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Spectral Domain Anterior Segment Optical Coherence Tomography in Microbial Keratitis

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Abstract: ***Purpose: To investigate the spectral domain anterior segment optical coherence tomography (SDAS-OCT) parameters in microbial keratitis. Design: Prospective, cross-sectional, observational study. Methods: Thirty eyes of 30 patients with proven microbial keratitis (fungal, bacterial and viral), at different stages of the disease, underwent SDAS-OCT imaging. Results 12 eyes were diagnosed with proven fungal keratitis, 10 eyes with proven bacterial keratitis and 8 eyes with proven of viral keratitis. Different types of SDAS-OCT presentations of microbial keratitis were found in this study. Conclusion: SDAS-OCT imaging provided a range of characteristic patterns that could be used as an additional tool in management and assessing the response to treatment of microbial keratitis.***

Keywords: Spectral Domain Anterior Segment Optical Coherence Tomography (SDAS-OCT), Microbial Keratitis

1. Introduction

Microbial keratitis is a sight-threatening process. A particular feature of bacterial keratitis is its rapid progression; corneal destruction may be complete in 24-48 hours with some of the more virulent bacteria. Corneal ulceration, stromal abscess formation, surrounding corneal edema, and anterior segment inflammation are characteristic of this disease.

Interruption of an intact corneal epithelium and/or abnormal tear film permits entrance of microorganisms into the corneal stroma, where they may proliferate and cause ulceration. During the initial stages, the epithelium and stroma in the area of injury and infection swell and undergo necrosis. Acute inflammatory cells (mainly neutrophils) surround the beginning ulcer and cause necrosis of the stromal lamellae.

The most common groups of bacteria responsible for bacterial keratitis are as follows: Streptococcus, Pseudomonas, Enterobacteriaceae (including Klebsiella, Enterobacter, Serratia, and Proteus), and Staphylococcus species.

Up to 20% of cases of fungal keratitis (particularly candidiasis) are complicated by bacterial coinfection.

Anterior segment optical coherence tomography (AS-OCT) was recently developed and has become a crucial tool in clinical practice. AS-OCT is a noncontact imaging device that provides the detailed structure of the anterior part of the eyes. In this review, we will discuss the various clinical patterns of AS-OCT in microbial keratitis mainly fungal and bacterial keratitis.

2. Methodology

This study was approved by the local Research Ethics Committee and informed consent was obtained from all patients. A clinical diagnosis of bacterial keratitis was made in the presence of a typical history and SLBE. Patients with a history and clinical findings suggestive of a viral keratitis or hypersensitivity type corneal ulceration were not recruited. Bacterial keratitis was considered resolved if the epithelial defect and signs of inflammation resolved completely. Recruited patients who did not respond to antibacterial treatment were excluded.

On fluroscein staining we found stain uptake in all 30 cases. In 12 cases uptake was in irregular pattern suggestive of bacterial keratitis, in 10 cases it was irregular with satellite lesion suggestive of fungal keratitis. In 6 cases there dendritic and SPK suggestive of herpes virus and in 2 cases only SPK present suggestive of adenovirus.

Corneal sensations were checked using cotton swab and it was decreased in 8 cases and increased in 22 cases. Diagnosis was confirmed by Corneal scraping for gram's stain, ZN stain, KoH stain, Geimsa and so we had 12 bacterial keratitis, 10 fungal keratitis and 8 viral keratitis.

Anterior segment imaging was carried out by OCT tomography (Topcon :3D OCT-1MAESTRO). AS-OCT imaging and clinical slit-lamp examination were carried out on presentation (day 0) and subsequently on days 3, 7, and 14 of treatment. All patients underwent treatment based on clinical findings and requirements. Standard antibacterial treatment was intensive Moxifloxacin 0.5% and natamycin 5% to the affected eye. Antibiotics were instilled at an hourly frequency for 48 hours, then reduced to two hourly for a further 48 hours. The frequency was then reduced to six hourly for a total treatment period of two weeks.

A standardized scanning protocol was used. At all visits high-resolution AS-OCT scans were carried out through the same area of corneal infiltration with the scanning beam running through the center of the infiltration at a defined axis. Corneal infiltration on the AS-OCT images was defined as the hyper-reflective area that corresponded to the clinical corneal infiltration. CT, IT, and IW were

measured with caliper tools of the OCT tomography software (Topcon, version 1.2.5; 3D OCT-1MAESTRO). CT was measured in the center of the infiltration with one caliper arm on the most anterior hyper-reflective corneal surface and the second arm on the hyper-reflective endothelium. IT, also in the center of the infiltration, was measured with one caliper arm on the most anterior hyper-reflective corneal surface and the second arm on the posterior border of the hyper-reflective area. IW was measured by placement of the caliper arms on the transverse borders of the hyper-reflective area.

3. Results

30 patients with proven microbial keratitis, at different stages of the disease, underwent SDAS-OCT imaging.

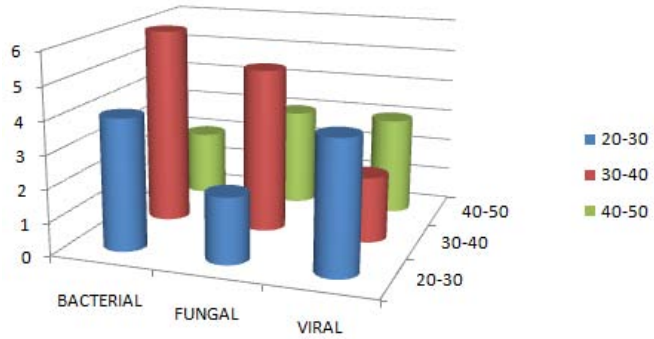

Chart 1: Age distribution in patients with different types of keratitis.

Table 1: SDAS-OCT pattern in different types of keratitis

SDAS-OCT pattern	*Bacterial keratitis*	*Fungal keratitis*	*Viral keratitis*
Epithelial defect	12	10	8
Hyperreflective stromal lesion	10	10	3
Stromal edema	7	5	3
Stromal thinning	1	2	0
Scar with intact epithelium on top without stromal thinning	2	2	0

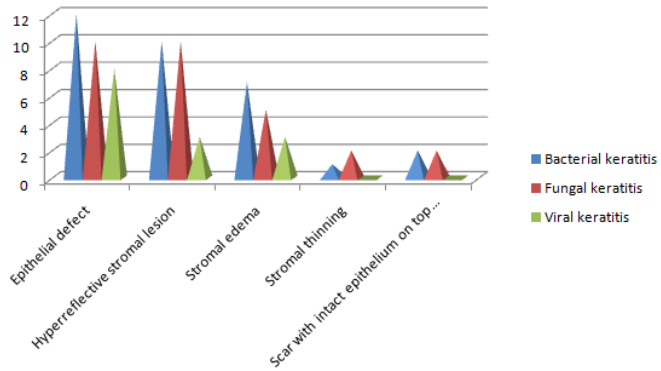

Chart 2: SDAS-OCT pattern in different types of keratitis.

4. Discussion

In clinical situations, the necrotic lesion and area of infiltration are not usually clear in microbial keratitis. Thus, it is easy for the cornea perforation and resection to become incomplete, and the recurrence of keratitis in severe cases needed surgical intervention [1]. In our study we found Epithelial defect, Hyperreflective stromal lesion, Stromal edema, stromal thinning, Scar with intact epithelium on top without stromal thinning.Fortunately, the use of OCT allows the objective measurement of the corneal thickness and is an additional method for following microbial keratitis with greater accuracy compared to biomicroscopy alone [2]. Soliman et al. [3] reported that fungal keratitis grasped two unique patterns of early localized and diffuse necrotic stromal cystic spaces. Sun et al. [1] suggested that the removal of the necrotic tissue combined with conjunctival flap under the guidance of AS-OCT in the treatment of fungal keratitis is a safe and effective method.

Conventional follow-up of infectious keratitis by slit lamp is based on measuring the extent of the epithelial defect and the infiltrate and in taking serial photographs. Using AS-OCT, we can objectively measure certain data that cannot be obtained in the slit lamp examination, such as depth of the infiltrate, thinning of the stroma in the region of the ulcer, whether in the active phase or in the assessment of the sequelae, and the depth of an endothelial plaque. All this is important for objectively analyzing the response to treatment (4).

5. Conclusion

SDAS-OCT imaging provided a range of characteristic patterns that could be used as an additional tool in diagnosis and management of keratitis.

References

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Figures

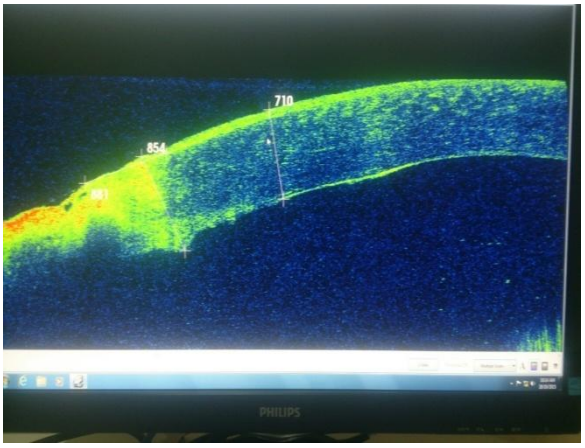

Figure a: IT and IW of stromal lesions

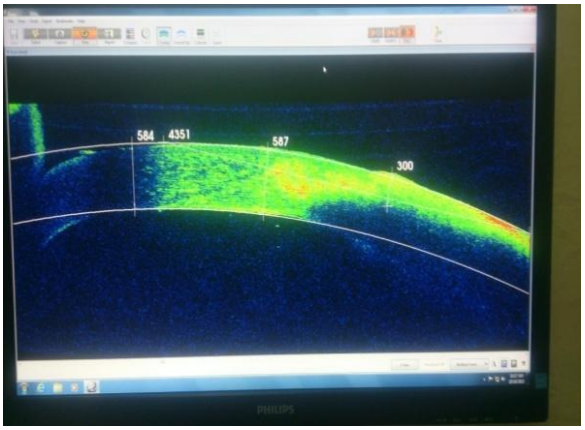

Figure b: IT and IW of stromal lesions

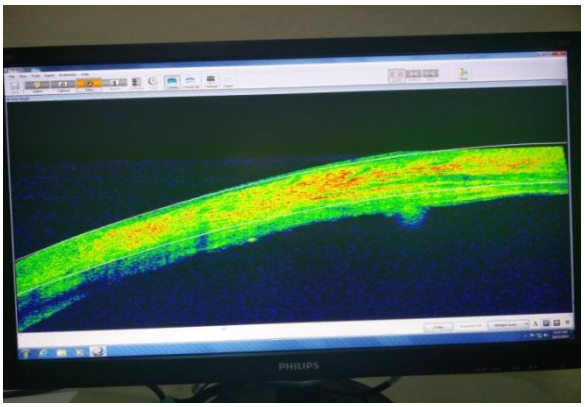

Figure c: Stromal oedema.

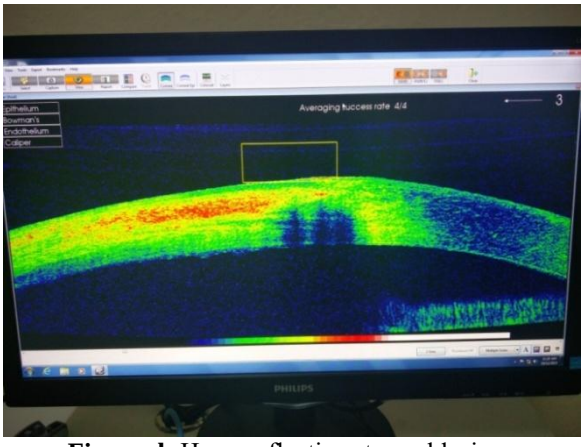

Figure d: Hyperreflective stromal lesion.

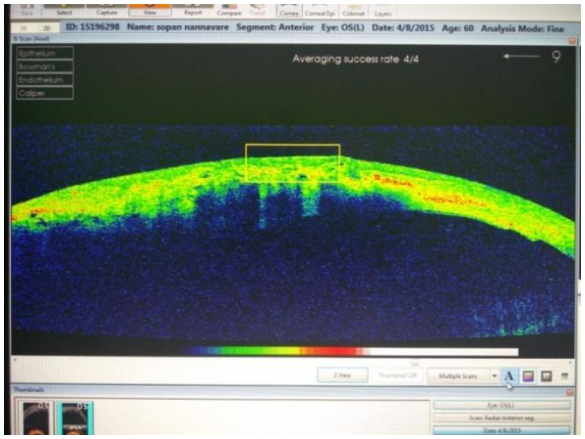

Figure e: stromal thinning.

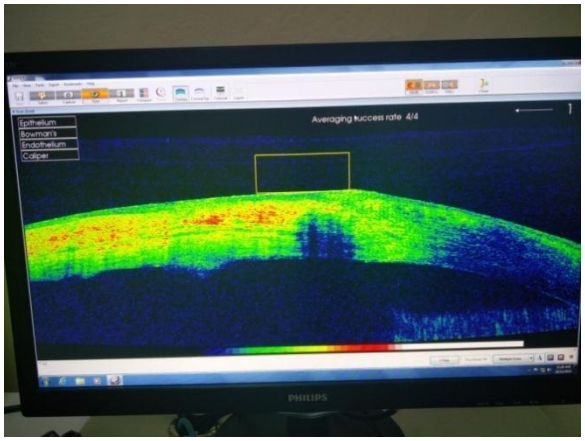

Figure f: Scar with intact epithelium and without stromal thinning

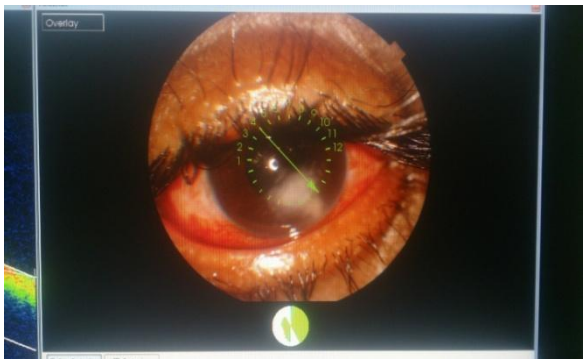

Figure A: Shows Corneal Ulcer

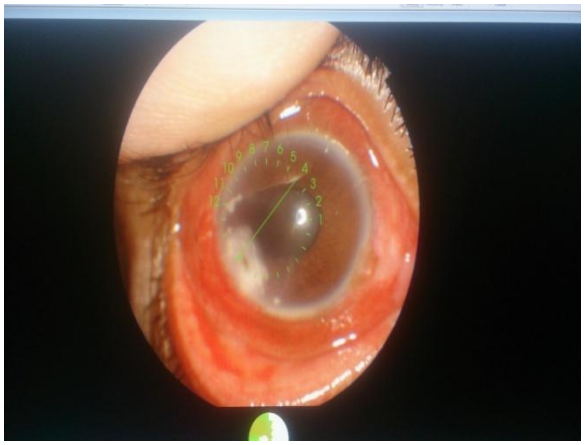

Figure B: Shows Corneal Ulcer