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Water drinking test in patients with advanced-terminal stage glaucoma and maximal topical hypotensive therapy

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ABSTRACT

Objective: To assess the impact of the water drinking test (WDT) on intraocular pressure (IOP) in advanced-terminal stage glaucoma patients, treated with maximal topical hypotensive therapy.

Method: This retrospective clinical study included patients with advanced or end-stage open-angle glaucoma, with or without prior glaucoma surgery and medication. Participants underwent the WDT, where they consumed 1 liter of water over 5 minutes. IOP was measured at baseline, and then at 15-, 30-, and 45-minutes post-administration.

Results: The IOP measurements (mean ± standard deviation) were as follows:baseline: 12.3 ± 2.1 mmHg; at minute 15: 14.8 ± 3.1 mmHg; at minute 30: 16.4 ± 3.3 mmHg and at minute 45: 14.7 ± 2.6 mmHg. A significant increase in IOP was observed at minute 30 compared to baseline ($p = 0.01$).

Conclusion: Ingesting 1000 ml of water within 5 minutes raises IOP in patients with advanced or end-stage glaucoma and maximal topical hypotensive therapy. Further research is needed to explore the relevance of these findings in medical scenarios requiring significant fluid intake, such as kidney-bladder, prostate, and gynecological ultrasounds.

Keywords: water drinking test, glaucoma, intraocular pressure.

Introduction

Considering that glaucoma is an entity that expresses itself silently and whose chronic and slow progression can also go unnoticed, detection and follow-up methods are constantly being improved. These methods propose the detection of both structural changes in the optic nerve and functional changes in vision and in the hydrodynamics of the aqueous humor.[1-6] Likewise, great advances are being made in the diagnosis and follow-up of glaucoma, especially in the field of diagnostic imaging, which is now beginning to be assisted by artificial intelligence.[7,8] This implies the need for using sophisticated technology and costly devices that are not accessible to all physicians, especially in less economically developed regions of the world.[9-12] Therefore, more accessible options are being sought to diagnose and monitor glaucoma, for example, through the use of smartphones.[13-16] Also, the information provided by simpler clinical studies, such as the water drinking test, has re-emerged and is gaining clinical value.[17,18]

The water overload test or water drinking test (WDT) began to spread in the early 1950s with the publication of Leydhecker,[19] which other authors later confirmed as one of the tests used to evaluate patients with glaucoma.[20-22] The importance of fluid intake and diuresis on intraocular pressure (IOP)[23] has been known for many decades. Although its usefulness was questioned,[24] it is still valid today in evaluating glaucoma patients who have undergone different pharmacological and surgical treatments according to recent publications.[25-34] A recent systematic review[35] evaluated the value of the water drinking test WDT and observed after analyzing all the evidence published up to the beginning of the year 2024, that there is a strong positive correlation between WDT peak IOP measurements and daytime IOP monitoring in glaucoma patients. Also, the peak IOP value observed on the WDT demonstrated good reproducibility and may be associated with greater future visual field progression.

Among other things, the WDT allows the evaluation of glaucomatous progression of the visual field, is useful for the follow-up of patients with glaucoma, and at the same time provides indirect information on trabecular function.[18,35] However, considering that this type of test may have a different impact depending on the type of glaucoma and also on the evolutionary stage of the disease. The present study aimed to evaluate the effect of the water overload test on IOP in patients with advanced-terminal open-angle glaucoma, treated with maximal topical hypotensive therapy.

Methods

DESIGN

A retrospective study was conducted to evaluate cases attended between March 2022 and March 2023 at the Hospital de Clínicas José de San Martín in the city of Buenos Aires, Argentina. The study was approved by the ethics committee of the institution and was developed following the guidelines of the Declaration of Helsinki. The data of the patients included in this review were treated anonymously, protecting their identity, and all participants signed an initial informed consent form, accepting that their data could be used for scientific-academic purposes.

POPULATION AND PARAMETERS

Patients over 18 years of age of both sexes, with a visual acuity of 1 to 4 tenths, who attended the glaucoma service of the hospital in the mentioned period, who had open-angle glaucoma treated with maximal hypotensive topical therapy, and who had not undergone any glaucoma surgery were included. The visual field and optic nerve evaluation showed that the glaucoma was in advanced terminal stage according to the Hodapp-Parrish-Anderson damage criteria (MD less than -12 dB, n points p-5% greater than 27 [50%], n points less than 1%: 14 and in 5 central degrees: any point 0 dB and in both hemifields points equal to or less than 15dB) and a papillary excavation of 0.8 or worse. Any patient with narrow-angle or closed-angle glaucoma with active ocular surface infections, corneal alterations, difficulty collaborating in applanation tonometry, renal failure, cardiac failure, and those who refused informed consent were excluded.

PROCEDURE FOR PERFORMING THE WDT

The WDT consisted of a 5-minute intake of 1,000 ml of drinking water after a total fast of at least four hours. IOP was recorded before drinking water (basal intake) and then at different times: 15, 30, and 45 minutes. IOP measurements were always taken by the same physician, with the same Goldmann Haag Streit flattening tonometer whose calibration was previously controlled and with the patient seated in front of the slit lamp.

STATISTICS

The data were analyzed by performing descriptive and comparative statistical tests using the XLMiner Analysis ToolPack software. After checking the normality of the data, the analysis of variance test (ANOVA) of repeated measurements was used to evaluate the existence of statistically significant differences considering $p <= 0.05$. To establish when these differences appeared, the pairs of averages were compared with each other (Bonferroni test).

Results

A total of 40 eyes with open-angle glaucoma were included. They were patients with maximum medication (3 drugs). The IOP values found at different times were (mean and standard deviation): baseline: 12.3 ± 2.1 mmHg; at minute 15: 14.8 ± 3.1 mmHg; at minute 30: 16.4 ± 3.3 mmHg and at minute 45: 14.7 ± 2.6 mmHg.

After analyzing the results, IOP at minute 30 was found to increase statistically significantly with respect to baseline values ($p = 0.01$). With a 95% confidence interval for the differences between baseline and 30-minute IOP averages, which ranged from 0.68 to 6.1 mmHg.

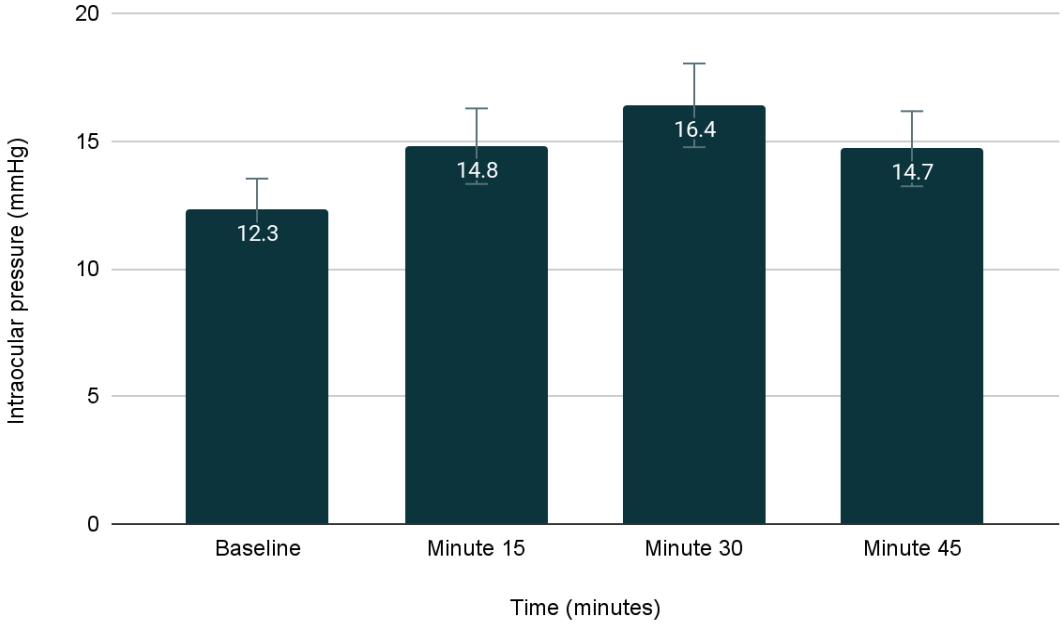

Figure 1. Variation of intraocular pressure evaluated before and after ingestion of one liter of water at different times in 40 eyes.

Discussion

In the present study, after performing the WDT with the rapid intake of 1 liter of water, a statistically significant increase in IOP was generated after half an hour in a group of patients with advanced end-stage glaucoma. This test is still very relevant today because, in spite of technological advances, it is accessible for all the ophthalmologists, is simple to perform and inexpensive. Its main usefulness is that it allows the follow-up of patients with glaucoma, but it is not useful for its diagnosis due to its low sensitivity (15.6%) despite being highly specific (96.7%).[25,36-38] There may be variations in its performance, depending on the amount of fluid administered (800 or 1000 ml) 15 or the time between IOP measurements. For example, Danesh-Meyers et al. in their work extended the time of intake (15') and IOP measurements up to 60 minutes, showing that the pressure decreases as time passes and that the peaks are lower in patients operated on for trabeculectomy with mitomycin C, compared to those exposed to medical therapy.[38]

In our study, the decrease in IOP was already evident after 30 minutes. It should be noted that different diagnostic medical practices are usually performed in complementary studies, where abundant fluid intake is required in a short period of time, such as in reno-vesical, prostate and gynecological ultrasounds. As seen in this study, this could determine the increase in IOP in patients with advanced glaucoma. There are studies that have evaluated visual field compromise in patients with advanced-terminal glaucoma by WDT.[25,34-38] These are data from this work that should be shared with other specialties, such as medical clinic and diagnostic imaging, and also with the patients themselves, explaining to them that they should avoid ingesting too much fluid in a short time.

As some of our study's limitations, taking into account the mechanism of action of WDT, the two populations of cases evaluated (operated and non-operated) could have been compared, since there are publications that talk about the different test results in operated patients, although this was not the primary objective of the present study and it may be interesting to evaluate it in the future, in an experimental design specifically set up for this purpose. Another limitation is related to the small sample size analyzed, in a single-center study. The study design was simple, which was a decision, considering that it was performed without any type of sponsorship with few resources in a public health hospital setting.

Finally, we would like to point out something indirectly related to our study, but which is potentially of great clinical relevance and hopefully may motivate other groups in the development of further research. What we have described is associated with understanding the impact of water intake on ocular pressure. Although there are different studies that analyze the impact of water intake on general health, renal and urinary disorders, skin conditions, cardiovascular system and even psychic performance,[39-44] there are not many studies that provide evidence of what is the critical level of water intake in relation to the intake time, so that it does not affect, potentially negatively, the intraocular pressure. In addition, it may be important to include in the clinical chart, how much liquid the patient ingests, in what time and, what type of liquids (water, sweetened sodas, alcoholic beverages, coffee, tea and other infusions).

Conclusion

After consuming 1 liter of water within 5 minutes, patients with advanced-terminal glaucoma experience an increase in intraocular pressure (IOP). Given the fragile visual condition of these patients and the imperative of maintaining low and stable IOP levels, it is advisable to caution against excessive fluid intake over short durations. Additionally, they should be aware of potential risks during common medical procedures like ultrasound scans that necessitate significant fluid intake. Furthermore, future research involving a larger sample size will be essential to validate these findings.

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