.
that reflective bands in the corneal stroma had also disappeared in all patients (case 1: Figure 1B; case 2: Figure 2B; case 3: Figure 3B).

**Herpetic Epithelial Keratitis Patients** Unlike the AS-OCT results found in AK, highly reflective HEK lesions were observed only in the subepithelial area, not in the stroma (Figure 4). In some patients, we observed corneal epithelial irregularity using slit-lamp biomicroscopy and AS-OCT. Table 2 summarizes the characteristics, treatment process and results of the HEK patients.

**DISCUSSION**

Solely using slit-lamp biomicroscopy examination to clinically diagnose AK is limited, especially at the early phase of the disease. Among other anterior segment features, radial

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**Table 2 Characteristics, clinical ocular histories and treatments of HEK patients**

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex/age</th>
<th>Laterality</th>
<th>Risk factor</th>
<th>Slit lamp exam</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M/42</td>
<td>OD</td>
<td>Ankylosing spondylitis</td>
<td>Dendritic ulcer, subepithelial infiltration, conjunctival injection</td>
<td>Topical acyclovir ointment</td>
<td>Good</td>
</tr>
<tr>
<td>2</td>
<td>M/83</td>
<td>OD</td>
<td>Old age DM HTN</td>
<td>Dendritic ulcer, subepithelial infiltration with surface irregularity, conjunctival injection</td>
<td>Topical acyclovir ointment</td>
<td>Subepithelial opacity</td>
</tr>
<tr>
<td>3</td>
<td>M/70</td>
<td>OD</td>
<td>HTN</td>
<td>Geographic ulcer, subepithelial infiltration with surface irregularity, conjunctival injection</td>
<td>Topical acyclovir ointment, artificial tear</td>
<td>Subepithelial opacity with surface irregularity</td>
</tr>
</tbody>
</table>

DM: Diabetes mellitus; HTN: Hypertension; HEK: Herpetic epithelial keratitis.
Reflective bands in the corneal stroma that present with radial keratoneuritis, which can be seen using AS-OCT, can be useful to distinguish AK from herpetic keratitis. However, because keratoneuritis is also a characteristic of other diseases than AK, further information, such as a detailed medical history about contact lens use, severe ocular pain, and other symptoms of AK, are necessary for an AK diagnosis. Because this study only included a small number of patients, future studies with a larger number of AK patients are necessary.

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Authors' contributions: Kim SJ and Park YM were responsible for obtaining consent, acquiring the data and drafting the manuscript. Yoo JM, Park JM, Seo SW and Chung YI participated in patient care and helped establish the final clinical diagnosis. Lee JS and Kim SJ critically revised the manuscript. All authors read and approved the final version of the manuscript.

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