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Clinical Profile and Intraocular Pressure Control of Medically Treated Glaucoma Patients Seen in a Tertiary Hospital in Enugu, Nigeria

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ABSTRACT

Background: Glaucoma is the second most common cause of blindness and the leading cause of irreversible blindness worldwide. It is a chronic optic neuropathy with characteristic optic disc changes and corresponding visual field defect.

Aim: The aim of this study was to determine the clinical profile and intraocular pressure control of Primary Open Angle Glaucoma (POAG) patients on medical treatment at the glaucoma clinic of Enugu State University of Science and Technology Teaching Hospital Parklane (ESUTTHP), Enugu with a view for better patient management.

Methods: The study was a hospital based cross sectional study on POAG patients on medical treatment attending the eye clinic of ESUTTHP, Enugu. 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. Water Drinking Test (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). The mean follow-up clinic intraocular pressure (IOP), IOP peak and fluctuation during WDT and phasing were determined and compared using T-test.

Results: A total of 130 primary angle glaucoma patients on medical treatment were examined comprising of 43.1% males and 56.9% females with mean age of 62.25±9.002. Few of the patients were blind (3.8%) while 66.2% had normal vision. Their mean vertical cup disc ratio was 0.78±0.13. Majority of the patients had thin central cornea and uncontrolled intraocular pressure. The mean follow-up clinic IOP, mean IOP peaks during WDT and phasing were 16.2±4.3, 22.9±5.7, 18.0±4.4mmHg, respectively. There was a significant correlation between central corneal thickness and IOP peaks in WDT and modified phasing as well as follow-up clinic IOP but there was no significant correlation between central corneal thickness and IOP fluctuations in WDT and modified phasing. There was a significant correlation between vertical cup disc ratio and IOP peaks in WDT as well as vertical cup disc ratio and follow-up clinic IOP ($p< 0.01$).

Conclusion: Few patients are blind from glaucoma but greater percentage still have uncontrolled IOP despite being on medical treatment. Therefore, other treatment options should be explored to bring their IOP under control to avoid further glaucomatous progression and consequent blindness.

ARTICLE DETAILS

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

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

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INTRODUCTION

Most of the people with glaucoma are unaware of their visual problem because central vision is preserved till the late stage,[1,2] causing majority of these patients to present late to the hospital.[3,4] Treatment of glaucoma, which can be medical or surgical, is aimed at reduction and diurnal stabilization of the intraocular pressure to a targeted pressure at which further progression of the disease is unlikely.[5,6] The risk factors for glaucoma progression include high peak intraocular pressure, high intraocular pressure fluctuations, low ocular perfusion pressure, older age, large cup-disc ratio, beta-zone peripapillary atrophy, thin corneal thickness and pseudoexfoliation syndrome.[7,8]

Glaucoma blindness is a public health problem leading to reduction in work force of the nation, low socioeconomic status, decrease in the quality of life of the patients and increased dependency on their relatives.[9,10] The prevalence of glaucoma is higher in blacks than whites.[11] In Nigeria, glaucoma prevalence is highest in the South-East geo-political zone.[12] In addition, glaucoma in blacks has earlier onset, more aggressive and more difficult to treat with attendant higher risk of progression and blindness.[13] Blindness from glaucoma is irreversible but avoidable. Therefore, there is need for early detection and adequate treatment.[5,10,14,15]

IOP is the only modifiable risk factor in glaucoma which is addressed in its management. Management of glaucoma patients requires regular review of their intraocular pressure at each clinic visit.[16] However, there is diurnal variation in intraocular pressure. To detect this, phasing or water drinking test need to be done. Although these tests are tasking and time consuming but they help to detect IOP peaks and fluctuations which if high are risk factors for glaucoma progression. Very commonly, a single IOP check in the clinic is done at follow-up visits. Due to diurnal variations in IOP level, this single IOP value may not reflect the patient's peak IOP and IOP fluctuation because some peaks may occur outside clinic hours.[17] Thus, the clinician is not sure whether the patient's IOP is actually controlled or not. Some of these patients may have apparently normal clinic IOP yet their glaucomatous damage progresses. It is challenging to manage such glaucoma patients.[18] This glaucoma progression may be due to high IOP peaks and high IOP fluctuations not detected during clinic visits.[19,20] Therefore, the aim of this study was to determine the clinical profile and intraocular pressure control of POAG patients on medical treatment at the glaucoma clinic of ESUTTHP, Enugu with a view to determining those patients at risk of glaucoma progression and manage appropriately.

METHODOLOGY

The study was a hospital based cross sectional study on POAG patients on medical treatment at ESUTTH Parklane, Enugu between August and October 2017. The study adhered to the tenets of the Helsinki declaration. Ethical approval was obtained from the ESUTTH Health Reasearch and Ethics Committee before commencement of the study. A written informed consent was obtained from each patient before being included in the study. Patients were free to withdraw from the study at any time without being punished.

A total of 130 already diagnosed POAG patients on medical treatment were selected by simple random sampling using a table of random numbers. Both eyes of each patient were examined which included visual acuity, gonioscopy, anterior and posterior segment examination, phasing and water drinking test. Consenting POAG patients 40 years and above on medical treatment were included in the study while those with angle closure or secondary glaucoma, history of previous glaucoma surgeries or laser treatment, ocular conditions requiring steroid therapy, underlying medical conditions like severe hypertension, renal or heart failure were excluded from the study. A structured interviewer-administered proforma questionnaire was used to obtain information on their biodata, clinical history as well as record the examination findings.

Phasing

This was done as a modified phasing from 8a.m to 4p.m. Intraocular pressure was measured at two hourly intervals in sitting position from 8a.m to 4p.m using Perkins applanation tonometer in the eye clinic. IOP fluctuation ≤6mmHg was considered as controlled or normal while IOP fluctuation >6mmHg was considered as uncontrolled.

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. The readings were recorded. This was done in the morning between 8a.m to 11a.m in the eye clinic. IOP fluctuation ≤6mmHg was considered as controlled while IOP fluctuation >6mmHg was considered as uncontrolled.

STUDY DEFINITIONS

Target pressure: level of IOP at or below which further glaucomatous optic nerve damage is unlikely to occur.[21]

Follow-up clinic IOP: IOP measured at the clinic during follow-up visit (the day the patient was selected for the study).

Mean follow-up clinic IOP: Arithmetic mean of follow-up clinic IOP of all the patients.

Controlled IOP: Follow-up clinic IOP at or below the target

pressure or IOP fluctuations ≤6mmHg during WDT and modified phasing.[18,22,23]

Uncontrolled IOP: Follow-up clinic IOP level above the target pressure or IOP fluctuations >6mmHg during WDT and modified phasing.[18,22,23]

Baseline IOP: IOP measured immediately before the patient drinks the one litre of water during WDT.[24]

Peak IOP is defined as the maximum IOP measured during the WDT or phasing.[24]

Mean peak IOP: Arithmetic mean of peak IOP of all the patients during WDT or phasing.

IOP fluctuation is defined as the difference between peak IOP and baseline IOP in WDT or the difference between peak IOP and the lowest IOP during phasing.[24]

Mean IOP fluctuation: Arithmetic mean of IOP fluctuations of all the patients during WDT or phasing.

DATA ANALYSIS

Obtained data was cleaned, coded and double entered into a computer. Data entry and analysis was done using Statistical Package for Social Sciences (SPSS) version 20 for windows (U.S.A). The demographic data of the patients was analysed and presented in percentages. The mean peak IOP and mean IOP fluctuation in phasing and WDT as well as mean follow-up clinic IOP were determined. The comparison between mean follow-up clinic IOP and mean peak IOP in WDT, mean follow-up clinic IOP and mean peak IOP in phasing, duration of treatment and regular use of drugs were done using t-test. Chi square/Fishers Exact was used to compare the type of drug used and the IOP control as well as regular use of drug versus IOP control in WDT, phasing and clinic follow-up. A p value of ≤ 0.05 was used to define statistical significance corresponding to a 95% confidence interval.

RESULTS

A total of 260 eyes of 130 POAG patients 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. One hundred patients were on prostaglandin analogues, 90 patients were on beta blockers, 31 patients were on topical carbonic anhydrase inhibitors, 20 patients were on alpha agonist while 2 patients were on miotics. These drugs were used either singly or in combination.

Using the World Health Organization (WHO) visual acuity classification, 66.2% of the patients had normal vision, 10.8% had mild visual impairment (VI), 19.2% had moderate to severe VI while 3.8% were blind.

Table 1. Visual Acuity (VA) of the study participants

VA Classification (By WHO)	Frequency (%)		
	Presenting VA (person)	Right eye (Unaided VA)	Left eye (Unaided VA)
Normal (6/12 or better)	86 (66.2)	53 (40.8)	60 (46.2)
Mild or no VI (worse than 6/12-6/18)	14 (10.8)	18 (13.8)	12 (9.2)
Moderate VI (worse than 6/18-6/60)	23 (17.7)	41 (31.5)	38 (29.2)
Severe VI (worse than 6/60-3/60)	2 (1.5)	3 (2.3)	2 (1.5)
Blindness (worse than 3/60)	5 (3.8)	15 (11.5)	18 (13.8)
Total	130 (100.0)	130 (100.0)	130 (100.0)

VI = Visual Impairment. WHO = World Health Organization.

Out of the 260 eyes of the study patients, 60 eyes had VCDR of 0.50 – 0.60, 115 eyes had VCDR of >0.60 – 0.80 while 85 eyes had VCDR of >0.80 – 1.0. The mean VCDR in all the eyes was 0.78±0.13.

Table 2. Vertical Cup Disc Ratio (VCDR)

VCDR Classification	Frequency (%)	
	Right eye	Left eye
0.50 - 0.60 (mild glaucoma)	30 (23.1)	30 (23.1)
>0.60 – 0.80 (moderate glaucoma)	58 (44.6)	57 (43.8)
>0.80 – 1.00 (advanced glaucoma)	42 (32.3)	43 (33.1)
Total	**130 (100.0)**	**130 (100.0)**
Mean ±S.D	**0.77±0.13**	**0.78 ±0.13**
Both eyes Mean ± S.D	**0.78 ±0.13**	

The mean follow-up clinic IOP was 16.2±4.3 mmHg. The mean peak IOP and mean IOP fluctuation during WDT were 22.9±5.7 mmHg and 7.9±3.9 mmHg respectively. The mean peak IOP and mean IOP fluctuation during Phasing were 18.0±4.4 mmHg and 5.6±2.4 mmHg.

On comparing the mean follow-up clinic IOP and the mean

peak IOP during WDT, there was a significant difference between the two parameters; $p \leq 0.05$.

Table 3. Comparison between Mean follow-up Clinic IOP and Mean Peak IOP in WDT

	Methods	N	Mean IOP	S. D.	t-value	P-value
Right eye	Clinic Follow-up	130	16.2	4.5	-9.39	0.001
	Water drinking test	129	22.8	6.5		
Left eye	Clinic Follow-up	130	16.2	4.8	-10.50	0.001
	Water drinking test	129	22.9	5.7		
Both eyes	Clinic Follow-up	260	16.2	4.3	-10.66	0.001
	Water drinking test	258	22.9	5.7		

On comparing the mean follow-up clinic IOP and the mean peak IOP during phasing, there was a significant difference between the two parameters; $p \leq 0.05$. The mean peak IOP during phasing was higher than the mean follow-up clinic IOP.

Table 4. Comparison between Mean follow-up Clinic IOP and Mean Peak IOP in Phasing

	Methods	N	Mean	S. D.	t-value	P-value
Right eye	Follow up	130	16.2	4.5	-3.12	0.002
	Phasing	124	18.1	4.8		
Left eye	Follow up	130	16.2	4.8	-2.96	0.003
	Phasing	124	17.9	4.9		
Both eyes	Follow up	260	16.2	4.3	-3.31	0.001
	Phasing	248	18.0	4.4		

The follow-up clinic IOP was controlled in 100 eyes and uncontrolled in 160 eyes of the patients.
During WDT, IOP was controlled in 115 eyes and uncontrolled in 143 eyes while during modified phasing, IOP was controlled in 162 eyes and uncontrolled in 86 eyes of the patients.

Table 5. IOP Control during follow-up clinic visit, WDT and modified phasing.

Methods	Frequency (%)					
	Right eye		Left Eye		All eyes	
	Controlled	Uncontrolled	Controlled	Uncontrolled	Controlled	Uncontrolled
Follow-up clinic IOP	51 (39.2)	79 (60.8)	49 (37.7)	81(62.3)	100 (38.5)	160 (61.5)
Water Drinking test	50(38.8)	79 (61.2)	65(50.4)	64(49.6)	115 (44.6)	143 (55.4)
Modified Phasing	71(57.3)	53 (42.7)	91 (73.4)	33(26.6)	162(65.3)	86 (34.7)

One hundred and eight of the participants had central corneal thickness (CCT) of <520µm (below normal) in the right eye and in the left eye, 19 and 18 patients had CCT of 520 - 540µm (normal) in the right and left eyes respectively while 3 and 4 patients had CCT of >540µm (above normal) in the right and left eyes respectively. The mean CCT in the right and left eyes were 523.5 ± 32.38µm and 524.65 ± 32.20µm respectively.

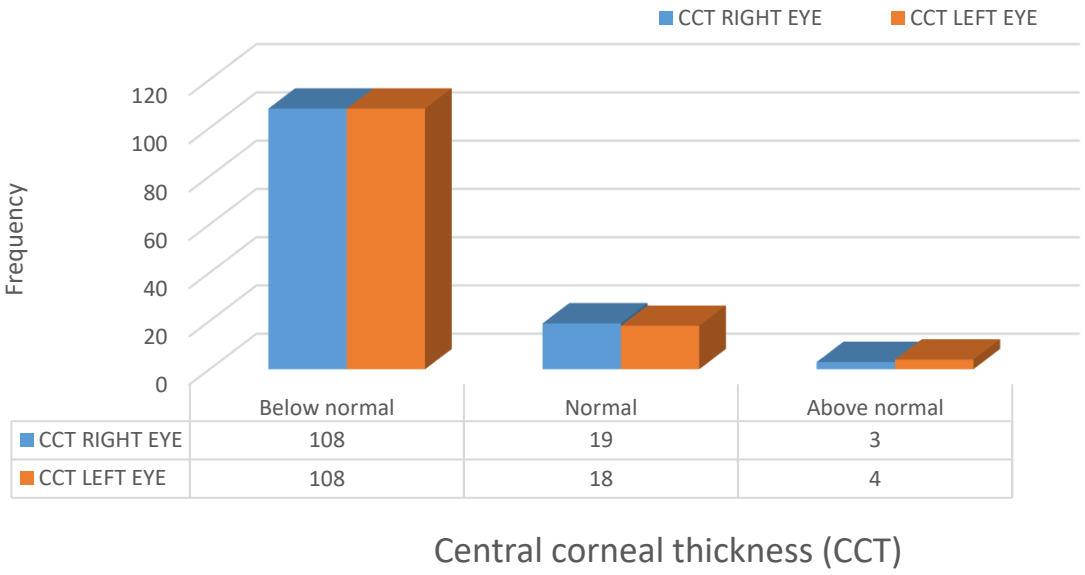

Figure 1. Central corneal thickness (CCT) of the study participants

CCT <520µm = below normal; CCT 520 - 540µm = normal; CCT of >540µm = above normal.

There was a significant correlation between central corneal thickness and IOP peaks in WDT and modified phasing as well as follow-up clinic IOP, $p \leq 0.05$ but there was no significant correlation between central corneal thickness and IOP fluctuations in WDT and modified phasing, $p > 0.05$.

There was a significant correlation between vertical cup disc ratio and IOP peaks in WDT as well as vertical cup disc ratio and follow-up clinic IOP, $p \leq 0.05$. There was no significant correlation between vertical cup disc ratio and IOP peaks during modified phasing, $p > 0.05$.

There was a significant relationship between regular use of drug or not and IOP control in WDT,

$p \leq 0.05$. However, there was no relationship between regular use of drug or not in IOP control in

modified phasing and in follow-up clinic IOP, $p > 0.05$.

For patients on single drug, the greatest number were on prostaglandin analogues alone (38 patients), followed by beta-blockers (34 patients), then alpha-agonist (6 patients) and carbonic anhydrase inhibitors (2 patients). There was no patient using miotics alone. On cross tabulation between IOP control and the type of drug used, there was no significant relationship between the type of drug patients were using and IOP control in WDT, modified phasing and clinic follow-up ($p>0.5$).

DISCUSSION

Glaucoma is the leading cause of irreversible blindness worldwide. The study showed that few patients were blind. It is comparable to the study by Gachago in Kenya where 78.5% of the glaucoma patients had normal vision while 6.4% were blind at presentation.[25] However, this is in contrast to previous studies in other parts of Nigeria (Bauchi, Ogun, Ibadan) by Abdull et al, Olajide et al, Olawoye and Tarella where greater percentage (35%, 20.8% and 29.7%, respectively) of the glaucoma patients were blind at presentation.[3,26,27] The mean VCDR was comparable to the findings of Abdull et al where the mean VCDR was 0.8.[26] However, Olawoye and Tarella found a higher mean VCDR (0.90±0.16) with majority of the patients (67.4%) having severe disease (VCDR ≥0.9) in at least one eye at presentation.[3]

The mean follow-up clinic IOP was lower than the mean peak IOP in WDT. When the mean follow-up clinic IOP was compared with the mean peak IOP in WDT, there was a statistically significant difference between the two. This shows that one single IOP check during follow-up clinic visit may not reflect the patient's peak IOP. Moraes et al in U.S.A found that the mean peak IOP during follow-up was 18.1±2.8mmHg and the mean peak IOP during WDT was 20.0 ± 2.9 mmHg and there was a significant correlation between the two ($P < 0.001$, $r = 0.75$).[28] However, in their study, the patients had eight follow-up visits in 6-12 months and the mean of their peak follow-up IOP was measured unlike in the present study where a single IOP measurement during one follow-up visit was taken.

The mean follow-up clinic IOP was also less than the mean peak IOP during phasing in the present study. Clinic IOP is just a small sample of the whole circadian variation of IOP which can occur both in glaucoma and healthy individuals. On comparing the mean follow-up clinic IOP with the mean peak IOP during phasing, there was a statistically significant difference between the two. This shows that a single IOP check during follow-up clinic visit may miss out the IOP peaks these glaucoma patients have which may occur outside the time of clinic visit. Similarly, the study by Moodie et al in UK found that the mean clinic IOP (15.91 ± 3.32 mmHg) was

less than the mean peak IOP in daytime phasing (19.38 ± 4.06 mmHg) although there was no significant difference between the two (p=0.13) unlike in the present study.[29] Arora et al in India also found that the mean office IOP in POAG patients on medications was 13.32 ± 4.07 mmHg which was less than the diurnal IOP (16.02 ± 3.50 mmHg) and this was statistically significant.[30] In addition, Hughes et al did a 24-hour phasing unlike in the present study where daytime phasing was done but they got similar findings whereby the peak IOP during phasing was found to be higher than the peak clinic IOP.[31] It was higher by 4.9mmHg in their study but higher by 1.8mmHg in the present study. Even though the study by Hughes et al showed that the highest IOP values occurred at night, clinical management of glaucoma is usually based on a single IOP measurement taken during hospital outpatient hours.[31]

From clinic follow-up and WDT, greater proportion of eyes had uncontrolled IOP while in contrast greater proportion of eyes had controlled IOP from phasing. This shows that some of these patients might be at risk of glaucoma progression, therefore, more aggressive treatment either surgery or laser may be required. With one single clinic IOP check, the clinician managing the patient may not to be exactly sure whether the patient's IOP is under control or not thus, the patient may be at risk of further glaucomatous damage without knowing.

The reason for the uncontrolled IOP could be because some of the patients were not using their drugs regularly. There was a significant relationship between using the drugs regularly or not with IOP control in WDT unlike in modified phasing and clinic follow-up. Duration of treatment may have affected regular use of the drugs as over time, patient's fear of blindness and belief in drug efficacy may reduce leading to less adherence. However, there was no significant relationship between duration of treatment and regular use of drug or not. In contrast, the study in Lagos by Onakoya and Mbadugha found that patients who had been on anti-glaucoma drugs for 6 years and more had the lowest adherence rates.[32] Another reason for uncontrolled IOP could be due to the type of drug the patient was using. For patients using single drug, greater percentages of those on beta-blockers achieved better IOP control from clinic follow-up than prostaglandins while greater percentages of those on prostaglandins achieved better IOP controls in WDT and modified phasing than beta-blockers. The disparity could be due to the different mechanisms of action of the drugs. Beta-blockers reduce aqueous production while prostaglandins enhance aqueous outflow through the uveoscleral pathway. These two mechanisms bypass the resistance to aqueous outflow at the trabecular meshwork which may have accounted for the better IOP control. However, on comparing IOP control in WDT, modified phasing as well as clinic follow-up and the type of drug patients were using, there was no significant relationship between them. This is in contrast to the findings of the previous studies by Vetrugno et al in Italy and Mansouri et al in California on POAG patients on medical treatment which showed that POAG patients on prostaglandin analogues had better IOP control when compared with those on other anti-glaucoma drugs.[33,34] Poor IOP control could also be because glaucoma is more aggressive and more difficult to treat in blacks.

The present study found that majority of the patients have thin central cornea which is a risk factor for glaucoma progression and there was a correlation between CCT and IOP peak during WDT but no correlation between CCT and IOP fluctuation during WDT. Furlanetto et al found there was no correlation between CCT and IOP peak as well as CCT and IOP fluctuation during WDT showing that WDT was not influenced by CCT.[35] In addition, Arora et al found that there was no significant relationship between CCT and IOP fluctuation.[30] There was a significant correlation between vertical cup disc ratio and IOP peaks in WDT as well as vertical cup disc ratio and follow-up clinic IOP. There was no significant correlation between vertical cup disc ratio and IOP peaks during modified phasing.

CONCLUSION

Majority of the patients had moderate glaucoma and thin central corneas. Few patients were blind from glaucoma even though greater number of patients had uncontrolled IOP. Therefore, there is need for their treatment to be adjusted to prevent glaucoma progression and its attendant irreversible blindness.

CONFLICTS OF INTEREST: None

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