CLINICAL SCIENCE

Twenty-four-hour repeatability of diurnal intraocular pressure patterns in glaucomatous and ocular hypertensive individuals

Marcelo Hatanaka, Mirko Babic, Remo Susanna Junior

Department of Ophthalmology - Faculdade de Medicina da Universidade de São Paulo, São Paulo/SP, Brazil.

OBJECTIVE: To verify the 24-hour repeatability of diurnal intraocular pressure patterns in glaucomatous and ocular hypertensive individuals.

METHODS: A prospective analysis of 88 eyes from 88 ocular hypertensive or open-angle glaucoma patients was conducted on diurnal tension curves obtained by the same examiner on two consecutive days. The intraclass correlation coefficient test was used for statistical analysis.

RESULTS: Eighty-eight eyes from 88 patients were analyzed. Fifty-seven patients (64.8%) were female. The mean age of all participants was 68.7 (SD 10.8, range 51–79) years. The intraclass correlation coefficient values for measurements at 8 AM, 11 AM, 2 PM, and 4 PM were 0.80, 0.82, 0.83, and 0.86, respectively (all intraclass correlation coefficient values, $p<0.001$).

CONCLUSION: Diurnal intraocular pressure data collected on a single day characterize the diurnal intraocular pressure variability over 24 hours in primary open-angle glaucoma and ocular hypertensive patients.

KEYWORDS: Intraocular pressure; Diurnal tension curve; Reproducibility.

INTRODUCTION

The presumption that circadian intraocular pressure (IOP) variation is reproducible from day to day has been used in clinical and research practice to assess IOP at standardized times of day both before and after administering IOP-lowering interventions. If the daily IOP pattern is not sustained from day to day, the validity of this common practice may be not valid.

Studies of the reproducibility of a given eye's IOP pattern over time offer conflicting data on the reproducibility of IOP patterns. Katavisto[1] found that 80% of glaucomatous eyes exhibited a reproducible curve shape upon retesting using Schiøtz tonometry. In contrast, Wilensky et al[2] found that only 28% of eyes with ocular hypertension and 34% of eyes with primary open-angle glaucoma (POAG) had reproducible curve shapes upon retesting using a home applanation tonometer operated by the patient. Realini[3] recently showed that in treated patients, there was fair to good agreement in intervisit IOP values at any given time of day.

We report the results of our prospective study, which evaluated the reproducibility of diurnal IOP patterns in patients with untreated POAG or ocular hypertension on two consecutive days.

METHODS

This prospective study was approved by the University of São Paulo institutional review board and was conducted in compliance with the tenets of the Declaration of Helsinki and the Health Insurance Portability and Accountability Act. All participating subjects provided their written informed consent.

In this prospective study, 88 patients with untreated ocular hypertension or open-angle glaucoma were submitted to standardized IOP measurement at the following time points: 8 AM, 11 AM, 2 PM, and 4 PM. The measurements were performed on two consecutive days by the same investigator (visit 1, first day; visit 2, second day). One eye from each patient was included in this study. If both eyes of the same patient were eligible, one eye was selected randomly.

Open-angle glaucoma was defined as an IOP level higher than 21 mmHg in at least one eye, the presence of reproducible glaucomatous visual field damage and/or typical glaucomatous optic nerve lesion, open angle, normal gonioscopy results and no history of any other ocular disease that could lead to a rise in IOP. Ocular hypertension was defined as an IOP level greater than or equal to

Table 1 - Mean Intraocular Pressure Values at Each Visit and Time Point.

Time of the IOP measurement	First visit Mean IOP±sd	Second visit Mean IOP±sd	ICC *
8:00 am	24.19±4.0	23.66±3.6	0.80
11:00 am	23.92±4.0	23.85±3.7	0.82
14:00 pm	23.30±3.5	23.18±3.5	0.83
16:00 pm	23.25±3.7	23.56±3.6	0.86

*all ICC measurements, p<0.001.

25 mmHg in at least one eye, with no glaucomatous visual field damage and no glaucomatous optic disc lesion.

The exclusion criteria were as follows: previous ocular surgery, laser trabeculoplasty, and any other ocular disease that could influence visual field examination results.

Visual field examinations were performed using a Humphrey 750 automated perimeter, with the Swedish Interactive Threshold Algorithm (SITA) strategy and the 24-2 program. A visual field defect was defined by the presence of a cluster of three or more nonedge points that had sensitivities of $p<5\%$, where one of the points had a sensitivity of $p<1\%$, a pattern standard deviation (PSD) value with $p<5\%$ or glaucoma hemifield test (GHT) results outside the normal limits.

A statistical analysis was performed with commercial software (SPSS 11.0, SPSS Inc., Chicago, IL, USA). We assessed the reproducibility of IOP measurements from the first visit to the second visit using intraclass correlation coefficients (ICCs), which were obtained as the ratio of the between-subject component of the variance to the total variance. The ICC indicates the proportion of variance in the measurements that is due to differences among subjects. The ICC will be large when there is little variation in the measurements obtained for the same subject compared with the measurements obtained for different subjects.[4] Poor, fair, and excellent reproducibility were noted when ICC values were below 0.4, between 0.4 and 0.75, and above 0.75, respectively.

RESULTS

In all, 88 eyes from 88 patients were analyzed. Fifty-seven patients (64.8%) were female. The mean age of all participants was 68.7 (SD 10.8, range 51–79) years.

Table 1 summarizes the IOP measurements at each visit and time point.

The ICC values for measurements at 8 AM, 11 AM, 2 PM, and 4 PM were 0.80, 0.82, 0.83, and 0.86, respectively (all ICC values, $p<0.001$).

DISCUSSION AND CONCLUSION

Intraocular pressure follows a repeatable diurnal pattern in patients with untreated glaucoma and ocular hypertension. There was excellent agreement among intervisit IOP values measured at any given time of day. To the best of our knowledge, this is the second report to evaluate the reproducibility of diurnal IOP patterns in subjects with POAG using Goldmann tonometry. The first study was performed by Realini et al[3]; the results conflict with our findings. Among treated patients evaluated one week apart, there was fair to good agreement for intervisit IOP values at any given time of day. This difference could be due to the treatment itself or the different lengths of time between visits in their study as compared with our study. Treatment may be an important confounding factor. The time of instillation as well as compliance, may interfere with the results. In addition, treating POAG with IOP-lowering medications may have masked an inherent IOP pattern or, perhaps, even induced an IOP pattern through the regularly scheduled instillation of medications. It has been suggested that untreated glaucomatous eyes with irregular IOP patterns may display more regular IOP patterns upon treatment.[5] It is important to emphasize that, in our study, the evaluated patients were not under treatment.

The current study demonstrates that diurnal IOP data collected on a single day characterize diurnal IOP variability over 24 hours in POAG and ocular hypertensive patients. This observation validates the clinical value of 1-day diurnal IOP testing in clinical practice, when the consecutive day is used to determine the IOP-lowering efficacy of glaucoma therapies.

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