Ability of novice clinicians to interpret high-resolution optical coherence tomography for ocular surface lesions

Michael Yim, MD,* Anat Galor, MD, MSPH,*,† Afshan Nanji, MD,* Madhura Joag, MD,* Sotiria Palioura, MD, PhD,* William Feuer, MS,* Carol L. Karp, MD*

ABSTRACT ●

Objective: To assess the ability of novice clinicians to use a commercially available high-resolution anterior segment optical coherence tomography (HR-OCT) device to diagnose various lesions of the ocular surface and cornea.

Methods: Cross-sectional study. Twenty-six black-and-white HR-OCT images were projected, and clinicians were asked to determine whether the lesions represented ocular surface squamous neoplasia (OSSN) or another ocular surface pathology. A 20-minute instructional lecture was given on HR-OCT interpretation, and the same 26 images were shown. The clinicians were asked to repeat their assessment of the lesions. Thirty-four novice clinicians at the Bascom Palmer Eye Institute, Miami, FL, participated. A commercially available device (RTVue, Optovue, Fremont, Calif.) was specifically chosen for this study.

Results: The mean frequency of correct identification of the 26 lesions was 70% (standard deviation [SD] 15%) before instruction; after a short lecture, the frequency of correct identification improved to 84% (SD 9%, $p = 0.002$). Novice clinicians were more accurate in correctly determining that a lesion was not an OSSN (ruling it out as a diagnosis) than in determining that a lesion was an OSSN ($p = 0.001$). Some lesions (both OSSN and not OSSN), however, were more difficult to interpret than others.

Conclusion: This study demonstrated that all levels of novice clinicians can quickly improve diagnostic accuracy with a commercially available HR-OCT after a short training session.

Ocular surface squamous neoplasia (OSSN) is a broad term that encompasses a spectrum of epithelial squamous malignancies from dysplasia to squamous cell carcinoma (SCC). Conjunctival intraepithelial neoplastic lesions range from mild, moderate, and severe dysplasia to carcinoma in situ.[1] Clinically, OSSN can have a plethora of presentations ranging from the classic papillary or leukoplakic lesions with characteristic tufts of abnormal blood vessels straddling the limbus to less obvious appearances such as opalescence on the cornea or chronic conjunctivitis. The wide range of appearances, and its co-existence in the setting of complex ocular surface disease such as limbal stem cell deficiency, ocular cicatricial pemphigoid, or pterygia, can make diagnosis difficult in some situations.[2]

The gold standard for the diagnosis of OSSN remains histopathologic evaluation after an incisional or excisional biopsy.[3] However, in the past 3 decades, technological advancements have allowed for alternative methods of diagnosis, including impression cytology, confocal microscopy, and high-resolution anterior segment optical coherence tomography (HR-OCT).[2,4–10]

In particular, HR-OCT can provide an "optical biopsy" of tissue, aiding in the diagnosis and follow-up of corneal and conjunctival lesions.[2,4,7–10] Several HR-OCT machines have been used to evaluate lesions, including a custom-built machine[2,4,8,10] and the commercially available RTVue (Optovue, Fremont, Calif.).[9] OSSN has been found to have a characteristic appearance on HR-OCT, with a thickened, hyper-reflective epithelium and an abrupt transition between the normal and affected epithelium.[2,4] Using epithelial thickness value of 142 microns or greater, Kieval et al. were able achieve 100% specificity and 94% sensitivity in differentiating between OSSN and pterygia on a custom-built machine.[4] Similarly, using an epithelial thickness value of 120 microns, Nanji et al. were likewise able to achieve 100% specificity and 100% sensitivity in differentiating between OSSN and pterygia on the commercially available RTVue.[9] In both of these studies, 2 ocular surface oncology experts reviewed all images to assess the presence or absence of OSSN by HR-OCT, and the results were confirmed with biopsy.

A remaining question is the general applicability of this technology for other eye care professionals. The purpose of this study was to determine whether novice clinicians at various levels of training could accurately use this technology to discern between OSSN and other lesions of the cornea and conjunctiva on a commercially available device and to study the impact of a short teaching lecture on the accuracy of diagnosis.

Materials and Methods

Study Population

Thirty-four novice clinicians at the Bascom Palmer Eye Institute participated in the study. Level of training

http://dx.doi.org/10.1016/j.jcjo.2017.08.010
ISSN 0008-4182/17

Canadian Ophthalmological Society | Société canadienne d'ophtalmologie
EYE PHYSICIANS AND SURGEONS OF CANADA | MÉDECINS ET CHIRURGIENS OPHTALMOLOGISTES DU CANADA

included optometry students and residents (n = 12); first-, second-, and third-year ophthalmology residents (n = 5, 5, and 4, respectively); and ophthalmology fellows (n = 6). Two clinicians did not disclose their level of training. This study was exempt from institutional review board review as participation was voluntary and no identifying information was collected from the participants.

Process

Twenty-six HR-OCT images were printed on paper, 1 image per sheet, and given to all participants. Of note, no colour photographs of the lesions were provided. All lesions had a biopsy-proven diagnosis. Twelve lesions were biopsy-proven to be OSSN, and 14 were non-OSSN lesions, consisting of anterior basement membrane dystrophy (1), pterygia (3), nevus (2), primary acquired melanosis (2), lymphoma (2), lymphoid hyperplasia (1), melanoma (2), and Salzmann's nodular degeneration (1).

Participants were first asked to identify whether a lesion was or was not an OSSN. The next question was to identify what the lesion was, if not an OSSN. After all had recorded their answers, a 20-minute lecture (C.L.K.) was given on the characteristics of all lesions described above. After the lecture, participants were asked to re-review the images and asked to again identify whether the lesions were or were not an OSSN, and re-identify the lesions. These responses were recorded and answer sheets were collected anonymously. The answer sheets were graded by an independent individual with no affiliation to the study.

Statistical Analysis

All statistical analyses were performed using the SPSS Version 22 (SPSS, Chicago, Ill.) statistical package. Descriptive analyses were first performed and reported. Analysis of variance (ANOVA) statistics were used to evaluate performance by level of training. Improvement in diagnosing lesions on HR-OCT after the lecture (compared to before) was evaluated using paired *t*-test methodology. A p-value < 0.05 was considered significant in the analysis.

Results

Ability of Novice Clinicians to Correctly Diagnose Ocular Surface Lesions by HR-OCT

Overall, the initial mean frequency of correct identification of the 26 lesions was 70% (standard deviation [SD] 15%, minimum 35%, maximum 100%). This improved to 84% after the single 20-minute lecture ($p < 0.002$).

In the 12 lesions that were pathologically diagnosed as OSSN, the mean frequency of correct identification was 62% (SD 22%) prelecture and 76% (SD 15%) postlecture ($p < 0.0005$; Table 1). In the 14 lesions that were pathologically determined not to be OSSN, the mean frequency of correctly determining that the lesion was not an OSSN (ruling it out) was 76% (SD 15%) prelecture and 89% (SD 12%) postlecture ($p < 0.0005$). Novice clinicians were more accurate in correctly determining that a lesion was not an OSSN over determining that a lesion was an OSSN (χ^2 comparison of pre- and post-test results, $p = 0.001$).

Table 1—Ability of novice clinicians to correctly diagnose or rule out OSSN by HR-OCT alone

	Pretest	Post-test	p^*
Correctly diagnose OSSN	62% (22%)	72% (15%)	<0.0005
Correctly rule out OSSN	76% (15%)	89% (12%)	<0.0005

OSSN, ocular surface squamous neoplasia; HR-OCT, high-resolution anterior segment optical coherence tomography.
N = mean frequency of correct identification (Standard deviation).
*Paired *t* test comparison of post- and pretest results by lesion (OSSN and non-OSSN).

OSSN Lesions

Within the 12 OSSN lesions, some images were deemed by the oncology experts (A.G., C.L.K.) to be classic for OSSN, with the images clearly depicting hyperreflective, thickened epithelium and an abrupt transition from normal to abnormal (Fig. 1), but others were more challenging. Three of the images were deemed easy/classic (25%), 3 intermediate (25%), and 6 challenging (50%) to interpret. In the easy example (Fig. 1) depicting the classic features of OSSN, 79% of novice clinicians correctly identified the lesion as OSSN prelecture and 100% did so postlecture. In other less classic images thought to be of intermediate difficulty, however, the lesions depicted most but not all features of OSSN. For example, in Figure 2, the abrupt transition is slightly more subtle than it was in Figure 1. In this case 68% correctly identified the lesion as OSSN prelecture and 74% did so postlecture. Some lesions were deemed challenging to interpret by C.L.K. and A.G. (Fig. 3); in this case, the frequency of identification was lower, with only 55% of clinicians correctly identifying the lesion as OSSN prelecture and 71% postlecture.

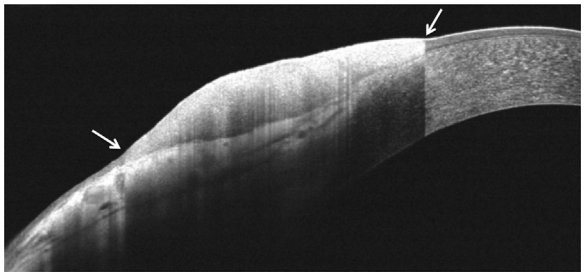

Fig. 1—A classic, easy image of an ocular surface squamous neoplasia (OSSN) on high-resolution anterior segment optical coherence tomography. All features of OSSN (epithelial thickening, hyper-reflectivity, and abrupt transition on both sides of the lesion [white arrows] from normal to abnormal epithelium) are seen.