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Risk of acute angle-closure and changes in intraocular pressure after pupillary dilation in patients with diabetes

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BACKGROUND: To evaluate the risk of AAC and intraocular pressure (IOP) changes in diabetic patients after pupil dilation.
METHODS: This cross-sectional study enrolled 2,287 diabetic patients among community residents in Guangzhou, China. All participants underwent routine pupil dilation unless they had a history of glaucoma. IOP was measured using a non-contact tonometer before and one hour after pupil dilation with tropicamide 0.5% and phenylephrine 0.5% eye drop. The proportion of AAC and changes in IOP after pupil dilation were evaluated.
RESULTS: Only one of the 2,287 participants (0.04%) with diabetes developed post-dilation AAC. The mean pre and post-dilation IOP in the right was 16.1 ± 2.7 and 16.5 ± 2.8 mmHg ($P < 0.001$); mean pre and post-dilation IOP in the left was 16.5 ± 2.7 and 16.8 ± 2.8 mmHg ($P < 0.001$). Sixty-one participants (2.7%) showed an increase in IOP ≥ 5 mmHg and 25 participants (1.1%) showed a post-dilation IOP > 25 mmHg, including 11 participants (0.5%) who had both an increase in IOP ≥ 5 mmHg and post-dilation IOP > 25 mmHg. Lower pre-dilation IOP (OR = 0.827; 95% CI, 0.742–0.922; $P = 0.001$) and shallower anterior chamber depth (ACD) (OR = 0.226; 95% CI, 0.088–0.585; $P = 0.002$) were significant risk factors for an increase in IOP ≥ 5 mmHg in multivariate logistic regression analysis.
CONCLUSIONS: The risk of developing AAC after pupil dilation in diabetic patients was very low. Lower pre-dilation IOP and shallower ACD are risk factors for increased post-dilation IOP.

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INTRODUCTION

As the leading cause of preventable blindness in middle-aged and older people globally [1], the number of patients with diabetic retinopathy (DR) increases with diabetic patients. A dilated-pupil fundus examination can significantly increase the possibility of detecting early DR and intervening to reduce the burden of visual loss caused by DR [2].

However, the potential risk of pupil dilation has remained a matter of great concern to general practitioners and family physicians, which preventing diabetic patients from having dilated-pupil fundus examinations [3]. First, pupil dilation can lead to a significant increase in intraocular pressure (IOP). IOP increased by 5 mmHg or more after pupil dilation in some patients, especially those with a history of glaucoma [4–6]. Second, studies have shown that pupil dilation may induce acute angle-closure (AAC) in general populations, and Asians have a higher risk of developing AAC than whites after mydriasis because of the high prevalence of narrow angles and angle closure in Asians [7, 8]. Third, a previous study indicated that diabetic patients have shallower anterior chambers than non-diabetic patients, who may have a higher risk of developing AAC after mydriasis [9].

Although there have been some studies on changes in IOP and the risk of AAC after pupil dilation [10–12], few have focused on the risk of AAC after pupil dilation in diabetic patients, especially in China, which has the largest number of cases of diabetes worldwide. One prospective observational case series of Asian diabetic subjects showed that none of the 1919 subjects developed post-dilation AAC. However, this study included Chinese, Malay, and Indian patients, and it did not analyse the relationship between ocular parameters and IOP spike [13]. Therefore, we explored the risk of AAC and changes in IOP after pupil dilation and the risk factors for increased post-dilation IOP in a large sample of Chinese diabetic patients.

MATERIALS AND METHODS

Study design and participants

This cross-sectional study was conducted from November 17, 2017, to December 19, 2019 in the Zhongshan Ophthalmic Centre, affiliated with Sun Yat-sen University, Guangzhou, China. The study adhered to the tenets of the Declaration of Helsinki and was approved by the hospital's internal ethics committee. All participants signed written informed consent before enrolment. This study recruited from the type 2 diabetes mellitus registered patients in communities near the Zhongshan Ophthalmic Center. Those with a history of glaucoma, penetrating ocular trauma, previous intraocular surgery (glaucoma surgery, cataract surgery or vitrectomy), history of laser therapy, corneal abnormalities (such as keratoconus, corneal scarring, and Fuchs' corneal dystrophy), severe

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systemic disease other than diabetes (such as uncontrolled hypertension, serious cardiovascular and cerebrovascular diseases), the presence of cognitive impairment, mental illness, or an inability to complete the questionnaires and examinations were excluded.

Ocular examination

Presenting visual acuity and best-corrected visual acuity (BCVA) was measured by Early Treatment Diabetic Retinopathy Study (ETDRS) LogMAR E charts (Precision Vision, Villa Park, IL). The anterior and posterior segments were evaluated by an experienced ophthalmologist using slit-lamp biomicroscopy (BQ-900, Haag-Streit, Switzerland). Refractive error was measured using an auto refractometer (KR-8800; Topcon, Japan). The ocular biological parameters of pupil diameter, central corneal thickness, axial length (AL), anterior chamber depth (ACD), and lens thickness were measured by a Lenstar LS900 (Haag-Streit AG, Koeniz, Switzerland). Each participant underwent 7-field fundus photography (Canon CR-2, Tokyo, Japan) after pupil dilation.

Measurement and management of IOP

All participants underwent measurement IOP in both eyes using a non-contact tonometer (Topcon CT-1, Tokyo, Japan) with the standardized protocol before and one hour after pupil dilation. The IOP of each eye was measured three times consecutively and the mean value of the three measurements was recorded. IOP was re-measured if the difference between the three measurements exceeded 3 mmHg. After the pre-dilation ophthalmologic examination, the pupils were dilated with tropicamide 0.5% and phenylephrine 0.5% eye drops, and IOP was measured by the same observer one hour after pupil dilation.

AAC was defined as the presence of at least two of these four conditions: (1) ocular or periocular pain, nausea or vomiting, an antecedent history of blurring of vision with haloes; (2) presenting at least three of the following signs: conjunctival hyperaemia, shallow anterior chamber, corneal epithelial oedema, mid-dilated pupil; (3) presenting post-dilation IOP higher than 28 mmHg by Goldmann applanation tonometry; and (4) the presence of closed angles of more than two quadrants in the affected eye by gonioscopy [14].

If the patient had increased IOP ≥ 5 mmHg or post-dilation IOP > 25 mmHg, post-dilation IOP was measured again using Goldmann applanation tonometry by an ophthalmologist. Patients with post-dilation IOP > 28 mmHg by Goldmann applanation tonometry or symptoms of AAC were immediately given IOP-lowering drugs and referred to the glaucoma department for further treatment. While the other patients were asked to sit and rest or were given IOP-lowering drugs, and their post-IOP was measured one half-hour later. If the patients still presented with an increase in IOP ≥ 5 mmHg or post-dilation IOP > 25 mmHg, they were also referred to the glaucoma department. Moreover, we interviewed those with IOP rose ≥ 5 mmHg or post-dilation IOP > 25 mmHg about their eye condition by phone 2 h after leaving the hospital, and invited them to return for a gonioscopy examination within a week to determine whether they had closed angles. All participants were educated on the signs and symptoms of AAC before leaving the hospital, and were provided with contact telephone numbers and access to emergency medical care in case they were needed.

Systemic measurements

Non-fasting venous blood samples were collected for analysis of glycosylated haemoglobin (HbA1c). Height and weight were automatically measured using a height-weight meter (HNH-318; OMRON). Body mass index (BMI) was calculated as weight (kilograms) divided by the square of height (meters). All participants received a detailed questionnaire survey of systemic and ocular diseases and current medications.

Statistical analysis

The proportion of AAC, increase in IOP ≥ 5 mmHg or/and post-dilation IOP > 25 mmHg in either eye was calculated. The difference in characteristics between post-dilation IOP > 25 mmHg or increase in IOP ≥ 5 mmHg and post-dilation IOP ≤ 25 mmHg and increase in IOP < 5 mmHg was evaluated by student's *t*-test and χ^2 test. Univariate and multivariate linear regression analysis was used to determine risk factors for change in IOP. A univariate model first fitted these parameters, and variables with P < 0.1 were included in the multivariate model. Logistic regression models were used to estimate the risk factors for the post-dilation increase in IOP ≥ 5 mmHg in either eye and those with P < 0.1 in the univariate model were included in the multivariate model. All statistical analyses were performed using Stata, version 15.0 (Stata Corporation, College Station, TX). Any P-value of less than 0.05 was considered to be statistically significant.

RESULTS

General characteristics of participants

Among the 2323 participants, 14 participants had a history of glaucoma, 4 refused pupil dilation, and 18 did not complete the examination program. Left 2287 participants who completed this study available for the final analysis, the average age was 64.4 ± 7.8 years, and there were 971 (42.5%) males. The duration of diabetes was 8.7 ± 6.9 years, and the average HbA1c was 7.0 ± 1.4%. The demographic and clinical characteristics are shown in Table 1. The average ACD before dilation was 2.44 ± 0.39 mm in the right eyes and 2.44 ± 0.39 mm in the left eyes (Fig. 1a, b).

Changes in IOP after pupil dilation

There was a significant increase in IOP after pupil dilation in both eyes (Fig. 1c, d). The mean pre-dilation IOP in the right eye was 16.1 ± 2.7 mmHg, and the mean post-dilation IOP was 16.5 ± 2.8 mmHg ($P < 0.001$, Fig. 1e). The mean pre-dilation and post-dilation IOP in the left eye were 16.5 ± 2.7 and 16.8 ± 2.8 mmHg, respectively ($P < 0.001$). However, 831 (36.3%) right eyes and 845 (36.9%) left eyes, post-dilation IOP decreased, with a mean reduction of 1.4 ± 1.8 and 1.4 ± 1.8 mmHg, respectively. The IOP between the participant's eyes was highly correlated (correlation coefficient (CC) = 0.863, $P < 0.001$ for pre-dilation IOP; CC = 0.835, $P < 0.001$ for post-dilation IOP).

There were 61 participants (2.7%) with increase in IOP ≥ 5 mmHg in either eye (Table 2), 25 participants (1.1%) had post-dilation IOP > 25 mmHg. Only 11 participants (0.5%) presented both an increase in IOP ≥ 5 mmHg and post-dilation IOP > 25 mmHg in either eye. Among the 75 patients (3.3%) with an increase in IOP ≥ 5 mmHg or post-dilation IOP > 25 mmHg in either eye, IOP decreased to normal after rest (63 patients) or with IOP-lowering drugs (11 patients) in 74 patients, and AAC occurred in one patient. Only three (six eyes) of the 74 participants were found to have narrow angles by gonioscopy in a review within a week.

Compared to participants with post-dilation IOP < 25 mmHg and increased IOP < 5 mmHg, those with post-dilation IOP > 25 mmHg or increased IOP ≥ 5 mmHg tended to have thicker CCT (554 ± 35 vs 546 ± 31 μm, $P = 0.042$), smaller pupil diameter (4.18 ± 0.86 vs 4.35 ± 0.72 mm, $P = 0.048$), and shallower ACD (2.30 ± 0.34 vs 2.45 ± 0.38 mm, $P < 0.001$). There were no significant differences between groups regarding age, sex, history of hypertension, HbA1c, duration of diabetes, BMI, BCVA, pre-dilation IOP, lens thickness, AL, and spherical refraction (Table 1).

Only one of the 2287 participants developed AAC after routine pupil dilation. The AAC case was 61-year-old. The pre-dilation IOP of the acute attack eye was 23.0 mmHg and the visual acuity was 20/25. The ACD and AL were 2.01 mm and 23.69 mm, respectively. Visual acuity decreased to 20/63 and the IOP was 32.7 mmHg one hour after pupil dilation. The gonioscopic examination showed one quadrant of occluded angle and 10:30–1:30 clocks of peripheral anterior synechia. The patient was immediately treated with IOP-lowering drugs (brimonidine tartrate 0.2%, pilocarpine nitrate 0.5% eye drops, and oral methazolamide 50 mg) and subsequently referred to the glaucoma department for further treatment. The patient was diagnosed with chronic angle-closure glaucoma and underwent phacoemulsification, intraocular lens implantation, and goniosynechialysis in the AAC eye one week later. Post-operative visual acuity was 20/20 and IOP was 17.0 mmHg.

Associated factors for changes in IOP after pupil dilation

In univariate linear regression analysis, lower pre-dilation IOP (β −0.183, SE 0.012; $P < 0.001$), smaller pupil diameter (β −0.126, SE 0.047; $P = 0.008$), shallower ACD (β −0.558, SE 0.090; $P < 0.001$),

Table 1. Demographics and clinical characteristics of the participants.

	All	Post-dilation IOP > 25 mmHg or increase in IOP ≥ 5 mmHg (n = 75)	Post-dilation IOP ≤ 25 mmHg and increase in IOP < 5 mmHg (n = 2212)	P
Age (years)	64.4 ± 7.8	63.0 ± 9.3	64.4 ± 7.7	0.121*
Sex (Male/Female)	971/1316	32/43	939/1273	0.970†
History of hypertension (%)	56.1	58.7	56.1	0.654†
HbA1c (%)	7.0 ± 1.4	7.0 ± 1.5	7.0 ± 1.4	0.710*
Duration of diabetes (years)	8.7 ± 6.9	9.1 ± 8.2	8.7 ± 6.8	0.581*
BMI (kg/m^2)	24.6 ± 3.3	24.6 ± 3.7	24.6 ± 3.3	0.925*
BCVA (logMAR)	0.23 ± 0.20	0.20 ± 0.16	0.23 ± 0.20	0.277*
Pre-dilation IOP (mm Hg)	16.31 ± 2.62	16.71 ± 4.53	16.29 ± 2.53	0.914*
Mean CCT (μm)	546 ± 32	554 ± 35	546 ± 31	0.042*
Mean pupil diameter (mm)	4.34 ± 0.73	4.18 ± 0.86	4.35 ± 0.72	0.048*
Mean ACD (mm)	2.44 ± 0.38	2.30 ± 0.34	2.45 ± 0.38	< 0.001*
Mean lens thickness (mm)	4.71 ± 0.35	4.73 ± 0.38	4.71 ± 0.35	0.507*
Mean axial length (mm)	23.6 ± 1.18	23.4 ± 1.13	23.6 ± 1.18	0.174*
Mean spherical refraction (D)	0.66 ± 2.53	0.79 ± 3.00	0.65 ± 2.52	0.640*

BMI Body mass index, *IOP* Intraocular pressure, *CCT* Central corneal thickness, *ACD* Anterior chamber depth.
*Student's t-test.
†χ^2 test.

thicker lens (β 0.344, SE 0.097; $P < 0.001$), shorter AL (β −0.077, SE 0.029; $P = 0.008$), and older age (β 0.011, SE 0.004; $P = 0.013$) were significant risk factors for increasing IOP after pupil dilation (Table 3). Lower pre-dilation IOP (β −0.191, SE 0.013; $P < 0.001$) and shallower ACD (β −0.686, SE 0.123; $P < 0.001$) remained significant risk factors for the increase of IOP after pupil dilation after adjusting for confounders. In univariate logistic regression analysis, lower pre-dilation IOP (OR = 0.822; 95% CI 0.740–0.913; $P < 0.001$), smaller pupil diameter (OR = 0.730; 95% CI 0.507–1.052; $P = 0.092$), shallower ACD (OR = 0.231; 95% CI 0.104–0.510; $P < 0.001$), and shorter AL (OR = 0.723; 95% CI 0.552–0.946; $P < 0.018$) were significant risk factors for post-dilation IOP increase of ≥ 5 mmHg (Table 4). However, in multivariate logistic regression analysis, lower pre-dilation IOP (OR = 0.827; 95% CI, 0.742–0.922; $P = 0.001$) and shallower ACD (OR = 0.226; 95% CI, 0.088–0.585; $P = 0.001$) both had statistical significance.

DISCUSSION

As the country with the largest number of diabetic patients worldwide, China has a 22.4% prevalence of DR in diabetic patients [15, 16]. Dilated-pupil fundus screening is an effective method to detect DR. Although some studies have reported a low risk of AAC after dilated pupils in the population [10–12], few studies assessed the risk of post-dilation AAC in Chinese diabetic patients. This current study shows that only one of 2287 (0.04%) diabetic participants developed AAC after routine pupil dilation. Our study also indicated that the number of participants with increased IOP ≥ 5 mmHg or post-dilation > 25 mmHg was low, only 3.3% participants. Moreover, we found that lower pre-dilation IOP and shallower ACD are risk factors that significantly increase IOP post-dilation.

Routine dilated-pupil fundus examinations can effectively detect DR and provide early intervention, reducing the risk of visual impairment and the socio-economic burden [17]. The American Academy of Ophthalmology recommends that patients with type 2 diabetes should have screening for DR immediately after diagnosis and at least once a year thereafter [18]. Our results showed a low risk of AAC in diabetic patients with dilated pupils, which is similar to the results of previous studies. For example, a retrospective study from Northern Ireland showed that only three patients (0.03%) developed AAC after pupil dilation in 95,265 diabetic patients [19]; another prospective observational study found 1,910 diabetic patients with dilated pupils in Singapore did not develop AAC [13]. The case of AAC in the current study was later diagnosed as chronic angle-closure glaucoma, mydriasis triggering an AAC attack. These studies all confirm that the risk of AAC in diabetic patients with dilated pupils is small.

Previous studies have shown that the risk of a significant increase in IOP with dilated pupils is low. For example, a prospective observational study of diabetes in Asians showed that 3.6% of subjects had an increase in IOP ≥ 5 mmHg after pupil dilation [13]. Our study confirmed that the clinical risk of significant increases of IOP after pupil dilation in Chinese diabetic patients was small; only 2.7% of participants had an increase in IOP of ≥ 5 mmHg. However, Hancox et al. reported 5% of subjects with an increase in IOP ≥ 5 mmHg in the right eye after dilatation in patients with a history of glaucoma [5]. This may be due to trabecular mesh dysfunction resulting in a reduced outflow of aqueous humour. Lavanya et al. reported an increase in IOP ≥ 5 mmHg in 4.76% of subjects with dilated pupils in Asian subjects with narrow angles [14]. It may be that narrow angles more likely to result in pupil block.

We evaluated the effect of mydriatic drugs on IOP changes and the results showed that the mean post-dilations IOP was significantly higher than pre-dilation. The exact mechanism of the increase of IOP after pupil dilation is unclear. Several theories have been put forward. First, ciliary muscle paralysis leads to a reduction in the traction of the trabecular network, and then the outflow of aqueous humour is reduced [20, 21]. Second, mydriatic drugs can lead to relative pupil block, prevent the flow of aqueous humour into the anterior chamber, cause bulging of the peripheral iris, and increase iridotrabecular contact, eventually leading to elevated IOP and even AAC [22]. However, our results also show that 36.3% right eyes and 36.9% left eyes decreased IOP after pupil dilation. Tan et al. speculated that mydriatic drugs might affect ciliary body tension and promote uveoscleral aqueous outflow, causing mild IOP decrease

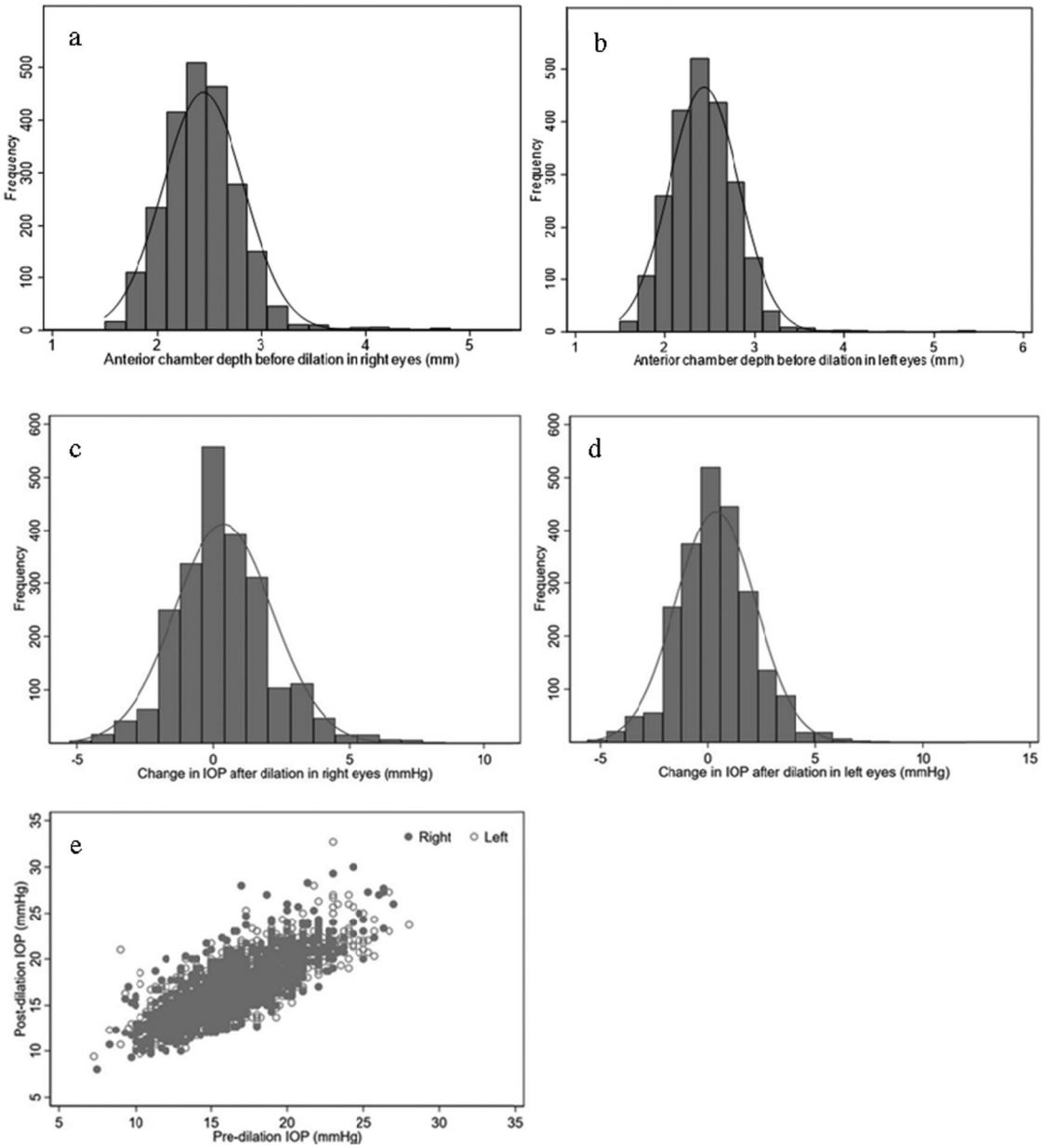

Fig. 1 Distribution of anterior chamber depth and intraocular pressure in both eyes. a, **b** Histogram of anterior chamber depth before dilation in the right and left eyes. **c**, **d** Histogram of change in IOP after pupil dilation in the right and left eyes. **e** Scatterplot of mean IOP before and after pupil dilation in both eyes (Fig. 1e).

Table 2. Change in intraocular pressure after dilation and post-dilation IOP in participants ($n = 2287$).

	Post-dilation IOP		
	≤ 25 mmHg	**> 25 mmHg**	**Total**
Increase in IOP < 5 mmHg	2212 (96.7%)	14 (0.6%)	2226 (97.3%)
Increase in IOP ≥ 5 mmHg	50 (2.2%)	11 (0.5%)	61 (2.7%)
Total	2262 (98.9%)	25 (1.1%)	2287 (100%)

[13]. Further studies are needed to explore the mechanism of IOP changes caused by dilated pupils.

Our study found that pre-dilation IOP was sensitive in predicting the risk of post-dilation IOP and an increase in IOP ≥ 5 mmHg after pupil dilation. Ko et al. reported that eyes with higher baseline IOP had higher IOP after pupil dilatation [23]. Lavanya et al. reported that although higher pre-dilated IOP was a risk factor for post-dilated IOP, pre-dilated IOP was not a risk factor for IOP increase ≥ 5 mmHg after pupil dilation [14]. One reason patients with higher pre-dilation IOP have higher post-dilation IOP was that less IOP elevation is needed. This study showed that ACD was associated with post-dilation IOP, and participants with shallower ACD were more likely to have increased IOP. Shallower ACD also is a risk for an increase in IOP ≥ 5 mmHg. Zhao et al. also showed that ACD was negatively associated with post-dilation IOP [24]. However, Lavanya et al. reported that ACD was not associated with post-dilation IOP [14]. Further studies on the association between ACD and post-dilation IOP are needed. Although some studies have shown shorter AL in patients with AAC [25, 26], this study did not show shorter AL as a risk factor for post-dilated IOP changes. High-risk patients should have a gonioscopy or

Table 3. Linear regression analysis of risk factors for change in IOP after pupil dilation in all patients.

	Univariate		Multivariate	
Determinants	**Unstandardized Coefficients β (SE)**	***P***	**Unstandardized Coefficients β (SE)**	**P**
Age (years)	0.011 (0.004)	0.013	−0.005 (0.005)	0.277
Sex (Male/Female)	0.109 (0.069)	0.113	0.123 (0.068)	0.072
Mean pre-dilation IOP (mmHg)	−0.183 (0.012)	< 0.001	−0.191 (0.013)	< 0.001
Mean CCT (μm)	−0.001 (0.001)	0.219		
Mean pupil diameter (mm)	−0.126 (0.047)	0.008	−0.054 (0.047)	0.251
Mean ACD (mm)	−0.558 (0.090)	< 0.001	−0.686 (0.123)	< 0.001
Mean lens thickness (mm)	0.344 (0.097)	< 0.001	−0.111 (0.118)	0.348
Mean axial length (mm)	−0.077 (0.029)	0.008	0.045 (0.032)	0.157
HbA1c (%)	0.035 (0.024)	0.146		
Duration of diabetes (years)	0.007 (0.005)	0.167		
BMI (kg/m^2)	0.002 (0.010)	0.864		
History of hypertension	0.103 (0.069)	0.133		

SE Standard error, *IOP* Intraocular pressure, *CCT* Central corneal thickness, *ACD* Anterior chamber depth, *BMI* Body mass index.

Table 4. Logistic regression analysis of risk factors for post-dilation Increase in IOP ≥ 5 mmHg.

	Increase in IOP ≥ 5 mmHg after dilation			
Determinants	**Univariate analysis OR (95% CI)**	***P***	**Multivariate analysis OR (95% CI)**	***P***
Age (years)	1.001 (0.968–1.034)	0.964	0.976 (0.941–1.014)	0.210
Sex (Male/Female)	0.927 (0.556–1.54)	0.773	0.831 (0.479–1.442)	0.511
Mean pre-dilation IOP (mmHg)	0.822 (0.740–0.913)	< 0.001	0.827 (0.742–0.922)	0.001
Mean CCT (μm)	0.999 (0.990–1.007)	0.723		
Mean pupil diameter (mm)	0.730 (0.507–1.052)	0.092	0.855 (0.582–1.257)	0.426
Mean center ACD (mm)	0.231 (0.104–0.510)	< 0.001	0.226 (0.088–0.585)	0.002
Mean lens thickness (mm)	1.397 (0.680–2.871)	0.363		
Mean axial length (mm)	0.723 (0.552–0.946)	0.018	0.919 (0.680–1.243)	0.584
HbA1c (%)	0.959 (0.797–1.154)	0.655		
Duration of diabetes (years)	1.014 (0.978–1.051)	0.454		
BMI (kg/m^2)	0.999 (0.925–1.079)	0.982		
History of hypertension	1.300 (0.769–2.196)	0.328		

SE Standard error, *IOP* Intraocular pressure, *CCT* Central corneal thickness, *ACD* Anterior chamber depth, *BMI* Body mass index.

ultrasound biomicroscopy to assess the anterior chamber angle before dilating.

This study has several limitations. First, the occurrence of AAC may be underestimated in this study because some AAC cases may go unrecognized. Elderly Asians with asymptomatic occluded angles have been reported [27]. In addition, because the IOP was measured only at 1 h after pupil dilation, delayed-onset AAC may have occurred during the reversing phase of pupil dilation after leaving the hospital. However, we educated the participants about the symptoms of AAC and instructed them to immediately contact a doctor or investigator if AAC happened after they left the hospital. Besides, we have not encountered participants who were returned to the hospital due to AAC, nor have we received any participants' complaints. Second, patients with a history of glaucoma who were not included in this study may underestimate the cases because the history of glaucoma is considered a risk factor for post-dilation ≥ 25 mmHg [13]. Thirdly, this study only investigated the effect of one pupil-dilating medication on IOP, and further studies are needed to investigate IOP changes caused by different pupil-dilating medications. Finally, this study was conducted on diabetic patients in Guangzhou and may not be generalizable to other regions of China.

CONCLUSIONS

In conclusion, this study found that despite a significant increase in IOP after pupil dilation in Chinese patients with diabetes, the mean increase in IOP with dilation is marginal and the rate of AAC was scarce. Lower pre-dilation IOP and shallower ACD are significant risk factors for IOP increase after pupil dilation.

Summary

What was known before

- There have been some studies on changes in IOP and the risk of AAC after pupil dilation. However, few have focused on the risk of AAC after pupil dilation in diabetic patients, especially in China.

What this study adds

- The increase in mean IOP was small, and the risk of AAC was minimal after pupil dilation in diabetic patients in China.

DATA AVAILABILITY

Data are available upon reasonable request.

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AUTHOR CONTRIBUTIONS

Conception and design: WH, KX, WL, LW, and JH. Administrative support: WH. Provision of study materials or patients: WH. Collection and assembly of data: KX, WW. Manuscript writing: All authors. Final approval of manuscript: All authors.

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COMPETING INTERESTS

All authors declare no competing interests.

ADDITIONAL INFORMATION

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