The Relationship Between Subbasal Nerve Morphology and Corneal Sensation in Patients Treated for Glaucoma

Antoine Labbé1,4, MD, PhD, Haiyan Alwani1, MD, Emmanuelle Brasnu1,2, MD, PhD, Charles Van WE1,4, MD, Dan Georgescu1,3, MD, PhD, Christophe Baudouin1-4, MD, PhD.

1. Department of Ophthalmology, University Hospital of Saint-Antoine, University Paris 7, France
2. Department of Ophthalmology and Vision Sciences, University of Montreal Hospital, Montreal, Quebec, Canada
3. INSERM U968, Paris F-75012, France; UPMC University Paris 06, UMR S 968, Institut de la Vision, Paris F-75012, France; CNRS, UMR 7210, Paris F-75012, France
4. Department of Ophthalmology, Antwerp University Hospital, Leuven, Belgium

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INTRODUCTION

- Cornea is the most densely innervated tissue in the human body. In addition to its important ion transport function, the corneal nerves provide protective and trophic functions and also regulate corneal epithelial integrity, proliferation and wound healing.
- In vivo confocal microscopy (IVCM) is a noninvasive imaging technique that provides high-resolution images of corneal subbasal nerves in the living human eye. Several morphologic parameters have been developed and IVCM has already been used to evaluate corneal subbasal nerves in normal subjects and in different pathological conditions such as diabetes mellitus, dry eye, keratoconus, contact lens wear, glaucoma patients, and after penetrating keratoplasty or refractive surgery.

OBJECTIVE

To evaluate the relationships between the in vivo confocal microscopic (IVCM) morphology of subbasal corneal nerves and corneal sensitivity in patients treated for glaucoma.

METHODS

- Patients: This study was done at the Center of Clinical Investigations (CIC) 503 at the Quantra-Virtus National Eye Center with the approval of the IRB of Saint-Antoine University Hospital (CPP-ile de France 5, number 10763). For healthy volunteers, and patients with ocular hypertension (OHT) or OHTM, 14 patients treated with IOP-lowering topical medications for glaucoma or OHTM were included in the OHTM group for more than six months (glaucoma group) and 12 patients with dry eye (3 patients with OHTM and 9 with keratoconjunctivitis sicca) were included in the study (dry eye group). One eye of each subject was included in the study.

- Central corneal sensation: Central corneal sensation was measured using the contact cotton thread. A 120 x 120 µm copper-Bonnet esthesiometer (Luneau, Prunay-Le-Gillon, France).

- In vivo confocal microscopy: In vivo laser scanning confocal microscopy (IVCM) of the cornea was performed using the Heidelberg Retina Tomograph® (HRT) (Heidelberg Engineering, Germany). A total of 180 images (400 x 400 µm) were acquired for each eye. Images were selected for analysis by a trained researcher and then automatically by automatic ImageJ® (National Institutes of Health, USA). Examples of subbasal nerves were evaluated, and their density and number were recorded.

- Statistical analysis: Results for descriptive statistics are presented as mean ± standard deviation (SD). Comparisons between groups were done using the Student’s t-test. The correlations between the different variables were studied using Pearson’s correlation coefficient. The mean corneal sensitivity in each group and each parameter were compared. The results were the mean of the analysis of 5 images. The different parameters evaluating the subbasal corneal nerve morphology were the nerve density, tortuosity, reflectivity, and number of branches.

RESULTS

- 1- Corneal sensitivity was significantly decreased in glaucoma patients compared to controls (Table 1).
- 2- The density and number of subbasal nerves was significantly decreased in glaucoma patients compared to controls (Table 2).
- 3- In the glaucoma group, the corneal sensitivity correlated negatively with the tortuosity of subbasal nerves. Conversely, in the dry eye group, corneal sensitivity correlated highly with the density and the number of nerves (Table 3).

DISCUSSION

- Decreased corneal sensitivity has already been described in patients treated for glaucoma.
- Despite the decreased number of subbasal nerves, an additional anesthetic effect of IOP-lowering medications and preservatives could explain the lack of correlation between the density or corneal nerves and central corneal sensation in patients treated for glaucoma or OHT.
- We recently showed a direct correlation between decreased corneal sensitivity and the number of preserved anti- glaucoma eye drops instilled every day.
- Unfortunately, considering the sample size of our study, we could not differentiate between patients receiving preserved and unpreserved eye drops or different molecules.
- The relationship between tortuosity of subbasal corneal nerves and corneal sensitivity suggested that a higher tortuosity also represents a marker of subbasal nerve abnormalities, or at least dysfunction, in glaucoma patients.

CONCLUSION

- The relationship between corneal sensitivity and subbasal nerve morphometry, as evaluated with IVCM, depends on the pathophysiological mechanism of ocular surface disease.