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GCC and RNFL Changes Following Topical Therapy in Primary Open-Angle Glaucoma

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ABSTRACT

Background and Objectives: Gradual loss of retinal ganglion cells and their axons, primarily in the retinal nerve fibre layer (RNFL), is the cause of glaucoma, a progressive optic neuropathy that is one of the leading causes of irreversible blindness globally. This study was conducted to ascertain Immediate change In Optic Nerve Head Stereometric Parameters In Primary Open-angle Glaucoma After Topical Medical Therapy.

METHODOLOGY: In this study, 120 patients diagnosed with primary open angle glaucoma were enrolled. These subjects had no other ocular or systemic illness. Patients with primary open glaucoma confirmed by glaucoma specialist were undergone for GCC (ganglion cell complex), RNFL (retinal nerve fibre layer), FLV (focal loss volume) and GLV (gross loss volume) measurement by OCT (RTVue-100;Optovue, version 6.1..0.21). After seeking glaucoma topical medical therapy by glaucoma specialist patients were revisited after one month. OCT was performed again to measure the GCC and RNFL, GLV and FLV again to observe the change in these values. The analysis of data was done by using SPSS version 22. Quantitative data was presented in terms of mean ± S.D and S.E. and qualitative data was presented in form of Pie chart. Normality assumption was checked by One Sample Kolmogorov-Smirnov test and all the variables were considered in normal distribution having p value > 0.05.

RESULTS: Out of 120 patients having primary open glaucoma. 53% were male and 46% were females. Mean age of patients was 52 years. Mean GCC was found to be improved with a difference of 0.73±1.02, $p > 0.05$ before and after the treatment. Average RNFL before the treatment was 82.98 ±9.93 and after was 83.61 ±10.0 with a difference of 0.63 ± 0.03 $p < 0.05$. FLV before the treatment was 4.19 ± 3.68 and after was 3.51 ± 2.82 with a mean difference of 0.68 ± 0.86 $p > 0.05$. average GLV before the treatment was 14.09 ± 6.92 and after was 15.08 ± 6.89 with a mean difference of 0.9 ± 0.03, $p > 0.05$.

CONCLUSION: Following topical medicinal therapy, immediate changes in ONH stereometric parameters in POAG patients provide important information about the early response to treatment and may be indicative of long-term outcomes.

KEYWORDS: Glaucoma, Optical Coherence Tomography, Gross loss volume (GLV), Focal loss volume (FLV).

INTRODUCTION

Gradual loss of retinal ganglion cells and their axons, primarily in the retinal nerve fibre layer (RNFL), is the cause of glaucoma, a progressive optic neuropathy that is one of the leading causes of irreversible blindness globally.1 Compression and displacement of the lamina cribrosa are contributing factors that inhibit axoplasmic flow and ultimately result in ganglion cell death.

Visual field loss is primarily correlated with damage to the inner retinal layers, which are the target of primary open-angle glaucoma (POAG), specifically the photo receptor layers and retinal pigment epithelium of the outer retina.2 The diagnosis requires a careful evaluation of the optic disc and neuroretinal rim measurements, which is difficult because of the impact of ocular magnification on measurement precision. Important diagnostic markers include optic nerve head (ONH) cup expansion, localised rim thinning, and rim notching.3

The three most common diagnostic modalities for glaucoma are ONH examination, visual field testing, and intraocular pressure (IOP) monitoring. Still, rely

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ing exclusively on IOP is limited because visual field problems only show up after significant ganglion cell loss. Different ONH anatomical variations in normal and glaucomatous eyes further impede ONH measurement, as do observer variability and minor early-stage changes.4,5

Various approaches for evaluating the optic nerve head have emerged to meet diagnostic challenges. One such methodology is optical coherence tomography (OCT), which is a noninvasive, high-resolution imaging instrument that provides cross-sectional pictures of the ONH. OCT provides accurate evaluation of optic nerve head characteristics, making it easier to identify minute structural alterations associated with glaucoma.6

The goals of treatment include reducing or changing risk factors, especially intraocular hypertension, which is frequently accomplished by using hypotensive drugs such as beta blockers, prostaglandin analogues, carbonic anhydrase inhibitors, alpha agonists, and cholinergic agents. OCT evaluation of optic nerve head characteristics is required to monitor response to treatment; this method is more sensitive than IOP measures alone.7,8

In conclusion, because of its silent progression and complex diagnostics, glaucoma presents major obstacles to early diagnosis and successful treatment.9 Accurate assessment and the best possible treatment stratification depend on embracing modern imaging technologies like OCT in addition to conventional diagnostic techniques. This improves clinical results and preserves visual function in affected individuals.10

METHODOLOGY

This prespective study was carried out in department of ophthalmology, Punjab rangers teaching hospital Lahore between 1st june 2023 to 30th January 2024. A total 120 patients diagnosed with primary open angle glaucoma were enrolled. These subjects had no other ocular or systemic disease except glaucoma.. This was quasi experimental study with non-probability convenience sampling. This study has been approved by local ethical committee of Punjab rangers hospital, lahore. Patients meeting inclusion criteria were enrolled. After informed consent, with demographic data and medical history collected. Visual acuity was assessed using a log Mar chart. Diagnosis of primary open-angle glaucoma was confirmed by a specialist. OCT imaging was performed, measuring GCC, RNFL, and optic nerve head parameters. After testing, printouts were obtained, noting variables such as GCC, RNFL, and optic nerve head volumes, cup/disc ratios, and rim area. Patients were then referred for glaucoma therapy. After one month, OCT measurements of macula and RNFL were repeated and change in these parameters was noted.

RESULTS

Data will be entered SPSS-20. Quantitative variables like age will be presented as mean ± SD. Qualitative variables like gender will be presented as frequency & percentages. Comparison of pre-medical topical therapy OCT parameters and post medical topical treatment OCT parameters apply independent sample t-test, P-value ≤ 0.0 Total 120 patients were added in this study out of which 64 were male and 58 were females. Mean age of included patients was 50 years with a minimum of 19 years and 82 years maximum.

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	man	64	53.3	53.3	53.3
	woman	56	46.7	46.7	100.0
	Total	120	100.0	100.0	

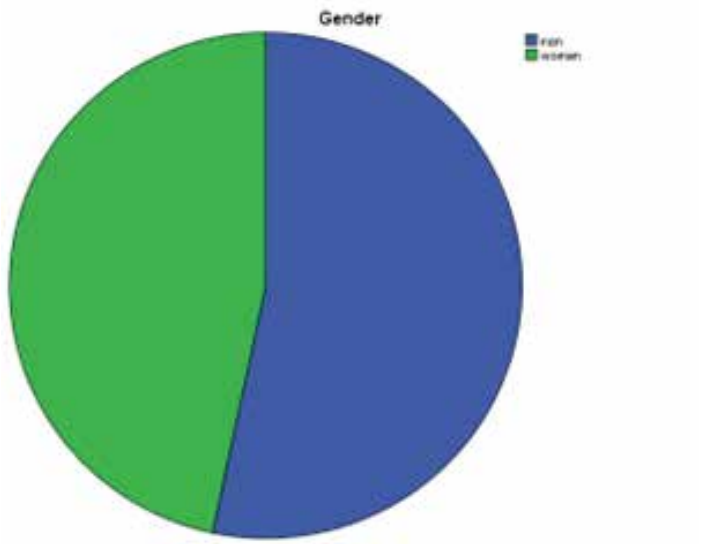

Table showing patients age:

	N	Minimum	Maximum	Mean	Std. Deviation
Age	120	19	82	50.18	14.137
Valid N (listwise)	120				

Normality assumption of test variables before and after treatment:

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
average RNFL before	.186	119	.000	.919	119	.000
average RNFL after	.184	119	.000	.922	119	.000
average GCC before	.073	119	.182	.970	119	.009
average GCC after	.072	119	.190	.976	119	.029
focal loss volume before	.171	119	.000	.854	119	.000
focal loss volume after	.120	119	.000	.887	119	.000
gross loss volume before	.102	119	.004	.973	119	.018
gross loss volume after	.095	119	.010	.973	119	.016

a. Lilliefors Significance Correction

Both the Kolmogorov-Smirnov and Shapiro-Wilk tests show very low p-values (Sig. <0.05) for average RNFL, GLV, FLV, and GCC before and after the treatment. This indicates that the data for "average RNFL, GCC, FLV and GLV before" and "data for average RNFL, GCC, FLV and GLV after" significantly deviate from a normal distribution.

Null hypothesis is rejected in both cases of average RNFL and average GCC before and after the treatment. It suggests that the data provide strong support for the existence of a significant change between before and after treatment retinal nerve fibre layer (RNFL) and ganglian cell complex (GCC) with significant p-value. Null hypothesis is retained in case of FLV and GL. It suggests that the data does not provide strong support for the existence of a significant change or effect between the median off focal loss volume and gross loss volume. So there is not significant difference in focal loss volume and gross loss volume before and after the topical medical therapy.

Descriptive Statistics of average RNFL, GCC, FLV and GLV

Report

	focal loss volume before	gross loss volume before	focal loss volume after	gross loss volume after	average RNFL before	average GCC after	average GCC before	average RNFL after
Mean	4.19529	14.09	3.51608	15.086112	82.9865	83.7141	82.9764	83.6140
Std. Deviation	3.688859	6.922	2.823328	6.8946447	9.93647	8.06329	7.60228	10.04194

Average RNFL before the treatment was 82.98 ±9.93 and after was 83.61 ±10.0 with a difference of 0.63 ± 0.03. Average GCC before the treatment was 82.97 ± 7.6 and after was 83.7 ± 8.06 with a mean difference of 0.73±1.02. Average FLV before the treatment was 4.19 ± 3.68 and after was 3.51 ± 2.82 with a mean difference of 0.68 ± 0.86. average GLV before the treatment was 14.09 ± 6.92 and after was 15.08 ± 6.89 with a mean difference of 0.9 ± 0.03.

DISCUSSION

Glaucoma stands as a formidable adversary in the realm of global ocular health, being a leading cause of irreversible vision impairment worldwide.11 Effective management of primary open-angle glaucoma (POAG) hinges significantly on the timely control of intraocular pressure (IOP), a pivotal factor in preserving visual function.12 Central to this endeavor is the strategic utilization of topical medication therapy, a cornerstone in halting or mitigating the progression of the disease.79,80 The immediate impact of such therapeutic interventions on optic nerve head (ONH) stereometric characteristics holds profound implications for clinical decision-making, underscoring the imperative of understanding these dynamics.13 The assessment of ONH stereometric parameters assumes paramount importance in discerning the acute alterations ensuing from topical medication treatment in POAG.14 Beyond mere observation, such evaluations serve as linchpins in devising efficacious diagnostic and therapeutic strategies for glaucoma.15 By furnishing insights into disease progression and treatment efficacy, these parameters furnish clinicians with indispensable tools for navigating the complexities of glaucoma management.

A comprehensive review of existing literature elucidates the current landscape and recent advancements in the assessment of ONH stereometric parameters, with a keen focus on the immediate ramifications of topical medication therapy in POAG. The imperative of prompt IOP control action in POAG management cannot be overstated, with topical medication therapy standing as a linchpin in the endeavor to stave off disease progression.16 Armed with a nuanced understanding of how such therapeutic interventions impact ONH stereometric characteristics in real time, clinicians are empowered to make more informed and effective decisions in the clinical setting

In essence, the interplay between topical medication therapy and ONH stereometric parameters represents a nexus of critical importance in the management of POAG. By unraveling the intricate dynamics at play, clinicians can chart a course towards preserving visual function and forestalling the ravages of glaucoma.17 Moreover, the integration of advanced imaging techniques lends further depth to our comprehension of glaucoma pathophysiology, heralding a new era of precision medicine in ocular healthcare. As we continue to unravel the mysteries of glaucoma, armed with ever-evolving insights and technologies, we inch closer towards a future where vision loss is no longer an inevitability, but a challenge met with knowledge, innovation, and unwavering resolve.18,10,20

The optic nerve head (ONH) serves as a crucial site for assessing damage caused by glaucoma and monitoring the progression of the disease. Various stereometric metrics of the ONH, such as the cup-to-disc ratio (CDR), rim area, disc area, and cup volume, can be quantitatively evaluated using different imaging techniques, including optical coherence tomography (OCT) and confocal scanning laser ophthalmoscopy (CSLO). Fluctuations in these metrics indicate structural changes associated with the development of glaucoma and its response to treatment.

Numerous studies have investigated the immediate changes in ONH stereometric parameters in patients with primary open-angle glaucoma (POAG) following the initiation of topical medicinal therapy. These studies primarily employ OCT or CSLO to assess structural alterations in the ONH shortly after the commencement of treatment. The rate at which a patient responds to therapy can offer valuable insights into its efficacy and may serve as an early predictor of long-term outcomes. In our study, The available data does not offer robust evidence supporting the presence of a substantial alteration or impact between the median off focal loss volume and gross loss volume. Thus, there appears to be no significant contrast in focal loss volume and gross loss volume prior to and following the administration of topical medical therapy. However for GCC and RNFL, the data strongly indicates a notable difference between the retinal nerve fiber layer (RNFL) and ganglion cell complex (GCC) before and after treatment, as evidenced by a significant p-value.

The mean RNFL measurement before treatment was 82.98 ± 9.93, while after treatment it was 83.61 ± 10.0, resulting in a difference of 0.63 ± 0.03. The average GCC measurement before treatment was 82.97 ± 7.6, which increased to 83.7 ± 8.06 after treatment, reflecting a mean difference of 0.73 ± 1.02. Before treatment, the average FLV was 4.19 ± 3.68, which decreased to 3.51 ± 2.82 after treatment, indicating a mean difference of 0.68 ± 0.86. The average GLV before treatment was 14.09 ± 6.92, which rose to 15.08 ± 6.89 after treatment, showing a mean difference of 0.9 ± 0.03

According to our study, Statistics of parameters including 'rim volme before and after, nerve head volume before and after, cup volume before and after, optic disc area ratio before and after, horizontal CD ratio before and after and vertical CD ratio before and after the medical topical therapy shows normal distribution. the paired-sample t-test results indicate that, for the parameters examined, there were no statistically significant changes in optic nerve head stereometric characteristics following topical medical therapy in primary open-angle glaucoma patient. Changes in rim volume before and after therapy were 0.065 and 0.066, showing them statistically not significant (p = 0.346). Changes in Nerve head volume before (mean 0.132) and after (0.144) the therapy were not statistically significant (p = 0.637).

The mean difference in cup volume before and after therapy was not statistically significant (p = 0.704) with mean values 0.493 and 0.504). changes in optic disc area before and after therapy were not statistically significant (p = 0.844). cup-to-disc area ratio mean value before and after was 0.590 and 0.608 showing no any significant change (p = 0.569). Horizontal Cup-to-disc ratio before (mean 0.825) and after (mean 0.833) therapy was not statistically signifinat (p = 0.781). Vertical cup-to-Disc ratio before (mean 0.759) and after (0.748) show no change (p = 0.685).

CONCLUSION

Understanding the rapid changes in ONH stereometric characteristics following the administration of topical medications holds significant therapeutic implications. Swift reductions in CDR and cup volume could potentially serve as early indicators of therapeutic response, aiding clinicians in monitoring disease progression. Moreover, identifying the most effective therapeutic agents for positively influencing ONH morphology can inform tailored treatment strategies, ultimately improving long-term outcomes for patients with POAG.

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Authors Contributions:

Uzma sattar: Substantial contributions to the conception and design of the work. Design of the work and the acquisition.

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