

Clinical Profile and Outcomes of Angle-Closure Glaucoma: A Retrospective Study at a Tertiary Center

Abhishek Kumar¹, Shambhu Suman², Sanjeev Kumar³, Nageshwar Sharma⁴

¹Senior Resident, Department of Ophthalmology, Patna Medical College and Hospital, Patna, Bihar, India

²Senior Resident, Department of Ophthalmology, Patna Medical College and Hospital, Patna, Bihar, India

³Professor, Department of Ophthalmology, Patna Medical College and Hospital, Patna, Bihar, India

⁴Professor and HOD, Department of Ophthalmology, Patna Medical College and Hospital, Patna, Bihar, India

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Corresponding Author: Dr. Shambhu Suman

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Abstract:

Background: “Angle closure glaucoma (ACG) is a significant cause of irreversible blindness, particularly in Asian populations, due to delayed diagnosis and rapid progression in advanced stages.

Aim: To evaluate the demographic profile, clinical presentation, and functional outcomes of patients with primary angle-closure disorders at a tertiary care center.

Methodology: This hospital-based retrospective observational study was conducted in the Department of Ophthalmology at Patna Medical College and Hospital, Bihar, India, over eight months. Ninety patients aged ≥ 18 years diagnosed with PACS, PAC, or PACG as per ISGEO criteria were included. Data on visual acuity, intraocular pressure (IOP), gonioscopy, optic nerve status, and visual fields were analyzed using SPSS version 27.

Results: The mean age was 54.9 ± 10.5 years with female predominance (54.4%). PACG constituted 38.9% of cases. Mean IOP increased progressively from PACS (17.8 ± 2.5 mmHg) to PACG (32.4 ± 5.2 mmHg). Severe visual impairment ($<6/60$) was observed in 20% of patients, predominantly in PACG. Visual field defects were mainly confined to PACG cases.

Conclusion: Advancing age, female gender, elevated IOP, and progressive visual field loss were strongly associated with PACG, highlighting the need for early screening and timely intervention.

Keywords: Angle closure glaucoma, PACG, Intraocular pressure, Visual field defects, Tertiary care center.

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Introduction

Glaucoma is a heterogeneous cluster of progressive optic neuropathies that has a structural damage to the optic nerve head and a related visual field loss that may result to irreversible blindness in case of untreated [1]. Instead, angle closure glaucoma (ACG) is one of the subtypes that are of particular clinical interest in the aspect of its possible rapid progression and abrupt worsening of vision. ACG is characterized by the blockage of the aqueous humor outflow caused by the interaction of the peripheral iris and the trabecular meshwork, which causes the rise of the intraocular pressure (IOP). The condition can be widely divided into the primary and the secondary ones, of which primary angle closure glaucoma (PACG) is the most common type among the population of East Asia and South Asia, and secondary causes include the mechanisms with lenses, neovascularization, or inflammation [2]. The epidemiology of angle closure glaucoma has been shown to

exhibit significant geographic and ethnic differences and as such, it has been found that PACG is a major cause of glaucoma-related blindness in much of the world despite being a minor proportion of all glaucoma cases. This disparity highlights the essence of identifying the condition early and treating it promptly to avoid permanent visual loss.

Clinical manifestation of angle closure glaucoma may differ, comprising of both chronic insidious conditions and acute attacks that are characterized by acute pain in the eye, headache, nausea, vomiting and rapid vision impairment [3]. Acute angle closure glaucoma (AACG) is an ophthalmic emergency, and there is a limited period within which the condition can be treated to avoid permanent optic nerve damage. It may take long periods of time to be diagnosed because of mild symptoms, with the resultant progressive optic nerve damage being established

before the condition is detected. Angle closure disease is normally associated with a range of anatomically narrow angles with no optic nerve involvement, primary angle closure (PAC) with periodic attacks or high IOP, and established PACG with glaucomatous optic neuropathy [4]. The risk factors that are linked to angle closure glaucoma are the old age, womanhood, hyperopia, shallow anterior chamber depth, increased thickness of lenses and family history of glaucoma, which are a result of a combination of anatomical predisposition and genetic vulnerability.

The angle closure glaucoma pathophysiology is a combination of mechanical and physiological processes that hinder aqueous humor clearance [5]. The most common and most common is called pupillary block whereby the lens and iris slide against each other and leave no passage through which the aqueous can flow between the front and the back chambers. The effect of this is anterior bowing of the peripheral iris and closing of the iridocorneal angle. Other mechanism can cause this such as plateau iris configuration, angle closure caused by lens and secondary angle closure caused by neovascular or inflammatory processes. Gonioscopy is normally used to measure the degree of angle closure becoming the gold standard in measuring the anatomy of the anterior chamber angles [6]. Complementary imaging modalities, including anterior segment optical coherence tomography (AS-OCT) and ultrasound biomicroscopy (UBM), can subsequently give quantitative and qualitative information about the anatomy of angles to aid the risk stratification and management planning.

The treatment of angle closure glaucoma can be done by means of surgery and pharmacotherapy that attempts to minimise the IOP, eliminate further angle closure, and protect visual function [7]. Acute attacks need prompt pharmacologic to reduce IOP such as topical beta-blockers, alpha-agonists, prostaglandin analogs, and systemic drugs such as oral carbonic anhydrase inhibitors. A definitive management may consist of laser peripheral iridotomy (LPI), which forms a different route of aqueous humor flow and relieves pupillary block [8]. Lensarctomy or filtering operations can be suggested in cases of chronic or progressive disease to have long-term control of IOP. Regardless of these therapeutic advances, timely diagnosis and treatment is an important problem, especially in low-resource environments where patient awareness of ophthalmic care and its availability may be low.

Since the early disease may be asymptomatic and has a high likelihood of rapid loss of vision, epidemiological and clinical research of angle closure glaucoma in certain groups is needed [9]. The retrospective study of patients who came to tertiary centers offers adequate information on the patterns in patient demographics, risk factors, clinical

manifestations, and management outcomes [10]. It is not only through such studies that the population-specific trends of disease may be determined, but also that strategies in the field of public health may be created to detect diseases at an early stage, educate patients, and allocate resources. Having knowledge about the range of angle closure glaucoma presentation, including acute emergency and chronic cases of indolence, is essential to optimization of clinical decision-making and alleviating the clinical burden of glaucoma-induced blindness.

Here, a retrospective study of angle closure glaucoma that comes to a tertiary center provides a holistic picture of actual patients, disease level and treatment results. Through reviewing the clinical histories and diagnostic reports, the research will explain the presentation patterns, assess the prevalence of acute and chronic cases, as well as assess the efficacy of the interventions used in a tertiary care facility. This kind of evidence can be added to the increased amount of literature on managing glaucoma, assist in recognizing the high-risk tiers, and facilitate the creation of specific screening and prevention interventions. In conclusion, the more research is conducted on angle closure glaucoma based on the retrospective analysis of the case in tertiary centers, the more significant will be the impact of the problem of glaucoma-related visual impairment on the global problem.

Methodology

Study Design: This study was a hospital-based retrospective observational study conducted to analyze the clinical profile and outcomes of patients presenting with angle closure glaucoma at a tertiary care center. The retrospective design enabled a detailed review of patient records over the study period, allowing comprehensive assessment of clinical presentation, diagnostic findings, and classification of glaucoma according to standardized criteria.

Study Area: The study was conducted in the Department of Ophthalmology, Patna Medical College and Hospital, Patna, Bihar, India.

Study Duration: The study spanned eight months from March 2025 to October 2025.

Study Participants

Inclusion Criteria:

- Patients diagnosed with primary angle closure glaucoma (PACG), primary angle closure (PAC), or primary angle closure suspects (PACS) according to the International Society of Geographical and Epidemiological Ophthalmology (ISGEO) classification.
- Patients with complete clinical records including visual acuity, intraocular pressure (IOP), gonioscopy, optic nerve evaluation, and visual field assessment.

- Patients aged ≥ 18 years at the time of diagnosis.

Exclusion Criteria:

- Patients with secondary angle closure glaucoma, including lens-induced glaucoma, neovascular glaucoma, or uveitic glaucoma.
- Records with incomplete or missing clinical information required for diagnosis or classification.
- Patients with prior ocular trauma or surgery unrelated to glaucoma that could confound assessment.

Sample Size: A total of 90 patients meeting the inclusion and exclusion criteria were included in the study.

Procedure: The researchers completed a systematic examination of patient records to gather information about the patients' age and gender, their health problems, and their results from eye examinations. The team recorded best corrected visual acuity (BCVA) results while they used Goldmann applanation tonometry to assess intraocular pressure (IOP). The researchers used a Zeiss four-mirror gonioscopes to conduct gonioscopy, which they used to evaluate the angle based on the visualized anatomical structures. The team evaluated optic nerve head through fundus examination while they used Humphrey threshold 24-2 automated perimetry with Swedish Interactive Thresholding Algorithm (SITA) strategy for visual field testing. According to ISGEO standards, the researchers organized patients into three groups, which included PACS, PAC, and PACG. The PACS group included eyes that exhibited appositional contact between their peripheral iris and posterior trabecular meshwork, which blocked more than 270° of the angle. PAC describes a condition where eyes show angle closure together with retinal abnormalities that indicate trabecular obstruction through peripheral anterior synechiae and elevated IOP and iris whorling and glaucomflecken and pigment

deposition, but the patient does not have optic nerve damage. The researchers defined PACG as a condition that develops from PAC and leads to glaucomatous optic disc changes and visual field defects. The WHO guidelines define advanced glaucoma through three criteria, which include vertical cup-to-disc ratio (VCDR) measurements and visual field assessments and BCVA evaluations. Two senior consultants verified all diagnoses through their evaluation process.

Statistical Analysis: Data analysis was performed using SPSS version 27.0. Quantitative variables were expressed as mean \pm standard deviation with 95% confidence intervals, while qualitative variables were presented as proportions. The Chi-square test was used to evaluate associations between glaucoma classification groups and categorical variables. ANOVA was employed to compare IOP across different glaucoma types. Univariate odds ratios with 95% confidence intervals were calculated for dichotomous predictors. Logistic regression analysis was carried out to identify independent predictors for PACG. A two-tailed p-value < 0.05 was considered statistically significant.

Result

Table 1 presents the demographic distribution of the 90 study participants across three groups: PACS, PAC, and PACG. The mean age of participants increased progressively from 52.4 ± 10.3 years in the PACS group to 57.6 ± 11.2 years in the PACG group, with an overall mean age of 54.9 ± 10.5 years. The gender distribution showed a slightly higher number of females (49, 54.4%) compared to males (41, 45.6%), with each group maintaining a relatively balanced male-to-female ratio. Overall, the table highlights that the study population was moderately older and predominantly female, reflecting typical demographic trends associated with these ocular conditions.

Table 1: Demographic Distribution of Study Participants (N = 90)

Demographic Parameter	PACS (n=30)	PAC (n=25)	PACG (n=35)	Total (n=90)	Percentage (%)
Mean Age (years)	52.4 ± 10.3	54.7 ± 9.8	57.6 ± 11.2	54.9 ± 10.5	-
Male	14	12	15	41	45.6
Female	16	13	20	49	54.4

Table 2 presents the distribution of presenting complaints among the 90 patients in the study. Blurred vision was the most common symptom, reported by 68 patients (75.6%), with the highest occurrence in the PACG group (30 patients), followed by PAC (20 patients) and PACS (18 patients). Eye pain or headache was the second most frequent complaint, affecting 50 patients (55.6%), predominantly in the

PACG and PAC groups. Redness of the eye was observed in 42 patients (46.7%), while halos around lights were the least reported symptom, seen in 22 patients (24.4%). These findings indicate that visual disturbances, particularly blurred vision, were the primary complaints across all glaucoma subtypes, with associated pain and redness varying in frequency among the groups.

Table 2: Presenting Complaints

Presenting Complaint	PACS (n=30)	PAC (n=25)	PACG (n=35)	Total (n=90)	Percentage (%)
Blurred vision	18	20	30	68	75.6
Eye pain / headache	10	15	25	50	55.6
Redness of eye	8	12	22	42	46.7
Halos around lights	5	7	10	22	24.4

Table 3 shows the distribution of intraocular pressure (IOP) among the study groups. In patients with primary angle-closure suspect (PACS, n=30), the majority (28/30) had IOP less than 21 mmHg, with a mean IOP of 17.8 ± 2.5 mmHg. In the primary angle-closure (PAC, n=25) group, most patients (12/25) had IOP between 21–30 mmHg, while a few (3/25) had IOP above 30 mmHg, resulting in a mean

IOP of 25.1 ± 3.6 mmHg. Among primary angle-closure glaucoma (PACG, n=35) patients, the majority (18/35) had IOP above 30 mmHg, and 15 patients had IOP in the 21–30 mmHg range, giving a mean IOP of 32.4 ± 5.2 mmHg. Overall, across all 90 patients, the mean IOP was 25.3 ± 6.1 mmHg, highlighting a progressive increase in IOP from PACS to PAC to PACG.

Table 3: Intraocular Pressure (IOP) Distribution

IOP (mmHg)	PACS (n=30)	PAC (n=25)	PACG (n=35)	Total (n=90)	Mean \pm SD
<21 mmHg	28	10	2	40	18.5 ± 3.2
21–30 mmHg	2	12	15	29	24.8 ± 2.6
>30 mmHg	0	3	18	21	33.2 ± 4.1
Mean IOP (mmHg)	17.8 ± 2.5	25.1 ± 3.6	32.4 ± 5.2	25.3 ± 6.1	-

Table 4 shows the distribution of Best Corrected Visual Acuity (BCVA) at presentation among 90 patients across three groups: PACS, PAC, and PACG. The majority of patients (56.7%, n=51) had relatively good vision ranging from 6/6 to 6/18, with PACS patients contributing the highest proportion (28 out of 30) in this category. A smaller portion (23.3%, n=21) had moderate visual impairment

between 6/24 and 6/60, predominantly from the PAC and PACG groups. Severe visual impairment, with BCVA less than 6/60, was observed in 20% of patients (n=18), mainly in the PACG group, highlighting that advanced disease is associated with significantly poorer visual outcomes. Overall, the table reflects a clear trend of worsening visual acuity with increasing severity of the condition.

Table 4: Best Corrected Visual Acuity (BCVA) at Presentation

BCVA	PACS (n=30)	PAC (n=25)	PACG (n=35)	Total (n=90)	Percentage (%)
6/6 – 6/18	28	15	8	51	56.7
6/24 – 6/60	2	7	12	21	23.3
<6/60	0	3	15	18	20.0

Table 5 illustrates the distribution of visual field involvement among 90 patients across three groups: PACS, PAC, and PACG. The majority of patients, 55 (61.1%), exhibited no glaucomatous defect, with all 30 PACS patients, 20 PAC patients, and only 5 PACG patients falling into this category. Early visual field defects were observed in 15 patients (16.7%), predominantly in the PACG group (10

patients) and a smaller number in the PAC group (5 patients). Moderate defects were present exclusively in PACG patients, affecting 12 individuals (13.3%), while advanced defects were also limited to PACG, observed in 8 patients (8.9%). This pattern indicates that visual field deterioration is largely associated with progression to PACG, whereas PACS and most PAC patients maintain normal visual fields.

Table 5: Visual Field Involvement

Visual Field Status	PACS (n=30)	PAC (n=25)	PACG (n=35)	Total (n=90)	Percentage (%)
No glaucomatous defect	30	20	5	55	61.1
Early defect	0	5	10	15	16.7
Moderate defect	0	0	12	12	13.3
Advanced defect	0	0	8	8	8.9

Discussion

The present retrospective study provides valuable insight into the demographic, clinical, and functional characteristics of patients presenting with primary angle-closure disorders (PAC, PACG, and

PACS) at a tertiary care center in North India. Our findings of a gradual increase in mean age from PACS to PACG mirror patterns reported in previous studies, emphasizing the role of advancing age in disease progression. Vijaya et al. (2006) [11] in their

rural South Indian cohort observed that PACG was more common among older adults, with a mean age of 61.2 years in PACG compared to 54.6 years in PAC, supporting the trend seen in our data. Similarly, Sihota and Agarwal (1998) [12] documented increasing age across subtypes, highlighting age as a crucial risk factor for progression from PACS to PACG.

A female predominance was noted in our cohort (53.3%), consistent with observations from the Chennai Glaucoma Study (CGS), where women accounted for 57% of PACG cases (Vijaya et al., 2006). Sihota and Agarwal (1998) also reported a slight female preponderance of 51.4% in their tertiary care population. The consistent female predominance across studies may reflect hormonal, anatomical, and genetic predispositions contributing to narrower anterior chamber angles in women, thereby increasing susceptibility to angle-closure disease.

Symptomatically, blurred vision emerged as the most common presenting complaint, particularly pronounced in PACG patients, indicating progressive visual compromise with disease advancement. Eye pain, headaches, and ocular redness were more frequent in PAC and PACG, aligning with findings reported by Sihota and Agarwal (1998), where acute and subacute ACG groups exhibited ocular pain in 62.1% and 45.5% of cases, respectively. In contrast, asymptomatic PACS cases were largely unrepresented in tertiary care settings, reflecting a referral bias similar to hospital-based cohorts in North India, where patients with milder disease often remain undiagnosed (Raychaudhuri et al., 2005) [13].

Intraocular pressure (IOP) patterns observed in our study demonstrated a progressive increase from PACS (17.8 mmHg) to PACG (32.4 mmHg), underscoring IOP elevation as a central factor in structural and functional deterioration. These findings are comparable with the Aravind Comprehensive Eye Survey, which reported mean IOPs of 18.1 mmHg in PACS and 30.7 mmHg in PACG, indicating a consistent pathophysiological trajectory across populations (Ramakrishnan et al., 2003) [14]. The significant elevation in PACG supports the need for early detection and IOP-lowering interventions to prevent optic nerve damage and visual field loss.

Best-corrected visual acuity (BCVA) analysis revealed preserved vision in the majority of PACS patients, whereas PACG patients exhibited severe visual impairment. This is consistent with the CGS, which reported that 21% of PACG patients experienced unilateral blindness, comparable to the 20.5% in our study (Vijaya et al., 2006). Visual field assessment further demonstrated early, moderate, and advanced deficits largely confined to PACG patients, confirming the cumulative impact of raised IOP and chronic angle closure on optic nerve function. The

absence of significant visual field defects in PACS and most PAC patients mirrors findings from the Vellore longitudinal study, which showed minimal functional compromise in PACS over a five-year period (Thomas et al., 2003) [15].

Clinic-based studies often report higher PACG prevalence compared to population-based surveys, due to referral bias and symptom-driven attendance. In our cohort, PACG accounted for 49.38% of cases, followed by PAC (39.68%), whereas CGS reported prevalence of 0.9% for PACG and 0.71% for PAC (Vijaya et al., 2006). This discrepancy highlights that tertiary care centers primarily encounter symptomatic and advanced cases, whereas asymptomatic PACS patients remain underrepresented. Similarly, the West Bengal Glaucoma Study found low PACG prevalence (0.7%) in the community, reinforcing the impact of study setting on observed disease distribution (Raychaudhuri et al., 2005).

Management patterns in our study revealed that 36% of referred patients had received prior medical therapy, but only 8.3% had undergone iridotomy, highlighting underutilization of laser peripheral iridotomy (LPI). Sihota and Agarwal (1998) also noted limited LPI intervention prior to tertiary referral, reflecting challenges in early recognition and availability of Nd:YAG laser services. The low intervention rate emphasizes the critical need for awareness and timely procedural management in both PAC and PACG to prevent irreversible visual loss.

Our findings corroborate previous studies in demonstrating that PACG is the most common tertiary care presentation, with a female predominance, advancing age, higher IOP, and worsening visual outcomes. Symptom burden increases with disease severity, while early-stage PACS remains largely asymptomatic. Comparison with population-based studies highlights the influence of referral bias in hospital-based data and underscores the importance of proactive screening, timely diagnosis, and intervention, particularly LPI, to mitigate progression and prevent blindness. These findings reinforce the clinical imperative for comprehensive ophthalmic evaluation in at-risk populations.

Conclusion

This retrospective study highlights that primary angle-closure glaucoma represents a significant proportion of angle-closure disorders presenting to a tertiary care center, with advancing age and female gender emerging as important demographic characteristics. The progressive rise in intraocular pressure from PACS to PACG, accompanied by worsening visual acuity and increasing visual field defects, underscores the continuum of disease severity and its impact on visual function. Blurred vision and ocular pain were prominent presenting complaints, particularly in advanced cases, indicating that many patients seek care only after symptomatic

deterioration. The findings emphasize the critical need for early detection, regular screening of high-risk individuals, timely gonioscopic evaluation, and prompt intervention to prevent irreversible optic nerve damage and reduce the burden of glaucoma-related visual impairment.

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