MEDICAL SCIENCE

To Cite:
Deewijit A, Guo J, Wang J. Risk factors, diagnosis and management of primary angle-closure glaucoma after cataract surgery: A systematic review and meta-analysis. *Medical Science* 2023; 27: e265ms3030. doi: https://doi.org/10.54905/disssi/v27i136/e265ms3030

Authors' Affiliation:
Department of Ophthalmology, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430030, China

*__Corresponding author__
Department of Ophthalmology, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430030, China
Email: eyedrwjm@163.com

ORCID List
Anunya Deewijit 0000-0001-7706-3497

Peer-Review History
Received: 25 April 2023
Reviewed & Revised: 29/April/2023 to 12/June/2023
Accepted: 18 June 2023
Published: 21 June 2023

Peer-review Method
External peer-review was done through double-blind method.

Medical Science
pISSN 2321–7359; eISSN 2321–7367

Risk factors, diagnosis and management of primary angle-closure glaucoma after cataract surgery: A systematic review and meta-analysis

Anunya Deewijit, Jing-Min Guo, Jun-Ming Wang*

ABSTRACT

Background: The world's most common reason for blindness is primary angle closure glaucoma (PACG) and treatment trends are changing. The development of anterior segment imaging has improved our understanding of pathophysiology and made it possible to monitor treatment modalities more accurately and objectively. This study investigates the risk factors, diagnosis and treatment strategies associated with PACG after cataract surgery. *Methods:* A systematic review using the PRISMA approach has been applied to ascertain the objective. *Results:* This study has identified 20 most relevant papers which presented the recent outcomes of PACG, its risk factors, diagnosis and management after cataract surgery. This study reveals several risk factors responsible for PACG, such as age, gender, ethnicity, ocular biometry and genetics. Most studies used a gonioscopy method, ultrasound bio microscopy (UBM), AS-OCT, SPAC and visual-field loss for PACG diagnosis. *Conclusion:* Cataract surgery offers the chance to treat many diseases with a single procedure in PACG, including enhancing vision, lowering IOP, minimizing IOP fluctuation, lowering medication requirements, removing a narrow-angle and raising GQL-15 scores. Nevertheless, the increasing frequency of cataract surgeries could potentially influence the occurrence of PACG.

Keywords : Blindness, gonioscopy, cataract, iridoplasty, iridotomy

1. INTRODUCTION

Primary angle-closure glaucoma (PACG), a major reason for vision loss globally, is estimated to be 112 million in 2040 (Tham et al., 2014). These figures are useful for informing the development of public health initiatives for glaucoma screening, treatment and associated activities. Various processes can cause angle-closure disease, but the most frequent ones are a relative pupillary block and a plateau iris. The main factor causing vision loss is PACG (Napier and Azuara-Blanco, 2018).

Iridotrabecular contact that causes intraocular pressure, leading to glaucomatous optic neuropathy, is known as PACG. Numerous risk factors increase the likelihood of getting PACG. Lenticular alterations, drug usage and East Asian ethnicity are a few of these. There have been reports of declining rates in several nations, nevertheless. Acute presentations of PACG may necessitate prompt treatment, typically as an inpatient requiring intense topical, oral or intravenous therapy as well as laser or surgical surgery. In an outpatient context, PACG may additionally show up more subtly and persistently.

According to Bourne et al., (2017), the number of blind persons grew globally by 17.6% in 2015. The scientists determined that two factors—a rise brought on by population expansion (38.4%) and population aging—were responsible for this shift. In 2015, the occurrence of blindness in older individuals was 4% or higher in three emerging regions: South Asia (4.0%), eastern sub-Saharan Africa (4.3%) and western sub-Saharan Africa (5.1%) (Bourne et al., 2017).

Severe vision loss is usually caused by PACG. Given the high occurrence of PACG among elderly Asian people and the changing world demography, this population will grow significantly over the next few decades (Friedman et al., 2012). In Asian people, the incidence of PACG is 1.2%, but rates in populations of European ancestry are predicted to range between 0.40 and 0.60%. In the future, a sizable population is predicted to get bilateral blindness due to PACG.

Significant unknowns remain regarding the best way to treat angle-closure illness and its natural course. The prevalence of PACG is likely under diagnosed in developed nations. Potential glaucoma patients with higher intraocular pressure (IOP) are advised to undergo bilateral gonioscopy (Smith et al., 2013). But, an analysis of actual practice shows that this is rarely done. Although the anterior chamber angle (ACA) shape is being studied using current technology, gonioscopic inspection and angle width changes, such as with indentation, may still be necessary to comprehend the situation fully.

Thomas et al., (2004) conducted clinic-based research in India in 2003. They reported that the 5-year risk for PACs acquiring PAC was 22%, with no cohort members experiencing functional impairment during that period. This is an insightful discovery, although the group was small, hospital-based and not typical population of different ethnic origins, with just 82 patients completing the research. A low conversion rate from PACs to PAC/PACG has been proposed. Vijaya et al., (2017) assert that LPI in treating PACs is related to a considerable risk of acquiring cortical cataracts over 6 years, despite the fact that LPI is not thought to be harmful.

Cataract surgery and goniosynechialysis have recently become more widely used in treating PACG (Salimi et al., 2021). Cataract surgery with goniosynechialysis is not involved the formation of a filtering bleb, which necessitates long-term close monitoring. Its success rate ranges from 80% to 95% (Hayashi et al., 2001; Qian et al., 2021). As a result, it is critical to understand the post-cataract surgery management process. Preoperative, intraoperative and postoperative planning should be considered before cataract surgery on a glaucoma patient to enhance quality of life. It can minimize the potential risk factors for negative outcomes (Shah et al., 2016).

According to recent meta-analyses, the incidence of glaucoma is projected to be 3.5% worldwide (Tham et al., 2014). Additionally, nearly 20% of individuals undergoing cataract surgery had some degree of concomitant glaucoma, indicating that they frequently appear in the same cohort of patients (Qian et al., 2021). Given the increase in glaucoma surgeries in recent years, a comprehensive understanding about the advancements in cataract surgery and management practices can ensure better treatment for patients (Shah et al., 2016). The majority of glaucoma sufferers are located in poorer nations. In individuals with anteriorly positioned ciliary processes, endoscopic cyclophotocoagulation (ECP) can also be used in conjunction with phacoemulsification to open the angle and lessen the generation of aqueous humour (Wright et al., 2016).

In these situations, endoscopic cyclophotocoagulation may be coupled with cataract surgery to potentially lower IOP even more (Husain, 2014). Such procedures have the indentical benefits of evading conjunctival incisions, increasing the likelihood that any necessary trabeculectomy will be effective in the future (Hollander et al., 2017). In any case, there are various reasons why trabeculectomy in a pseudophakic eye is preferred. Patients who undergo trabeculectomy in phakic eyes should be informed that a succeeding cataract is expected and it is best to delay cataract surgery for a year or more to lessen the risk of bleb failure. This study offers a solid justification for glaucoma's risk factors, diagnosis and management.

Many previous original studies focused on the primary angle closure glaucoma (PACG)'s changing trends (Gillan et al., 2016; Bourne et al., 2017; Chen et al., 2019), risk factors (Lee et al., 2016; Vijaya et al., 2017; Romero et al., 2018) and diagnosis (Marchini et al., 2015; Razeghinejad and Myers, 2018; Yoo et al., 2023). Several documents also presented the cataract surgery for PACG (Lee et al., 2014; Gillan et al., 2016; Salimi et al., 2021) and management after cataract surgery (Tojo et al., 2014; Kwon and Sung, 2017).

A few review articles also focused on risk factors and the management of PACG (Amerasinghe and Aung, 2008; Husain, 2014; Wright et al., 2016). But no recent study shows a scientific update on the risk factors, diagnosis and management of PACG after cataract surgery. Therefore, this study fills the research gap by addressing a research question, "what are the risk factors, diagnosis

methods and management practices of PACG after cataract surgery". So, this study explores the risk factors, diagnosis and management of PACG after cataract surgery.

2. METHODS

Research design

A systematic review procedure was employed, which encompassed a research protocol for retrieval of the most important information in the literature. PRISMA checklists were followed in the review process (Moher et al., 2009). PRISMA is a technique that is frequently employed for carrying out systematic reviews of the literature. 27 checklists were used to finish the document selection process.

Eligibility criteria

The disciplinary area of PACG, the article's language, the debate around the risk factors, diagnosis and management and the publication date were all considered as the criteria for inclusion. Journal papers written in English and peer reviewed were examined in the study. This study's twelve-year time frame extends from January 2010 to October 2022. The last twelve years have been selected due to rapidly changing technology concerning risk factors, diagnosis and management of PACG.

Search strategy

After researching popular databases, the key search string was settled to meet the database's requirements. It includes findings including risk factors, diagnosis, cataract surgery and management of PACG. The documents for the qualitative analysis were gathered using well-known databases like PubMed and Scopus. The study protocol used in this experiment is in (Table 1).

Table 1 Research protocol summary, developed for guiding the systematic review process from January 2010 to October 2022

Items	Details
Nominated databases	PubMed and Scopus
Article criteria	Original and peer-reviewed article
Language	English
Selected duration	From January 2010 to October 2022
Search keywords	Risk factors, diagnosis, cataract surgery, management and PACG
Fields of the search	Title, abstract and keywords
Document type	The article focused on only primary angle-closure glaucoma.
Inclusion criteria	Papers focusing on the risk factors, diagnosis, cataract surgery and management of PACG

Data extraction

On all of the chosen documents, consistent data gathering was done. The author, the year the study was published, the subject matter, the sample size, the setting for the study, the research methods and the findings are all included in the data for each study. The risk factors, diagnosis, cataract surgery and management of PACG for this study extensively considered the findings of the primary data or trails in various settings.

Ethical consideration

Prior to commencing the study, ethical clearance was obtained from the Medical Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology, China (Ethical approval code: TJH-201906015).

3. RESULTS

Document identification

The PRISMA strategy relies on four critical components: Identification, screening, eligibility and inclusion. The research followed these critical stages. To find the most relevant materials, PRISMA criteria (Moher et al., 2009) were used. During the identification step, 83 documents were obtained from a single core database, while nine documents were obtained from reference sources. A thorough screening procedure was used at the second level, removing 41 superfluous papers. Many records were left out because the full text was unavailable or outdated. Because the expected information was unavailable, 19 papers were removed from

consideration. Finally, the 20 most pertinent papers were chosen for a thorough examination. The materials were chosen from scholarly papers based on relevance (Figure 1).

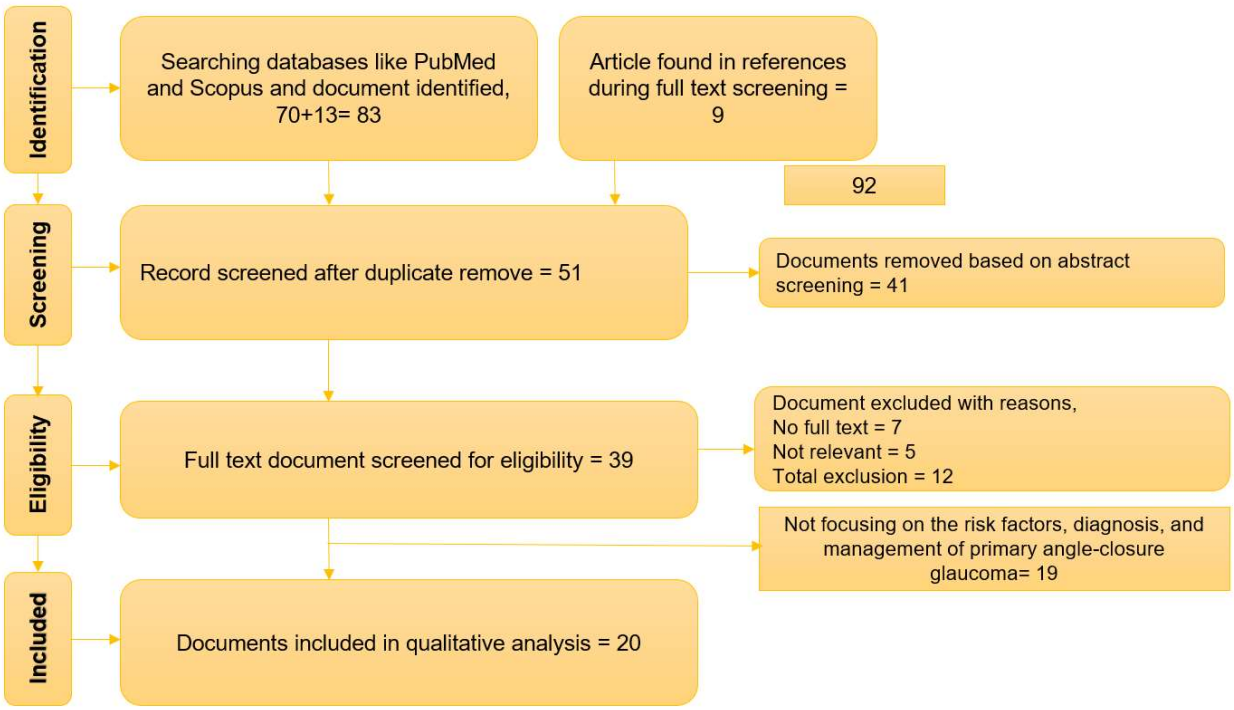

Figure 1 Article selection process following PRISMA approach

Analysis of the selected documents

The selected documents have been analyzed regarding their publication years, objectives, sample sizes, design and methodology and findings. The information has been extracted based on the study objective. The publication of documents was ranged from 2010 to 2022. It has been observed that most (30%) glaucoma-related articles were published in 2016, followed by 2013 and 2021 (15%). Most of the studies are Retrospective studies with a defined sample size. A few of them had no fixed sample size. Some of the studies measured ACD, AL, lens thickness and VL. The observations are in (Table 2).

Table 2 Summary of the selected documents identified through the following research protocol, n=20, from January 2010 to October 2022

Selected articles	Sample	Design/ method	Findings
Zhou et al., (2010)	53 inpatients	Comparative observation	Following surgery, the mean ACA width rose from 24.7u to 38.1u
Azuara-Blanco et al., (2011)	Not fixed (≥ 50 years old)	Multicenter pragmatic randomized study	A comparison of laser peripheral iridotomy versus clear-lens extraction revealed that the latter was more effective and less expensive
Kameda et al., (2013)	109 eyes with phaco-GSL	The preoperative IOP checked	Age, preoperative IOP, and postoperative LPI may all affect how phaco-GSL for PAC/PACG turns out
Lee et al., (2014)	53 eyes	Cataract surgery with stable and unstable refractive outcomes	Patients with APAC had higher odds of having an unstable refractive outcome following cataract surgery
Tojo et al., (2014)	10 PACG patients	PEA+IOL surgery, AS-OCT	AS-OCT revealed a considerable improvement in the anterior chamber's anatomical characteristics

Yong et al., (2014)	427 patients	To assess the lens vault, AS-OCT was used	Myopia affected angle-closure patients. Longer VLs and ALs were seen in myopic angle-closure participants
Siak et al., (2016)	24 patients	AS-OCT imaging and phacoemulsification	Regardless of angle status, all eyes showed a comparable IOP decrease following phacoemulsification
Azuara-Blanco et al., (2016)	419 patients	Normal therapy and laser peripheral iridotomy	As a first-line therapeutic decision, clear-lens extraction should be used
Gillan et al., (2016)	Data 1998-2012	Demographic data of APACG, PI, & cataract surgery patient	Overall, the PI rate grew by 116.3%, Cataract surgery rates raised by 73.4% during the same 15-year period
Lee et al., (2016)	56 eyes	Retrospective cohort analysis	The cataract surgery was significantly correlated with a lower preoperative VFI score
Nongpiur et al., (2016)	2047 (≥ 50 years old)	An autorefractor & a sphere plus cylinder	Angle-closure patients had significant age differences, and larger LVs
Özyol et al., (2016)	39 eyes	GQL-15 questionnaires	Cataract surgery in PACG allows one to treat various diseases with a single procedure
Varma et al., (2017)	1229 patients	Retrospective chart review	A narrow angle or angle closure was seen in 1.5% of individuals who were recommended for cataract surgery
Alzuhairy, (2018)	102 eyes.	Five years' data of CACG patients	Following surgery, fewer people took glaucoma drugs considerably
Romero et al., (2018)	Not fixed	Retrospective cohort analysis	The presence of a crystalline lens was the initial risk factors linked to failure
Zhang et al., (2019)	2054 inpatients	Ultrasonography bio microscopy and lens surgeries	Lens surgery also markedly reduced intraocular pressure and deepened the anterior chamber
Li et al., (2021)	111 PACG eyes	SRK/T, Barrett II, Hoffer Q, and Kane	AL had a significant impact on the refractive results
Qian et al., (2021)	16 patients (18 eyes)	PAS, medications and BCVA	Cataract surgery with EGSL may be a successful surgical approach for treating advanced PACG
Salimi et al., (2021)	158 eyes	Retrospective research	IOP and medication reductions were considerably better in the phaco-stent cluster than phaco-only cluster
Yoo et al., (2023)	3985 patients	Cox proportional hazards models	The risk is higher for elderly individuals and lower for those having cataract surgery. Long-term surveillance appears to be of limited use for ANA patients, emphasizing the necessity for new clinical approaches to recognize individuals at increased risk for PACG

Risk factors of PACG

Several risk factors from the existing literature have been discovered in this study. Most scholars used various factors responsible for PACG, such as age, gender, ethnicity, ocular biometry, genetics, pupillary block mechanism and non-pupillary block mechanisms. The main risk factors are in (Table 3).

Table 3 Summary of the risk factors, identified from the existing literature

Possible risk factors	Relationship	Sources
Age	PACG is increased with the ages of the people	Zhou et al., (2010), Yong et al., (2014), Siak et al., (2016), Özyol et al., (2016) and Li et al., (2021)
Gender	Females are more vulnerable to PACG than males	Amerasinghe and Aung, (2008), Tham et al., (2014), Yong et al., (2014), Romero et al., (2018) and Li et al., (2021)
Ethnicity	Asian people are more susceptible to PACG than other continents	Yong et al., (2014), Gillan et al., (2016), Siak et al., (2016), Romero et al., (2018) and Yoo et al., (2023)
Ocular biometry	Angle-closure risk rises with a deeper ACD, which correlates with demographic characteristics	Shin et al., (2010), Yong et al., (2014), Melancia et al., (2015) and Sun et al., (2017)
Genetics	A single dominant gene carried the PACG. The myocilin gene may have a mutation in PACG individuals	Amerasinghe and Aung, (2008) and Sun et al., (2017)
Pupillary block mechanism	It is a major cause of angle closure	Gillan et al., (2016), Razeghinejad and Myers, (2018) and Alzuhairy, (2018)
Non-pupillary block mechanisms	Plateau iris syndrome and configuration The thickness of the iris The Crystalline Lens's Function Despite a successful and patent laser iridotomy, some eyes will still have a residual angle	Amerasinghe and Aung, (2008), Azuara-Blanco et al., (2011), Tojo et al., (2014), Gillan et al., (2016), Razeghinejad and Myers, (2018) and Alzuhairy, (2018)

Diagnosis

Our research found several possible ways of diagnosing PACG in the current literature. Most studies used a Gonioscopy technique, UBM, AS-OCT, SPAC and visual loss for PACG diagnosis (Table 4). According to Tojo et al., (2014), PACG was diagnosed if these three criteria were met: (1) narrow angles; (2) glaucomatous optic disc neuropathy supported by respective visual field defects; (3) a SITA 30-2 threshold checkup representing a glaucoma hemifield test "outside normal limits".

Table 4 Summary of the diagnosis, identified from the existing literature

Possible ways of diagnosis	Explanation	Sources
Gonioscopy technique	A darkened environment should be used during gonioscopy. The patient should be gazing in the main posture and have a sufficient topical anesthesia. The slit lamp beam has to be 1mm tall and skinny. The light should be kept far from the pupil and must be at the minimum illumination level necessary for accurate angle perception. To look above the convexity of the iris, the lens can be pushed very little along the cornea. However, care must be given to avoid applying pressure and creating indentation	Zhou et al., (2010), Siak et al., (2016), Özyol et al., (2016), Hollander et al., (2017) and Yoo et al., (2023)
Ultrasound biomicroscopy (UBM)	Typically, UBM is carried out with the patient supine	Kameda et al., (2013), Siak et al., (2016) and Napier and Azuara-Blanco, (2018)
Anterior segment optical coherence tomography (AS-OCT)	The AS-OCT is a noncontact device that quickly acquires infrared light pictures of the angle and anterior chamber. It cannot scan the ciliary body, in contrast to the UBM. The image capture scan, which	Zhou et al., (2010), Tojo et al., (2014), Siak et al., (2016) and Costa et al., (2020)

	is similar to snapping a picture, takes a short while	
Scanning peripheral anterior chamber (SPAC) depth analyzer	The SPAC does not take picture of the angle; instead, it uses an optical technique to quickly capture slit pictures of the anterior chamber's center and periphery	Amerasinghe and Aung, (2008), Lai et al., (2016) and Razeghinejad and Myers, (2018)
Visual-field loss	Superior and inferior hemifield loss is identified	Tan et al., (2009) and Siak et al., (2016)

Management practices

Common management practices

It has been noted that higher diurnal IOP variations are associated, at least in part, with visual field loss in PACG patients. Therefore, it is crucial for glaucoma therapy to lower the range of circadian IOP changes. IOP variations can be continually tracked using contact lens sensors (CLS) for patients in an ambulatory context, seven days a week, 24 hours a day. A cataract formed in almost 33% of eyes in the trabeculectomy arm after surgery, a complication that may have been prevented with phacoemulsification in the first place (Tham et al., 2014).

20% of patients who were initially randomized to surgical intervention ultimately required cataract extraction, with trabeculectomy being the main contributor to cataract development. Another option for therapy is endoscopic cyclophotocoagulation, which is compatible with cataract surgery. Due to its capacity to promote outflow and optimize angle configuration, endoscopic cyclophotocoagulation may have a distinct benefit in PAC.

In individuals with anteriorly positioned ciliary processes, endoscopic cyclophotocoagulation (ECP) can also be used in conjunction with phacoemulsification to widen the angle and lessen the generation of aqueous humour. When used in conjunction with phacoemulsification, endoscopic cyclophotocoagulation involves laser coagulation of the ciliary processes and can reduce IOP by 17.6 to 46.9% (Budenz and Gedde, 2014). Concern has also been raised concerning the greater risk of complications following surgery compared to drainage devices (Berke, 2006).

Complication diseases after surgery

Angle closure is typically a bilateral condition because of the anatomical factors that result in a restricted irido-corneal angle (Emanuel et al., 2014). In AACC, there is a rapid increase in IOP as a result of an acute and full or almost full closure of ACA is the most dreaded complication of such an anatomic variation. Azuara-Blanco et al., (2016) found at least one complication of 75 patients among 419 patients. But as a direct result of laser iridotomy, they did not find any serious complication. Tham et al., (2010) mentioned that in CACG eyes with concomitant cataract, combined phacotrabeculectomy led to noticeably greater surgical complications than phacoemulsification alone.

Dosage (Amount of medication before and after operation)

The patient must be treated while taking into account any particular circumstances, such as symptoms that might indicate intermittent angle closure, systemic drugs that could increase the risk of pupillary block or unreliable access to healthcare. Azuara-Blanco et al., (2016) reported that the clear-lens extraction group had drug intolerance less frequently than the normal group. They argued that PACG with elevated intraocular pressure should be treated initially by clear-lens extraction. The pre- and post-operative medication has been presented in (Table 5).

Table 5 The pre and post operative medication

Name of the drug	Type and dosage	Frequency	Cited sources
Preoperative medication			
Norfloxacin, Moxifloxacin, Ofloxacin, Ciprofloxacin	Eye drop	4 times/ day	(Raut and Deshmukh, 2017)
Gatifloxacin, Moxifloxacin, Ciprofloxacin	Tablet	One time 2 hrs before surgery	Raut and Deshmukh, (2017)
Tropicamide	Eye drop	Only 1 day 1 drop at 15 minutes interval	Shin et al., (2010)

Atropine	Ointment	Thrice daily X 3days	Sun et al., (2017) and Razeghinejad and Myers, (2018)
Manitol	Infusion	300 ml in 30 minutes	Salimi et al., (2021)
Acetazolamide	Tablet 250 mg-500mg	1 tablet 3 times/day	Amerasinghe and Aung, (2008) and Tan et al., (2009)
Timolol	Eye drop	1 drop 2 times/day	Amerasinghe and Aung, (2008), Tan et al., (2009), Siak et al., (2016) and Alzuhairy, (2018)
Postoperative medication			
Ofloxacin, Ciprofloxacin, Norfloxacin, Moxifloxacin, Tropicamide, phenylephrine (10.0%), cyclopentolate (1.0%)	Eye drop	1 drop 6 times/ days (in one week)	Shin et al., (2010) and Marchini et al., (2015)
Gatifloxacin, Ciprofloxacin, Ibuprofen, Antacid, Rantac	Tablet 400mg	Twice daily (5days)	Raut and Deshmukh, (2017)

4. DISCUSSION

Influencing risk factors of PACG

CACG is a type of glaucoma characterized by the anterior chamber angle's slow and progressive closure. This closure occurs due to PAS, which leads to elevated IOP. The synchronized presence of cataracts and glaucoma is a discovery frequently observed in aging populations. The aging of populations around the globe is anticipated to hasten the progression of this pattern. The incidence of CACG is also known to rise with advancing age and is commonly found in conjunction with cataract. Because of this, the part that a lens that is thickened and positioned anteriorly plays in the course of angle closure is gaining more and more importance.

The occurrence of acute angle closure is higher in populations that are located in East Asia. Lower angle-closure is observed among South and South East Asians, in comparison to East Asians. It is important to remember that approximately 25–35% of Asian people have symptoms. According to several studies conducted in India, PACG is far more prevalent in Indians and has the propensity to be symptomless (Siak et al., 2016; Sun et al., 2017; Yoo et al., 2023). PAC's incidence rate is 0.1% or less in those who are over the age of 40. The prevalence of PACG among people of Bantu ethnicity was found to be 0.5%, which is significantly lower than the prevalence of other types of glaucoma, according to studies that looked at people of Bantu ethnicity.

Small investigations have suggested that PACG patients may have a myocilin gene mutation (MYOC). It is hypothesized that mutant MYOC proteins build up in the trabecular meshwork in POAG, preventing the outflow of aqueous fluid. Chinese patients with chronic PACG underwent genetic investigation of the MYOC gene, but the results were negative and did not confirm the idea that MYOC mutations are responsible for the etiology of chronic PACG of people in China (Amerasinghe and Aung, 2008).

Diagnosis of PACG

In the gonioscopy method, a darkened environment is used. The patient should gaze in the main posture and have appropriate topical anesthesia (Salimi et al., 2021). The beam of the slit light should be 1mm high and thin. The light should be maintained distance from the pupil and at the lowest possible luminance to allow for angle viewing. To look beyond the convexity of the iris, the lens can be pushed slightly over the cornea. However, caution must be used to avoid pressing too hard and leaving an imprint. Extreme magnification can be used to identify the corneal wedge close that marks the trabecular meshwork's anterior boundary. The scleral spur must also be identified since it is immediately anterior to the trabecular meshwork.

The AS-OCT is a non-contact device that fast snaps high-resolution photographs of the angle as well as anterior chamber applying infrared light. The image capture scan is similar to taking a snapshot and takes a few seconds. The technology enables objective and reproducible qualitative and quantitative angle imaging.

PACG's pattern of visual-field loss differs from POAG's. POAG patients lost more of their superior hemi field than their inferior hemi field. The PACG patients showed a less noticeable difference between the two hemi fields. However, the visual-field loss in the PACG group is more significant than in the POAG group. The authors proposed that although PACG is primarily pressure-related, POAG is considered to be caused by a mix of pressure-related processes.

Management after cataract surgery

If the cataract is substantial, cataract surgery should be done first, avoiding conjunctival incisions and utilizing a clear corneal tunnel. For patients with XFG or PACG, the advantage of this strategy is clear because occasionally a considerable IOP decrease may be obtained. When the PACG is greater than 90 degrees, cataract surgery and goniosynechialysis can be done at the same time. Even in situations of POAG, removing the cataract first may, in some instances, lower IOP. If the IOP is not sufficiently reduced, a subsequent trabeculectomy may be required, though 6 months are required before doing so.

Acetazolamide taken orally is a temporary measure. It is recommended practice to let the patient know that further glaucoma surgery would be needed if necessary, during the cataract surgery permission procedure. The fact that cataract surgery can be challenging, especially for patients with PXF or PACG, necessitating iris hooks or raising complication rates is another benefit of doing cataract surgery first (rather than phacotrabeculectomy). Treatment of these cataracts alone, as opposed to in combination with a trabeculectomy, is far more favorable (Chew et al., 2012).

Trabeculectomy can be performed on patients with POAG who have minimal or no cataract. Remind the patient that if more cataract surgery is needed, it may be best to delay it for at least a year to enable the bleb morphology to settle and lower the chance of early bleb failure. If cataract surgery is performed, it should be supplemented with MMC/5-FU or bevacizumab (Husain, 2014). It is controversial whether cataract surgery should be conducted in PXF or PACG patients without lens opacity before trabeculectomy. This query will be addressed in PACG situations by the EAGLE project, the findings of which will be made public shortly.

In the majority of situations, it is advised to conduct cataract surgery even the absence of a cataract. The likelihood of issues including inadequate dilatation and zonular instability increases the longer one waits to have XFG cataract surgery. Additionally, the evidence indicates that taking off the lens may lessen the chance of additional IOP rises. Trabeculectomy induces anterior chamber shallowing, which lasts even five years after the treatment, which is why it should not be done initially in patients with PACG and no cataract.

If one assumes that irido-trabecular contact is caused by a crowded anterior chamber and serves as a contributing factor to the rise in IOP in PACG, then trabeculectomy alone will not solve the problem; in fact, it will exacerbate it. The rising rates of the procedure appear to be crucial in preventing PACG by lessening the effect of lens block. Combination phacotrabeculectomy appears to have little indication or benefit. However, this viewpoint likely exaggerates the hypothetical difficulties of this technique. In patients with higher IOP and cataract, phacotrabeculectomy may be the procedure of choice. In these circumstances, cataract surgery may cause a pressure spike, potentially leading to disc 'wipe-out'.

Strengths and limitations of the study

Strengths

A research protocol was developed for guiding this meta-analysis.

This study followed PRISMA guidelines for the analysis.

Recent studies were undertaken for analysis and covered last twelve years.

It covers key dimensions of PACG such as Risk factors, diagnosis and management

Limitations

This study is a systematic review which is solely based on secondary sources of the information. This study retrieved information from PubMed and Scopus databases due to considering time, cost and accessibility.

The findings of this study are based on the selected documents, so generalization of the findings is limited.

This limitation should be overcome by a primary data-based study on the risk factors, diagnosis and management of PACG after cataract surgery.

5. CONCLUSION

Although angle-closure glaucoma causes are becoming better understood, there are still many questions about how well various treatments for the condition actually work. This study focused on the risk factors, diagnosis and management of PACG after cataract surgery. This study identifies a number of risk variables for PACG, including genetics, ocular biometry, ethnicity, age and gender. For PACG diagnosis, the majority of studies employed gonioscopy, UBM, AS-OCT, SPAC and visual-field loss.

The possibility of treating many illnesses with a single treatment is also examined in relation to cataract surgery in PACG. However, the prevalence of PACG may be impacted by the raised occurrence of cataract surgery. This study argues that PACG is a

frequently severe and blinding condition that requires cataract surgery. By determining the mechanism behind a patient's disease and risk factors, the care of that patient may be customized properly.

Acknowledgement
We thank Tongji Medical College, Huazhong University of Science and Technology, China for support.

Author Contributions
All authors have made a significant intellectual contribution and have given their consent of approval for publication.

Ethical approval
The study was approved by the Medical Ethics Committee of Tongji Medical College, Huazhong University of Science and Technology, China, (Ethical approval code: TJH-201906015).

Informed consent
Not applicable.

Funding
This study has not received any external funding.

Conflict of interest
The authors declare that there is no conflict of interests.

Data and materials availability
All data sets collected during this study are available upon reasonable request from the corresponding author.

REFERENCES AND NOTES

1. Alzuhairy SA. Chronic angle closure glaucoma: presentation and outcomes at a tertiary eye hospital of Saudi Arabia. Int Surg J 2018; 6(1):73. doi: 10.18203/2349-2902.isj20185066
2. Amerasinghe N, Aung T. Angle-closure: Risk factors, diagnosis and treatment. Prog Brain Res 2008; 173(65):31-45. doi: 10.1016/S0079-6123(08)01104-7
3. Azuara-Blanco A, Burr J, Ramsay C, Cooper D, Foster PJ, Friedman DS, Scotland G, Javanbakht M, Cochrane C, Norrie J; EAGLE study group. Effectiveness of early lens extraction for the treatment of primary angle-closure glaucoma (EAGLE): A randomised controlled trial. Lancet 2016; 388(10052):1389-1397. doi: 10.1016/S0140-6736(16)30956-4
4. Azuara-Blanco A, Burr JM, Cochran C, Ramsay C, Vale L, Foster P, Friedman D, Quayyum Z, Lai J, Nolan W, Aung T, Chew P, McPherson G, Mc-Donald A, Norrie J; Effectiveness in Angle-closure Glaucoma of Lens Extraction (EAGLE) Study Group. The effectiveness of early lens extraction with intraocular lens implantation for the treatment of primary angle-closure glaucoma (EAGLE): Study protocol for a randomized controlled trial. Trials 2011; 12:1-10. doi: 10.1186/1745-6215-12-133
5. Berke SJ. Endolaser Cyclophotocoagulation in Glaucoma Management. Tech Ophthalmol 2006; 4(2):74-81.
6. Bourne RRA, Flaxman SR, Braithwaite T, Cicinelli MV, Das A, Jonas JB, Keeffe J, Kempen JH, Leasher J, Limburg H, Naidoo K, Pesudovs K, Resnikoff S, Silvester A, Stevens GA, Tahhan N, Wong TY, Taylor HR; Vision Loss Expert Group. Magnitude, temporal trends and projections of the global prevalence of blindness and distance and near vision impairment: A systematic review and meta-analysis. Lancet Glob Health 2017; 5(9):e888-e897. doi: 10.1016/S2214-109X(17)30293-0
7. Budenz DL, Gedde SJ. New options for combined cataract and glaucoma surgery. Curr Opin Ophthalmol 2014; 25(2):141-147. doi: 10.1097/ICU.0000000000000027
8. Chen HY, Lin CL, Kao CH. Changes in glaucoma medication numbers after cataract and glaucoma surgery: A nationwide population-based study. Medicine (Baltimore) 2019; 98(4):e14128. doi: 10.1097/MD.0000000000014128
9. Chew P, Cecilia M, See J. Surgical Treatment of Angle-Closure Glaucoma. Dev Ophthalmol 2012; 50:137-145.
10. Costa VP, Leung CKS, Kook MS, Lin SC; Global Glaucoma Academy. Clear lens extraction in eyes with primary angle closure and primary angle-closure glaucoma. Surv Ophthalmol 2020; 65(6):662-674. doi: 10.1016/j.survophthal.2020.04.003

11. Emanuel ME, Parrish RK, Gedde SJ. Evidence-based management of primary angle closure glaucoma. Curr Opin Ophthalmol 2014; 25(2):89-92. doi: 10.1097/ICU.0000000000000028
12. Friedman DS, Foster PJ, Aung T, He M. Angle closure and angle-closure glaucoma: What we are doing now and what we will be doing in the future. Clin Exp Ophthalmol 2012; 40(4):381-387. doi: 10.1111/j.1442-9071.2012.02774.x
13. Gillan SN, Wilson PJ, Knight DS, Sanders R. Trends in Acute Primary Angle-Closure Glaucoma, Peripheral Iridotomy and Cataract Surgery in Scotland, 1998-2012. Ophthalmic Epidemiol 2016; 23(1):1-5. doi: 10.3109/09286586.2015.1083035
14. Hayashi K, Hayashi H, Nakao F, Hayashi F. Effect of cataract surgery on intraocular pressure control in glaucoma patients. J Cataract Refract Surg 2001; 27(11):1779-1786. doi: 10.1016/S0886-3350(01)01036-7
15. Hollander DA, Pennesi ME, Alvarado JA. Management of plateau iris syndrome with cataract extraction and endoscopic cyclophotocoagulation. Exp Eye Res 2017; 158:190-194. doi: 10.1016/j.exer.2016.07.018
16. Husain R. The management of patients with cataracts and medically uncontrolled glaucoma. Med hypothesis Discov Innov Ophthalmol 2014; 3(1):20-30.
17. Kameda T, Inoue T, Inatani M, Tanihara H; Japanese Phaco-Goniosynechialysis Multicenter Study Group. Long-term efficacy of goniosynechialysis combined with phacoemulsification for primary angle closure. Graefes Arch Clin Exp Ophthalmol 2013; 251(3):825-830. doi: 10.1007/s00417-012-2091-8
18. Kwon J, Sung KR. Factors Associated with Zonular Instability During Cataract Surgery in Eyes with Acute Angle Closure Attack. Am J Ophthalmol 2017; 183:118-124. doi: 10.1016/j.ajo.2017.09.003
19. Lai J, Choy BNK, Shum JWH. Management of primary angle-closure glaucoma. Asia Pac J Ophthalmol (Phila) 2016; 5(1):59-62. doi: 10.1097/APO.0000000000000180
20. Lee CK, Lee NE, Hong S, Kang E, Rho SS, Seong GJ, Hong YJ, Kim CY. Risk factors of disease progression after cataract surgery in chronic angle-closure glaucoma patients. J Glaucoma 2016; 25(4):e372-e376. doi: 10.1097/IJG.0000000000000350
21. Lee HS, Park JW, Park SW. Factors affecting refractive outcome after cataract surgery in patients with a history of acute primary angle closure. Jpn J Ophthalmol 2014; 58(1):33-39. doi: 10.1007/s10384-013-0285-1
22. Li Y, Guo C, Huang C, Jing L, Huang Y, Zhou R, Qiu K, Zhang M. Development and Evaluation of the Prognostic Nomogram to Predict Refractive Error in Patients with Primary Angle-Closure Glaucoma Who Underwent Cataract Surgery Combined with Goniosynechialysis. Front Med (Lausanne) 2021; 8:749903. doi: 10.3389/fmed.2021.749903
23. Marchini G, Chemello F, Berzaghi D, Zampieri A. New Findings in the Diagnosis and Treatment of Primary Angle-Closure Glaucoma. Prog Brain Res 2015; 221:191-212. doi: 10.1016/bs.pbr.2015.05.001
24. Melancia D, Pinto LA, Marques-Neves C. Cataract surgery and intraocular pressure. Ophthalmic Res 2015; 53(3):141-148. doi: 10.1159/000377635
25. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 2009; 6(7):e1000097. doi: 10.1371/journal.pmed.1000097
26. Napier ML, Azuara-Blanco A. Changing patterns in treatment of angle closure glaucoma. Curr Opin Ophthalmol 2018; 29(2):130-134. doi: 10.1097/ICU.0000000000000453
27. Nongpiur ME, Singhal S, Stewart S, Htoon HM, Narayanaswamy AK, Wong TY, Perera SA, Aung T. The impact of lens vault on visual acuity and refractive error: Implications for management of primary angle-closure glaucoma. J Glaucoma 2016; 25(3):e236-e240. doi: 10.1097/IJG.0000000000000264
28. Özyol P, Özyol E, Sül S, Baldemir E, Çavdar S. Intra-ocular pressure fluctuation after cataract surgery in primary angle-closure glaucoma eyes medically controlled after laser iridotomy. Acta Ophthalmol 2016; 94(7):e528-e533. doi: 10.1111/aos.13023
29. Qian Z, Huang J, Song B, Wei L, Fu L, Austin MW, Spaeth GL, Pan W, McAlinden C. Cataract Surgery (Phacoemulsification with Intraocular Lens Implantation) Combined with Endoscopic Goniosynechialysis for Advanced Primary Angle-Closure Glaucoma. Ophthalmol Glaucoma 2021; 4(4):365-372. doi: 10.1016/j.ogla.2020.11.003
30. Raut AS, Deshmukh J. Medications Used Before and After Cataract Surgery in A Tertiary Care Hospital. J Med Sci Clin Res 2017; 5(3):18510-18514.
31. Razeghinejad MR, Myers JS. Contemporary approach to the diagnosis and management of primary angle-closure disease. Surv Ophthalmol 2018; 63(6):754-768. doi: 10.1016/j.survophthal.2018.05.001
32. Romero P, Hirunpatravong P, Alizadeh R, Kim EA, Nouri-Mahdavi K, Morales E, Law SK, Caprioli J. Trabeculectomy with Mitomycin-C: Outcomes and Risk Factors for Failure in Primary Angle-closure Glaucoma. J Glaucoma 2018; 27(2):101-107. doi: 10.1097/IJG.0000000000000842
33. Salimi A, Abu-Nada M, Harasymowycz P. Matched Cohort Study of Cataract Surgery with and Without Trabecular Microbypass Stent Implantation in Primary Angle-Closure Glaucoma. Am J Ophthalmol 2021; 224:310-320. doi: 10.1016/j.ajo.2020.12.032

34. Shah M, Law G, Ahmed IK. Glaucoma and cataract surgery: Two roads merging into one. Curr Opin Ophthalmol 2016; 27(1):51-57. doi: 10.1097/ICU.0000000000000224
35. Shin HC, Subrayan V, Tajunisah I. Changes in anterior chamber depth and intraocular pressure after phacoemulsification in eyes with occludable angles. J Cataract Refract Surg 2010; 36(8):1289-1295. doi: 10.1016/j.jcrs.2010.02.024
36. Siak J, Quek D, Nongpiur ME, Ho SW, Htoon HM, Perera S, Aung T, Wong T. Anterior chamber angle and intraocular pressure changes after phacoemulsification: A comparison between eyes with closed-angle and open-angle glaucoma. J Glaucoma 2016; 25(3):e259-e264. doi: 10.1097/IJG.0000000000000271
37. Smith SD, Singh K, Lin SC, Chen PP, Chen TC, Francis BA, Jampel HD. Evaluation of the anterior chamber angle in glaucoma: A report by the American Academy of Ophthalmology. Ophthalmology 2013; 120(10):1985-1997. doi: 10.1016/j.ophtha.2013.05.034
38. Sun X, Dai Y, Chen Y, Yu DY, Cringle SJ, Chen J, Kong X, Wang X, Jiang C. Primary angle closure glaucoma: What we know and what we don't know. Prog Retin Eye Res 2017; 57:26-45. doi: 10.1016/j.preteyeres.2016.12.003
39. Tan AM, Loon SC, Chew PTK. Outcomes following acute primary angle closure in an Asian population. Clin Exp Ophthalmol 2009; 37(5):467-472. doi: 10.1111/j.1442-9071.2009.02060.x
40. Tham CCY, Kwong YYY, Leung DYL, Lam SW, Li FC, Chiu TY, Chan JC, Lam DS, Lai JS. Phacoemulsification vs phacotrabeculectomy in chronic angle-closure glaucoma with cataract complications. Arch Ophthalmol 2010; 128(3):303-311. doi: 10.1001/archophthalmol.2010.12
41. Tham YC, Li X, Wong TY, Quigley HA, Aung T, Cheng CY. Global prevalence of glaucoma and projections of glaucoma burden through 2040: A systematic review and meta-analysis. Ophthalmology 2014; 121(11):2081-2090. doi: 10.1016/j.ophtha.2014.05.013
42. Thomas R, Sekhar GC, Kumar RS. Glaucoma management in developing countries: Medical, laser and surgical options for glaucoma management in countries with limited resources. Curr Opin Ophthalmol 2004; 15(2):127-131. doi: 10.1097/00055735-200404000-00012
43. Tojo N, Otsuka M, Miyakoshi A, Fujita K, Hayashi A. Improvement of fluctuations of intraocular pressure after cataract surgery in primary angle closure glaucoma patients. Graefes Arch Clin Exp Ophthalmol 2014; 252(9):1463-1468. doi: 10.1007/s00417-014-2666-7
44. Varma DK, Kletke SN, Rai AS, Ahmed IIK. Proportion of undetected narrow angles or angle closure in cataract surgery referrals. Can J Ophthalmol 2017; 52(4):366-372. doi: 10.1016/j.jcjo.2017.01.008
45. Vijaya L, Asokan R, Panday M, George R. Is prophylactic laser peripheral iridotomy for primary angle closure suspects a risk factor for cataract progression? The Chennai Eye Disease Incidence Study. Br J Ophthalmol 2017; 101(5):665-670. doi: 10.1136/bjophthalmol-2016-308733
46. Wright C, Tawfik MA, Waisbourd M, Katz LJ. Primary angle-closure glaucoma: An update. Acta Ophthalmol 2016; 94(3):217-225. doi: 10.1111/aos.12784
47. Yong KL, Gong T, Nongpiur ME, How AC, Lee HK, Cheng L, Perera SA, Aung T. Myopia in Asian subjects with primary angle closure: Implications for glaucoma trends in East Asia. Ophthalmology 2014; 121(8):1566-1571. doi: 10.1016/j.ophtha.2014.02.006
48. Yoo K, Apolo G, Zhou S, Burkemper B, Lung K, Song B, Wong B, Toy B, Camp A, Xu B. Rates and Patterns of Diagnostic Conversion from Anatomical Narrow Angle to Primary Angle-Closure Glaucoma in the United States. Ophthalmol Glaucoma 2023; 6(2):169-176. doi: 10.1016/j.ogla.2022.08.016
49. Zhang Y, Zong Y, Jiang Y, Jiang C, Lu Y, Zhu X. Clinical Features and Efficacy of Lens Surgery in Patients with Lens Subluxation Misdiagnosed as Primary Angle-Closure Glaucoma. Curr Eye Res 2019; 44(4):393-398. doi: 10.1080/02713683.2018.1548130
50. Zhou AW, Giroux J, Mao AJ, Hutnik CML. Can preoperative anterior chamber angle width predict magnitude of intraocular pressure change after cataract surgery? Can J Ophthalmol 2010; 45(2):149-153. doi: 10.3129/i10-009