EFFECT OF GREEN TEA ON INTRAOCULAR PRESSURE IN PRIMARY OPEN ANGLE GLAUCOMA AND HEALTHY SUBJECTS

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ABSTRACT

Purpose: This study aims to assess green tea's impact on intraocular pressure in patients with primary open angle glaucoma and healthy volunteers.

Methodology: Quasi experimental study design was conducted at Munawar Memorial Hospital, Chakwal. Convenient sample of 100 subjects with age between 40-65 years of both genders was included in this study. Sample was divided into two groups. Groups were made on the basis of present and absence of primary open angle glaucoma. The duration of the study was from September 2022 to May 2023. Informed consent was taken from the subjects. Demographic data and history was taken using specially designed proforma. Slit lamp examination was carried out to exclude any ocular pathology. Before drinking green tea, intraocular pressure was measured using Goldmann Applanation tonometer. Intraocular pressure was rechecked one and two hours after consuming green tea.

Results: Green tea reduced Intraocular Pressure in both groups, with p- value of 0.000 ($p<0.05$). The decrease in intraocular pressure after one hour in glaucoma subjects was 2.70+1.01 and 1.70+1.093, after two hours in same group it reduced significantly with a difference of 6.50+1.542 in right eye and 5.54+1.809 in right and left eye respectively. In healthy group after one hour it was 1.62+0.753 in right eye and 1.30+0.886 in left eye.

But after two hours it had much better effect of 4.100+1.432 and 4.40+1.55 in right and left eye respectively.

Conclusion: After drinking green tea, there was a noticeable decrease in intraocular pressure. Intraocular pressure was reduced more significantly in glaucoma group.

Key words: Catechins, Green tea, Intraocular pressure, Polyphenols, Primary open angle glaucoma

1. INTRODUCTION

Glaucoma is a set of diseases with varying pathogenesis, risk factors, manifestations, therapies, and prognosis. The word glaucoma is derived from the Greek word glaukós, which is a general term meaning grey or green. A typical sign of progressive optic nerve degeneration is the death of retinal ganglion nerve cells, thinning of the retinal nerve fibers layer, and increase in the cup disc ratio. The ganglion cells, which are found within the brain are nerves that collect messages from rods and cones, evaluate them, and then transmit them via the optic nerve towards other parts of the brain. These axons pass through the lamina cribrosa, a collagen-based structure resembling a sieve, along with the retinal arteries as they travel from the ganglion cell's nucleus in retina to the optic disc. The neurons, which are covered in a myelin sheath, continue to function as the optic nerve behind the lamina cribrosa. Elevated IOP, lower capillary tension, and low cerebrospinal fluid pressure all contribute to papillary hypoperfusion, which impairs axonal transport in the optic nerve fibers and increases the gradient across the lamina cribrosa. The front part of the lamina cribrosa openings tends to be enlarged in POAG (1).

The impact of vision impairment will rise over the coming years as a consequence of aging of the population, which is a significant public health concern. A progressive optic neuropathy called glaucoma is defined as gradual damage to optic nerve and an irreversible but preventable loss of field of vision. Until the disease is advanced, it usually has no symptoms, but then it causes irreversible vision issues. Given the importance of early diagnosis and effective treatment, it is important to have a better understanding of the frequency and incidence of glaucoma as well as the risk factors related to primary open angle glaucoma (2).

Glaucoma, is the most frequently occurring cause of lifelong blindness. The usual symptoms involve a steady decline in the field of view. Glaucoma can proceed to total loss of vision if neglected. Just over half of patients are aware that they have the condition, and sometimes permanent harm occurs decades before detection because the harm done to one's eye is gradual and silent. Abnormal cell death of eyeball and abnormal rise in intraocular pressure are characteristic indicators of glaucoma, the

relationship among mechanical stresses and the condition is yet unexplained and of significant interest in research, treatment, and trade (3).

Through mechanisms that are currently unknown, a pressure gradient in the anterior eye causes optic neuropathy inside the posterior eyeball (retina). To adapt to increased mechanical stress, the network of trabecular cells in the front of the eye, RGCs and cells called glia undergo changes in structure and function referred to as glaucomatous remodeling (4).

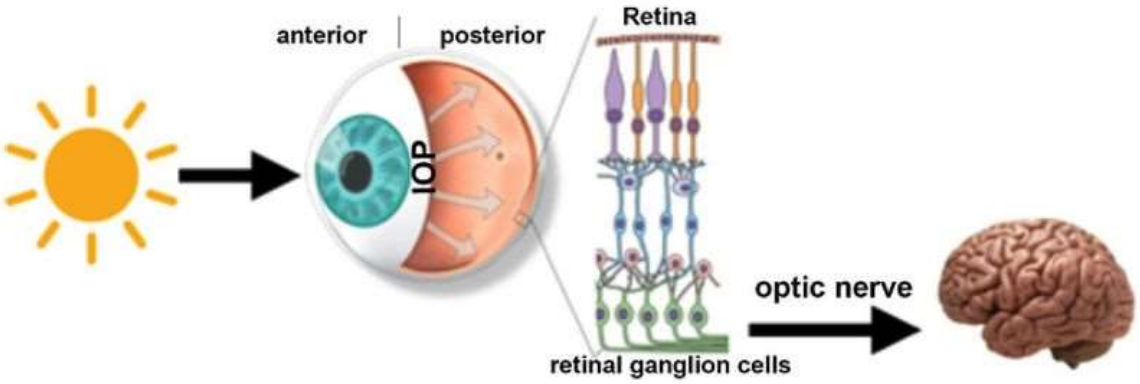

Figure 1.1: The retinal ganglion cells (4).

Globally, glaucoma is a significant contributor to visual impairment. The patient's quality of life is impacted by their visual impairment, which also places a greater economic and social burden on the community. By the year 2040, it is expected that there might be up to 111.8 million people worldwide who suffer from glaucoma. Especially in the early stages, many patients are unaware of their disorder, and permanent damage is frequently present at the time of diagnosis (5).

The most prevalent type of glaucoma, which accounts for more than eighty percent of cases in the Western World, is primary open angle glaucoma. The term "angle" alludes to the iridocorneal gap, which is "opened" in healthy individuals and also in POAG (Figures 1.2). This gap allows aqueous humour to flow into the trabeculum and Schlemm's canal. Open angle, IOP greater than twenty-one mm Hg, and visual field loss due to ganglion cell axon degeneration are clinical hallmarks of POAG. POAG is very infrequent in

subjects below the age of fifty. Men appear to have a larger prevalence than women. When the rate of compression is very high and the intraocular pressure surpasses 50 mm Hg, POAG may progress to absolute blindness in the majority of instances without the patients noticing any discomfort or pain.

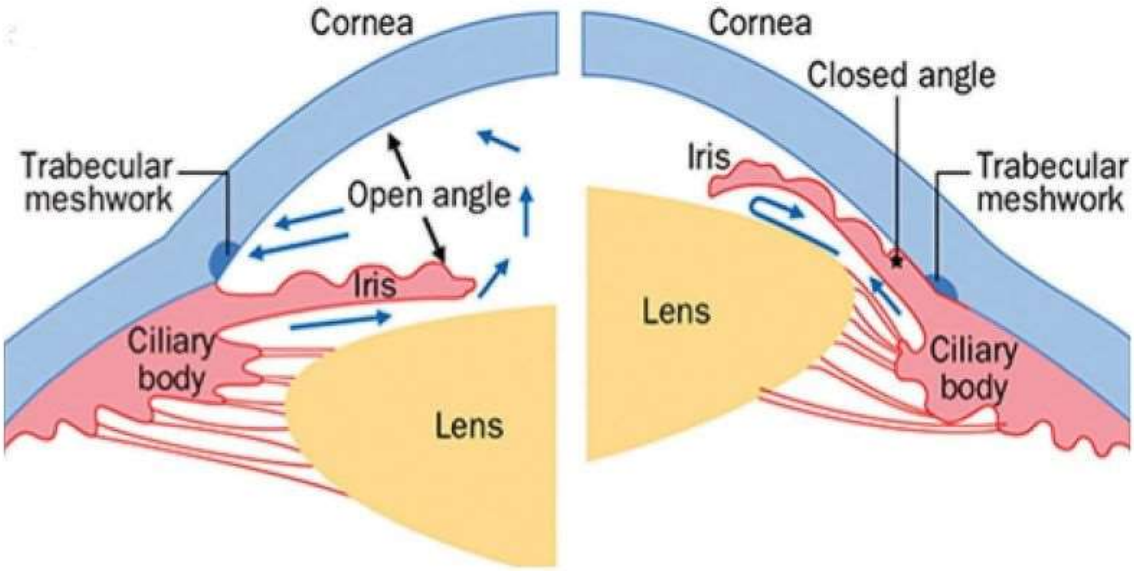

Figure 1.2: A schematic illustration of the anterior eye in open angle (left) and closed angle (right) glaucoma (4).

Intraocular pressure, which ranges from seven to less than twenty mm Hg, is a significant genetically inherited open angle glaucoma risk factor. The primary risk component for the onset and advancement of glaucoma, coupled with advancing age, is increased intraocular pressure. Intraocular pressure dependency is a factor in thirty to seventy percent of glaucoma patients. Usually, IOP amplitudes in the right eye are a little bit higher than in the left, but there is very little lifetime variation in IOP amplitude of each eye. Intraocular pressure is momentarily raised by blinking, rubbing the eyes, sneezing, accommodating lenses, systemic vascular resistance, and ocular movements. Posture orientation, lifting weights, and swimming goggles can all raise IOP and the chance of developing glaucoma, however moderate activity and a meal abundant in omega three and six fatty acids can lower IOP by four to five mm Hg (4).

In the body, reactive oxygen species are generated, and an excess of ROS can cause cell damage in individuals and encourage the onset of certain diseases. One of the primary antioxidant compounds, polyphenols offer a wide range of biological properties and positive effects on health. There has been some discussion about the use of naturally occurring antioxidants in both the management and avoidance of certain illnesses. The plant Camellia sinensis L. produces the renowned drink known as green tea. The catechins in green tea are thought to be the primary cause of these benefits, which have been shown to be negatively correlated with the risk of various degenerative illnesses, including malignancy, diabetes, and cardiac diseases. Several in vivo and in vitro investigations have been done on the antioxidant capacity of green tea. The vast majority of catechins include epicatechin, epicatechin gallate, EGC and EGCG. However, possibility of liver toxicity brought on by consumption of green tea extract has sparked widespread worry, and epigallocatechin gallate has been identified as the primary cause of the liver toxicity. Therefore, reducing the amount of epigallocatechin gallate in green tea in some circumstances might be good for people's health (6).

The scientific method significantly affects green tea's antioxidant potency. Green tea has a significantly greater catechins concentration than black tea. One of the most prevalent and varied classes of polyphenol is the flavonoid family. Powerful antioxidant activities are a result of the molecules' abundance of hydroxyl groups. More than 10 different constituent groups can be found in the chemical makeup of green tea. The primary ingredients are phenolics, catechins, polyphenolic chemicals, peptides and lipids (7).

The catechins group is thought to provide the most significant anti-inflammatory, antioxidants, and anticarcinogenic effects. Catechins' primary roles involve their antioxidant activities, such as the removal of ROS, suppression of the production of harmful radicals, and inhibiting the peroxidation of lipids. Based on previously published study, two elements that have a significant impact on the antioxidant properties of catechins present in green tea and their subsequent effect on societal disease prevention are the presence of the structural subunits and the quantity of hydroxyl groups in the molecules. Pulmonary, esophageal, gastrointestinal, pancreatic, breast, prostate, and urinary system cancers are just a few of the malignancies that green tea may protect (8).

Chemical Composition of Green Tea						
Amino acids	**Carbohydrates**	**Volatile compounds**	**Lipids**	**Vitamins**	**Phenolic acids**	**Trace elements**
L-Theanine	Glucose	Alcohols	Linoleic acid	Vitamin A	Gallic acid	Magnesium
Tyrosine	Cellulose	Esters	Alpha-linoleic acid	Vitamin B2		Chromium manganese
Tryptophan	Sucrose	Hydrocarbons		Vitamin B3		Calcium
Threonine 5-N-Ethylglutamine		Aldehydes		Vitamin E		Copper
Glutamic acid				Vitamin K		Zinc
Serine				Vitamin C		Iron
Glycine						Selenium
Valine						Sodium cobalt
Leucine						Nickel
Aspartic acid						
Lysine						
Arginine						

Figure 1.3: Chemical compounds of green tea (7).

Their anti-inflammatory and antioxidant benefits have been confirmed by clinical research as well as in vivo and in vitro trials. The primary antioxidants in green tea are catechins, which have antioxidant properties and they remove the metal ions in the reduction and oxidation process to neutralize free oxygen and nitrogen radicals. However, there wasn't any way to determine an epigallocatechin gallate dosage from green tea preparations that might be regarded as safe. There is no sign of hepatic injury under eight hundred epigallocatechin gallate per day for up to twelve months according to the clinical trials we evaluated (9).

Thus many factors are in favor of using plants polyphenols to avoid or cure a variety of aging-related diseases, particularly in conjunction with other, more focused medications. Additional knowledge will enable a much more widely spread utilization of these substances as a crucial tool to help stop or to reduce the frequency of these extremely frequent dysfunctions, making sure safer ageing, given it will also verify the possibility of plant polyphenolic compounds in the protection of metabolic-, aging-, or lifestyle-associated diseases and disorders currently without definitive treatments (10).

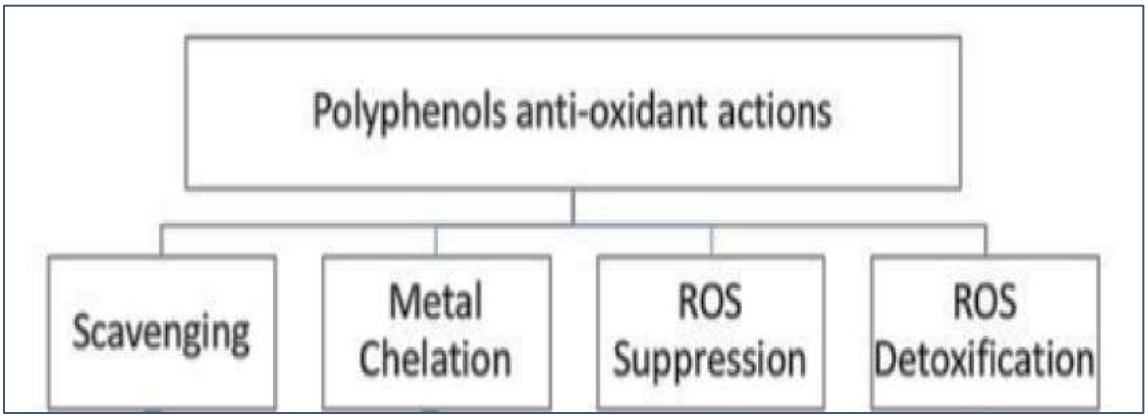

Figure 1.4: Major anti-inflammatory effects of polyphenolic antioxidants (11).

In glaucoma patients, oxidative damage is substantially more severe and closely correlated with both intraocular pressure and visual field abnormalities on the trabecular meshwork. Age-related disorders mostly have a strong correlation with oxidative damage to DNA in the trabecular meshwork. Oxidative stress is caused by a rise in reactive oxygen species that is greater than the tissue's antioxidant activities. Glaucoma sufferers' trabecular meshwork cells have impaired mitochondrial function, making them unusually susceptible to calcium stress and unable to manage intraocular pressure as a result. The meals we eat on a daily basis can change how genes are expressed in tissues, which can have either a good or bad physiologic consequence. Therefore, nutrition is important for maintaining ocular wellbeing. Numerous vegetables and fruits can operate as chemo-protective drugs, according to epidemiological research, because the compounds they carry can interfere with the pathophysiological pathways of several disorders. They can control a number of cellular molecular mechanisms that control death, redox potentials, inflammation, and other conditions. Well about elements that we have only briefly

discussed, a lot more could be stated. Study on glaucoma continues to be difficult due to the disease's intricacy as well as the numerous chemicals and metabolic pathways that are involved. Additionally, the development of glaucoma disease involves a wide range of target tissues in the eyeball; as a result, simply lowering intraocular pressure is insufficient to provide a favorable prognosis in this condition. Therefore, it seems like a worthwhile endeavor to use additives to combat the fundamental mechanisms that drive the development of glaucoma (12).

Many pressure reducing drugs are used in the present medication of chronic and acute types of glaucoma. Unfortunately, though after the use of such medications, visual loss has persisted. Such nerves degeneration may be brought on by peroxidation and may worsen once reactive oxygen species are produced. Therefore, a combination of anti-radical and anti-oxidative therapies for neuroprotection is required. In the past ten years, researchers have examined the polyphenolic molecule and discovered it to be helpful in neuroprotective effects against eye disorders like glaucoma. Combining polyphenolic compounds with food and drug authority approved hypotensive anti-glaucoma medications may be a wise decision for glaucoma care. However, their therapeutic usage is limited as a result of their poor solubility and inadequate absorption. Therefore, biotechnology-based methods are required to increase bioavailability of ocular tissues. Furthermore, to move these substances from the laboratory to the clinics, significant clinical research is needed (13).

OBJECTIVES

- To evaluate the effect of green tea on intraocular pressure (IOP) in healthy subjects.
- To evaluate the effect of green tea on intraocular pressure (IOP) in subjects with primary open angle glaucoma.

2. METHODOLOGY

2.1 STUDY DESIGN: It was a Quasi-Experimental study.

2.2 PLACE OF STUDY: Study was carried out at Munawar Memorial Hospital (MMH) and College of Optometry Chakwal, Punjab, Pakistan.

2.3 STUDY DURATION: Study was conducted from September 2022 to May 2023.

2.4 POPULATION OF STUDY: Both gender participants of age between 40 and 65 was included in this study.

2.5 SAMPLE SIZE: Total 100 subjects were included in the sample, which were divided into two groups. 50 with primary open angle glaucoma and 50 were healthy individuals.

2.6 SAMPLING TECHNIQUE: The technique of non-probability convenient sampling was applied.

2.7 INCLUSION CRITERIA

- Both genders included
- Freshly diagnosed cases of primary open angle glaucoma only (with glaucomatous damage)
- Intraocular pressure > 20 mmHg
- Age between 40-65 years
- Subjects willing to participate in study

2.8 EXCLUSION CRITERIA

- Any ocular pathology other than Primary open angle glaucoma
- Any ocular infection
- Angle Closure Glaucoma
- Secondary glaucoma
- Uveitis
- Ocular trauma
- Diabetic retinopathy
- Hypertensive retinopathy
- History of using anti-glaucoma
- Cataract
- Corneal edema or corneal scarring

- Subjects not willing to participate in the study
- Non cooperative subjects

2.9 DATA COLLECTION INSTRUMENTS: These instruments were used in this research study

- Slit lamp (Topcon)
- Goldman applanation tonometer (Holyavision)
- 90 D lens (Volk)

2.10 DATA COLLECTION TOOLS: This research was carried out by self-structured proforma.

DATA COLLECTION PROCEDURE: Study was carried out at eye department of Munawar Memorial Hospital and College of Optometry Chakwal. Informed consent was taken from the subjects. First of all, data including patient's age, gender, any previous ocular and medical history and duration of glaucoma (if present or known), was collected through specially designed proforma. Patients will be divided into two groups (healthy and glaucoma subjects). All subjects underwent slit lamp examination to eliminate any anterior or posterior segment diseases. Retinal examination was carried out using 90 D lens to check the cup disc ratio in subjects whom intraocular pressure was increased and they were suspected for primary open angle glaucoma. The intraocular pressure was calculated using a Goldman applanation tonometer with 0.5% proparacaine eye drops were instilled to subjects' eyes as topical anesthesia and 1% fluorescein to stain the tear film. A cup of green tea was made using 1.5 to 2 grams of green tea. Water was boiled and green tea was added in it. Patient was instructed to drink one cup of organic green tea (which contains 1.5 to 2 grams of green tea). After that patient was seated to wait for 1 hour and using same procedure of Goldman applanation tonometer, to measure the IOP was employed. The same procedure was repeated after two hours

3. DATA COLLECTION INSTRUMENTATION

3.1 SLIT LAMP BIO MICROSCOPE (TOPCON): A slit lamp is a device that emits a narrow strip of light into the human eye from an intense light source that may be centered. It is combined with a bio microscope for utilization. The light makes it easier to examine the human eye's cornea, iris, natural crystalline lens, eyelid, sclera, conjunctiva, & both posterior and anterior segments. Physical diagnoses can be obtained for a range of

eye disorders because of the binocular enlarged picture of the eye components provided by the binocular slit-lamp examination. The retina is inspected using an additional hand-held lens (90 D lens or 78 D lens). Slit lamp was used in the study to examine the anterior and posterior segments of the eye. It helped to exclude any ocular pathology before green tea consumption. Detailed examination was performed on slit lamp. Applanation tonometer which was used later was also attached to the slit lamp bio microscope. For evaluation of posterior segment 90 D lens was also used in conjunction with slit lamp to visualize the structures like retina, optic disc and macula.

3.2 GOLDMANN APPLANATION TONOMETER (HOLYAVISION): Goldmann applanation tonometer is a gold standard method of measuring intraocular pressure. It measures force needed to flatten the central cornea of about 3.06 mm. It is used in conjunction with slit lamp bio microscope. Blue filter is used in slit lamp to visualize the mires made by fluorescein dye. The view of the tear meniscus is divided into an upper and a lower arc using a split-image prism. When these curves are positioned such that their interior borders barely touch, the intraocular pressure is measured. The patient was asked to keep his head against the head rest and his chin on the chin rest while he was seated on the slit lamp. Before measuring intraocular pressure eye was anesthetized by topical proparacaine. Topical fluorescein was also used. Pressure was measured three times using Goldman applanation tonometer. High astigmatism, a deformed or damaged cornea, applying pressure on the lid during the reading, breathe holding by the individual during the evaluation, and fluorescein levels that are too high or too low in the tear film can all affect the precision of the readings from a Goldmann tonometer.

3.3 90 DS LENS: A Volk 90 D lens was used to examine retina and optic disc. It is the most common and commonly used retinal examination lens for slit lamps. It has a 0.76 times picture magnification. Although the retinal photograph is really minimized by the lens, an enlarged picture of the retina may be seen utilizing the slit lamp's enlargement technology. Refractive errors related to large axial length and the spacing of the lens from the tested eye have a significant impact on the retinal image's magnification. In order to calculate the real cup disc ratio, a factor of correction is employed. Its tiny diameter ring is perfect for in-orbit adjustment and active evaluation. It may be applied to tiny pupils. Patient was dilated using mydracil eye drops. Patient was seated at a comfortable chair

with chin and head rested against slit lamp. Cup disc ratio of patients was examined in detail.

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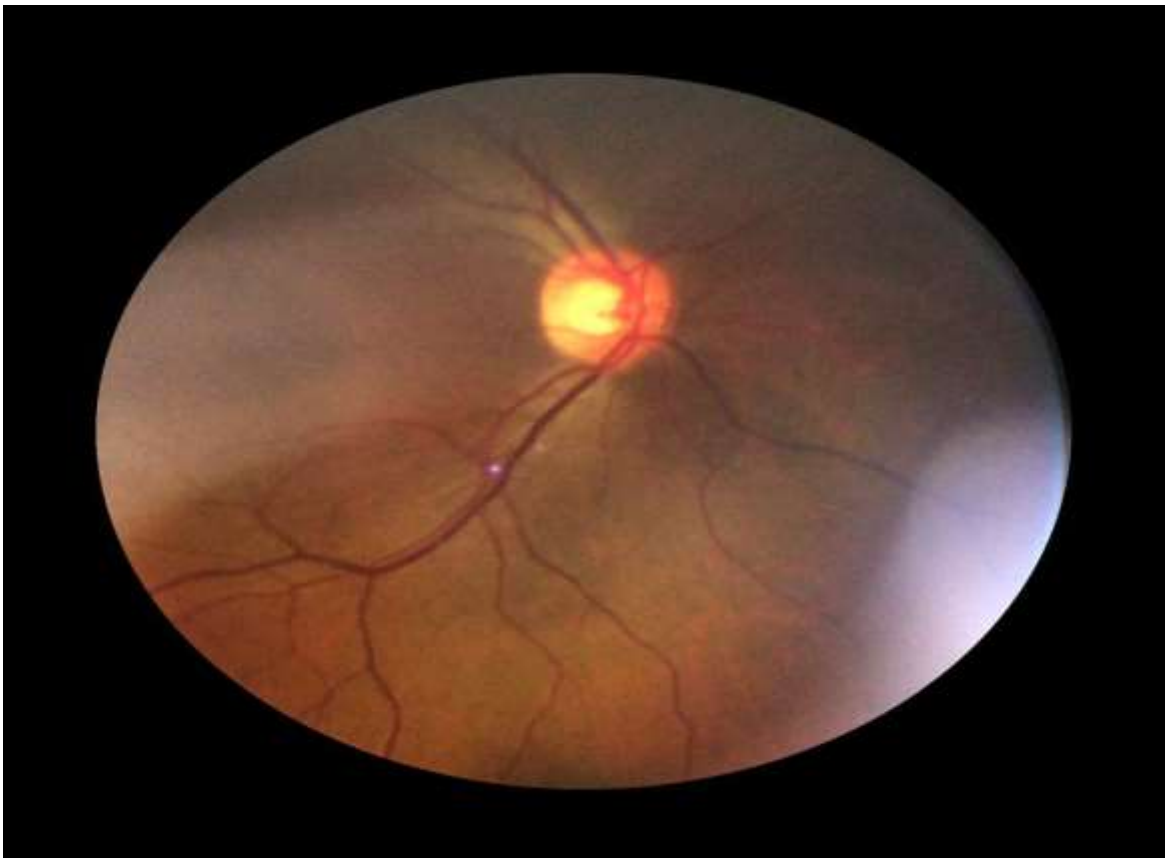

Figure 3.5: High cup disc ratio in Primary Open Angle Glaucoma patients.

DATA ANALYSIS METHOD: Data was analyzed using a paired sample t test by SPSS version 26.

ETHICAL CONSIDERATION: Both verbal and written consent was obtained from patients after explaining the procedure and purpose of the study by briefly describing the study topic, its purpose and duration to ensure that included subjects understood this information.

4. RESULTS

This study included total100 subjects with age ranging from 41-65 years. Out of these, 50 primary open angle glaucoma patients and 50 healthy subjects were used in the study. Both groups were made to consume green tea and intraocular pressure was measured before and after & two hours of its consumption.

4.1: GENDER DISTRIBUTION OF SUBJECTS

The table below (4.1.1) shows that total 100 subjects. Patients were divided into two groups. Out of these, 50 were healthy subjects and 50 subjects of primary open angle glaucoma, were included in this research. 50 out of the 100 participants were men and 50 were women.

Table 4.1.1: Frequency of gender distribution.

Gender	Frequency	Percentage	Valid Percentage	Cumulative Percent
Male	50	50.0	50.0	50.0
Female	50	50.0	50.0	50.0
Total	100	100.0	100.0	100.0

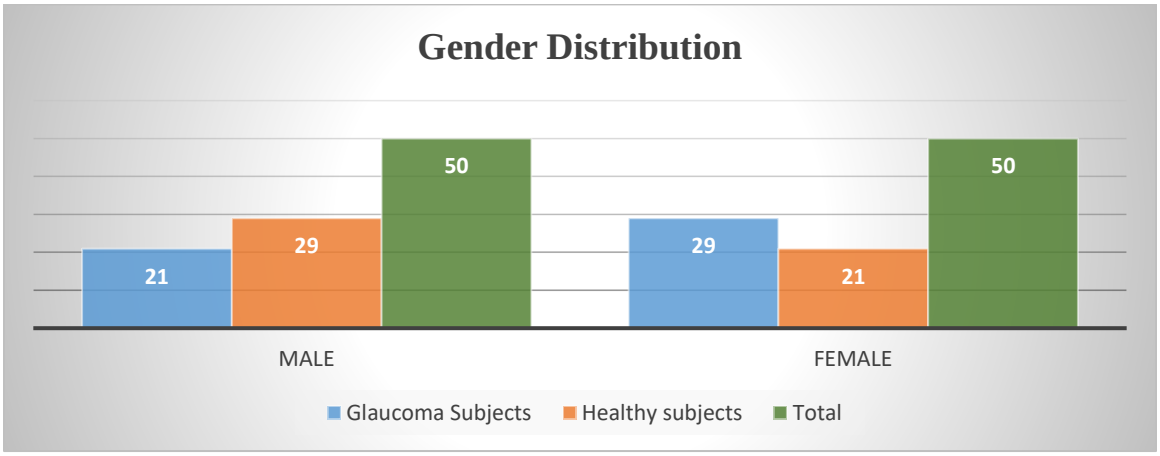

Figure 4.1.2: Gender distribution of subjects.

4.2: AGE DISTRIBUTION OF GLAUCOMA GROUP

The table below (4.2.1) shows the frequency of age distribution of primary open angle glaucoma group. Subjects were enrolled after fulfillment of inclusion criteria. Minimum age was 41 years while maximum age was 65 years.

Table 4.2.1: Frequency of Age distribution of glaucoma group.

Age Groups	Frequency	Percentage	Valid Percentage	Cumulative Percent
41-45 years	5	10	10	10
46-50 years	12	24	24	34
51-55 years	13	26	26	60
56-60 years	16	32	32	92
61-65 years	4	4	4	100
Total	50	100	100	

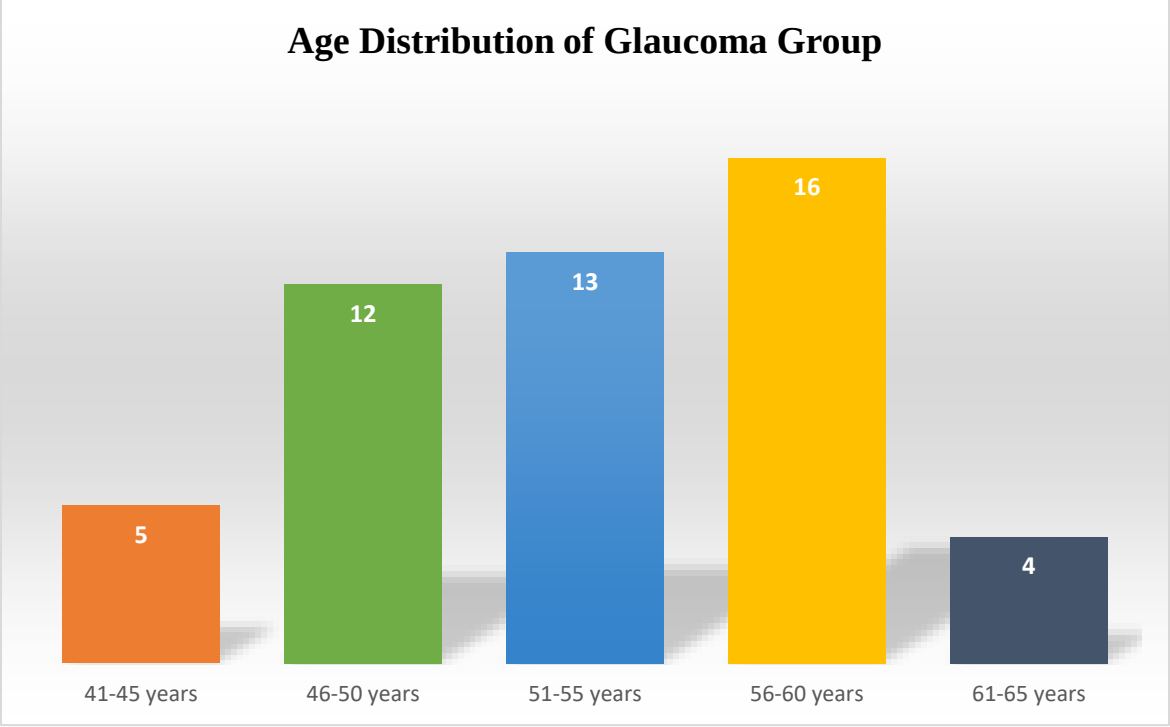

Figure 4.2.2: Age Distribution of glaucoma group.

4.3: FREQUENCY OF AGE DISTRIBUTION OF HEALTHY GROUP

The table below (4.3.1) shows the frequency of age distribution of healthy subjects. Subjects were enrolled after fulfillment of inclusion criteria. Minimum age was 41 years while maximum age was 65 years.

Table 4.3.1: Frequency of age distribution of healthy group.

Age Groups	Frequency	Percentage	Valid Percentage	Cumulative Percent
41-45 years	8	16	16	16
46-50 years	10	20	20	36
51-55 years	6	12	12	48
56-60 years	22	44	44	92
61-65 years	4	8	8	100
Total	50	100	100	

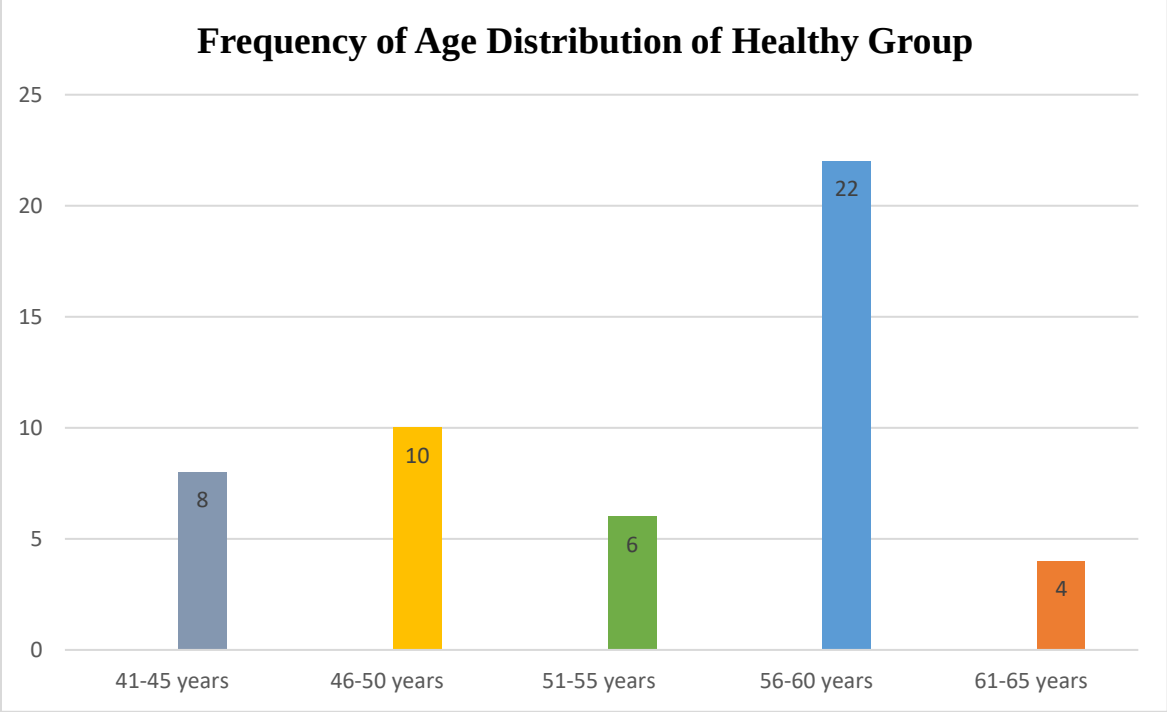

Figure 4.3.2: Frequency of age distribution of healthy group.

4.4: FREQUENCY OF INTRAOCULAR PRESSURES OF GLAUCOMA GROUP IN RIGHT EYE

The table below (4.4.1) shows the frequency of Intraocular Pressure of Glaucoma Cases in right eye. The minimum intraocular pressure was 21 mm Hg and maximum intraocular pressure was 40 mm Hg.

Table 4.4.1: Frequency of intraocular pressures of glaucoma group in right eye.

Intraocular Pressures in mm Hg	Frequency	Percentage	Valid Percentage	Cumulative Percent
21-25	22	44	44	44
26-30	23	46	46	90
31-35	4	8	8	98
36-40	1	2	2	100
Total	50	100	100	

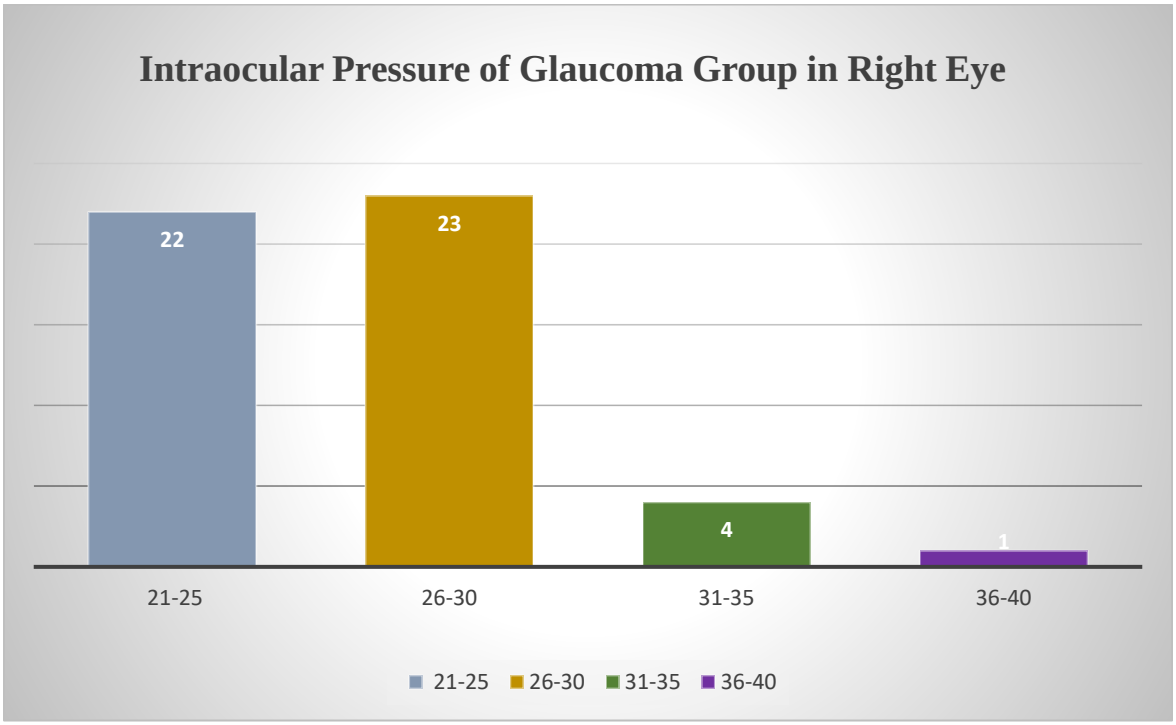

Figure 4.4.2: Frequency of intraocular pressures of glaucoma group in right eye.

4.5: FREQUENCY OF INTRAOCULAR PRESSURES OF GLAUCOMA GROUP IN LEFT EYE

The table below (4.5.1) shows the frequency of Intraocular Pressure of Glaucoma Group in left eye. The minimum intraocular pressure was 21 mm Hg and maximum intraocular pressure was 35 mm Hg.

Table 4.5.1: Frequency of intraocular pressure of glaucoma group in left eye.

Intraocular Pressures in mm Hg	Frequency	Percentage	Valid Percentage	Cumulative Percent
21-25	27	54	54	54
26-30	18	36	36	90
31-35	5	10	10	100
Total	50	100	100	

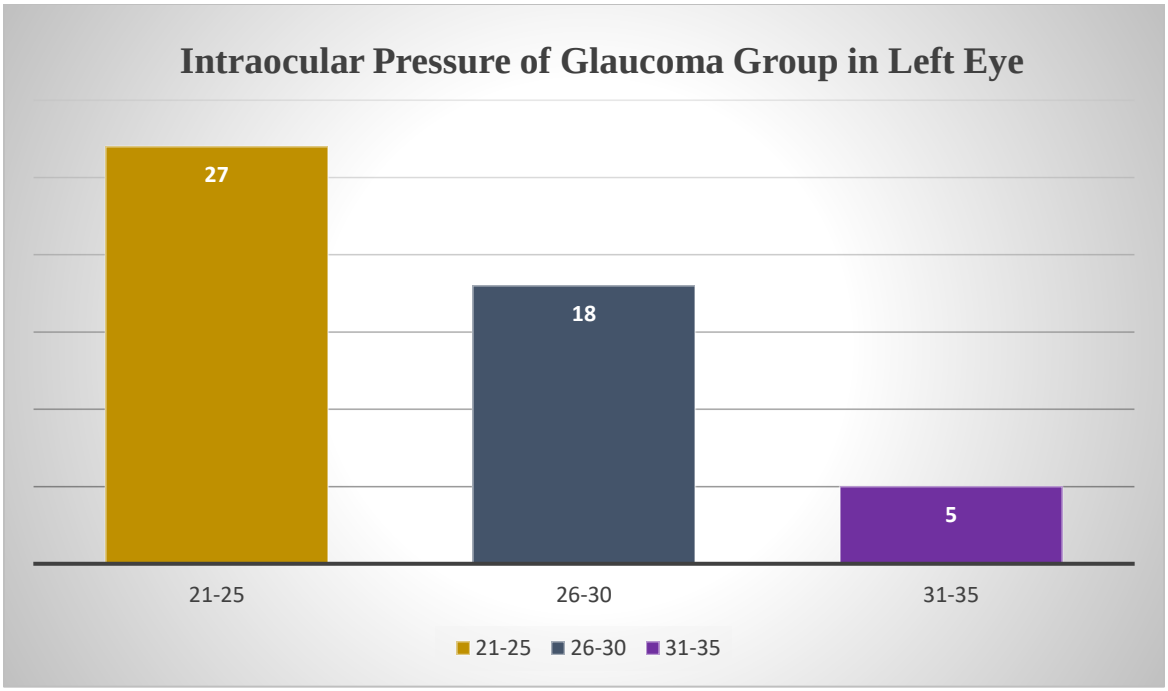

Figure 4.5.2: Frequency of intraocular pressure of glaucoma group in left eye.

4.6: FREQUENCY OF INTRAOCULAR PRESSURES OF HEALTHY GROUP IN RIGHT EYE

The table below (4.6.1) shows the frequency of Intraocular Pressure of Healthy Group in right eye. The minimum intraocular pressure was 11 mm Hg and maximum intraocular pressure was 20 mm Hg.

Table 4.6.1: Frequency of intraocular pressure of healthy group in right eye.

Intraocular Pressures in mm Hg	Frequency	Percentage	Valid Percentage	Cumulative Percent
11-15	31	62	62	62
16-20	19	38	38	100
Total	50	100	100	

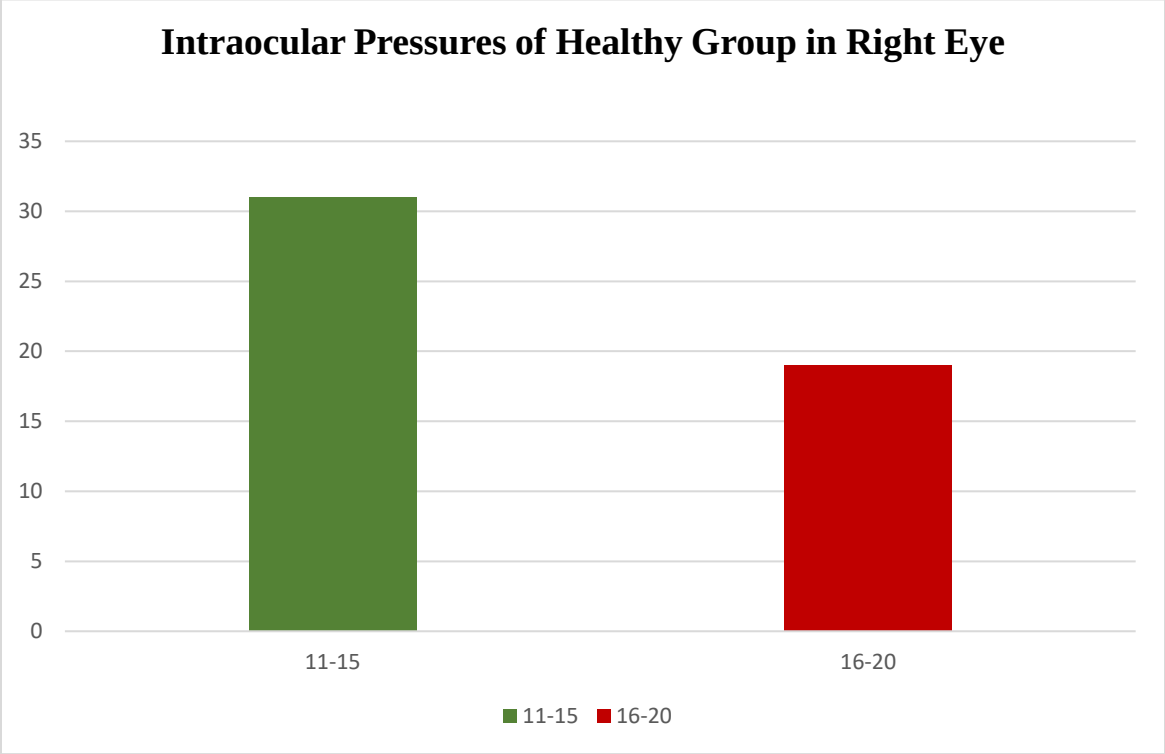

Figure 4.6.2: Frequency of intraocular pressure of healthy group in right eye.

4.7: FREQUENCY OF INTRAOCULAR PRESSURES OF HEALTHY GROUP IN LEFT EYE

The table below (4.7.1) shows the frequency of Intraocular Pressure of Healthy Group in left eye. The minimum intraocular pressure was 11 mm Hg and maximum intraocular pressure was 20 mm Hg.

Table 4.7.1: Frequency of intraocular pressures of healthy group in left eye.

Intraocular Pressures in mm Hg	Frequency	Percentage	Valid Percentage	Cumulative Percent
11-15	31	62	62	62
16-20	19	38	38	100
Total	50	100	100	

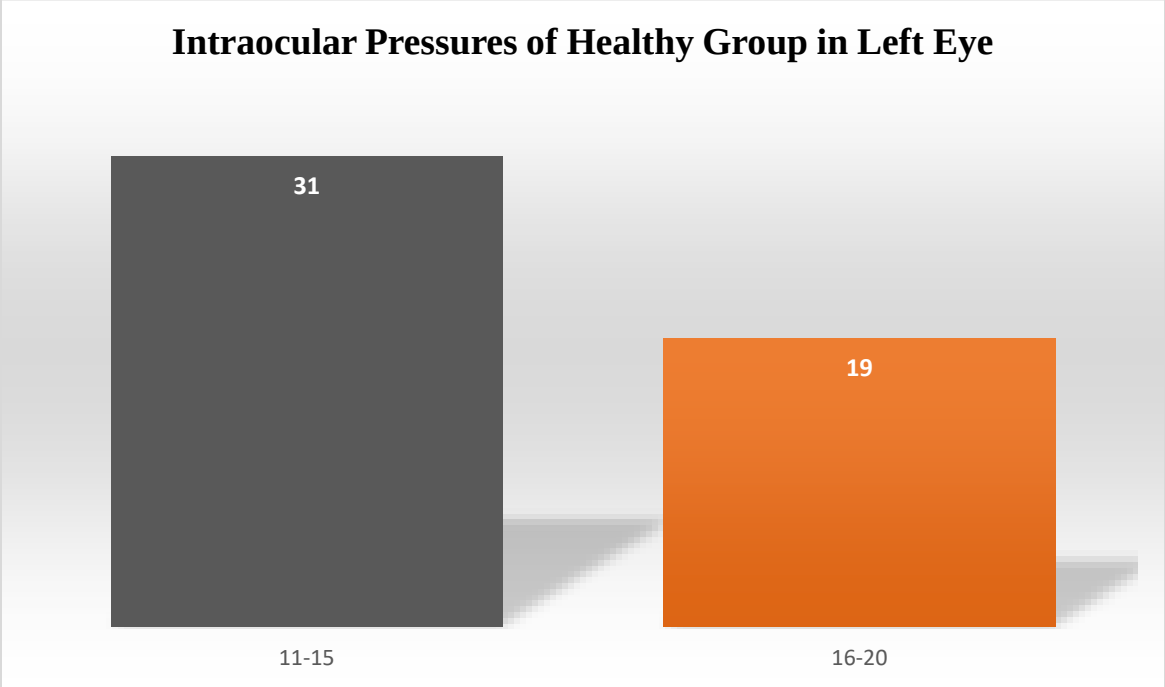

Figure 4.7.2: Frequency of intraocular pressures of healthy group in left eye.

4.8: FREQUENCY OF CUP DISC RATIO OF GLAUCOMA GROUP IN RIGHT EYE

The table below (4.8.1) shows the frequency of Cup Disc Ratio in Glaucoma Group in Right Eye. The minimum CDR was 0.2 and maximum was 1.0.

Table 4.8.1: Frequency of cup disc ratio of glaucoma group in right eye.

Cup Disc Ratio	Frequency	Percentage	Valid Percentage	Cumulative Percent
0.2-0.4	12	24	24	24
0.5-0.6	12	24	24	48
0.7-0.8	12	24	24	72
0.9-1.0	14	28	28	100
Total	50	100	100	

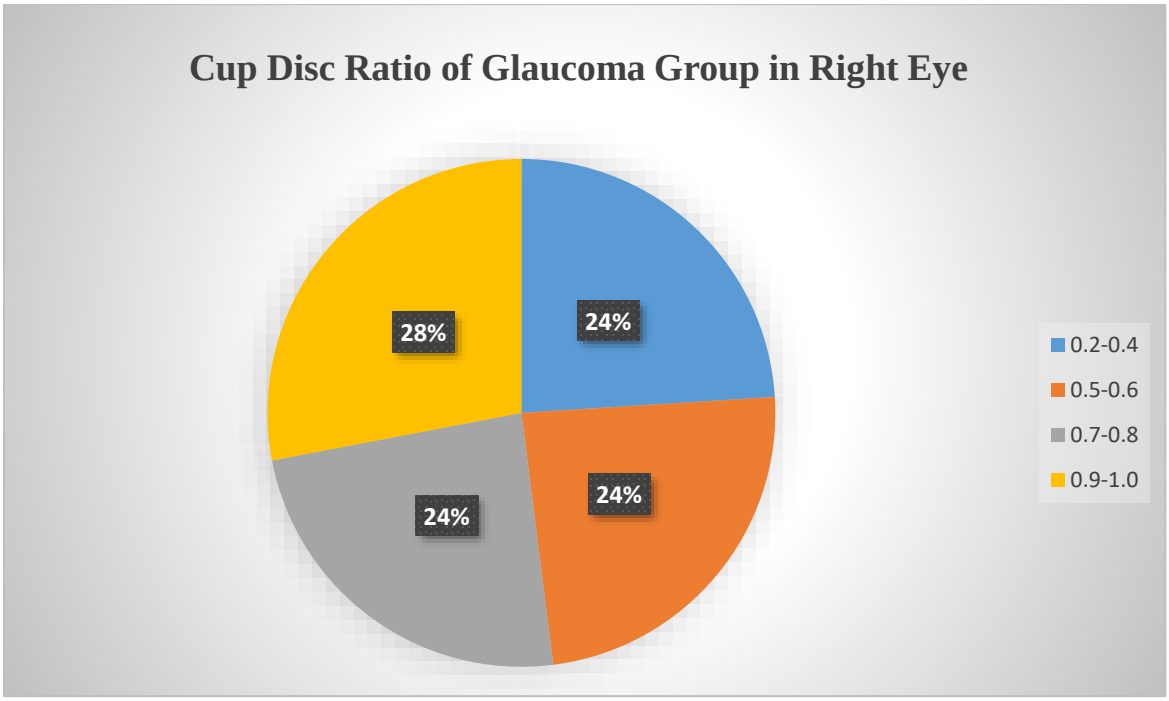

Figure 4.8.2: Frequency of cup disc ratio of glaucoma group in right eye.

4.9: FREQUENCY OF CUP DISC RATIO OF GLAUCOMA GROUP IN LEFT EYE

The table below (4.9.1) shows the frequency of Cup Disc Ratio in Glaucoma Group in Left Eye. The minimum CDR was 0.2 and maximum was 1.0.

Table 4.9.1: Frequency of cup disc ratio of glaucoma group in left eye.

Cup Disc Ratio	Frequency	Percentage	Valid Percentage	Cumulative Percent
0.2-0.4	17	34	34	34
0.5-0.6	12	24	24	58
0.7-0.8	16	32	32	90
0.9-1.0	05	10	10	100
Total	50	100	100	

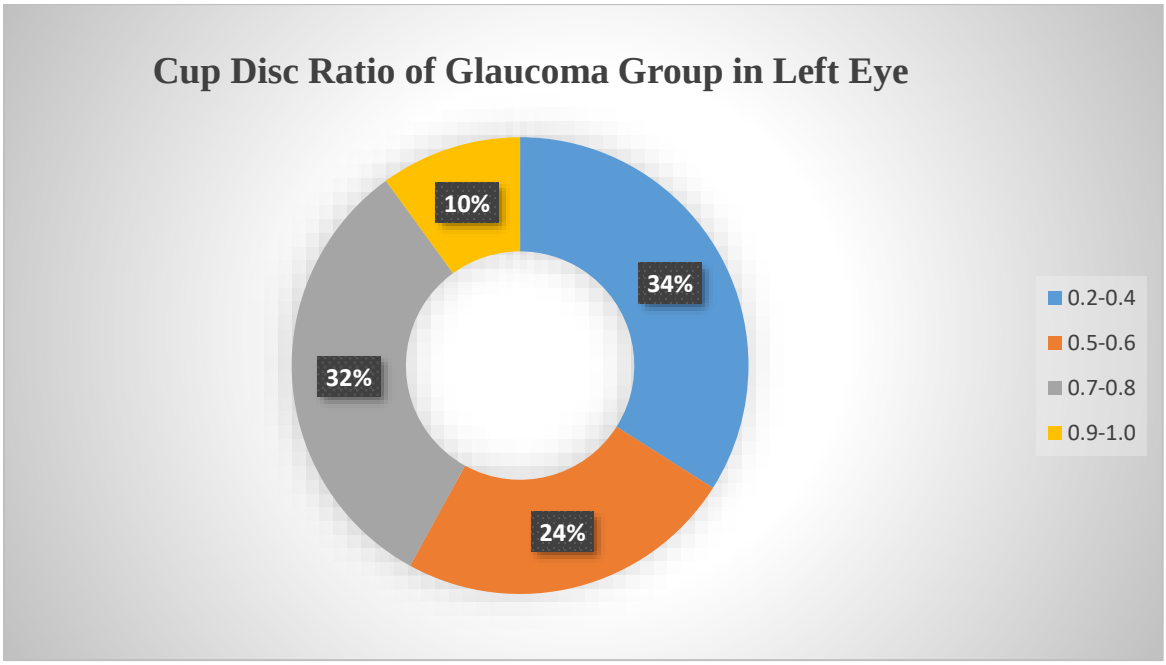

Figure 4.9.2: Frequency of cup disc ratio of glaucoma group in left eye.

4.11: COMPARISON OF MEAN INTRAOCULAR PRESSURE VALUES BEFORE AND AFTER CONSUMPTION OF GREEN TEA

Comparative analysis was performed to compare IOP values before and after green tea consumption. This comparative analysis was done between baseline IOPs with one hour, and then baseline IOPs with two hour IOPs. Table 4.11.1 shows the comparative analysis of both groups.

Table 4.11.1: Comparison of mean intraocular pressure values before and after consumption of green tea.

Parameters	Glaucoma Group		Healthy Group	
	Right Eye	Left Eye	Right Eye	Left Eye
Basal IOP	26.34±3.915	24.48±4.883	14.60±2.167	14.98±2.055
IOP after 1 hour	23.64±3.669	22.78±4.674	12.98±2.025	13.68±1.834
IOP after 2 hours	19.84±3.478	18.94±4.142	10.50±1.474	10.58±1.357

4.12: MEAN DIFFERENCE IN THE INTRAOCULAR PRESSURES AFTER CONSUMPTION OF GREEN TEA IN GLAUCOMA GROUP

All subjects were divided into two groups on the basis of presence and absence of primary open angle glaucoma. The traits of the two groups were compared using a paired sample t test. Table 4.12.1 shows the mean difference in intraocular pressures after consumption of green tea in glaucoma group.

	Basal IOP	**IOP after 1 hour**	**Mean difference**	**P value**	**IOP after 2 hours**	**Mean difference (b/w basal and 2 hour IOP values)**	**P value**
Right Eye	26.34+3.91	23.64+3.66	2.70+1.01	<0.05	19.84+3.47	6.50+1.542	<0.05
Left Eye	24.48+4.88	22.78+4.67	1.70+1.093	<0.05	18.94+4.14	5.54+1.809	<0.05

Table 4.12.1: Mean Differences in the Intraocular Pressures after consumption of Green Tea in Glaucoma Group.

4.13: MEAN DIFFERENCE IN THE INTRAOCULAR PRESSURES AFTER CONSUMPTION OF GREEN TEA IN HEALTHY GROUP

Table 4.13.1 shows the mean difference in intraocular pressures after consumption of green tea in healthy group.

Table 4.13.1: Mean differences in the intraocular pressures after consumption of green tea in healthy group.

	Basal IOP	**IOP after 1 hour**	**Mean difference**	**P value**	**IOP after 2 hours**	**Mean difference (b/w basal and 2 hour IOP values)**	**P value**
Right Eye	14.60+2.16	12.98+2.02	1.62+0.753	<0.05	10.50+1.474	4.100+1.432	<0.05
Left Eye	14.98+2.05	13.68+1.834	1.30+0.886	<0.05	10.58+1.357	4.40+1.55	<0.05

5. DISCUSSION

Although the impact of catechins and polyphenols present in green tea, have not yet been deeply analyzed, but a few researches demonstrating their benefits (particularly those of Epigallocatechin gallate). It can protect against cancer, diabetes, obesity and many infections. It can also protect heart, liver and has many neuroprotective effects as well (14). According to a study the antioxidants presents in green tea can react with ROS and NO species which are harmful for the body and cause the raised intraocular pressure in primary open angle glaucoma. Thus green tea helps in eliminating those harmful free radicals (15).

In current study we used only 30-40 milligrams of green tea which is a completely safe dose and which cannot develop any systemic side effects. It was also proved by a study that an individual who has a healthy liver, it is safe to consume up to 700 milligrams of epigallocatechin gallate (the main component responsible to reduce intraocular pressure) in liquids like green tea. It was also proved that a healthy person can also take capsules or pills of concentrated green tea extracts of up to 338 milligrams/deciliter (16). Toxicity of the liver is the primary side effect of strong green tea extracts (17).

In a study which was conducted by Kornelijus Gasiunas in 2022, the intraocular pressure reduction in green tea group was significant in right eye but not in the left eye (left eye 0.29±2.59 mm Hg, P=0.646; right eye 1.88±2.03 mm Hg, P=0.001), in present study it was observed that it also reduced greatly in right eye but not in left eye after one hour of intake (2.70±1.01 in right eye and 1.70±1.093 in left eye, P<0.05).

In present study we found drinking green tea can somewhat lower intraocular pressure after an hour, but after two hours, it has a more noticeable impact on both groups. The variations in and reduction in intraocular pressure were (left eye 2.18±3.19 mm Hg, P=0.012; right eye 2.59±1.97 mm Hg, P=0.000). These values demonstrated in the current study are also showing that green tea effects intraocular pressure significantly after two hours (6.50+1.542 in right eye and 5.54+1.809 in left eye, P<0.05). As higher the intraocular pressure was in subjects the more significant decreasing effect green tea produced on it. Similar results were found in another study, in which green tea decreased intraocular pressure in both eyes especially after two hours of consumption (18). Additionally, prior research has demonstrated that every single decrease of mercury of intraocular pressure decrease can lower the chance for developing glaucoma up to 10 % (19).

According to this study the frequency of large cup disc ratio was associated with patients with glaucoma. It was as high as 32% in right eye and 28% in left eye. In another study this point was proved that increased intraocular pressure is the main risk factor which is not only responsible for POAG but also with high CDR (20).

Primary open angle glaucoma has age as a major risk factor. In present study glaucoma was found to be associated in patients with age above 50. The frequency of glaucoma

found in patients aged more than 50 was 32% and was higher than other age groups. A cohort study was done to evaluate to risk factors, incidences and prevalence of glaucoma and it also proved that age more than 50 is linked with greater risk of glaucoma development (21).

A significant risk factor for patients with POAG is high intraocular pressure. In current study frequency of intraocular pressure above 21 mm Hg was about 54%. The highest frequency was associated with the range of 21-25 mm Hg of intraocular pressure. Elevated intraocular pressure is a particularly persistent and important associated risk factor for the development and advancement of primary open angle glaucoma, according to a study that looked at the connection among intraocular pressure and glaucoma's onset and development (22).

However, a person who has a good health never faces any fluctuations in the intraocular pressure. But the person who has glaucoma will likely to have fluctuations in the intraocular pressure. Thus an abnormal rise in intraocular pressure will not allow the optic nerve to recover from its damaged condition; rather this high intraocular pressure will cause more damage to the cup disc ratio. The use of other therapies, such as ingesting green tea or its derivatives, would be advantageous. Green Tea would help more at a period when intraocular pressure would be highest and it would be most likely to cause damage to the optic disc. This study focused on the consumption of green tea and emphasizing its need to be added in the diet (23).

5.1 CONCLUSION

The goal was to find out whether green tea reduces intraocular pressure in primary open angle glaucoma patients and healthy individuals, and green tea can impact higher intraocular pressures such as in glaucoma cases.

- In conclusion, people who had higher intraocular pressures such as in glaucoma, they greatly benefitted from drinking green tea.
- The individuals who were more likely to develop glaucoma or who were at higher risk of glaucoma, green tea reduced intraocular pressure significantly in those subjects.

- Green tea put a greater lowering effect on the intraocular pressure, the higher the intraocular pressure. So it greatly impacted those who had higher intraocular pressures in one or both eyes.

5.2 LIMITATIONS

- Sample size was less
- Study duration was limited
- Only limited and single concentration of green tea was used
- Some patients were reluctant to wait for 2 hours
- Longitudinal & follow up study can help in future studies to have better outcomes

5.3 RECOMMENDATIONS

- It can help making dietary changes, such as including green tea, in the diets of patients who are susceptible to primary open angle glaucoma.
- Green tea can assist in maintaining intraocular pressure management in glaucoma, particularly in the early stages.
- Green tea can be used in conjunction with topical primary open angle glaucoma medication to reduce pressure effectively.
- It can help to prevent the primary open angle glaucoma especially in patients who are prone to risk factors.
- In order to know more about the effect of green tea on IOP, cohort study needs to be conducted in future as it was a short duration study to check the effect of green tea on IOP.

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