

## COMMUNICATIONS

### ACUTE ANGLE-CLOSURE GLAUCOMA\*† THE SECOND EYE: AN ANALYSIS OF 200 CASES

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DURING 1961, under Research Project No. 14 of the Ophthalmic Research Institute of Australia and Research Project No. 13 of The Royal Victorian Eye and Ear Hospital, 240 cases of angle-closure glaucoma were documented. Cases were drawn from the 1950 to 1961 cross-indexed history files of the hospital, to which were added a few cases seen in private practice during that time. The hospital patients included public and intermediate (semi-private) classes. New cases presenting during 1961 were personally examined and old patients were requested to attend for a research interview and tests. Many could not be traced or were deceased, but usually their case records, although very incomplete, contained information that could be used in some of the analyses. Some patients attended the hospital during this time only because of the involvement of the second eye, and the first eye might have suffered an acute attack many years previously, so that in such cases the time period extends over more than 10 years.

Cases of angle-closure glaucoma were selected according to the criteria defined by the participants of the C.I.O.M.S. Symposium on Glaucoma (Duke-Elder, 1955) and of the first Macy Congress on Glaucoma (Newell, 1956), and those previously proposed by Barkan (1938), Sugar (1941), and Chandler (1952) under the title of "narrow-angle glaucoma". Other types of acute glaucoma were excluded, but the decisions for some exclusions became very difficult. There is no doubt that the various forms of glaucoma do not always occur as distinct entities.

This paper presents an analysis of 200 "second eyes" of patients who developed an attack of acute angle-closure glaucoma in the "first or other eye". Table I (overleaf) shows that 23 (just over 10 per cent.) had bilateral onset or at least had both eyes involved by the time they presented to hospital. In another series of 200 cases, Bain (1957) recorded seventeen cases with bilateral onset. Of the remaining 177 cases in the present series, 64 received prophylactic surgery and 113 were treated conservatively.

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TABLE I

ACUTE ANGLE-CLOSURE GLAUCOMA IN THE SECOND EYE IN 200 CASES

Onset Bilateral		23
Prophylactic Surgery		64
Conservative Treatment	Developed acute attack	58
	No recorded acute attack	55
Total		200

### Prophylactic Pilocarpine

Conservative treatment varied greatly and tended to change with the years. It was especially influenced by the changing views of the treatment of chronic simple glaucoma. In times when the diagnosis of primary glaucoma was made upon tensions and cupped discs, the treatment was surgical. Following acute glaucoma in one eye the second eye was frequently not treated until subacute symptoms or an acute attack occurred. Sometimes pilocarpine drops 0.5 per cent. were ordered once or twice daily.

With the development of conservatism towards, and the use of stronger and more frequent miotics for, chronic simple glaucoma, some ophthalmologists, who continued to regard primary glaucoma as a single disease, tended to use stronger pilocarpine more frequently as a prophylactic measure in angle-closure glaucoma. The variations in the strengths of pilocarpine used and the varying frequency of application in the present series were too great to allow any decision on the most effective regime.

That pilocarpine appeared to help was illustrated by two patients who developed acute glaucoma shortly after they unintentionally stopped the regular use of their drops—in one case because the supply was exhausted and in the other because the patient's husband (who instilled the drops) became ill. On the other hand, another patient outside this series developed acute glaucoma for the first time just after commencing to use pilocarpine 4 per cent. (presumably through pupil block as the iris hugged the forward lens).

### Results of Conservative Treatment

While receiving various forms of conservative treatment, 58 of the 113 patients (50 per cent.) developed an attack of acute angle-closure in the second eye, while 55 (approximately an equal number) have, so far, no recorded acute attack in the second eye. Of the 58 who developed acute attacks, the various broad groups of conservative treatment are shown in Table II (opposite).

The two patients shown as receiving only Diamox had acute attacks while in hospital. The Diamox was being administered for an acute attack in the first eye and the ordering of miotics for the second eye had apparently been

TABLE II

CONSERVATIVE "TREATMENT" OF CASES IN WHICH ACUTE GLAUCOMA DEVELOPED IN SECOND EYE

None	26
Pilocarpine	25
Pilocarpine unintentionally discontinued	2
Diamox (pilocarpine probably overlooked)	2
Unknown	3
Total	58

overlooked. Under similar circumstances another patient developed an acute attack despite the administration of Diamox and pilocarpine.

A number of patients came for regular observation for 2 or 3 years and then discontinued attending, only to report back from one to several years later with the second eye involved.

A rational miotic regime does not seem to have been established. As miotics distress so many people, should only weak strengths be used in the hope that they will keep the angle open, or should strong miotics be used to achieve this effect and the subjective complaints be ignored? In the present series, attacks of acute glaucoma broke through pilocarpine used in all strengths up to 4 per cent. administered up to four times daily. Many patients were considerably disturbed by the blurred vision produced by the pilocarpine and without informing their medical advisers they changed the frequency of instillation.

A previous analysis of the time of onset of acute glaucoma showed that the large majority began late in the evening or during the night (Lowe, 1961), so that a suitable trial regime might be 2 per cent. pilocarpine administered after the evening meal and again at bedtime. Eserine was usually unsuitable for prolonged use because of the development of sensitivity, and acute attacks were recorded despite its use. A patient, outside this series, developed acute angle-closure while regularly using demecarium bromide 0.5 per cent. drops night and morning.

#### Time Interval between Attacks in the First Eye and the Second Eye

Bain (1957) recorded that, of 85 patients who developed symptoms in the second eye, 67 developed them in the period "up to 5 years". The time intervals of the 58 cases in the present series are shown in Table III (overleaf); 34 per cent. developed an acute attack within the first year, but a larger group (40 per cent.) developed the acute attack between 5 and 10 years after that in the first eye, and one patient only after 25 years. (Bain had one case in which the interval was 32 years.) Those who developed an attack within 12 months had practically all been ordered miotics. As time passed miotics were likely to be stopped or at least to be used irregularly, and those for

TABLE III  
TIME INTERVAL BETWEEN FIRST AND SECOND EYE ATTACKS IN  
CASES RECEIVING CONSERVATIVE "TREATMENT"

Under 2 wks or in hospital	7	21
2 to 4 wks	3	
1 to 6 mths	3	
7 to 12 mths	8	
13 to 24 mths	3	9
2 to 5 yrs	6	
5 to 7½ yrs	13	23
7½ to 10 yrs	10	
10 to 15 yrs	3	5
15 to 20 yrs (20)	1	
Over 20 yrs (25)	1	
Total		58

whom some years had passed since the first acute attack were frequently not using miotics when they presented with the second eye involved.

Of the 55 patients who continued with conservative treatment, eleven have died or were old and ill when last seen, so that not every angle-closure subject develops an acute attack in the second eye. However, those deceased form only 10 per cent. of the group conservatively treated to date (Table IV).

TABLE IV  
FATE OF SECOND EYE IN 113 PATIENTS GIVEN CONSERVATIVE TREATMENT

Total No. of Cases					113
Developed Acute Angle-Closure Glaucoma					58
No Recorded Acute Attack	Stopped Attending (not traced)				12
	Gone Elsewhere				3
	Died or Probably Died				11
	Attending or Recalled (Years of Observation)	Under one 1 to 5	3 12	15	29
		5 to 7½ 7½ to 10	7 2	9	
10 to 15 15 to 20 (16) (19*) Over 20 (22†)		2 2 1	5		

\* Afraid to read.

† One acute attack 16 years ago ? cured.

Of the 29 still under observation, only half have passed the 5-year follow-up period and only five have been followed for 10 years. Some of these will

return with acute glaucoma. Three patients may escape acute attacks because they have small fixed pupils—one with posterior synechiae due to past iritis, one with a thin iris and fixed pupil after herpes ophthalmicus, and one with a small fixed pupil and iris atrophy following an attack of acute angle-closure glaucoma treated medically.

Many difficulties experienced by those treated conservatively cannot be recorded statistically, but they become very important in the care and treatment of patients. Many patients are greatly inconvenienced by relatively frequent visits to hospital, by blurred vision due to the use of miotics, and by the reduction in such activities as reading, sewing, or viewing television, which is voluntarily imposed to try to prevent another attack similar to that experienced in the first eye. When these people become elderly their ocular burdens are considerably increased by poor general health, lens sclerosis, or macular degeneration. The true state of the lens and retina is usually not assessed because of the unwillingness of many ophthalmologists to dilate the pupil for fear of precipitating an acute attack. Many of the elderly are incapable of instilling their own drops and it is surprising to learn how they may be dependent upon arthritic or frail husbands, or, if living alone, how they rely upon good neighbours.

Another approach to this problem is to select one particular year and to try to find out what happened to the patients presenting during that year. Table V shows the follow-up of patients who presented in 1950—the year the hospital's medical cross-index was started and 2 years before prophylactic surgery was begun. The examination records of patients seen 10 years ago seldom give the information one wishes to-day—but they can be helpful. Of ten cases suitable for consideration, eight developed acute glaucoma in the second eye and two had escaped during the years followed, but these two can no longer be traced. Table V shows the time intervals between attacks and again demonstrates the importance of the 5 to 10-year interval.

TABLE V  
FATE OF SECOND EYE IN 15 CASES FIRST PRESENTING IN 1950

Developed Acute Glaucoma (Time intervals: 2 wks, 1 mth, 6, 7½, 8, 8, 8, 8 yrs)	8*
No Attack in Second Eye (No. of years followed: 4, 8),	2†
Bilateral Presentation	2
First Eye Neglected (Reported years later only when second eye involved)	3
Total	15

\* Three had prophylactic pilocarpine.  
† Two had prophylactic pilocarpine.

### Prophylactic Surgery

64 patients were submitted to prophylactic surgery—mainly peripheral iridectomy (Table VI). When the second eye contains a cataract, intracapsular lens extraction with peripheral iridectomy is favoured. Full iridectomy is sometimes unavoidable because of a large iris prolapse occurring through a small scratch incision. Attempted iris reposition is unwise if it presents difficulty, but there now seems to be no indication for performing a purposeful “full basal glaucoma iridectomy”. Acute angle-closure glaucoma can occur in eyes with chronic simple glaucoma with appropriate narrow angles. In the present series, cases are recorded in which advanced chronic simple glaucoma was being treated with miotics and a sudden typical acute angle-closure attack occurred. A drainage operation which includes an iridectomy may then be appropriate upon the second eye.

TABLE VI  
PROPHYLACTIC SURGERY OF SECOND EYE

Peripheral Iridectomy	54
Iridencleisis	4
Cataract Extraction	3
Full Iridectomy	2
Trephine	1
Total	64

### Prophylactic Peripheral Iridectomy

The importance of the pupil-block and angle-block mechanisms in the causation of acute angle-closure glaucoma in predisposed eyes is now beyond serious dispute. That other important and unknown precipitating factors are involved is well recognized, but world authorities are now agreed that a small opening in the iris will almost always prevent angle-closure.

In the present series, 54 prophylactic peripheral iridectomies were performed according to the technique of Chandler (1952) or Barkan (1954). Table VII shows the few complications which occurred.

TABLE VII  
COMPLICATIONS IN 54 CASES OF PROPHYLACTIC PERIPHERAL IRIDECTOMY

Developed Acute Glaucoma	1
Operative Complications	1 “Several”
	Total Avulsion of Iris Posterior Synechia

Following prophylactic peripheral iridectomy one patient developed a devastating acute glaucoma. The first attack occurred 2 days post-operatively and was possibly caused by pupil dilatation with 10 per cent. “neo-synephrine”. The peripheral iridectomy contained an apron of posterior pigment epithelium that had been incompletely removed although a small

through-and-through hole was present. Possibly this small hole blocked when the iris bunched. The attack was controlled by Diamox and eserine, but severe iris and lens damage occurred. When the eye quietened the angle appeared open and a full iridectomy was performed. The operation appeared satisfactory but there was severe post-operative iris reaction leaving the iris stuck to the lens. The eye appeared to quieten again but in 2 months the tension rose and congestive symptoms appeared remorselessly. A trephine at 6 o'clock made conditions worse and the eye gradually degenerated, with raised tension and iritis, but it is at present phthisical. The patient's left eye, which suffered the original attack and had an iridencleisis, has only a little sight. In the second eye the angle was extremely narrow; it appeared that without surgery an acute attack was very likely, and that the results of such an attack would probably be very bad. In some way the prophylactic operation may have accelerated the bad outcome. Such cases are fortunately very rare, but occasionally iridectomy does not seem to provide all the answers to an apparently simple problem.

The operations recorded were performed by many surgeons of differing calibre from learning house-surgeons to senior clinicians. The only other remarkable complication was total iris avulsion that occurred to one astonished house-surgeon; in this case the elderly patient had numerous lens opacities and is well pleased with the result, the outflow studies being normal.

Posterior synechiae are very prone to occur and, if the pupil remains small, vision may be somewhat blurred. Kessler (1956) has described how the normal flow of aqueous periodically opens the physiological adhesion between the pupillary margin of the iris and the anterior surface of the lens. As the peripheral iridectomy short-circuits this mechanism, conditions become favourable for the formation of posterior synechiae. To prevent posterior synechiae the pupil should be dilated daily by 10 per cent. "neo-synephrine", enough drops being used until dilatation occurs. By the next day the effect will have worn off and the pupil will be small again. Daily dilatation should continue until the eye is quiet. Several patients developed extensive posterior synechiae before the above regime was established.

All surgery upon intra-ocular structures carries risk to sight, but attacks of acute glaucoma can also be very destructive. Table VIII (overleaf) analyses the loss of vision caused by acute attacks of glaucoma in the 58 of the 113 eyes which were treated conservatively and in the 64 eyes subjected to prophylactic surgery.

Eight patients suffered severe loss of vision due to acute glaucoma, whereas vision was lost in only one case following prophylactic surgery (and this loss was probably not entirely attributable to the surgery). The general reactions of acute glaucoma are incomparably greater than those which follow prophylactic surgery and the death of a patient following acute glaucoma is not surprising when the age incidence is considered (Lowe, 1961). But loss of vision, although the most important consideration, is not the only form of

TABLE VIII  
LOSS OF VISION IN THE SECOND EYE

With Acute Attack of Glaucoma	Died in hospital			1
	6/6 or better reduced to	6/18	3	8
		6/24 6/36 Hand movements	1 2 2	
After Prophylactic Peripheral Iridectomy	6/6 or better reduced to	No perception of light		1
Total				10

destruction which may follow acute glaucoma. Many of the involved second eyes showed considerable lens and iris damage. The optic nerves or retinae of such eyes tend to deteriorate after several years.

It is customary to warn patients receiving conservative treatment to report immediately if any eye trouble is noticed. Despite the patient's experience with the first eye, Table IX shows that in some cases a long time elapsed before treatment was received for the acute glaucoma in the second eye. Of those cases in which the duration of the attack was recorded, nearly half reported more than 24 hours after the onset and after some weeks or months.

TABLE IX  
TIME BEFORE ATTACK IN SECOND EYE REPORTED TO OPHTHALMOLOGIST

Duration of Attack	Number of Cases
Under 12 hrs	12
12 to 24 hrs	10
25 to 48 hrs	6
During 3 to 6 days	7
"A week"	0
During 8 to 14 days	2
During 3 to 4 wks	1
"A month"	1
During 5 to 8 wks	1
During 3 to 5 mths	1
Too vague or not recorded	17
Total	58

Acute glaucoma is prone to be precipitated by acute illness (Lowe, 1961). One patient developed an attack while being treated for congestive cardiac failure, and another during influenza. Sometimes country patients waited in the hope that the attack would subside hoping to avoid a long trip to Melbourne, but others obviously procrastinated in the hope of avoiding a return to hospital. Some of the attacks were not severe but it was disappointing to see patients delay when vision was reduced to the perception of hand movements and the first eye had already been severely damaged by acute glaucoma.



### Management of the Second Eye

It is the surgeon's duty to assess the risk and benefits of surgery against those of conservative treatment. In Australia patients do not wish a statistical evaluation nor an explanation of all the factors involved. They expect the surgeon to do what he advises for the best and very few refuse to accept clear recommendations.

The results of this analysis confirm that, although there are risks of prophylactic surgery following angle-closure glaucoma, the surgical risks are less than those of conservative treatment. Further, the long-term management of a patient who has had successful prophylactic surgery is incomparably more normal than that of one subjected to conservative treatment with miotics. Then the fear of future attacks is gone, there usually are no eye-drops to instil, repeat visits become less frequent, activities return to normal, and the eye can still be fully examined and accurately assessed whenever this becomes necessary.

Once the pupil-block angle-closure mechanism is known to be present and the second eye is known to be subject to this risk, the sooner prophylactic surgery can be arranged the safer the eye will be. This requires careful history-taking and full clinical examinations, but these can be performed while the first eye is being controlled. Patients with acute angle-closure glaucoma should be admitted urgently to hospital and should have surgery upon both eyes before they leave. If the eye with the acute attack takes some days to prepare for surgery, the uninvolved eye should have its prophylactic operation first. Not only does this save days in hospital, but it removes the risk of acute glaucoma developing in the second eye while the other eye is being treated. Details of treatment have been discussed elsewhere (Lowe, 1960). Malignant glaucoma did not occur in the present series, but its possibility is such that bilateral operations at the same operation session are not justified.

The particular prophylactic operation should be determined according to the conditions. It will usually be peripheral iridectomy. The surgery should be simple, painless, and quick, and the technique of Chandler (1952) is recommended. More complicated operations are unnecessary and encourage procrastination especially by the less-skilled surgeon. The patients are frequently elderly, frail, or very upset, but age should be no bar to the operation. General anaesthesia is indicated only for the most apprehensive middle-aged patients. Even retrobulbar anaesthesia and lid akinesia are unnecessary. Local anaesthetic drops of amethocaine, reinforced by a swab soaked in them and placed in the upper fornix, plus a tiny subconjunctival injection of lignocaine ("Xylocaine") without adrenalin placed at the site of operation render the surgery painless. Wound closure by  $6 \times 0$  chromic catgut makes suture removal unnecessary. Next day the eye-pad should be discontinued. The knowledge that vision is intact has a big effect on patient morale.

### Late Results of Peripheral Iridectomy

The late results of prophylactic peripheral iridectomy performed on the correct cases are usually excellent. Practically all eyes become normal. Some patients will be found to suffer from chronic simple glaucoma as well, and they then need treatment for that disease—usually control by miotics. A few develop filtering blebs over the sites of the incision—so far these have led to no harm and occasionally they have assisted the treatment of chronic simple glaucoma. At present an analysis is being attempted to determine the proportion of apparently uncomplicated cases that develop chronic simple glaucoma. The number is not high but the possibility must not be ignored.

It is admitted that these 200 patients are selected material. They are drawn mainly (but not entirely) from the lower income groups of European Australians attending one hospital, and from only one State (Victoria) of the Commonwealth of Australia. No completely valid conclusions can therefore be drawn for Australia as a whole or glaucoma in general. Yet it seems that any series must always be selective. From personal experience elsewhere, from discussions, and from the literature, this series seems to concur sufficiently well with those of other ophthalmologists. The treatment recommended is offered as the best treatment. Although circumstances may make it impossible, few cases are envisaged where it would not be desirable.

### Summary

This paper presents an analysis of 200 "second eyes" of patients who developed an attack of acute angle-closure glaucoma in the "first or other eye". The risks of conservative treatment, even with miotics, are so much greater than those of prophylactic surgery that an appropriate operation should be performed at the earliest opportunity.

This research could not have been conducted without the help of many people. I wish to thank my colleagues at The Royal Victorian Eye and Ear Hospital, and especially the other senior ophthalmic surgeons, for their cooperation, and for access to their patients and to their records. Dr. Magda Horvat has assisted with the examinations and performed the tonography tests. The nursing staff, the medical records staff, and the medical librarian all gave invaluable assistance.

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