# THE WATER DRINKING TEST: PRACTICAL TIPS

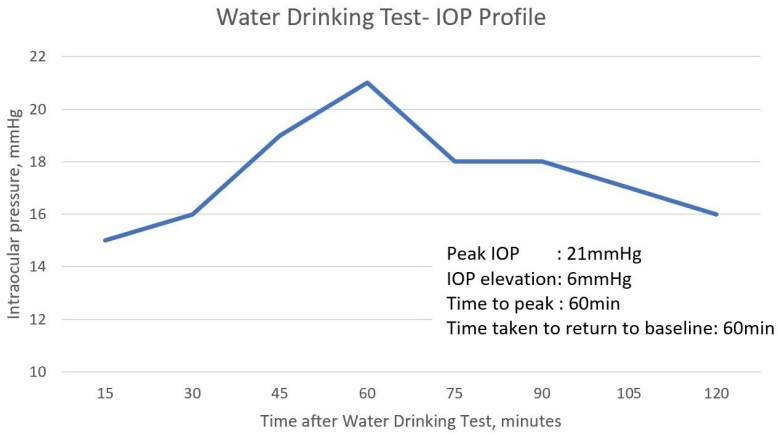
Intraocular pressure (IOP) is the primary modifiable risk factor that has been linked to glaucoma development and progression. Interestingly, individuals with low IOP also develop glaucomatous optic neuropathy, while some treated patients continue to progress despite having satisfactory IOP control. It has been postulated that IOP independent factors such as altered optic nerve head microcirculation, oxidative stress, immune mechanisms, and increased translaminar stress from low cerebrospinal fluid pressures may play a role in progressive optic neuropathy.[1, 2] However, pitfalls in IOP measurements have also been shown to contribute to this phenomenon.

Like any other biological parameter, IOP is not a fixed value but varies considerably during the circadian cycle and in between clinic visits. Twenty-four-hour IOP profile studies have shown that two-thirds of patients experienced peak IOP outside regular clinic hours.[3] Diurnal and 24-hour IOP curves have been useful to determine peak IOP. Circadian variations can be best assessed by a noninvasive recording of ambulatory, continuous 24-hour IOP monitoring using a contact lens sensor or other telemetric devices.[4] However, is not always feasible or cost-effective to implement in routine clinical practice. The water drinking test (WDT) is an apt assessment that can reliably predict peak and average IOP in an office setting.

The WDT is a provocative test that was initially developed to differentiate open-angle glaucoma from ocular hypertension patients. However, it has been shown that the WDT lacked the sensitivity and specificity needed to be a reliable screening test. In recent years WDT has attracted attention as an indirect tool for evaluating ocular outflow facility to detect IOP fluctuations and to estimate peak IOP.

## How to perform WDT

Coexisting systemic diseases, including cardiac or renal disease, or history of urinary retention, are the contraindications to this test. The patient is required to liquid fast for two hours before the WDT. After measuring the baseline IOP, the patient is instructed to drink a given volume of water (a fixed volume of 800ml, or 10mL of water /kg) in 5 minutes. The IOP is measured at 15-min intervals, documenting the maximum elevation, time taken to reach the peak IOP and time taken to return to baseline IOP (figure 1). Normal eyes handle the fluid challenge by increasing outflow, whereas a glaucomatous eye with outflow resistance would not be able to tolerate the fluid influx and manifest it by an increased IOP.




## Mechanism of action

The exact mechanism behind WDT has not been established. Studies have suggested that increase in episcleral venous pressure, blood-aqueous osmotic pressure gradient, choroidal expansion, and autonomic nerve stimulation may lead to the IOP changes post WDT.[5-7]

## Application

WDT plays an important role in the management of glaucoma patients who show functional and/or structural signs of progression despite an apparently well-controlled IOP in the clinic.

1. To identify IOP peaks that correlate with circadian peaks

Peak IOP value is identified as a better predictor of glaucoma progression than average IOP or IOP fluctuation.[3] WDT has shown good correlation and agreement with physiological IOP peaks in circadian cycle.[8] Susanna et al investigated the WDT response in patients with bilateral disease with symmetrical baseline IOP and found that eyes with higher IOP peak have worse visual field damage than their fellow eye.[9]

2. Risk assessment for progression

Several studies have concluded that the WDT peak is a strong predictor of progression in treated open angle glaucoma patients, where the clinic-based single IOP measurements failed to show such significant association.[10, 11] A prospective study found that average peak IOP and percentage of IOP variation during WDT is significantly higher in patients with visual field progression when compared to patients who did not progress.[12]

3. To detect impaired trabecular outflow facility

Pseudoexfoliation glaucoma patients showed significant IOP elevation with WDT as compared to those with pseudoexfoliation syndrome alone, indicating impairment in the drainage system of the eye in question.[13] Primary angle closure patients showed rapid IOP recovery following WDT after peripheral iridectomy, reflecting an improved outflow facility.[14]

4. Evaluation of efficacy of treatment

WDT has been proven to be a good tool in evaluating the efficacy of IOP lowering intervention. Brubaker suggested using the WDT as an indirect measurement test of the outflow facility to compare the IOP responses of glaucomatous eyes to different drugs.[15] Patients with open-angle glaucoma treated with selective laser trabeculopasty have significantly reduced peak IOPs and fluctuation in IOP in response to the WDT.[16] Subjects who had undergone filtering surgery showed a stable WDT- IOP profile as compared to those on ocular hypotensive drops.[17]

In summary, WDT is an inexpensive and feasible clinical test that is useful in evaluating IOP dependent factors that contribute in glaucoma progression. WDT response allows clinicians to reevaluate the efficacy of current IOP lowering treatment and tailor the management accordingly.

**Key points:**

- **It is essential to identify both IOP-dependent and non-IOP dependent factors to understand why progression takes place in glaucoma patients with satisfactory IOP control in clinics.**
- **Current 24-hour ambulatory, continuous IOP monitoring devices are not cost-effective**
- **Surrogate measures such as inter-visit IOP variation or diurnal IOP curves, although helpful, are sometimes impractical.**
- **Water drinking test (WDT) is a feasible, evidence-based alternative measure to determine IOP fluctuation and peak IOP in clinical setting**
- **Peak WDT-induced IOP correlates well with peak diurnal IOP and may help to identify patients with significant IOP fluctuation.**
- **The WDT requires the patient to drink a given volume of water (a fixed volume of 800ml, or 10mL of water /kg) in 5 minutes, and IOP is measured at 15 minutes interval post water consumption.**
- **A glaucomatous eye with outflow resistance would not be able to tolerate the fluid challenge and reveal elevations in IOP that are ordinarily experienced in 24 hour cycle.**
- **WDT is a reliable test to identify peak IOP that correlate with peak circadian IOP and to estimate risk of progression in treated glaucoma patients**
- **WDT response allows clinicians to reevaluate the efficacy of current IOP lowering intervention for a certain patient and tailor the treatment plan accordingly.**

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