



## A PROSPECTIVE STUDY OF THE INCIDENCE OF ACUTE ATTACK OF ANGLE CLOSURE GLAUCOMA IN PATIENTS ATTENDING GLAUCOMA CLINIC IN A TERTIARY EYE CARE HOSPITAL

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### Abstract

**Background:** Glaucoma is the leading cause of irreversible blindness. Glaucoma is a group of ocular disorders defined by optic nerve head and visual field changes characterized by increased IOP (Intra Ocular Pressures) and can result in optic neuropathy and vision loss if left untreated. Acute angle closure glaucoma is an ocular emergency that presents as a sudden onset of severe unilateral ocular pain or headache often associated with blurring of vision, a history of coloured halos around bright lights, nausea and vomiting. Data relating to the Indian population during this ocular emergency is sparse. Hence, the present study was undertaken to estimate the incidence of acute attacks of angle closure glaucoma among patients attending glaucoma clinics in a tertiary eye care hospital and to analyze the outcome of the patients after treatment.

**Methods:** This was a prospective study conducted among patients with acute attacks of angle closure glaucoma attending the glaucoma clinic at RIOGOH during the period March 2019-February 2020. A detailed history was obtained and all patients were subjected to measurements of initial presenting visual acuity, intraocular pressure with an iCare rebound tonometer or Goldmann applanation tonometer, anterior segment examination to look for corneal edema and shallow anterior chamber angle and posterior segment examination for optic nerve head changes using a 90D lens. Patients were followed up after starting medical, surgical, or laser iridotomy with gonioscopy for measurement of angles. They were then monitored regularly at monthly intervals. At each visit, visual acuity, anterior segment examination by slitlamp, intraocular pressure measurement by rebound tonometry and gonioscopy for angle measurement were done. Depending on the status of

the angles, either trabeculectomy or lens removal for cataractous lenses was done and the patients were followed up for a period of 6 months.

**Results:** In the present study, the incidence of acute angle-closure glaucoma was 11.4% in patients aged less than 50 years, 37.1% in 51-60 years, 45.7% in 61-70 years, and 5.7% above 70 years. 80.0% of the study subjects were females and 20.0% were males. The majority, 51.4%, had an acute attack in the left eye and 48.6% had an acute attack in the right eye. The minimum IOT observed at presentation was 30.0 mmHg, the maximum 54.0 mmHg, with a mean of  $43.7 \pm 6.8$  mmHg, which was significantly higher than the normal value of 241 mmHg. The values were significantly lower at 3 and 6 months of follow-up. Axial length was found to be significantly lower than the normal value of 24mm. An improvement in the visual acuity was observed at the end of 6 months, compared to the time of presentation.

**Conclusion:** Acute angle-closure glaucoma represents a sight-threatening emergency necessitating swift intervention, which results in favorable outcomes.

**Key words:** Acute Angle-Closure Glaucoma, Incidence, Intra Ocular Pressure, Visual Acuity.

## INTRODUCTION

Glaucoma is the leading cause of irreversible blindness.<sup>[1]</sup> Glaucoma is a group of ocular disorders defined by optic nerve head and visual field changes characterized by increased IOP (Intra Ocular Pressures) and can result in optic neuropathy and vision loss if left untreated. There are two types of glaucoma: primary and secondary or open-angle and closed-angle glaucomas. Primary glaucoma often affects both eyes and is, by definition, unrelated to any known systemic or ocular conditions. Secondary glaucoma frequently occurs unilaterally and is linked to systemic or ocular conditions.

Primary angle-closure glaucoma with an acutely elevated intraocular pressure is classified as an acute attack of angle-closure glaucoma. Intraocular pressure is generally agreed to be between 10 and 21 mmHg. The rate of aqueous humour generation, the barrier to aqueous outflow via Schlemm's canal and the trabecular meshwork, and the episcleral venous pressure are the variables that influence intraocular pressure. Aqueous humour normally exits the body through the ciliary body, the pupil, the trabecular meshwork, and Schlemm's canal in the anterior chamber angle. The primary cause of the abruptly elevated intraocular pressure in acute angle-closure glaucoma is the blockage of the aqueous humour outflow. The physically shallow anterior chamber angle is the main risk factor.

An optical emergency known as acute angle closure glaucoma manifests as an abrupt onset of severe unilateral ocular discomfort or headache, frequently accompanied by blurred vision, a history of coloured halos surrounding bright lights, and a history of nausea and vomiting. Physical examination findings include a fixed mid-dilated pupil, a foggy or hazy cornea, and noticeable circumcorneal congestion. There will be a noticeable increase in intraocular pressure, which may reach 60 to 80 mm Hg. Cells and a small quantity of aqueous flare are also visible. An acute angle closure attack can also cause swelling in the optic nerve head. Blindness may result from delayed diagnosis and treatment.

PACG (Primary Angle-Closure Glaucoma) is more visually devastating than POAG (Primary Open Angle Glaucoma), with both conditions causing nearly equal rates of blindness. However, it is expected to account for 25% of all primary glaucoma cases, compared to 75% for POAG.<sup>[1]</sup> According to current estimates, between 19 and 42% of instances of primary angle closure illness in people descended from Europeans manifest severely.<sup>[2,3]</sup> There is a lack of information on AAC (Acute Angle Closure) epidemiology in Europe. Retrospective assessments of patient attendances are used to determine the current reported incidence rates, and the results are then extrapolated. Instances across European nations were observed to vary from 1.4 to 4.2 per 100,000 annually.<sup>[4-6]</sup>

Data relating to the Indian population during this ocular emergency is sparse. Hence, the present study was undertaken to estimate the incidence of acute attacks of angle closure glaucoma among patients attending glaucoma clinics in a tertiary eye care hospital and to analyse the outcome of the patients after treatment.

## MATERIALS & METHODOLOGY

This was a prospective study conducted among patients with acute attack of angle closure glaucoma attending the glaucoma clinic at RIOGOH during the period, March 2019 – February 2020. Patients with primary open-angle glaucoma, juvenile glaucoma, secondary glaucomas, and those who have undergone surgery for glaucoma were excluded from the study.

A detailed history was obtained and all patients were subjected to measurements of initial presenting visual acuity, intraocular pressure with an iCare rebound tonometer or Goldmann applanation tonometer, anterior segment examination to look for corneal edema and shallow anterior chamber angle and posterior segment examination for optic nerve head changes using a 90D lens. The treatment undergone initially to reduce the intraocular pressure was noted.

Patients were followed up after starting medical, surgical or laser iridotomies with gonioscopy for measurement of angles. They were then monitored regularly at monthly intervals. At each visit, visual acuity, anterior segment examination by slitlamp, intraocular pressure measurement by rebound tonometry and gonioscopy for angle measurement were done. Depending on the status of the angles, either trabeculectomy or lens removal for cataractous lenses was done and the patients were followed up for a period of 6 months.

## Statistical Analysis

The collected data were analyzed with SPSS statistics software, Version 23.0. Frequency and percentage analysis were used for categorical variables and the mean and standard deviation were used for continuous variables.

## RESULTS

In the present study, the incidence of acute angle-closure glaucoma was 11.4% in patients aged less than 50 years, 37.1% in 51-60 years, 45.7% in 61-70 years, and 5.7% above 70 years. 80.0% of the study subjects were females and 20.0% were males. The majority, 51.4%, had an acute attack in the left eye and 48.6% had an acute attack in the right eye.

Descriptive Statistics					
	N	Minimum (mmHg)	Maximum (mmHg)	Mean (mmHg)	S.D
Intraocular tension in the affected eye	35	30.0	54.0	43.7	6.8

**Table 1: Intraocular Tension in Affected Eye**

Table 1 shows descriptive statistics of intraocular tension in the affected eye. The minimum IOT observed was 30.0 mmHg, the maximum 54.0 mmHg, with a mean of 43.7±6.8 mmHg.

Test Value = 21mmHg	N	Mean	SD	MD	T-Value	P-Value
IOP during acute attack	35	43.7	6.8	22.7	19.806	0.0005 **
IOP after 3 months	35	23.4	5.9	2.4	2.363	0.024 *
IOP after 6 months	35	20.5	4.8	0.5	.672	0.506 #

\*\* Highly Statistical Significance at  $p < 0.01$ , \* Significant at  $p < 0.05$

**Table 2: Comparison of IOP with Normal Value 21**

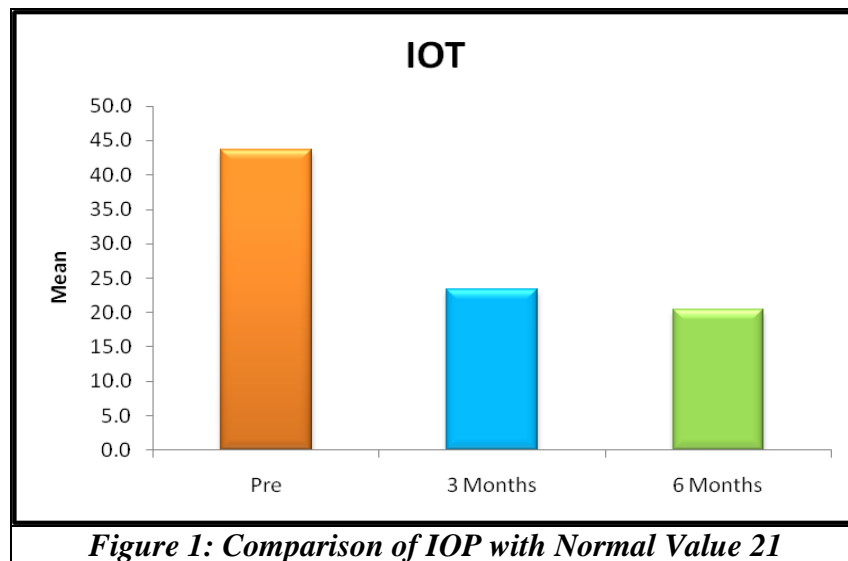


Table 2 and Figure 1 show the comparison of IOT with the normal value of IOT 21 mmHg with IOP during acute attack, after the 3<sup>rd</sup> month and after the 6<sup>th</sup> month, which shows a highly statistically significant difference with  $p = 0.0005 < 0.01$  and a mean elevated difference of 22.7 during acute attack. Similarly, at IOP 3<sup>rd</sup> month, there was a statistically significant difference with  $p = 0.024, < 0.01$  with normal value 21 and the mean elevated difference was 2.4, whereas at 6<sup>th</sup> month, there was no statistically significant difference with  $p = 0.506, > 0.05$  and a mean elevated difference of 0.67.

Descriptive Statistics					
	N	Minimum	Maximum	Mean	S.D
Introcular tension after 6 months	35	12.0	32.0	20.5	4.8

**Table 3: Intraocular Tension after 6 months**

Table 3 shows descriptive statistics of intraocular tension after 6 months. Minimum IOT observed was 12.0 mmHg, maximum 32.0 mmHg, with a mean of 20.5±4.8 mmHg

Descriptive Statistics					
	N	Minimum	Maximum	Mean	S.D
Cup Disc Ratio	35	0.3	0.6	0.4	0.1

**Table 4: Cup Disc Ratio in the Affected Eye**

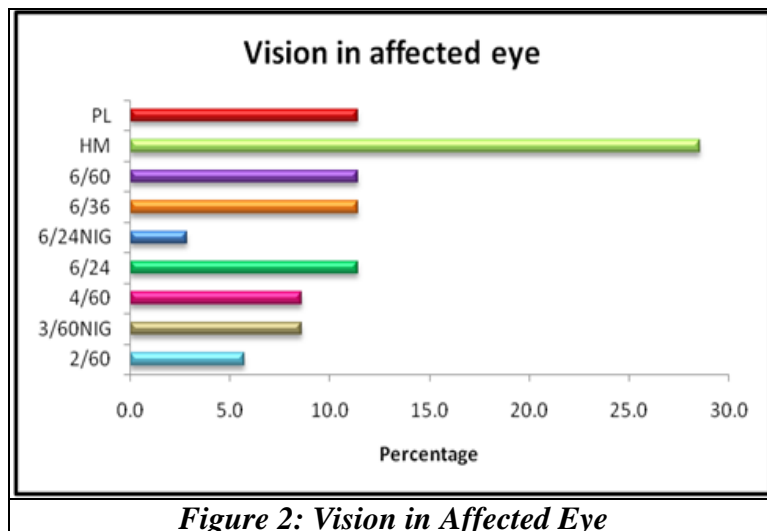
Table 4 shows descriptive statistics of cup disc ratio in the affected eye, with a minimum of 0.3, a maximum of 0.6, and a mean of 0.4±0.1.

Test Value = 24	N	Mean	SD	MD	t-value	P-Value
Axial length	35	21.81	1.13	2.18	11.466	0.0005 **

\*\* Highly Statistical Significance at  $p < 0.01$

**Table 5: Comparison of Axial Length with Normal Value 24**

Table 5 shows the comparison of axial length with the normal value of axial length 24, which shows a highly statistically significant difference with a  $p = 0.0005, < 0.01$ , and a mean elevated difference of 2.18.

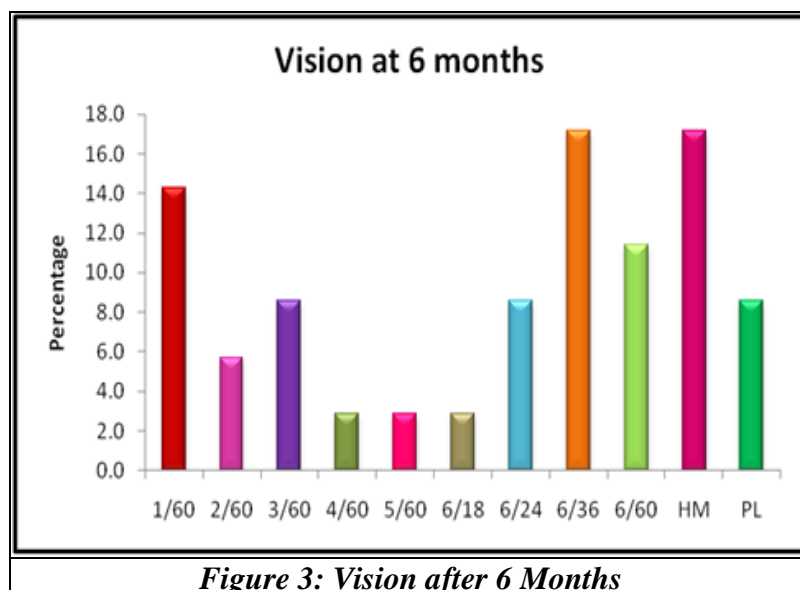


**Figure 2: Vision in Affected Eye**

Figure 2 shows the vision in the affected eye at presentation. 5.7% had a vision of 2/60, 8.6% had 3/60 NIG, 8.6% had 4/60, 11.4% had 6/24, 2.9% had 6/24NIG, and 11.4% had 6/36, 11.4% had 6/60, 28.6% had HM, 11.4% had PL (perception of light)

### Vision after 6 Months

At the end of 6 months, 14.3% had a vision of 1/60, 5.7% had 2/60, 8.6% had 3/60, 2.9% had 4/60, 2.9% had 5/60, 2.9% had 6/18, 8.6% had 6/24, 17.1% had 6/36, 11.4% had 6/60, 17.1% had HM, and 8.6% had PL. (Figure 3)



**Figure 3: Vision after 6 Months**

## DISCUSSION

A demographic distribution similar to the present study was observed in the study by Melanie Martel et al.<sup>[7]</sup> wherein 75.0% of the affected were females. The mean age at presentation was 63.7 (range 19-89) years.

In the present study, 71.4% were diabetic and 42.9% had hypertension. While 85.7% had no systemic illness, 2.9% suffered from bronchial asthma, 8.6% had CAD and 2.9%, had COPD.

A research was undertaken by J. S. Lai et al.<sup>[8]</sup> to determine the incidence of acute angle-closure glaucoma in the Chinese population of Hong Kong. In those thirty years of age and older, the incidence rate was 10.4 per 100,000 years. Acute attacks were more common in patients 70 years of age and older (the age-specific incidence was found to be 58.7 per 100,000 per year). Females had a

relative risk of 3.8 (95% confidence interval, 1.7-8.4) when compared with males. Seventeen patients were noted to have an upper respiratory tract infection (23.6%) before the attack, and 25 patients had taken antitussive agents, accounting for 34.7%. The monthly rate of influenza and the monthly acute attack rate showed a statistically significant inverse association.

Lovro Bojic et al.<sup>[9]</sup> in a study conducted in Dalmatia, southern Croatia, the incidence of acute angle-closure glaucoma was found to be 2.9/100,000 with a 95% confidence interval [CI] of 1.6-4.5. The incidence among men was 1.9 (95% CI, 0.3-3.8) and among women was 3.9 cases/100,000 per year (95% CI, 1.7-6.1). The relative risk of developing an acute angle-closure attack was found to be 2.1 times higher for women when compared to men (95% CI, 1.5-2.9). The RR of acute angle-closure glaucoma was 1.9 in the 40-49 year age group, 6.5 in the 50-59 year age group, 17 in the 60-69 year age group, and 28 in those over 69 years. The median time of presentation at the hospital was 2 days, ranging from 1 to 15 days.

45.9% of all primary adult glaucoma cases had PAC and glaucoma, according to a study conducted at a hospital in North India.<sup>[10]</sup> Acute angle closure glaucoma was identified in 24.8% of these individuals, subacute PAC in 31.2%, and chronic PACG in 44%. The male-to-female ratio in PAC and glaucoma patients was 48.6:51.4. In both the acute subgroup (79.8%) and the subacute group (66.7%), women were more prevalent. 75.4% of afflicted males were in the chronic category. The age range for PAC and glaucoma was 30 to 80 years old, with the sixth decade having the highest incidence. Between the fourth and fifth decades of life, subacute PAC predominated, while acute PACG dominated the third and fourth decades. The distribution of the subtypes was about equal above 60.

There have been recent studies suggesting that AAC may be becoming less common over time. The incidence of AAC appeared to have decreased over the past ten years, according to a 2010 analysis of Hospital Episode Statistics Data from England. This was probably due to more laser peripheral iridotomies, phacoemulsification cataract surgery, and more people knowing about angle-closure mechanisms as a major but treatable cause of glaucoma.<sup>[11,12]</sup> According to a comparable investigation that used information from the Information Service Division (ISD) Scotland, between 1998 and 2012, the rate of AAC decreased by 46%.<sup>[12]</sup> Singapore, located in the Far East, has a significantly higher frequency of AAC; in people over 30, Seah et al.<sup>[13]</sup> observed 12.2 per 100000 cases. Most likely, other ethnic groupings take precedence over this. Singapore is home to 80% Chinese people, while Scotland is home to 96% white people. It is often known that Chinese people have a higher PACG rate.<sup>[14]</sup>

The majority, 51.4%, had an acute attack in the left eye and 48.6% had an acute attack in the right eye. In the study by Melanie Martel et al.<sup>[7]</sup> the left eye was more commonly affected than the right (47% vs. 53%).

In the present study, a minimum CDR of 0.3, a maximum of 0.6, and a mean of  $0.4 \pm 0.1$  were observed. It is commonly known that chronic angle closure or prolonged APAC (Acute Primary Angle Closure) episodes can lead to an increase in CDR. It has not yet been completely understood, though, how the ONH is changed following an APAC event that is swiftly treated and causes the IOP to quickly return to normal. Subjectively analysing ONH appearance following APAC, Douglas et al.<sup>[15]</sup> found optic disc pallor in afflicted eyes but no elevated CDR. This is consistent with the results of Quigley and Addicks<sup>[16]</sup> experimental primate glaucoma model, which showed that optic disc pallor, but not an elevated CDR, followed an abrupt, brief rise in IOP. In their investigation, a higher CDR was only shown when the acute IOP rise lasted more than a week. Using stereoscopic optic disc photography and computer-assisted planimetry, Shen et al.<sup>[17]</sup> did find that between two weeks and four months following an APAC episode, there was a rise in mean CDR ( $0.56 \pm 0.05$  to  $0.590 \pm 0.03$ ;  $P < 0.001$ ) and a commensurate decrease in neuroretinal rim area. Consequently, it appears that the length of the IOP rise and the intensity of the acute event have a significant role in

influencing the emergence of anomalies in the morphologic aspects of the ONH following APAC. It is anticipated that an early presentation and quick IOP normalisation will stop an elevated CDR following APAC.

The average axial length in the current investigation was  $21.81 \pm 1.13$ . Corresponding to the current results, a South Indian investigation found that occludable angle group members had lower axial lengths ( $22.07 \pm 0.69$  mm) than normal eyes ( $22.76 \pm 0.78$  mm).<sup>[18]</sup> Compared to normal participants ( $3.00 \pm 0.30$  mm), eyes with occludable angles had a deeper anterior chamber depth ( $2.53 \pm 0.26$  mm).

Primary angle closure is associated with elevated intraocular pressure during the initial stages of the illness, although there is no loss of vision. In order to unblock the drainage channels and lower intraocular pressure, laser peripheral iridotomy and medical therapy with eye drops are the standard of care for primary angle closure and primary angle-closure glaucoma. Surgery, usually a trabeculectomy, is recommended if the condition is not under control. This procedure has a risk of major consequences. An alternate strategy for treating primary angle-closure glaucoma is surgical lens extraction, similar to how it is done to treat age-related cataracts.

Two separate studies by Sihota R and Das J et al. found that an iridotomy alone could control IOP in 12.9% of cases after the initial high IOP was brought under control medically. However, in 51.6% of cases, a filtering procedure was eventually needed. In 91.1% of the eyes, the ultimate visual acuity was  $<20/40$ .<sup>[19,20]</sup>

In the present study, an improvement in visual acuity was observed at the end of 6 months, compared to the time of presentation. Chua, P. Y. et al.'s study from six months later<sup>[21]</sup> revealed that, in contrast to 35% upon presentation, only 6 patients (7%) had corrected distant visual acuity of less than 6/60. In our analysis, glaucomatous optic neuropathy accounted for 5 out of 6 individuals (83%). In both short- and long-term follow-up, prior investigations found that 12–15% of eyes had a decreased BCVA of  $<6/60$ .<sup>[22,23]</sup> Remarkably, Tan et al. demonstrated that at the final follow-up, 90.5% of their cohort had a BCVA of greater than 6/12, and none had a BCVA of less than 6/60.<sup>[24]</sup>

Different ethnic origins, inclusion criteria, and follow-up lengths might all be contributing factors to the varied outcomes. None of our patients qualified for eye impairment registration after an AAC assault, according to the Department of Health's guidelines for Certificates of Vision Impairment.

In the Melanie Martel et al.<sup>[7]</sup> research, 6% of patients had complete loss of vision and no awareness of light, while 26% of patients had ultimate legal blindness, which is defined as vision of 20/200 or worse. This data (range 5.6-24%) is similar to those reported in previous investigations.<sup>[25,26]</sup> While using a higher threshold value of blindness (20/400 or worse), several investigations find lower percentages of blindness (6-11.4%).<sup>[27]</sup> The values from these higher threshold studies are comparable to the 6% incidence of ultimate visual acuity of NLP found in our investigation. About one in four patients has a dire prognosis of legal blindness, which emphasises how important it is for emergency room doctors to identify and appropriately treat this condition. Our findings clearly imply that a starting VA of 20/200 or below might serve as a predictor for a final VA of the same level.

## CONCLUSION

Acute angle-closure glaucoma represents a sight-threatening emergency necessitating swift intervention, which results in favourable outcomes.

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