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CLINICAL STUDY

Correlation of previous acute angle-closure attack with extent of synechial angle closure in chronic primary angle-closure glaucoma patients

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Abstract

Aim **To document any correlation between previous acute angle-closure attack and the extent of synechial angle closure in chronic primary angle-closure glaucoma (PACG) patients.**

Methods **Consecutive cases of chronic PACG with patent peripheral iridotomy had gonioscopy performed. The extents of synechial angle closure of those chronic PACG eyes with previous documented acute angle-closure attack were compared to those eyes without such a history.**

Results **A total of 102 chronic PACG eyes of 102 patients were recruited. Twenty-seven eyes (26.5%) had a previous documented acute angle closure, while 75 eyes (73.5%) did not. The mean extent of synechial angle closure ±1 SD was 307 ± 68 degrees (range, 150–360 degrees) in those chronic PACG eyes with a history of previous acute angle closure, compared to 266 ± 89 degrees (range, 90–360 degrees) in those chronic PACG eyes without such a history ($P = 0.03$, Student's *t*-test). There were no statistically significant differences between the two groups in age, LogMAR visual acuity, intraocular pressure (IOP), number of glaucoma eye drops, vertical cup-to-disk ratio, mean deviation or pattern SD in Humphrey automated perimetry, and anterior chamber depth ($P > 0.05$).**

Conclusion **Previous acute angle-closure attack correlated with more extensive synechial angle closure in chronic PACG patients in this study.**

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Keywords: acute glaucoma; synechiae; angle-closure

Introduction

Some cases of chronic primary angle-closure glaucoma (PACG) have a gradual and insidious onset, while others may be preceded by one or more previous episodes of acute angle-closure attack. Certain anatomical factors, such as a thick[1,2] and anteriorly positioned lens, shallow anterior chamber,[1–3] and short axial lengths,[4] may increase the chance of developing chronic PACG, but it is uncertain which of these anatomical factors correlate with acute angle closure attack in these chronic PACG eyes.

Conceptually, there are good reasons for the extent of synechial angle closure to correlate with acute angle closure attack in chronic PACG eyes. On the one hand, chronic PACG eyes with more synechial angle closure may be more prone to acute angle closure. On the other hand, an appositionally closed angle in an inflamed eye during an acute attack may predispose to the formation of more synechial angle closure. Finding a correlation may not tell us which of the above two mechanisms predominate, but will certainly put us one step closer towards understanding the complex relationship between acute angle-closure attack and chronic PACG.

In this study, we aim to document any correlation between previous acute angle-closure attack with the extent of synechial angle closure in chronic PACG eyes, by comparing the extent of synechial angle closure in chronic PACG eyes with previous acute angle closure to chronic PACG eyes without such a history.

Materials and methods

This study uses clinical data from a randomized controlled interventional trial on chronic PACG (registered with Centre for Clinical Trials (CCT), The Chinese University of Hong Kong. Unique trial registration number: CUHK_CCT00043). The study followed the declaration of Helsinki and the ICH-GCP guidelines. Approval from the institutional review board was obtained. Each patient signed an informed consent to participate.

Chronic PACG eyes fulfilling all the recruitment criteria (Table 1) during the recruitment period from July 2003 to July 2005 were included in this analysis. In patients with bilateral chronic PACG, only one eye was randomly selected for inclusion in this analysis.

Documented evidence for previous acute angle closure attack was sought for in our ophthalmology records and in referral letters sent to us by qualified ophthalmologists. Criteria for confirming a previous attack are outlined in Table 2.

All gonioscopic examinations were performed by experienced gonioscopists using the Volk G-4 gonio lens (Volk Optical Inc., Mentor, USA) in the presence of patent peripheral iridotomy under topical anaesthesia. The gonioscopy was performed with and without indentation. Only the extent of synechial angle closure, and not appositional angle closure, was documented in degrees of arc. The whole circumference of the drainage angle was divided into 12 clock hours of smaller segments, each extending over 30 degrees. Each of these 30-degree segments was recorded as either open (posterior pigmented trabecular meshwork could be visualized) or closed (posterior pigmented trabecular meshwork obstructed by peripheral anterior synechiae on indentation). If both open and closed areas were seen within the same 30-degree segment, that segment was recorded as 'open'; if more than half of that segment was open, and vice versa. Because of this methodology, all the recorded extents of synechial angle closure were multiples of 30 degrees. The gonioscopist had no knowledge of whether the patient had previous attack of acute angle closure or not during the examination.

Intraocular pressure (IOP) (median of three Goldmann applanation readings), number and types of IOP-lowering drugs, best corrected visual acuity (BCVA),

Table 2 Documented evidence for previous acute angle-closure attack

Documentation of the followings either in our own ophthalmology records or in the referral letter of a qualified ophthalmologist
● IOP ≧40 mmHg
● Symptomatic: symptoms may include any of the followings:
i. Eye pain
ii. Acute visual loss
iii. Seeing halo around lights
iv. Headache
v. Nausea and/or vomiting
● At least three of the following clinical signs:
i. Corneal oedema
ii. Shallow anterior chamber
iii. Iris bombé
iv. Sluggish mid-dilated pupil
v. Ciliary flush or conjunctival injection

Table 1 Recruitment criteria

Inclusion criteria	● Presence of at least two quadrants of angle closure, intermittent or continuous, with at least one quadrant being synechial, obliterating pigmented part of trabecular meshwork in the presence of a patent peripheral iridotomy
	● Requiring intraocular pressure (IOP)-lowering medications, or IOP higher than 21 mmHg without IOP-lowering medications
	● Visual field loss compatible with glaucoma[a] and/or glaucomatous optic disc changes[b]
	● Patient able and willing to give informed consent to participate
Exclusion criteria:	● Patients unable to cooperate for a detailed gonioscopic examination
	● Previous intraocular surgery or laser procedure, with the exception of laser peripheral iridotomy or argon laser peripheral iridoplasty
	● Patients recalling a previous diagnosis of 'acute glaucoma', but with no documentation as defined in table 2

[a]Minimal criteria for glaucomatous visual field defect as per published standard:[5] glaucoma hemifield test outside normal limits, pattern SD with a *P*-value of $<5\%$, or a cluster of $\geqslant 3$ points in the pattern deviation plot in a single hemifield (superior or inferior) with a *P*-value of $<5\%$, one of which must have a *P*-value of $<1\%$. Any one of the preceding criteria, if repeatable, was considered sufficient evidence of a glaucomatous visual field defect.
[b]An optic disc was considered 'glaucomatous', if two or more of the following features were present: vertical cup-to-disk ratio greater than the fellow eye by 0.2, presence of localized notching in neuroretinal rim, localized pallor in neuroretinal rim, and wedge thinning defect in retinal nerve fibre layer.

vertical cup-to-disk ratio (VCDR) and optic nerve head assessment from optic disc photography, and visual field (VF) (static automated white-on-white threshold perimetry—program 24- 2, SITA-standard, model 750, Humphrey Instruments, Dublin, CA), were documented for each study eye. The VCDR was taken to be the longest vertical cup diameter divided by the longest vertical disc diameter. Anterior chamber depth was measured by ultrasound biomicroscopy (UBM).

A comparison of all continuous data collected was made between the two groups (those with and those without a previous documented attack of acute angle closure) using the Student's *t*-test in the Analysis ToolPak of Microsoft Excel 2002 (Microsoft Corporation, USA). A *P*-value of smaller than 0.05 was taken as statistically significant.

Results

During the study period of July 2003 to July 2005, 102 chronic PACG eyes of 102 patients fulfilling the recruitment criteria in Table 1 were included in this analysis. A total of 27 chronic PACG eyes of 27 patients (26.5%) had documented previous acute angle closure, while 75 chronic PACG eyes of 75 patients (73.5%) did not have such a history. All 27 chronic PACG eyes with previous acute angle closure had only one documented episode compatible with acute angle closure. For the 27 eyes with a previous documented episode of acute angle closure, the mean documented IOP ± 1 SD during the acute episode was 62.9 ± 11.8 mmHg (range, 40–79 mmHg). The demographic and ophthalmic data of the two groups of patients are summarized in Table 3. There were no statistically significant differences between the two groups in age, LogMAR visual acuity, IOP, number of glaucoma eye drops, VCDR, mean deviation or pattern SD in Humphrey automated perimetry, and anterior chamber depth ($P > 0.05$).

The mean extent of synechial angle closure ± 1 SD was 307 ± 68 degrees of arc (range, 150–360 degrees of arc) in the 27 chronic PACG eyes with previous acute angle closure, compared to 266 ± 89 degrees of arc (range, 90–360 degrees of arc) in the 75 chronic PACG eyes without such a history ($P = 0.03$, Student's *t*-test).

Discussion

The chronic PACG eyes in this study had at least two quadrants of angle closure, with at least one quadrant being synechial (Table 1). The extent of synechial angle closure was therefore more extensive in this patient population than previously published.[6] Our results may not be applicable to those less severe chronic PACG eyes with smaller extent of angle closure.

Based on the results from this study, chronic PACG eyes with a positive history of acute angle closure have significantly greater extent of synechial angle closure than chronic PACG eyes without such a history ($P < 0.05$). This may imply that each attack of acute angle closure increases the risk of peripheral anterior synechiae formation and progression. This may not be surprising, because during an acute angle closure attack, the drainage angle is appositionally closed over a great extent in an inflamed eye, which in theory at least, should increase the risk of the peripheral iris adhering to the trabecular meshwork. On the other hand, our results

Table 3 Demographic data and results

	Chronic PACG eyes with previous AAC	*Chronic PACG eyes with no previous AAC*	P-*value*
Number	27	75	
Mean age ± SD (range)/years	71.9 ± 6.3 (61–83)	71.4 ± 7.1 (55–91)	$P = 0.77$[a]
Male/female ratio	6: 21	32: 43	$P = 0.06$[b]
Left/right eye ratio	12: 15	37: 38	$P = 0.66$[b]
Mean LogMAR visual acuity ± SD (range)	0.8 ± 0.5 (0.2–3.0)	0.8 ± 0.5 (0.2–3.0)	$P = 0.66$[a]
Mean IOP at recruitment ± SD (range)/mmHg	18.1 ± 6.4 (11–34)	19.5 ± 5.9 (9–38)	$P = 0.31$[a]
Mean number of glaucoma drugs ± SD (range)	2.3 ± 0.9 (1–4)	2.5 ± 1.1 (1–5)	$P = 0.52$[a]
Mean vertical cup-to-disk ratio ± SD (range)	0.6 ± 0.2 (0.3–0.9)	0.7 ± 0.2 (0.3–1.0)	$P = 0.07$[a]
Humphrey automated perimetry mean MD ± SD (range)/db	−13.5 ± 9.2 (−27.5 to −1.0)	−17.7 ± 8.5 (−29.9 to −3.3)	$P = 0.06$[a]
Humphrey automated perimetry mean PSD ± SD (range)/db	4.7 ± 2.6 (1.2–9.5)	5.7 ± 3.1 (1.6 to 12.4)	$P = 0.18$[a]
Mean anterior chamber depth ± SD (range)/μm	1278.6 ± 526.6 (535–2260)	1276.8 ± 529.6 (394–2477)	$P = 0.99$[a]
Mean extent of synechial angle closure ± SD (range)/ degrees of arc	307 ± 68 (150–360)	266 ± 89 (90–360)	$P = 0.03$[a]

AAC = acute angle closure; PACG = primary angle-closure glaucoma; HM = seeing hand movement only; IOP = intraocular pressure; MD = mean deviation; PSD = pattern standard deviation.
[a]Student's *t*-test.
[b]Pearson's χ^2 test.

may also suggest that eyes with a greater extent of pre-existing peripheral anterior synechiae are more prone to acute angle closure attacks. This is also understandable that eyes with a greater extent of pre-existing peripheral anterior synechiae require appositional closure over a smaller segment of the angle before a rapid rise in IOP occurs. Further studies are needed to determine whether these hypotheses are correct.

It is interesting to note that despite the significant difference in the extent of peripheral anterior synechiae between the two groups, there were no significant differences between the two groups in terms of IOP and mean number of IOP-lowering drugs required. This may suggest that the extent of synechial closure may not directly correlate with IOP control. One possible explanation could be that the trabecular meshwork in those open portions of the angle may not be functioning perfectly, even among those eyes with no documented history of previous acute angle closure. A previous study of Mongolian eyes suggested that synechial angle closure may correlate with poor IOP control.[7] This discrepancy may be due to the fact that more severe chronic PACG eyes were recruited into our study. Another study demonstrated that the extent of synechial angle closure had no effect on the IOP-lowering efficacy of a prostaglandin analogue drug.[8,9]

We attempted to ensure that only those chronic PACG eyes with a genuine episode of acute angle closure in the past were included in the acute angle closure group. To achieve this, we had taken into account only medical records made by qualified ophthalmologists. We did not trust self-reported episodes of suggestive symptoms. Nor did we trust self-reported previous diagnosis of acute angle closure without documentation. We excluded patients with unconfirmed history of acute angle closure.

On the other hand, in the group with a negative history for acute angle closure, some of the cases might have had mild acute angle closure that did not produce symptoms severe enough to result in clinical presentation. This is an inherent weakness in any study that focuses on subgroups with supposedly no previous attack of acute angle closure.

Traditional schemes for classifying gonioscopic findings, such as the Shaffer system or the Spaeth system, do not allow for the quantification of peripheral anterior synechiae. Gonioscopic photography at the slit lamp may sound promising, but in practice, the image quality obtained is often suboptimal due to corneal distortion during indentation. Furthermore, there may also be a distortion of scale towards the two ends of a gonio mirror. For these reasons, the authors believe that attempts to document extent of angle closure down to a single degree in arc may be meaningless, considering the possibility of large errors. We have, therefore, decided to subdivide the whole drainage angle into 12 equal and smaller segments, and used the method described as a practical approach to documenting the extent of synechial angle closure. The gonioscopic examinations were performed by three experienced gonioscopists. Interobserver variability may exist.

Fifteen of the 27 eyes with a history of acute angle closure had received argon laser peripheral iridoplasty (ALPI) treatment. Our previous study demonstrated that ALPI treatment for acute angle closure would not increase the extent of peripheral anterior synechiae, compared to conventional treatment with medications.[10]

In conclusion, those chronic PACG eyes with a previous acute angle-closure attack have a significantly greater extent of synechial angle closure than chronic PACG eyes without such a history.

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