

## PRIMARY CREEPING ANGLE-CLOSURE GLAUCOMA\*

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IN some eyes with shallow anterior chambers and narrow angles, an insidious and usually symptomless angle-closure occurs until the unsuspecting patient suddenly becomes aware of reduced vision. So stealthy is the theft of vision that blindness may occur in one eye before the patient realizes that anything is wrong. The disease may closely resemble chronic simple glaucoma with narrow angles but the outflow impairment is different.

Hidden from gonioscopic view by the iris bombé, the root of the iris slowly creeps, or is pushed, into the depths of the narrow angle until it gradually smothers the outflow channels and causes shortening of the angle of the anterior chamber as depicted by Gorin (1960). Creeping angle-closure glaucoma is therefore one cause of primary chronic angle-closure glaucoma. (A chronic closure of the angle can occur for different reasons under different conditions and a careful differential diagnosis is required for correct clinical management, especially of the fellow eye).

### Incidence

At the Glaucoma Unit of The Royal Victorian Eye and Ear Hospital, Melbourne, 250 patients with some form of primary angle-closure glaucoma were examined by the writer. Seventeen (7 per cent.) had creeping angle-closure glaucoma; eleven were females with an age range of 42 to 75 years (average 60) and six were males with an age range of 40 to 70 years (average 56.5). Eleven were born in Australia and one each in Latvia, Poland, Czechoslovakia, Russia, Greece, and France.

### Symptoms

Symptoms vary considerably. The most common complaint is blurred vision. Episodes of blurred vision comparable with attacks of subacute angle-closure glaucoma (Lowe, 1961) may be observed but tend to be ignored by the patient. They may occur at any time of the day or night but have a characteristic sameness for the particular patient. If they occur on waking, they usually clear after an hour or two and then probably represent high peaks of diurnal pressure variations on a raised base pressure. Some attacks occur at night and may then be true attacks of subacute angle-closure glaucoma occurring concomitantly with the creeping angle-closure.

In the early stages, the attacks seldom last beyond one day and their spontaneous recovery is the cause of procrastination. Later, a deterioration of vision (apart from the attacks) becomes obvious so that the patient reports perhaps 12 to 24 months after the commencement of symptoms. Equally frequently, the initial blurred vision is not observed at all, so that when the patient begins to suspect an eye disorder and one eye is covered the more affected eye is found to have extremely little residual vision.

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Pain sufficient to cause distress will occur eventually but it is uncommon as a warning symptom. Two women complained of severe pain that woke them during the night—in this respect the pain resembled that of acute angle-closure glaucoma except for the brevity of each episode and the long course of the attacks.

Only two patients noticed haloes over any length of time (12 months). When early attacks of blurred vision occurred during the day, haloes were not seen. Occasional haloes were reported in the late stage of high base pressure.

Recurrent nausea was experienced by two patients; for one woman it accompanied the head pain that occurred during the night.

### Examination

By the time of presentation, all patients had at least one obviously glaucomatous optic disc and undoubtedly raised intra-ocular pressure in at least one eye. (No ophthalmologist missed a diagnosis of "glaucoma"). All eyes were free from congestion and corneal oedema was minimal even though the tension was high.

Anterior chambers were consistently shallow. When measured with the Jaeger apparatus on the Zeiss Opton slit lamp, the anterior chamber depth range was from 1.5 to 2.6 mm. (axial depth from corneal endothelium to anterior lens surface). Irides were taut and the forward ballooning could be appreciated with the slit lamp, especially in the periphery where iris almost touched cornea.

Gonioscopy is essential for diagnosis, especially to differentiate creeping angle-closure glaucoma from chronic simple glaucoma with narrow angles. If the tension is raised and the angle can be seen to be free of peripheral anterior synechiae throughout its full depth, then the diagnosis is chronic simple glaucoma. Unfortunately, when the iris is so ballooned that the depths of the angle cannot be seen, a definite differentiation cannot be made by gonioscopy.

Field defects are almost invariably present in the more involved eye, but the companion eye may have escaped damage.

Glaucoma Unit special tests are seldom necessary. Tonography helps in assessing the less involved eye. Any of the provocative tests is likely to be positive because these eyes behave as though they had mixed glaucoma. Four of the companion eyes were submitted to diurnal phasing while the patients were in hospital following surgery upon the more involved eye. After four or five tonometer applications the intra-ocular pressure rose from near normal to 42, 51, 51, and 80 mm. Hg respectively, to indicate the poor tension control characteristic of these narrow angle eyes.

### Management

Eyes with shallow anterior chambers and ballooned irides causing narrow angles have an episodic pupil block that makes medical control so unreliable that it is usually contraindicated.

Miotics, by drawing the iris away from the angle, may prevent angle-closure but by tightening the iris across the lens they increase the tendency to pupil-block. Weak miotics may produce the desired effect upon the tension and outflow, but strong miotics have a greatly increased risk of pupil-block that may precipitate an acute and destructive angle-closure attack. The prolonged administration of carbonic anhydrase inhibitors to reduce ocular tension is undesirable, because in narrow

angle eyes they appear to permit tension fluctuations that increase peripheral anterior synechiae.

Medical treatment therefore encourages a difficult condition to become worse—peripheral anterior synechiae increase, the base pressure gradually rises, episodic rises are added, and finally surgery becomes obligatory. The high base pressure and the shallow anterior chamber increase the risk of malignant glaucoma from the drainage operation that, by then, becomes essential. This unfortunate outcome occurred in one eye, which was later enucleated, and the fellow eye is causing much worry to both patient and ophthalmologist.

By the time the patient presents, the more involved eye usually needs a drainage operation and an iridectomy to break the pupil-block. In eyes in which sight is lost, these operations are probably not justified.

The fellow eye is frequently the cause of much anxiety, especially if the other eye has no useful vision. Provided tension and outflow are normal or can be controlled with miotics, a peripheral iridectomy with firm scleral suture is the safest procedure. Breaking the pupil-block removes the threat of an attack of acute angle-closure glaucoma, permits iris relaxation and proper evaluation by gonioscopy, almost certainly halts the progressive creep of the iris into the angle, and stops the quiet smothering of the trabeculae.

After peripheral iridectomy, continued medical treatment may be necessary to control tension, improve outflow, or reduce secretion, but the eye will be in a much better condition to allow these measures to be pushed, if necessary. If a peripheral iridectomy and medical control remain inadequate, a drainage operation may be necessary, or cyclodiathermy may be tried if the threat of malignant glaucoma appears to be too great a risk.

#### Illustrative Case Reports

**Case 1, a man aged 75 years, Australian born,** complained in August 1955 of attacks of blurred vision on waking and lasting one hour; there was no pain and no haloes.

*Examination.*—Visual acuity 6/9 in each eye; anterior segments no congestion; anterior chambers moderately shallow; lenses no exfoliation or flakes; optic discs: right—glaucomatous cup, left—normal; visual fields: right eye—10/2,000 white 7°, left eye—2/2,000 white 15° with bared blind spot; gonioscopy: right no angle details seen and appeared closed, left angle—very narrow, no details seen but probably open; ocular tension (7.5 g. wt corrected to 1955 scale): right—46 and left 17 mm. Hg (Schiötz).

*Treatment.*—In August, 1958, a right iridencleisis was performed. Surgery and convalescence were uneventful.

Five days after this operation on the right eye, a 2-hrly phasing of the left intra-ocular pressure was undertaken with the following results:

Time	4 p.m.	6 p.m.	8 p.m.	10 p.m.	12 M.N.	4 a.m.	6 a.m.	10 a.m.	12 Noon	2 p.m.
Tension (mm. Hg Schiötz)	15	17	15	15	15	15	17	51*	17	15

\* Eserine 0.5 per cent. eye drops instilled.

The following day, a peripheral iridectomy with scleral suture was performed upon his left eye.

*Result.*—The patient has remained without symptoms or treatment, and a review in 1963 showed the following.—Visual acuity: right 2/60, left 6/6; visual fields: right—only large targets seen around fixation, left—2/2,000 white, 15° with blind spot bared; electronic tonography:  $Po=15$ , 15;  $C=0.25$ , 0.30;  $Po/C=60$ , 75 (right and left eyes respectively); anterior chamber depths (Jaeger apparatus): right 2.6 mm., left 2.1 mm.; gonioscopy: right eye—iris occludes depths of angle all around, left eye—iris relaxed, angle remains very narrow but clean and open; provocative tests left eye: water-drinking tonography—negative, 2-hrly phasing from 9 a.m. to 5 p.m. no rise of tension.

*Summary.*—Primary creeping angle-closure glaucoma in the right eye. The left eye had a narrow angle and unstable tension but was rendered safe by peripheral iridectomy. Follow-up 5 years.

**Case 2, a married woman aged 46 years, Polish born, first attended during April, 1961, and stated that for several weeks she had had headaches in the evenings: she saw haloes only once and had noticed no change in her vision until a few days previously when watching television and she thought her sight was blurred. She then covered each eye alternately and found that her right eye was blind.**

*Examination.*—Visual acuity: right eye—no perception of light, left eye—6/4; right eye white but with moderate corneal oedema, left eye clear; anterior chambers both very shallow; optic discs: right grossly cupped, left normal; visual field: left normal to 2/2,000 white; gonioscopy: right angle not seen, left iris ballooned, angle very narrow, angle depths not seen superiorly but iris pushing into the depths of the angle inferiorly; applanation tonometry: right  $>80$ , left 40; left electronic tonography  $C=0.09$ ,  $Po/C=455$ .

*Treatment.*—Eye drops of eserine 0.25 per cent. were instilled into the left eye and tonography after 90 minutes showed the following improvements—applanation tension 20,  $C=0.17$ ,  $Po/C=123$ . After 2 days' Diamox administration the right cornea cleared sufficiently to permit gonioscopy and the angle was seen to be closed firmly all around and dusted with pigment inferiorly.

A peripheral iridectomy with scleral suture was performed upon the left eye (Chandler technique) and miotics were discontinued. Five days later she noticed blurred left vision and the applanation tension was 36. After the application of 4 per cent. pilocarpine eye drops the tension fell to 18 mm. Hg, and gonioscopy showed the left angle open for 2 hours of arc on each side of the peripheral iridectomy, but elsewhere iris was irregularly in the depths of the angle.

*Result.*—Subsequently the pilocarpine eye-drops were reduced to 2 per cent. three times daily, and the patient has been maintained on this régime during the succeeding 3 years. The left tension has been consistently 17 mm. Hg (Schiötz) (5.5 g. wt 1955 scale) and, although the tonographic results have averaged  $C=0.17$  and  $Po/C=110-120$ , she has maintained a full left visual field to 2/2,000 white. The left anterior chamber depth is 2.2 mm. with the Jaeger apparatus.

In the meantime, however, the right eye had become very painful and required enucleation.

*Summary.*—Primary creeping angle-closure glaucoma in both eyes, with absolute glaucoma in the right before presentation. The creeping angle-closure glaucoma in the left eye was arrested by peripheral iridectomy, but required pilocarpine eye-drops to control the residual tension. Follow-up 3 years.

**Case 3, a married woman aged 75 years, Australian born, presented in June, 1957, and stated that for several weeks her left eye had become painful so that she involuntarily shut it. The attacks lasted perhaps 5 minutes and occurred at any time or place. One came on during a visit to the city and she had attended an ophthalmologist who had told her the sight was gone from her left eye. Two nights later she woke with severe pain in the left eye and came to the casualty department of The Royal Victorian Eye and Ear Hospital.**

*Examination.*—Visual acuity in the right eye 6/5, and in the left reduced to perception of light; right eye free of inflammation; left eye: ciliary injection, corneal oedema, no cells or flare, pupil

fixed, oval, and semi-dilated; anterior chambers: both shallow; right optic disc: cupped; right visual field to 3/2,000 white—lower nasal step; ocular tension: right 22 mm. Hg (Schiötz), left >80 mm. Hg; gonioscopy: right eye—unable to see into the angle which is very narrow but probably open.

*Treatment.*—She was admitted to hospital and given intensive medical treatment, and a left iridencleisis was performed with a view to relieving the pain. Diamox was discontinued and 5 days later the right eye was submitted to 2-hrly phasing with the following result.

Time	6 a.m.	8 a.m.	10 a.m.	12 noon	2 p.m.	6 p.m.	8 p.m.
Tension (mm. Hg Schiötz)	24	22	22	37	59*	80	17

\* Diamox tablets, two 6-hrly, eserine 0.25 per cent. eye drops.

On the following day a right iridencleisis was performed. Convalescence was uneventful for both eyes.

*Result.*—The intra-ocular pressure has since remained normal. For 2 years the visual acuity in the right eye was 6/18, but it then quickly diminished to 3/60 owing to macular degeneration.

In 1961 the visual acuity was 1/36 in the right eye and poor perception of light in the left; Goldmann perimeter visual fields right eye: IV/4 target—60° below, 40° above, II/4 target—lower field 40°, central scotoma, no upper field; lenses clear; maculae extensive bilateral exudative degeneration; gonioscopy angles appear closed all around by iris in depths.

*Summary.*—Mixed glaucoma, primary creeping angle-closure glaucoma left eye, chronic simple glaucoma right eye (probably both eyes), right narrow angle provocatively closed during phasing in hospital, tensions controlled by iridencleisis both eyes.

**Case 4, a married woman aged 58 years, Russian born, attended for new glasses in 1960 and had no special symptoms.**

*Examination.*—Visual acuity: right eye 6/9, left eye 6/9; optic discs: right cupped, left grossly cupped; ocular tension (Schiötz tonometer) right 34, left 50 mm. Hg; anterior chambers both very shallow; gonioscopy irides ballooned, angles very narrow but considered to be open.

*Treatment.*—As she was an extremely apprehensive woman she was treated first with Pilocarpine eye drops, but later with oral Diamox (which upset her too much) and 1 per cent. adrenalin-base eye drops. Medical treatment was continued for almost 2 years during which time the tension varied considerably—being mostly moderately raised before one form of treatment was changed for another, but sometimes normal.

In September, 1962, the ocular tension rose to right 45 and left 50 mm. Hg (x tonometer); a left iridencleisis was performed after further treatment with Diamox. Malignant glaucoma developed, however, and despite intensive treatment and lens extraction the eye deteriorated and enucleation became necessary.

“Covered” by intravenous Mannitol, a large peripheral iridectomy with scleral suture and immediate refilling of the anterior chamber was performed upon the right eye. The tension in the right eye has since been difficult to control with Diamox Sequels and Eppy 1 per cent. eye-drops, and the eye is causing much anxiety to the patient and worry to her ophthalmologist.

*Result.*—Gonioscopy shows a wide basal peripheral iridectomy and although the iris is flat it crosses the angle and covers the trabeculae by many (almost contiguous) peripheral anterior synechiae (which remind one of the teeth of a circular saw). The right anterior chamber depth measures 1.85 mm. with the Jaeger apparatus.

*Summary.*—Primary creeping angle-closure glaucoma in both eyes. After 2 years’ medical treatment the left eye was lost by malignant glaucoma following a drainage operation, and the right eye is being managed with difficulty by medical treatment after a sealed peripheral iridectomy.

### Discussion

Eyes with shallow anterior chambers, ballooned irides and narrow anterior chamber angles are prone to develop glaucoma from closure of the angle. The most common mechanism is by a sudden and complete angle-closure precipitated by a block of aqueous circulation around the pupil. This is the acute angle-closure attack that so frequently brings agony and destruction. Approximately 30 per cent. of acute attacks are preceded by subacute angle-closure attacks that resolve spontaneously and are characteristically benign so that patients usually do not present or the attacks are not diagnosed except in retrospect following a severe acute attack.

In the subacute attacks, Chandler (1952) postulated that angle-closure was incomplete, whereas Sugar (1961) considered that the attack subsided because the episode was not accompanied by inflammation. Shaffer (1962) has stated that congestion is necessary for anterior synechiae to form, and that if an eye is never congested the iris may remain against the angle wall for months or years without sticking. But a small percentage (7 per cent. in the present series) of shallow-anterior-chamber-narrow-angle eyes develop a quiet and progressive angle-closure without congestion (until the angle is so occluded that the base-pressure becomes high). To distinguish this type of angle-closure the term "primary creeping angle-closure glaucoma" is submitted. Like the terms "subacute" and "acute primary angle-closure glaucoma" this term is merely descriptive, because, apart from the importance of the pupil-block-angle-closure, we must admit ignorance concerning the other mechanisms that are involved in causing angle-closure glaucoma.

One form of angle-closure may lead to another or may be mixed with other forms of glaucoma (especially the chronic simple form). Subacute angle-closure glaucoma tends to terminate in acute angle-closure glaucoma and chronic simple glaucoma appears to be added in a few more cases than would be expected from the general population. In these more common forms of primary angle-closure glaucoma, the aqueous outflow is typically normal between attacks, and this free outflow probably encourages a pressure difference on each side of the pupil block; but when the outflow is impaired in narrow angle eyes—as with creeping angle-closure or with the addition of chronic simple glaucoma—the pressure differences probably become damped and acute angle-closure tends to occur as a late phenomenon. Nevertheless, these narrow angle eyes are so unstable that angle-closure can and does occur at earlier stages, especially if strong miotics are used.

However, typical acute and subacute angle-closure does appear to be relatively uncommonly associated with creeping angle-closure glaucoma which seems more closely allied to chronic simple glaucoma. Although, in the present series, females considerably outnumbered the males, they did so proportionately less than in a series of cases of subacute and acute angle-closure glaucoma (Lowe, 1961). This is perhaps another indication of the intermediate position of creeping angle-closure glaucoma, but although this concept may be useful it must not cause those responsible for treatment to advise a medical régime and neglect the importance of breaking the pupil-block by surgery.

A further warning needs to be issued concerning the medical treatment that may be required after peripheral iridectomy or an inadequate drainage operation. Some

of these eyes develop decreased outflow or even malignant glaucoma when miotics are used postoperatively, whereas this situation is reversed by mydriatic-cycloplegics (Chandler and Grant, 1962). Frequent tension records and gonioscopic control are necessary in the initial stages of such therapy. The strong adrenalin solutions used for chronic simple glaucoma appear safe and are frequently effective.

### Summary

From a series of 250 cases of primary angle-closure glaucoma, seventeen (7 per cent.) were found to have a quiet creeping of the iris into the angle, causing increased ocular tension and damaged vision. This insidious condition is named "primary creeping angle-closure glaucoma". Symptoms are few until the late stages of raised base pressure. The condition resembles an intermediate form of glaucoma between the more violent acute angle-closure attacks and chronic simple glaucoma. Its progress seems halted by peripheral iridectomy, but an aqueous drainage procedure frequently has to be added. Long-term medical treatment without surgery is unsatisfactory and frequently dangerous.

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