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Cataract and Acute Glaucoma

Chao-Chien Hu, M.D. 胡朝乾

Cataract Surgery and Angle-Closure Glaucoma

胡朝乾

新光吳火獅紀念醫院眼科

Outlines of my lecture

- Two epidemiology studies
- The Intraocular Pressure Change After Cataract Surgery in non-glaucomatous eyes
- The Intraocular Pressure Change After Cataract Surgery in post-APAC eyes
- Discussion and conclusion

Epidemiology studies of Acute angle-closure glaucoma in Taiwan

A 7-Year Population Study of Primary Angle Closure Glaucoma Admissions and Climate in Taiwan

Chao-Chien Hu[1,2,3] Hemg-Chang Lin[1] and Chin-Shyan Chen[4]

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Ophthalmic Epidemiology 15:66-72, 2008

Purpose: Using data from seven years of hospital admissions in Taiwan, this study sets out to investigate meteorological factors associated with primary angle closure glaucoma (PACG). We investigated the relationship between PACG admissions and five different climate indices. *Method*: Hospital admissions data from the *Taiwan National Health Insurance Research Database* (1997 to 2003) provided monthly PACG admission rates (per 100,000 population). We categorized the 4,722 PACG cases by gender and age (including four subgroups: 40–49, 50–59, 60–69, and ≥ 70 years). After adjusting for the time-trend effect, the Auto-Regressive Integrated Moving Average regression method was performed to evaluate the effects of climatic and monthly factors on PACG admission rates. *Results*: The mean annual rate of PACG admissions across the entire study period was 9.48/100,000 and higher in females than males (11.28 vs. 7.80/100,000). The PACG admissions were significantly higher in March for male patients, and for the 60 to 69-year-old and > 69-year-old age groups ($p < 0.05$). After adjustment for seasonality, month, and time-trend, a significant association between relative humidity and monthly PACG admission rates was observed for the total data set, for males, and for the 60- to 69-year-old ($p < 0.05$) populations. No such relationship existed with temperature, rainfall, barometric pressure or hours of sunshine. *Conclusion*: This is the largest, nationwide, population-based study to investigate the dependence of PACG admission rates on meteorological conditions. PACG admission rates were significantly higher in March and with increased relative humidity. We recommend data be collected from other regions and from other ethnic groups to determine the general pattern worldwide.

A 7-Year Population Study of Primary Angle Closure Glaucoma Admissions and Climate in Taiwan

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Table 2. Demographics and angle-closure glaucoma in patients in Taiwan, 1997-2003 (n = 4587)

Variable	n (%)
Gender	
Male	1990 (42.1)
Female	2732 (57.9)
Age group (years)	
40-49	255 (5.0)
50-59	844 (17.9)
60-69	1751 (37.1)
≥ 70	1892 (40.1)

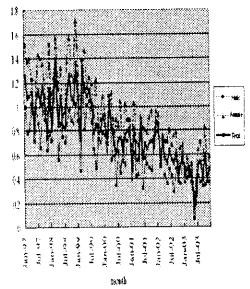

Figure 2. Monthly admission rates (per 100,000) of primary angle closure glaucoma in Taiwan by gender from 1997 to 2003

Admissions for APAC by year (Taiwan)

- 797 cases, 11.33/100,000 (1997)
- 850 cases, 11.66/100,000 (1998)
- 813 cases, 10.78/100,000 (1990)
- 663 cases, 8.51/100,000 (2000)
- 618 cases, 7.70/100,000 (2001)
- 562 cases, 6.80/100,000 (2002)
- 419 cases, 4.92/100,000 (2003)

- Versus : 10.4/100,000 per year in Hong Kong (APAC) (Lai et al. 2001)

為什麼急性青光眼住院逐年降低

- 經濟不景氣?
- 醫師:治療觀念改變?
- 健保環境改變?
- 健保資料不正確?
- 其他因素（白內障手術）?

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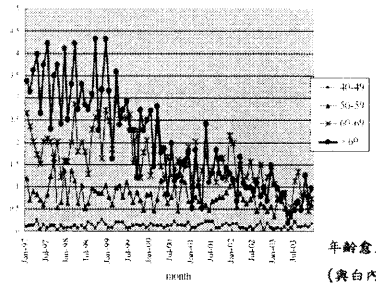

年齡愈大的族群減少最多
（與白內障手術年齡吻合）

Figure 1. Monthly admission rates (per 100,000) for primary angle closure glaucoma in Taiwan by age, from 1997 to 2003

白內障手術增加與急性青光眼住院減少之相關性

Reduction in admissions of patients with acute primary angle closure occurring in conjunction with a rise in cataract surgery in Taiwan

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[4]Department of Economics, National Taipei University, Taiwan

Acta Ophthalmol. 2008: 86: 440–445

To investigate

- the relation between cataract surgeries and acute primary angle closure (APAC) (acute angle-closure glaucoma) admissions
- among different **age** and **gender** groups in Taiwan from 1997 to 2004.

Table 1 Demographic characteristics of angle-closure glaucoma inpatients and cataract operations in Taiwan, 1997-2004

Variables	Angle-closure Glaucoma Total No.	%	Cataract Operations Total No.	%
Age Group (years)				
40-49	242	6.4	16,409	3.3
50-59	795	20.8	54,315	10.8
60-69	1,483	38.9	175,003	34.7
≥70	1,294	33.9	257,960	51.2
Gender				
Male	1,374	36.0	237,453	47.1
Female	2,440	64.0	266,234	52.9
Years				
1997	630	16.5	26,600	5.3
1998	643	16.9	54,152	10.8
1999	605	15.9	58,779	11.7
2000	481	12.6	68,536	13.6
2001	405	10.6	74,187	14.7
2002	392	10.3	75,158	14.9
2003	307	8.1	68,354	13.6
2004	351	9.2	77,924	15.5

Note: * Total sample number = 507,501

Table 2 Monthly mean values of cataract operations and angle-closure glaucoma in Taiwan, 1997-2004

Variables	Mean	Std. Dev.	Min	Max
Angle-closure glaucoma per 100,000 of the population (by age groups)				
40-49 years	0.0737	0.0539	0.0000	0.2449
50-59 years	0.4318	0.2447	0.1211	1.3036
60-69 years	1.0790	0.4002	0.2687	2.0841
>70 years	1.0899	0.5057	0.2747	2.4508
Angle-closure glaucoma per 100,000 of the population (by gender groups)				
Male	0.3514	0.1540	0.0448	0.7792
Female	0.6433	0.2697	0.2037	1.2664
Total	0.4951	0.1897	0.1238	0.9061
Cataract operations per 100,000 of the population (by age groups)				
40-49 years	4.8461	1.0496	1.5359	8.8706
50-59 years	27.2315	9.3498	7.4068	47.2336
60-69 years	125.8002	42.3628	33.1293	198.3859
>70 years	208.5283	57.4443	72.6519	305.4084
Cataract operations per 100,000 of the population (by gender groups)				
Male	58.9512	14.6792	20.8025	78.9868
Female	67.5998	20.0917	18.2086	96.2141
Total	63.1302	17.2670	19.5371	87.5316

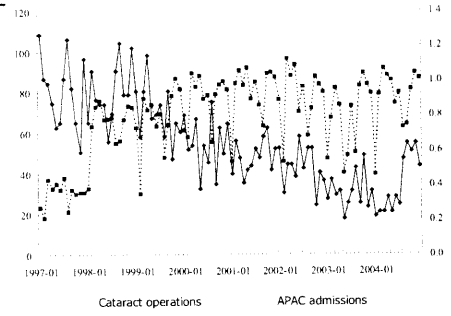
Note: * Total sample number = 507,501

Table 3. Spearman's rank correlation coefficients between monthly angle-closure glaucoma rates and cataract operation rates in Taiwan, 1997–2004.

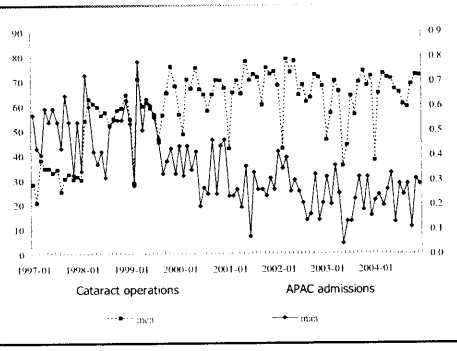
	Cataract Operations per 100,000 of the Population						
	(by age groups)				(by gender groups)		
	40-49 Years	50-59 Years	60-69 Years	≥70 Years	Male	Female	Total
PACG Admissions per 100,000 of the Population							
(by age groups)							
40-49 years	0.315***	0.264**	0.228*	0.063	0.123	0.103	0.105
50-59 years	0.520***	0.497***	0.389***	0.139	0.402***	0.396***	0.400***
60-69 years	0.421***	0.435***	0.417***	0.196	0.345***	0.344**	0.344**
≥70 years	0.522***	0.490***	0.473***	0.042	0.363***	0.339**	0.348**
PACG Admissions per 100,000 of the Population							
(by gender groups)							
Male	0.489***	0.499***	0.443***	0.012	0.336***	0.284**	0.297**
Female	0.578***	0.549***	0.546***	0.135	0.446***	0.414***	0.435***
Total	0.590***	0.558***	0.533***	0.084	0.419***	0.401***	0.407***

Notes:
* Total sample number = 505,271.
** indicates $p<0.01$, and *** indicates $p<0.001$.

Mean monthly cataract operation and APAC admission rate (**female**) 1997-2004



Mean monthly cataract operation and APAC admission rate (**male**) 1997-2004



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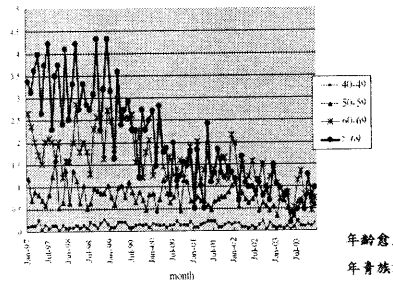

年齡愈大族群減少最多
年青族群未變

Figure 1. Monthly admission rates (per 100,000) for primary angle closure glaucoma in Taiwan by age, from 1997 to 2000

為什麼：白內障手術增加會降低老年患者急性青光眼住院率？

- PACG and cataracts are both age-related disorders
- the enlarged lens pushing the lens-iris diaphragm forward
- narrowing the angle
- creating the pupillary block
- further narrows the angle
- leading to angle closure attacks.

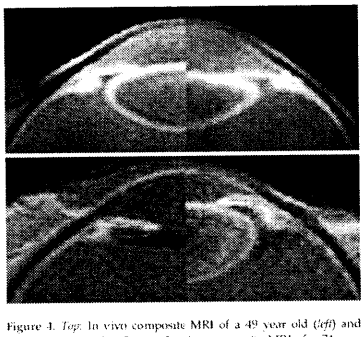

Figure 4. *Top:* In vivo composite MRI of a 49 year old (*left*) and a 25 year old (*right*). *Bottom:* In vivo composite MRI of a 74 year old (*right*) and the fellow eye (*left*) in which the crystalline lens was replaced with an artificial lens.

(Poley et al. JCRS 35: 1946-55, 2009)

Yang and Hung et al.

- anterior chamber depth in the PACG patients group
1. preoperative : 2.04 ± 0.29 mm
2. postoperative : 3.44 ± 0.16 mm.

- Scheimpflug image:
1. postoperative : the anterior chamber angle widened significantly
(superior, inferior, temporal and nasal quadrants)

- Decreased anti-glaucoma medication & controlled IOP well in patients with PACG after cataract surgery

Yang & Hung et al Intraocular lens position and anterior chamber angle changes after cataract extraction in eyes with primary angle-closure glaucoma. J Cataract Refract Surg 1997;23:1109-13

The Intraocular Pressure Change After Cataract Surgery in non-glaucomatous eyes

唐浚恩 胡朝乾

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Patients and Methods

- Retrospective, non-randomized consecutive interventional case series
- From January 2009 to May 2009
- **139 eyes /139 patients** of first eye
- Operation : Phaco + PC-IOL
- Follow-up at least 1 month
- Study design

1. **Study group :** first operated eye, 139 eyes
2. **Control group:** Fellow phakic eye , 139 eyes

Patients and Methods

- Exclusion criteria:
  - Glaucomatous eye
  - Complication cases such as vitreous loss
  - Combined other ocular surgeries

Patients and Methods

- **Pre-operative** assessment:
  - Auto-refraction
  - IOP (Air-puff tonometry)
  - Best-corrective visual acuity (BCVA)
  - K and digital biometric ruler (K and DBR)
- **Post-operative** assessment at 1 D, 1 W , 1 M
  - BCVA
  - IOP

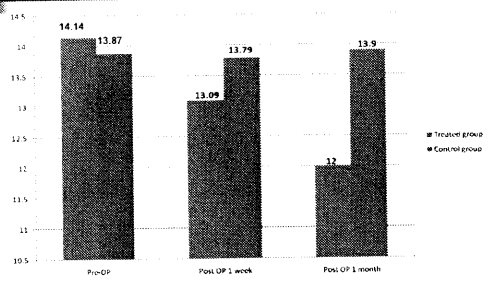
Patients and Methods

- Divided into **6 groups** according to **axial length (AL)**
  - Group 1 : AL < 22mm N= 9
  - Group 2 : 22.0mm≤ AL<22.5 mm N = 20
  - Group 3: 22.5mm ≤ AL<23.0 mm N = 21
  - Group 4 : 23.0mm ≤ AL<23.5mm N = 32
  - Group 5 : 23.5mm ≤ AL<24.0 mm N = 19
  - Group 6: AL ≥ 24mm N = 38

Demographic data

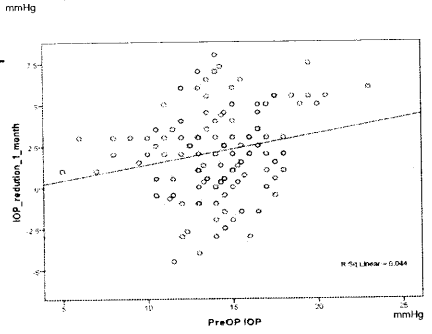
	Treated group	Control group	P value
Patient numbers	139		
Eye numbers	139		
Gender Male: Female	52:87		
Mean age± SD. years (range)	66.79 ±9.56 (39~88)		
AL ± SD, mm (range)	23.78 ± 1.84 (21.22~32.17)	23.72 ± 1.67 (21.22~30.15)	P = 0.78
Spherical equivalent (SE) ± SD, diopter (range)	-2.87 ± 6.23 (-24.75~7)	-1.43 ± 4.39 (-20.5~5.375)	P = 0.055
Pre-OP IOP ± SD, mmHg (range)	14.14 ± 2.84 (5 ~ 23)	13.87 ± 2.73 (5~20.5)	P = 0.43 [Student t test]

IOP change after operation



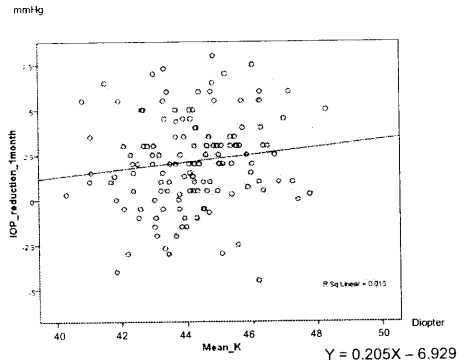
IOP (mmHg)

Relationship between IOP reduction & **pre-op IOP**



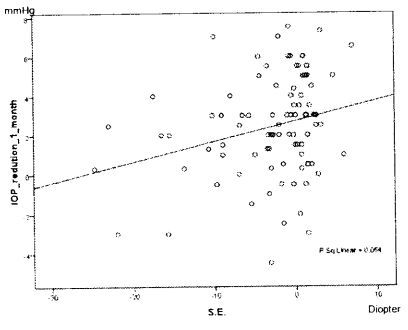
Y = 0.187 X – 0.507
R = 0.210 R^2 = 0.044
P = 0.013

Relationship between IOP reduction & **mean K**



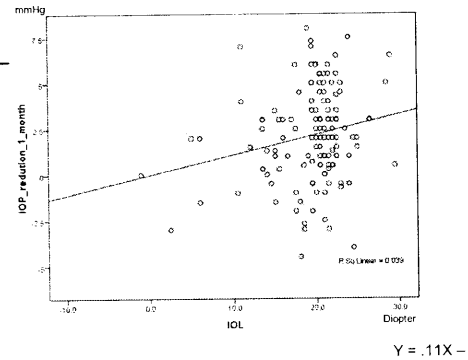
Y = 0.205X – 6.929
R = 0.123 R^2 = 0.015
P = 0.154

Relationship between IOP reduction & **sperical equivalent (SE)**



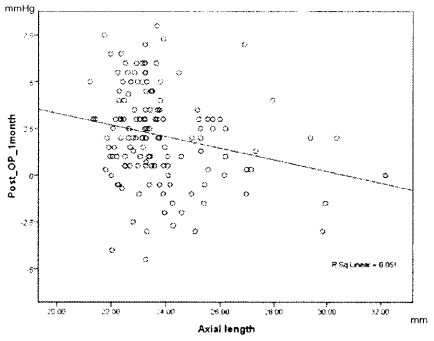
Y = .103X + 2.722
R = .253 R^2 = .064
P = .016

Relationship between IOP reduction & **IOL power**



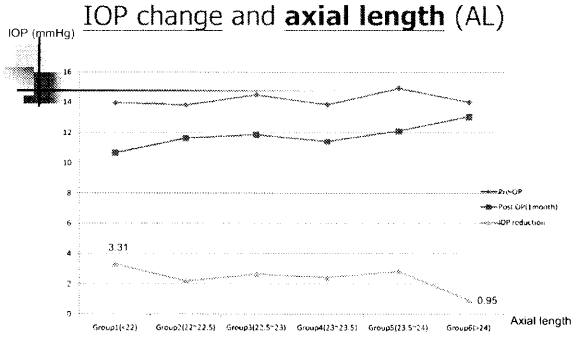
Y = .11X – 0.009
R = .198 R^2 = .039
P = .019

Relationship between IOP reduction & **AL**



Y = -.301X + 9.543
R = -.227 R^2 = 0.044
P = 0.007

IOP change and **axial length** (AL)



A significant **IOP drop** in **all groups** (All P<0.05) [Pair t test]

A significant **difference** in IOP reduction **between groups**. (P= 0.021)
[One way ANOVA]

IOP change in subgroups of AL

AL (I)	AL (J)	Mean difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
Group 6	Group 1	-2.356	.910	.011	-4.16	-.56
	Group 2	-1.235	.678	.071	-2.58	.11
	Group 3	-1.695	.668	.012	-3.02	-.37
	Group 4	-1.473	.589	.014	-2.64	-.31
	Group 5	-1.876	.690	.007	-3.24	-.51

[One way ANOVA]

Discussion

- IOP decreased only in eyes with glaucoma but did not change significantly in non-glaucoma participants
  Dimitrov et al Clin Experiment Ophthalmol 2001;29:128-132
- Mean IOP decreased significantly in PACG, POAG and non-glaucomatous eye *Hayashi et al* Ophthalmology 2000;107:698–703
- We demonstrate a mean 2.13 mmHg IOP reduction after cataract surgery in non-glaucomatous eye

Discussion

- Preoperative **anterior chamber depth** and **IOP** were found to be more strongly predictive for IOP reduction following cataract surgery
  S A Issa et al Br. J. Ophthalmol.2005;89;543-546
- We have shown other predictive factors:
  - Pre-operative axial length
  - Refractive status
  - IOL diopter according to K and DBR

Conclusion

- IOP reduced significantly with a **mean 2.13 mmHg** after cataract surgery in non-glaucoma patients
- Group 1 (**AL < 22mm**) : **3.31 mmHg**
- Group 6 (**AL≧ 24mm**) : **0.95mmHg**
- IOP reduced significantly in
  - **Higher** pre-op IOP
  - **Hyperopic** eyes
  - **Shorter** axial length
  - **More** IOL diopters
- IOP reduction is **unrelated** to keratometry

The Intraocular Pressure Change After Cataract Surgery in post-APAC eyes

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Patients and Methods

- Retrospective, non-randomized consecutive interventional case series
- From October 1994 to April 2010
- **16 eyes /16 patients** of first eye
- Operation : Phaco + PC-IOL
- Study design

1.Study group : First operated eye, 16 eyes

2.Control group: Fellow phakic eye , 16 eyes

Patients and Methods

- Exclusion criteria:
  - Prior ocular surgeries
  - Complication cases such as vitreous loss
  - Combined other ocular surgeries

Patients and Methods

- Pre-operative assessment:
  - Auto-refraction
  - IOP (Air-puff tonometry)
  - Best-corrective visual acuity (BCVA)
  - K and digital biometric ruler (K and DBR)
  - Numbers of IOP lowering drugs
- Post-operative assessment at 1 week, 1 month, 6 months, 1 year and final visit
  - BCVA
  - IOP
  - Numbers of IOP lowering drugs

Demographic data

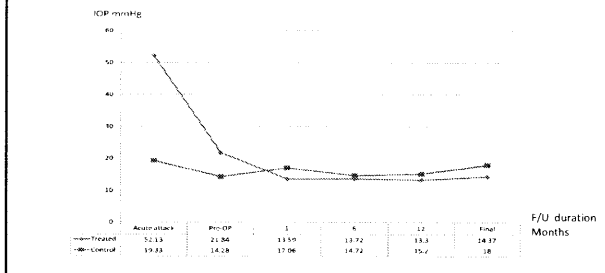
	Treated group	Control group
Patient numbers	16	
Eye numbers	16	
Gender Male: Female	2: 14	
Mean age ± SD, years (range)	73.81 ± 7.06 (59 ~ 86)	
Mean follow-up duration ± SD months, (range)	32.06 ± 31.8 (1~57.3)	

Preoperative status

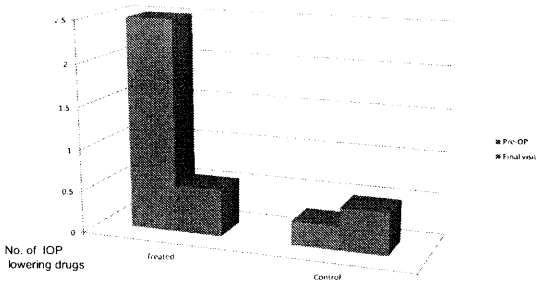
	Treated group	Control group	P value
IOP at attack ± SD, mmHg (range)	52.13 ± 14.93 (30~88)	19.33 ± 16.25 (8~68)	P<0.001
Pre-OP IOP ± SD, mmHg (range)	21.84 ± 12.2 (9 ~ 48)	14.28 ± 9.65 (4~48)	P = 0.03
Mean Pre-OP BCVA ± SD, logMAR (range)	0.28 ± 0.26 (0.09 ~ 2)	0.22 ± 0.23 (0~0.69)	P=0.003
AL ± SD, mm (range)	22.32 ± 0.82 (21.31 ~ 23.86)	22.42 ± 0.85 (21.33~23.9)	P = 0.37
Spherical equivalent (SE) ± SD, diopter (range)	0.69 ± 1.85 (-1.75~2.625)	1.15 ±1.16 (-1 ~2.875)	P = 0.23
Pre-OP No. of IOP lowering drugs (range)	2.5 ± 0.51 (2~3)	0.28 ± 0.46 (0~1)	P<0.001

[Student t test]

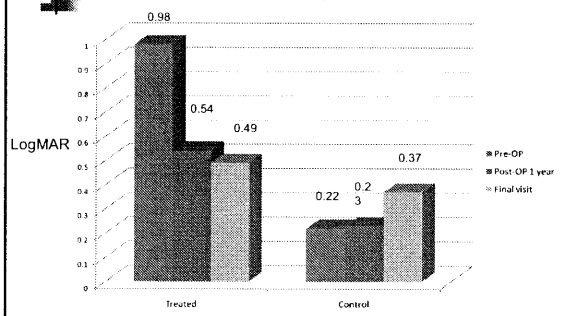
IOP change after operation



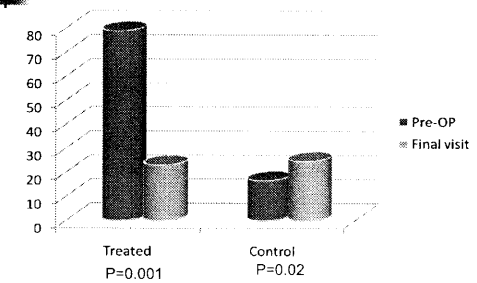
IOP lowering drugs



BCVA



IOP Control Index



IOP Control Index = (mean number of drugs + 1) x mean IOP

Discussion

The Intraocular Pressure Change After Cataract Surgery in eyes with Acute PAC

Study	Journal	Eyes	Preop IOP	Final IOP	Eyedrop	Additional surgery
McKibbin	JCRS 1996; 22: 633	9	26-80	9-17	nil	nil
Jacobi	Ophthalmology 2002;109:1597	43 PPI	40.5	17.8	0.18	11.5%
		32 Surg. PI	39.7	20.1	0.45	63%
Yoon	Korean J. ophtha. 2003; 17:122-6	10	Initial 50 Preop. 34.9	12.8	0.7	nil

The Intraocular Pressure Change After Cataract Surgery in eyes with chronic PACG

- Several studies have well documented cataract extraction and IOL implantation lowers IOP to some extent in eyes with chronic primary angle closure glaucoma (PACG)

Wishart et al. Eye 1989;3: 706
Yang & Hung JCRS 1997; 23:1109
Acton et al. JCRS 1997; 23:930
Gunning et al. 1998; 24: 1347

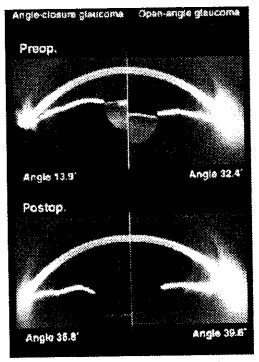
Teekhasaenee et al. Ophthalmology 1999; 106:669
Di Staso et al. Acta Ophthal. 2002; 17-18
Kubota et al. Ophthalmologica 2003; 217:325-8
Lai et al. J. Glaucoma 2006; 15:47
Tham et al. Ophthalmology 2009; 116:725-31
Vizzeri *et al.* Curr Opin Ophthalmol 2009

The Intraocular Pressure Change After Cataract Surgery in non-glaucoma eyes

- IOP decreased only in eyes with glaucoma but did not change significantly in non-glaucoma participants
  Dimitrov et al Clin Experiment Ophthalmol 2001;29:128-132
- Mean IOP decreased significantly in PACG, POAG and non-glaucomatous eye *Hayashi et al* Ophthalmology 2000;107:698–703
- We demonstrate a mean 2.13 mmHg IOP reduction after cataract surgery in non-glaucomatous eye

- Mean IOP decreased significantly in PACG, POAG and non-glaucomatous eye

Hayashi et al Ophthalmology 2000;107:698

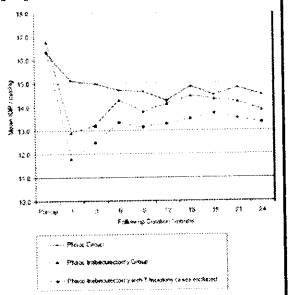


Phaco. alone versus combined phacotrabeculectomy (controlled CACG)

Prospective Randomized clinical trial

group	patients	Glaucoma drops	Hypotony
Phaco. alone	35		0
Combined phacotrabe. + MMC	37	0.8 fewer	7

Tham et al. Ophthalmology 2008; 115:2167

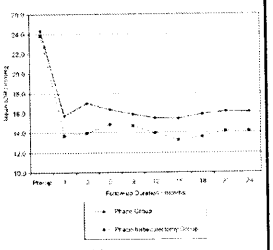


Phaco. alone versus combined phacotrabeculectomy (uncontrolled CACG)

Prospective Randomized clinical trial

group	Pt's	Glaucoma drops	Progression of optic Neuropathy
Phaco. alone	27		0
Combined phacotrabe. + MMC	24	1.25 fewer	16.7% Wipe-out: 2 cases

Tham et al. Ophthalmology 2009; 116:725



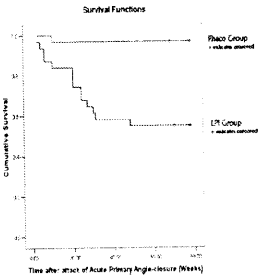
Phaco. alone versus. laser PI (to prevent IOP rise after APAC)

Prospective randomized

Controlled trial

group	Pt's	Glaucoma drops	Mean IOP
Early Phaco. alone	31	0.03	12.6
LPI	31	0.90	15.0

Lam et al. Ophthalmology 2008; 115: 1134



IOP rise after LPI

Table 4 Reported Prevalence of Intraocular Pressure (IOP) Rise after Acute Primary Angle Closure (APAC) in the Literature

Study	Treatment	Prevalence of IOP Rise at Different Follow-up Time Points		
		≤6 mo	≥12 and < 18 mo	≥18 mo
Aung et al [2003][14]	Medications + LPI	44.5% (6 mo)	49.2% (12 mo)	58.1% (30 mo)
Lai et al [2002][15]	ALPI + LPI	27.3% (6 mo)	30.0% (12 mo)	30.0% (33 mo)
Lai et al [2004][16]	Medications + LPI	34.3% (4 mo)	41.3% (12 mo)	NA
Lai et al [2006][17]	ALPI + LPI	NA	19.5% (12 mo)	NA
Lai et al [2006][18]	Medications + LPI	NA	31.8% (18 mo)	NA
Present study (2007)	Medications + LPI	32.1% (6 mo)	45.2% (12 mo)	46.7% (18 mo)
Present study (2007)	Medications + early phacoemulsification	3.2% (6 mo)	3.2% (12 mo)	3.3% (18 mo)

ALPI = argon laser peripheral iridoplasty; LPI = laser peripheral iridotomy; NA = not available.

Visual acuity after APAC

Table 1 Demographic characteristics and presenting clinical features of patients with acute primary angle closure in this study

Age (years)	
Mean	63.6 (SD 9.6)
Range	42–89
Sex	
Male	28 (20.7%)
Female	107 (79.3%)
Race	
Chinese	129 (95.6%)
Malay	4 (3.0%)
Indian	2 (1.5%)
Laterality	
Right	65 (48.1%)
Left	70 (51.9%)
Presenting IOP (mm Hg)	58.6 (12.8 [range 6–80]
Duration of symptoms (days)	2.8 (SD 3.2) (range 1 hour–21 days)

Table 2 Best corrected visual acuity in affected eyes of individuals with acute primary angle closure after resolution of the acute event

Visual acuity	No	%
≥6/7.5	37	27.4
6/9–6/12	31	23.0
6/15–6/24	34	25.2
6/30–6/48	8	5.9
<6/60	25	18.5

Assessed 1.7 (2.7) days after APAC

Tan et al. BJO 2006; 90: 14

What's the VA criteria for cataract surgery ?

- VA < 6/9 ?

Randomized Trial of Early Phacoemulsification versus Peripheral Iridotomy to Prevent Intraocular Pressure Rise after Acute Primary Angle Closure

- VA < 6/15 ?

Visual acuity after acute primary angle closure and considerations for primary lens extraction

Should eyes with better VA & clearer lens considered for phaco?

- **Benefits :**
  1. Eliminate pupil block
  2. Widening of the angle
  3. Decrease need for long-term IOP lowering drops
- **Drawbacks :**
  1. Loss of accomodation
  2. Risk of surgery: endophthalmitis, hemorrhage etc.

Thanks for your attention!