
Time of Peak Intraocular Pressure during Water Drinking Test and Modified Phasing Among Glaucoma Patients in South-East Nigeria

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ABSTRACT

Background: High intraocular pressure (IOP) peaks and fluctuations which are among the significant risk factors for glaucoma development and progression can be detected through water drinking test (WDT) and phasing.

Aim: To determine the time of peak IOP during WDT and modified phasing among primary open angle glaucoma (POAG) patients on medical treatment at Enugu State University of Science and Technology Teaching Hospital Parklane (ESUTTHP), Enugu.

Methodology: The study was a hospital based cross sectional study on POAG patients on medical treatment attending the eye clinic of ESUTTHP, Enugu. One hundred and thirty patients were selected by simple random sampling. Their eyes were examined which included visual acuity assessment, follow-up clinic intraocular pressure measurement, gonioscopy, anterior and posterior segments examination. WDT and modified phasing were carried out on them. WDT was done over 2 hours after intake of 1 liter of water with intraocular pressure measured every 15 minutes. Modified phasing was done over 8 hours with intraocular pressure measured at 2 hourly intervals. Data analysis was done using SPSS version 20 (U.S.A).

Results: A total of 130 POAG patients (260 eyes) on medical treatment were examined comprising of 56 males (43.1%) and 74 females (56.9%). Their age ranged between 42 and 83 years with mean age of 62.25 ± 9.002 . The peak IOP occurred in 90.2% of patients within the first 1 hour of water drinking test with 23.6% of the eyes having peak IOP at 15 minutes, 24.0% at 30 minutes, 22.9% at 45 minutes, 20.2% of eyes at 60 minutes, 6.6% of eyes at 75 minutes, 2.3% at 90 minutes, 0.0% at 105 minutes and 0.4% at 120 minutes. The peak IOP occurred in two-thirds (74.1%) of eyes within the first 4 hours of commencing modified phasing while 25.8% had their IOP peak after 4 hours with 30.6% of the eyes having peak IOP at onset of the test, 28.2% at 2 hours, 15.3% at 4 hours, 16.1% at 6 hours and 9.7% at 8 hours.

Conclusion: WDT may be done over 1 hour instead of 2 hours as a quick clinic test to detect IOP peaks among glaucoma patients on treatment. Some POAG patients also have IOP peaks occurring in the afternoon during modified phasing and such peaks should not be missed in those patient's management.

KEYWORDS: Time, Intraocular pressure, Water Drinking Test, Modified Phasing, Primary open angle glaucoma.

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Abbreviations: IOP: Intraocular pressure, WDT: Water Drinking Test, POAG: Primary open angle glaucoma, ESUTTHP: Enugu State University of Science and Technology Teaching Hospital Parklane.

INTRODUCTION

Glaucoma is the second most common cause of blindness and the leading cause of irreversible blindness worldwide.^{1,2,3}

Raised intraocular pressure (IOP) is the only modifiable risk factor in glaucoma treatment.⁴ IOP has a diurnal variation with the peak occurring early in the morning at 8 – 11 a.m.^{5,6}

Time of Peak Intraocular Pressure during Water Drinking Test and Modified Phasing Among Glaucoma Patients in South-East Nigeria

Dynamic balance between aqueous inflow and outflow facility determines the circadian fluctuations in intraocular pressure.

Phasing is a test done to monitor the diurnal variation in IOP. It is helpful therefore in detecting IOP peaks and fluctuations. It is a useful test in monitoring IOP in glaucoma patients on treatment. It involves the measurement of IOP every 2-3 hours over twenty-four hours (full phasing) or during office hours (modified diurnal tension curve).⁷

The water drinking test (WDT) was first described by Schmidt in 1928 as a diagnostic tool for glaucoma but was later abandoned due to its poor diagnostic accuracy.^{8,9} However, this test has regained significant interest in recent years as it was found to be useful in monitoring glaucoma treatment and predicting diurnal IOP peaks as well as fluctuations.^{8,10} Studies have shown that WDT peak IOP was significantly correlated with the modified diurnal tension curve peak IOP.^{7,11} WDT is done by giving a patient one litre of water to drink within five minutes with IOP checked immediately before and after.⁸ Subsequently, IOP is measured every 15 minutes for 1-2 hours.⁸ Normal eyes are able to handle the fluid challenge by increasing outflow whereas glaucomatous eyes with impaired outflow would be less able to adapt to the fluid influx.¹²

WDT is faster, requires no hospitalization and can be done as an office procedure. Full phasing (twenty-four hour diurnal IOP curve) is tasking, time consuming and requires hospital admissions.^{7,13} Modified phasing which does not require hospital admission is still time consuming as it spans throughout a clinic period (8:00am – 4:00pm). The use of Sensimed contact lens which is a newer technique for estimating twenty-four hour diurnal tension curve does not require hospital admission but it is expensive and not readily available.¹⁴ Therefore, this study was prompted by the need to find a quick clinic test that can be used to assess IOP peaks as well as fluctuations for better management of glaucoma patients.

METHODOLOGY

Study design

The study was a hospital-based cross sectional study on POAG patients on medical treatment seen at the glaucoma clinic of ESUTTHP Enugu over a three months period between August and October 2017.

Study area

The study was carried out at ESUTTHP Enugu. ESUTTHP Enugu is a state tertiary hospital in Enugu state, located within the heart of Enugu town.

Study population

The study population consisted of all adult follow-up POAG patients aged 40 years and above on medical treatment attending the Friday glaucoma clinic in the Eye clinic of ESUTTHP Enugu during the period of the study.

Sample size calculation

The sample size was calculated using the formula for population less than 10,000:

$$nf = \frac{n}{1 + \left(\frac{n}{N}\right)}$$

where,

nf = desired sample size when population <10,000

N = estimated size of the population = 672 (from the clinic records, average of 56 POAG patients (83% of all glaucoma patients) are seen on each glaucoma clinic giving 672 POAG patients in 3 months).

$$n = \frac{(z_{\alpha} + z_{\beta})^2 pq}{d^2}$$

n = desired sample size when population >10,000

z_{α} = standard normal deviate; corresponds to 95% confidence level ($z=1.96$)

z_{β} = standard normal variate for power = 0.84 at 80% power

p = proportion of target population with the characteristics (prevalence of POAG = 73.4% of 6.5 = 4.8% = 0.048).¹⁵

q = 1 - p

d = precision = 5%

n will be

$$n = \frac{(1.96 + 0.84)^2 (0.048)(0.952)}{(0.05)^2}$$

$$n = 143$$

Substituting for n ,

$$nf = \frac{143}{1 + \left(\frac{143}{672}\right)}$$

$nf = 118$

Correcting for an attrition rate of 10%, the minimum sample size was 130.

Inclusion criteria

1. Consenting adult (≥ 40 years) POAG patients on medical treatment attending the glaucoma clinic of ESUTTHP Enugu.
2. No previous glaucoma surgeries or laser treatment.

Exclusion criteria

1. Angle closure glaucoma.
2. Secondary glaucoma.
3. Previous glaucoma surgery or laser treatment.
4. Chronic, recurrent or ongoing ocular inflammation or other conditions requiring corticosteroids.
5. Underlying medical conditions like severe hypertension (blood pressure $\geq 180/110$ mmHg), renal or heart failure.
6. Media opacity negating view of the fundus in both eyes.
7. Pregnant women.

Time of Peak Intraocular Pressure during Water Drinking Test and Modified Phasing Among Glaucoma Patients in South-East Nigeria

8. Lack of consent.

Ethical considerations

The study adhered to the tenets of the Helsinki declaration and the National code of Health research. Ethical approval was obtained from the ESUT Teaching hospital Health Research and Ethics Committee before commencement of the study. A written informed consent duly signed or thumb printed was obtained from each patient before being included in the study.

Sampling technique

A simple random sampling method using a table of random numbers was used to select the patients for the study. The list of POAG patients that present to the glaucoma clinic every Friday was used as the sampling frame. Patients who were selected but refused to give consent to participate in the study were replaced by other patients who were willing to take part in the study. About 12-15 patients were selected on each glaucoma clinic. This was done until the minimum sample size was obtained.

Study procedure

Patients for the study were then selected by simple random sampling using a table of random numbers. Selected patients who met the inclusion criteria and were willing to participate in the study signed or thumb printed the written consent form. A proforma questionnaire divided into 2 sections was used for data collection. Section A consisting of biodata of the patient while Section B was used for documenting the ocular examinations findings including WDT and modified phasing. On obtaining informed consent, biodata of the patients were obtained. Ocular examinations were carried out which included visual acuity, anterior and posterior segment examination, gonioscopy, modified phasing and WDT.

Modified Phasing

This was done from 8a.m to 4p.m. Intraocular pressure was measured at two hourly interval in sitting position using Perkins applanation tonometer in the eye clinic.

Water Drinking Test

Patients were informed not to drink water at least 3 hours before the WDT. With patient in a sitting position, baseline IOP was measured just before patient drinks water using Perkins applanation tonometer. Patient then drank 1 litre of water (2 bottles of 50cl eva water at room temperature) within 5 minutes. IOP was checked immediately after drinking water and then every 15 minutes for 2 hours. This was done in the morning between 8a.m to 11a.m in the eye clinic.

Data analysis

Obtained data was cleaned, coded and double entered into a computer. Data analysis was done using Statistical Package for Social Sciences (SPSS) version 20 for windows (U.S.A). The time of peak IOP during WDT and modified phasing were determined.

RESULTS

A total of 130 POAG patients (260 eyes) on medical treatment were examined comprising of 56 males (43.1%) and 74 females (56.9%). Their age ranged between 42 and 83 years with mean age of 62.25 ± 9.002 . Civil servants made up of 27.7% of the patients while 26.9% were traders, 16.2% were farmers and 9.2% were artisans.

Out of the 258 eyes that did WDT, the peak IOP occurred in 90.2% within 1 hour of drinking water with 23.6% of the eyes having peak IOP at 15 minutes, 24.0% at 30 minutes, 22.9% at 45 minutes, 20.2% of eyes at 60 minutes, 6.6% of eyes at 75 minutes, 2.3% at 90 minutes, 0.0% at 105 minutes and 0.4% at 120 minutes (Figure 1).

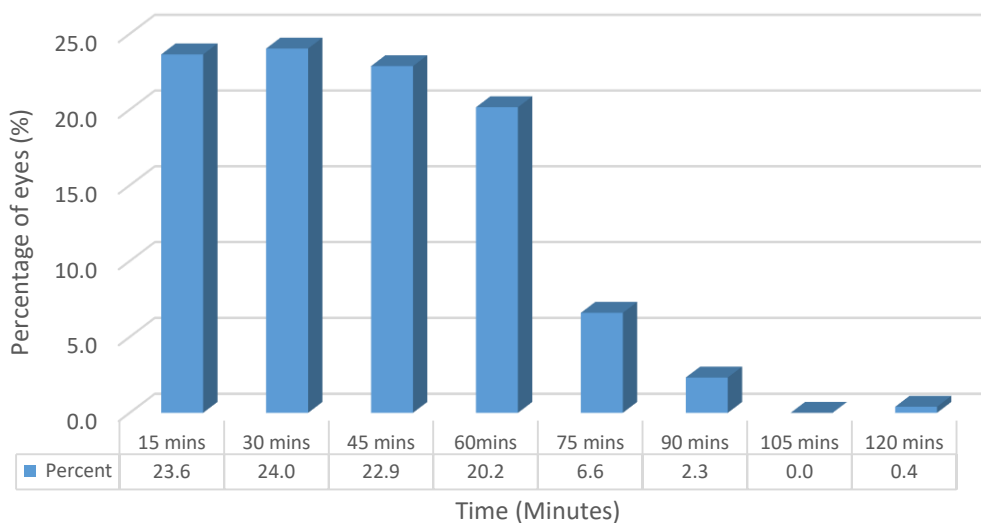


Figure 1: Time of IOP peak during Water Drinking Test

Time of Peak Intraocular Pressure during Water Drinking Test and Modified Phasing Among Glaucoma Patients in South-East Nigeria

Out of the 248 eyes that did modified phasing, the peak IOP occurred in two-thirds (74.1%) of eyes within the first 4 hours of commencing phasing while 25.8% had their IOP peak after

4 hours of starting phasing with 30.6% of the eyes having peak IOP at onset of the test, 28.2% at 2 hours, 15.3% at 4 hours, 16.1% at 6 hours and 9.7% at 8 hours (Figure 2).

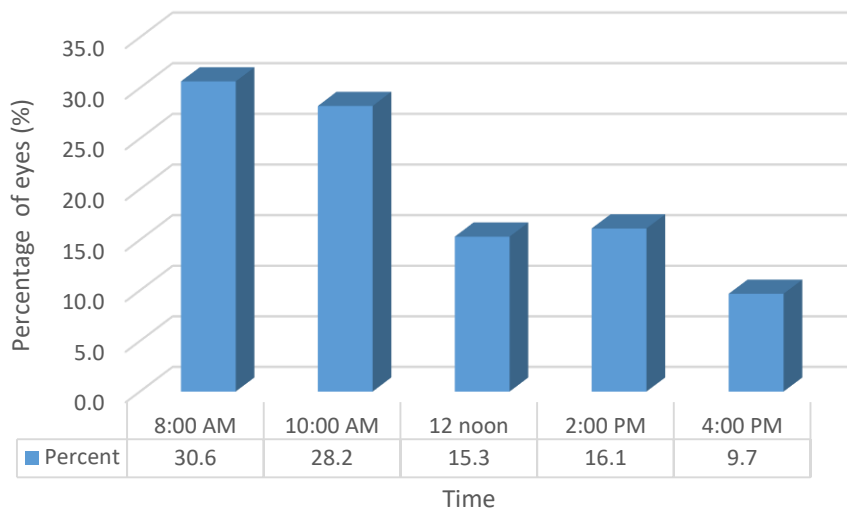


Figure 2: Time of peak IOP during modified Phasing

DISCUSSION

Elevated intraocular pressure is presently the only modifiable risk factor in glaucoma and it is well known that IOP fluctuates at different times of the day and night. This has prompted diurnal IOP measurements (via phasing) which are of great importance in the treatment of glaucoma because significant IOP peaks and fluctuations may predispose a patient to progression. However, in clinical practice, management of glaucoma may be based on single IOP measurement usually taken during follow-up clinic visits. The water drinking test is a provocative test that was found to correlate with diurnal tension curve and recently it has been proposed as an alternative method to monitor intraocular pressure.

In the present study, greater percentage of eyes had peak IOP occurring within 1 hour while only a few eyes had IOP peak occurring after 1 hour during the WDT. This suggests that WDT can be done as a quick clinic procedure over 1 hour instead of 2 hours as in some previous studies to monitor IOP peaks and fluctuations of POAG patients on medical treatment.^{16,17,18}

During modified phasing, it was observed most of the eyes had IOP peak at or before 12 noon while a few had after 12 noon. This means that about 1 in 4 patients peaked after 12 noon and those that run glaucoma clinic in the morning may miss these patients. The afternoon peak might be due to the effect of anti-glaucoma drugs. Similarly, David et al found that 65% of peak IOP during phasing occurred before 12 noon although they used untreated newly diagnosed glaucoma patients unlike in the present study that used old glaucoma

patients on medical treatment.¹⁹ In addition, Rota-Bartelink et al found a significant increase in IOP throughout the phasing period between 7am and 5pm for POAG patients on beta-blockers with afternoon IOP values being significantly higher than the morning values.²⁰ This shows that afternoon clinic can still pick some IOP peaks because some people prefer it after business hours. Therefore, revision of timetable for IOP examination for some glaucoma patients may be needed.

CONCLUSION

Greater percentage of POAG patients had their peak IOP occurring in the first 1 hour during WDT. Therefore, WDT may be done as a quick clinic procedure to detect IOP peaks among glaucoma patients on treatment so as to know those at risk of progression. In addition, a few patients were noted to have their peak IOP occurring after 12 noon during modified phasing. Thus, it is important not to miss out these patients to ensure better management of their glaucoma.

Conflicts of interest: None

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Time of Peak Intraocular Pressure during Water Drinking Test and Modified Phasing Among Glaucoma Patients in South-East Nigeria

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