Diurnal IOP Control: How Important Is It?

Many glaucoma experts agree that IOP variation is important to evaluating and managing patients with glaucoma.

BY SANJAY ASRANI, MD

Primary open-angle glaucoma (POAG) is a multifactorial optic neuropathy with only one currently identified, treatable risk factor, the level of IOP. Despite controlled IOP, however, many glaucoma patients’ conditions continue to worsen, which has led to speculation that changes in IOP—throughout the day, over different days, or during various visits—may be the as yet unidentified risk factor in glaucoma. There is a dearth of measurements, however, to support or disprove this idea. Recent reports suggest that IOP fluctuation itself may be an independent risk factor for disease incidence, prevalence, and progression.1,2

EVIDENCE FOR IOP FLUCTUATION AS A RISK FACTOR

There are three types of IOP fluctuations: (1) ultrashort-term that happen in minutes, (2) short-term that occur over hours to a few days, and (3) long-term that happen over months or years. Ultrashort-term fluctuations occur with Valsalva maneuvers, blinking, the cardiac pulse, and eye movement. There is currently little substantiating evidence to suggest that ultrashort-term fluctuations affect glaucoma. On the other hand, short- and long-term fluctuations have been found to have a significant influence.

Short-term fluctuations were first evaluated in the 1990s using self-performed home tonometry five times a day for 5 days. In this study, mean home IOP and baseline office IOP measurements were found to be similar in eyes that had stable versus those with progressive disease, but the average variation in home IOP was found to be 10 mm Hg. The ranges in IOP over multiple days were identified as significant risk factors for disease progression after 5 years of follow-up, even after adjusting for variables such as office IOP, age, race, gender, and baseline visual field status. The hazard ratio between the highest and lowest quartiles of IOP fluctuation was 5.7 even after adjusting for risk factors such as age, race, level of visual field damage at baseline, and baseline office IOP. (Reprinted with permission from Asrani et al.2)

Long-term IOP variation has been evaluated in post-hoc analyses of several of the well-known glaucoma clinical trials. In the Collaborative Initial Glaucoma Treatment Study (CIGTS), three IOP parameters—maximum, standard deviation, and range—were associated with worsening visual field scores (Figure 2). The researchers suggested more aggressive treatment measures in patients with significant IOP variation.3 In the Advanced Glaucoma Intervention Study (AGIS), the investigators reported that IOP fluctuation remained significantly associated with progression when regression...
analyses accounted for cataracts and changes in management due to advanced glaucoma. A subsequent analysis found that long-term IOP fluctuation was associated with disease progression in patients with a low mean IOP but not in those with a high mean IOP.5

Several smaller studies have reported similar results. In a retrospective study of 24 eyes with advancing POAG that underwent trabeculectomy, 14 eyes stabilized, and 10 experienced continued glaucomatous progression over 3.5 years of follow-up. The researchers found that the variability of the postoperative IOPs was the only significantly different parameter between the two groups; mean postoperative IOP and reduction in IOP were similar between the groups.6 A retrospective, longitudinal study of newly diagnosed POAG patients in Olmstead County, Minnesota, found that, over a 30-year period, the IOP variability was significantly higher in eyes that went blind compared to those that did not.7 A single-center, retrospective study of consecutive patients with POAG and angle-closure glaucoma who had five visual fields or more over a 9-year period found that IOP fluctuation was the only pressure-related parameter significantly associated with the rate of disease progression and remained so when evaluated in a multivariate model with other risk factors.8

The role of long-term fluctuation in glaucomatous progression is not without controversy. In the Early Manifest Glaucoma Trial (EMGT), the intervisit IOP variation was not related to glaucomatosus progression.9 The European Glaucoma Prevention Study (EGPS) found that IOP variation was not related to untreated patients’ risk of developing glaucoma.10 These results may suggest that variation in IOP is less essential in early disease or that it may take longer than the typical 5-year study period to demonstrate the effects of IOP variation in early glaucoma.

**STRATEGIES TO TREAT IOP FLUCTUATIONS**

There is no widely accepted target IOP fluctuation. That said, in my opinion, the range should be less than 5 mm Hg for patients with mild glaucoma, less than 4 mm Hg for those with moderate glaucoma, and less than 3 mm Hg for those with advanced glaucoma. There are, of course, many considerations in addition to these guidelines, including central corneal thickness measurements, the rate of disease progression, and myriad other factors that necessitate therapy tailored to the individual.

**CONCLUSION**

Despite conflicting research results, many glaucoma experts argue that IOP variation is important to the evaluation and management of patients with glaucoma. Katz and Myers suggested, “Not only is an ideal mean target IOP needed, but also a target for IOP fluctuation.”11 Clinicians need to be cognizant of this risk factor, maximize strategies to detect fluctuations, and tailor therapies in vulnerable patients. 

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