VISUAL PROGNOSIS IN ADVANCED GLAUCOMA: A COMPARISON OF MEDICAL AND SURGICAL THERAPY FOR RETENTION OF VISION IN 101 EYES WITH ADVANCED GLAUCOMA*

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THE MANAGEMENT OF PATIENTS WITH ADVANCED GLAUCOMA PRESENTS DIFFICULTIES not ordinarily encountered in the treatment of glaucoma. While visual acuity may remain good even with extensive field loss, any minimal increase in optic nerve damage can result in marked loss of central vision. Once the defect approaches fixation, therefore, the value of visual fields in following the progression of the disease is greatly compromised. Furthermore, many surgeons have noted that when the visual field is markedly constricted, immediate and permanent loss of central vision may follow otherwise successful glaucoma surgery. In a recent review of the risks of sudden visual loss following glaucoma surgery, Lichter and Ravin[1] found various authors to be about evenly divided on whether or not such sudden visual loss occurs. Recommendations for surgery in such patients ranged from the opinion that medical treatment should be the only therapy when there is advanced field loss in an only eye,[2] to the comment that loss of central vision virtually never occurs as a result of surgery regardless of the smallness of the preoperative visual field.[3]

While surgery may or may not be a factor in the loss of central vision in advanced glaucoma, it should also be remembered that some patients treated medically also lose central acuity. Such loss is anticipated when the intraocular pressures are markedly elevated. Chandler and Grant[4] noted, however, that when advanced field loss is present, progression may occur even in spite of seemingly good control of the glaucoma.

The present study was undertaken to assess the relative risks of medical and surgical therapy in the loss of central vision in patients with advanced open-angle glaucoma.

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METHODS

Records were reviewed of all patients seen during the last 20 years by the glaucoma referral service and the Glaucoma Center of Washington University. Approximately 3500 records were evaluated. Patients who met the following criteria were selected for study. All patients had advanced, unoperated, primary, open-angle glaucoma when initially examined. Patients with angle-closure and secondary glaucoma, or patients who had had eye surgery prior to their initial referral were eliminated. All patients had advanced glaucomatous visual field loss, defined by the presence of typical field defects extending to within 5° of fixation with the I_{2e} target on the Goldmann perimeter or with the 2/1000 white target on the tangent screen. Fixation was considered to be "spared" or "split" depending upon whether the field defect surrounded or crossed the point of fixation with the above test stimuli. When available, static perimetry was also used to help in this determination. In spite of the presence of advanced field loss, visual acuity had to be 20/60 or better when initially tested, and all patients were followed for a minimum of four years and for at least six months after any operative procedure. These criteria are summarized in Table I. Typical examples of the visual field defects of patients in the study are depicted in Figures 1-5.

Once included in the study, all office and hospital records pertaining to the patient's ocular problems were reviewed and analyzed. In order to compare methods of treatment, cases were separated into categories of "medical therapy," "glaucoma surgery," and "cataract surgery." Visual fields were evaluated to determine progression of field loss with special reference to maintenance or loss of central vision. Central vision was considered "lost" when best corrected visual acuity was 20/200 or less. Central vision was "maintained" when visual acuity was 20/100 or better. When loss of central vision occurred, efforts were made to determine if any cause other than glaucoma was responsible.

Every intraocular pressure measurement noted in the records was recorded, and average intraocular pressures were calculated for each year of follow-up. When diurnal studies were available, the average of the diurnal measurements was taken as a single value in the calculations.

TABLE I: CRITERIA FOR INCLUSION IN STUDY

1. Primary open-angle glaucoma
2. Visual field defect $\leq$ 5° of fixation (I_{2e} or 2/1000)
3. Visual acuity 20/60 or better
4. No surgery prior to initial exam
5. Follow-up $\geq$ four years and $\geq$ six months after any surgery

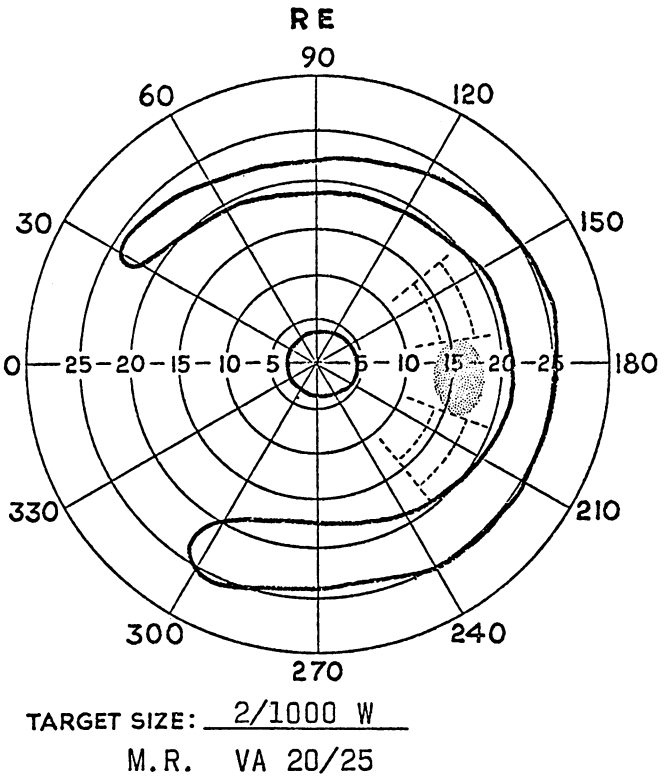

FIGURE 1
Tangent screen field demonstrating extensive field loss with sparing of fixation. This eye has retained good central vision for 16 years.

Following surgery for cataract or glaucoma, pressures in the operated eye during the first month postoperatively were not considered. This was thought to be sufficient time to eliminate the early postoperative pressure rise or hypotony that may accompany any intraocular surgical procedure. All other pressure readings were included. When both Schiøtz and applanation measurements were made, the latter values were used.

Standard statistical methods were applied to determine the significance of results, using the Student t-test and chi-square analysis when applicable. Numerical data are recorded as mean ± one standard deviation.

RESULTS

The characteristics of the patients involved in the study are described in Table II. A total of 101 eyes of 76 patients met the established criteria for inclusion into the study. There were 40 males and 36 females; 58 patients were white and 18 were black. The average age of these patients at the time of inclusion in the study was 60.1 ± 12.7 years, with a range from 13 to 88 years. The duration of follow-up was 7.1 ± 3.6 years, and ranged from 4 to 20 years. The refractive errors were between +3.00 D and −3.00 D in 87% of the eyes. Nine eyes were more than 5 diopters myopic.

In the entire series of 101 eyes, loss of central vision defined by uncorrectable visual acuity of ≤ 20/200, occurred in 20 eyes. Reduction of vision to this level developed in 12 eyes of medically treated patients and in 8 eyes of patients who underwent surgery. Of the latter group, central vision was lost in five eyes in the immediate postoperative period, while three eyes had good vision early postoperatively but later lost vision. Loss of vision was due to macular degeneration in two of these patients (two to four years postoperative) and to poor glaucoma control in one patient (five years postoperative). Thus, loss of central vision resulting from glaucoma or surgical intervention developed in 18 eyes (12 treated medically and six surgically), or 17.8% of the study population.

At the time of the initial examination, fixation was judged to be "split" in 54 eyes and "spared" in 47. Loss of visual acuity to a level of ≤ 20/200 occurred in 12 eyes (22%) of the former group, and in six eyes (13%) of the latter. Thus, the likelihood of losing central vision is about twice as great when the field defect splits fixation as when it is spared. While this difference is not statistically significant, evaluation of the involved cases demonstrated that no patient lost central vision without first going through a phase where the field defect split fixation. This process occurred even when sparing was present at the initial examination. It should also be noted that no case lost central vision immediately following surgery when the operation was performed when fixation was spared.

TABLE II: CHARACTERISTICS OF THE STUDY POPULTATION

All patients met the criteria described in Table I

1. 101 eyes, 76 patients
2. 40 male, 36 female
3. 58 white, 18 black
4. Average age 60.1 years (range 13-88)
5. Average follow-up 7.1 years (range 4-18)

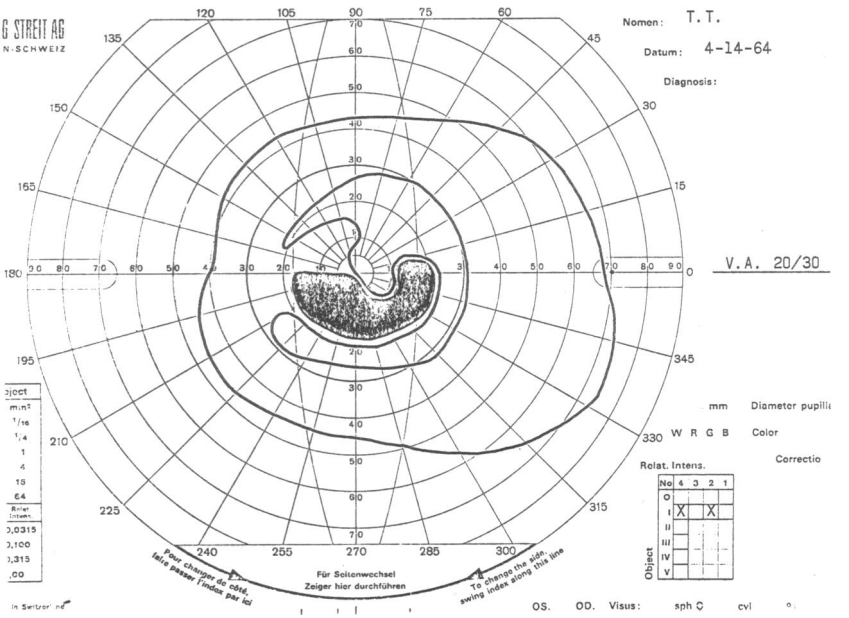

FIGURE 2
Advanced field loss with the defect reaching fixation. Visual acuity remains unchanged after glaucoma filtering surgery and cataract extraction.

MEDICAL THERAPY

During the study there were 59 eyes of 49 patients that received only medical treatment for their glaucoma. Of this group, 12 eyes of 11 patients (8 white, 3 black) lost central vision. There were, in addition, 17 eyes that were treated medically for over four years prior to having surgery. Of this group, 16 ultimately had surgery for cataract and one had surgery for glaucoma. The duration of follow-up prior to surgery was 7.6 years (range 4-15 years). Thus, a total of 76 eyes were treated medically for glaucoma with a minimum period of therapy of four years. Loss of central vision occurred in 12, or 15.8%. The findings regarding this group of patients are summarized in Tables III and IV. Those eyes in which central vision was lost had a slightly higher average intraocular pressure (21.1 ± 4.1 mm Hg) than those that maintained central vision (19.2 ± 2.7 mm Hg) ($P < .05$). When compared by average level of intraocular pressure, loss of central vision was rare (4%) when pressures were maintained under

TABLE III: MEDICAL THERAPY — 76 EYES

	Central Vision Maintained	Central Vision Lost
Number	64	12
Age at presentation (years)	60.9	57.9
Average IOP (mm Hg)	19.2 ± 2.7	21.1 ± 4.1
Average time to loss of central vision (years)	—	4.3
Progression of field loss (unrelated to cataract)	20/42 (47.6%)	—

18 mm Hg but rose progressively when pressures were higher, reaching 29% when average pressures were over 22 mm Hg.

Progression of field loss, as demonstrated by reduction in peripheral field, enlargement of scotomas, or extension of the field defect to involvement of fixation (spared to split) was seen frequently even when actual loss of central vision did not occur. In attempting to evaluate this, the 16 eyes that eventually had cataract surgery after four or more years of medical therapy were not included since the development of cataract might be expected to cause contraction and depression of the peripheral field (such depression was noted in nine). In addition, six eyes that demonstrated progressive field loss also were noted to have increasing lens changes that could account for the alteration in the visual field. These cases were also eliminated. There were then 54 eyes treated medically for four years or longer where cataract could not account for a change in the visual field. Of these, progression of field loss was seen in 20 and loss of central vision in an additional 12. Thus, 59.3% of medically treated eyes demonstrated progression of field loss, and 48% had peripheral progression even when central vision was maintained.

GLAUCOMA SURGERY

In 22 eyes of 19 patients (13 white, 6 black) glaucoma surgery was felt to be necessary in order to maintain vision. The findings are summarized

TABLE IV: MEDICAL THERAPY

Loss of central vision 12/76 eyes (15.8%)	
Average IOP (mm Hg)	Central Vision Lost
< 18	1/25 (4.0%)
18-22	7/37 (18.9%)
> 22	4/14 (28.6%)

TABLE V: GLAUCOMA SURGERY — 22 EYES, 19 PATIENTS

Age at presentation	58.0 ± 16.0 years
Followed preoperatively	11.5 months
Followed postoperatively	4.4 years
Preoperative IOP	31.8 ± 9.4 mm Hg
Postoperative IOP	15.7 ± 4.0 mm Hg
Procedures performed	Trabeculectomy 11 Thermal sclerostomy 7 Posterior lip sclerectomy 2 Gonio puncture 2
Central vision lost	3 (13.6%)
Progression of field loss	2 (10.5%)

in Table V. The average age at the time of initial examination was 58.0 ± 16.0 years (range 13 to 75 years). The patients were followed for an average of 11.5 months (range < 1 month to four years) prior to surgery, with 15 of the 22 operations (68%) performed less than one year after presentation. Postoperatively the eyes were followed an average of 4.4 years (range 6 months to 15 years). Indications for surgery consisted of progression of visual field loss in four instances and uncontrolled intraocular pressure on maximum tolerated therapy in the remainder. The cases demonstrating progression of field loss were followed from six months to four years prior to surgical intervention.

The average intraocular pressure prior to surgery was 31.8 ± 9.4 mm Hg (range 21-60 mm Hg). This is significantly higher than for those eyes treated medically ($P < .001$). Following operation, intraocular pressure averaged 15.7 ± 4.0 mm Hg (range 8.9 to 24 mm Hg), a drop in pressure from preoperative values that is highly significant ($P < .001$). As noted in Table V, there were four types of operations performed, with trabeculectomy and thermal sclerotomy accounting for 18 of the 22 procedures. Only five eyes required medication postoperatively; none required cholinesterase inhibitors, only one needed carbonic anhydrase inhibitors, and three were controlled with either epinephrine or pilocarpine alone. In only one instance was the average postoperative intraocular pressure above 21 mm Hg.

Central vision was lost in three eyes (13.6%) of three different patients after surgery for glaucoma. In each instance the loss was immediate with postoperative visual acuity < 20/200 on all subsequent visits. One of these patients had a flat anterior chamber for a week after surgery and another was operated upon while using demecarium bromide and had a violent anterior chamber reaction postoperatively. All three had successful filtration with pressure in the low teens without medical therapy. Three different procedures were performed on these eyes: posterior lip sclerec-

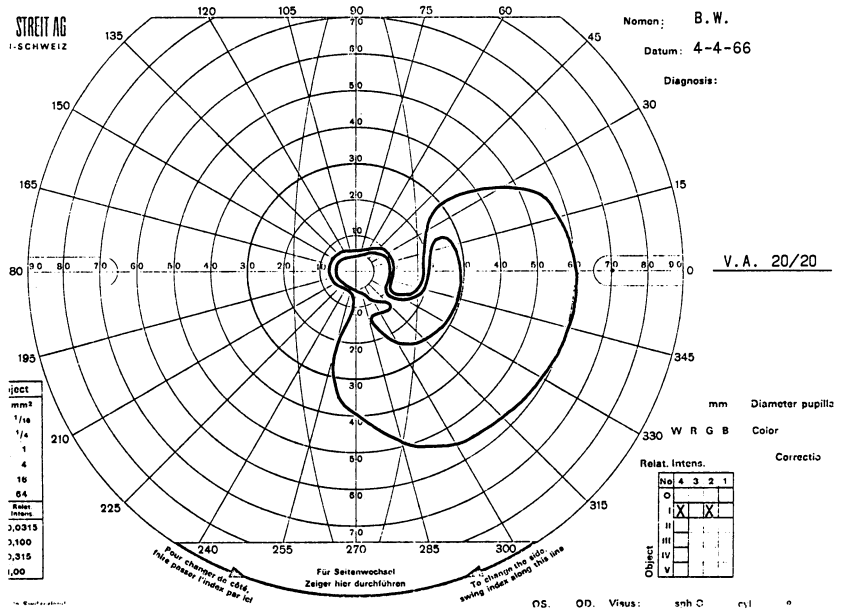

FIGURE 3
Sparing of fixation with marked glaucomatous field loss. The defect surrounds but does not split fixation.

tomy, thermal sclerostomy, and trabeculectomy. The patients were slightly older than the average in the study, being 65, 70, and 75 years of age when initially seen. The oldest patient had a trabeculectomy performed on her second eye three months after surgery on the first eye and has maintained central vision for three years postoperatively. The visual field defect split fixation in both eyes and intraocular pressures were approximately 40 mm Hg on maximum therapy preoperatively. Following surgery, the pressures have remained in the range of 11 to 15 mm Hg without medication.

Progression of field loss after surgery for glaucoma was seen in only two patients (besides the three that lost central vision). One was the only patient in whom the average intraocular pressure was > 21 mm Hg, and the only patient treated with carbonic anhydrase inhibitors following filtering surgery. The second patient had good control of intraocular pressure (average 15.5 mm Hg without medication) for three years postoperatively. She has severe cardiovascular disease, has had several myocardial infarctions, a known cardiac arrest, and was noted to have

a hemorrhage on the disc margin on one occasion. The visual field of all other patients remained stable with no further deterioration. Surgery, once successful, thus appears capable of arresting the progression of field loss even when damage is extensive.

Visual acuity was unchanged throughout the study in 12 of the 19 eyes that maintained central vision after surgery for glaucoma. One patient had deterioration of vision from 20/40 to 20/70+ resulting from a spontaneous detachment of the pigment epithelium and subsequent macular degeneration. This developed two years following surgery. Formation of cataract was responsible for reduced vision in six eyes (32%). Cataract extraction has been performed on four patients with recovery of 20/40 vision or better in each eye, and the other two patients are to have cataract surgery.

CATARACT SURGERY

Cataract surgery was performed on 23 eyes of 18 patients (17 white, 1 black). The characteristics of these patients and the surgical results are noted in Table VI. The average age at presentation (63.9 ± 8.9 years, range 48-78 years) of the patients who underwent cataract extraction was slightly higher than that of the patients treated medically or surgically, but the difference was not statistically significant ($P > .10$). In contrast to the relatively short preoperative treatment period before surgery for glaucoma, those patients on whom cataract surgery was performed were followed for an average of 6.6 years (range 7 months to 15 years) before their operation. Cataract extraction was intracapsular in 21 eyes, extracapsular in 2, and four eyes had prior filtering operations before their cataract extraction.

Loss of central vision in the immediate postoperative period occurred in two eyes (8.7%). These patients were 76 years and 79 years of age at the time of surgery. In one of these eyes the cataract was removed extracapsularly and endothelial dystrophy eventually developed. Visual acuity, however, was reduced to counting fingers even when the media of the eye was relatively clear. The patient's opposite eye had had uncomplicated cataract surgery a year previously with a good visual result that has been maintained for five years postoperatively. The second patient lost central vision immediately after uncomplicated cataract surgery. Her opposite eye had a cataract but did not have surgery, and had maintained 20/70 vision when last examined.

In addition to the eyes that lost central vision immediately after surgery, there were three eyes in which the visual acuity became reduced to

TABLE VI: CATARACT SURGERY — 23 EYES, 18 PATIENTS

Age at presentation	63.9 ± 8.9 years
Followed preoperatively	6.6 years
Followed postoperatively	4.0 years
Preoperative IOP	20.3 ± 4.7 mm Hg
Postoperative IOP	19.0 ± 3.6 mm Hg
Central vision lost	
immediate	2 (8.7%)
late	3

< 20/200 after initially achieving good vision. Macular degeneration was felt to be responsible in two instances where central vision was lost two and four years respectively following surgery. Postoperative visual acuity had initially been 20/25 and 20/30 in these eyes. In another eye, vision was improved to 20/25 following cataract surgery in spite of the fact that fixation was split preoperatively. Intraocular pressures, however, could not be controlled below the mid-twenties on medical therapy and the patient lost central vision five years later. The opposite eye maintained central vision after cataract surgery until the patient's death 8½ years later. In each of the eyes where loss of central vision occurred, perimetry demonstrated that the glaucomatous defect had split fixation prior to cataract surgery. This was true even in the patients who later lost vision from macular degeneration.

Mean intraocular pressure prior to surgery was 20.3 ± 4.7 mm Hg (range 9.2 to 21.0 mm Hg), and postoperatively was 19.0 ± 3.6 mm Hg (range 13.8 to 27.6 mm Hg). Preoperative pressures were essentially the same as in the medically treated patients, and significantly lower than in the patients who underwent glaucoma filtering procedures. This would be anticipated, since the indications for cataract surgery were generally related to visual loss from lens change rather than to inadequate glaucoma control. The mean intraocular pressure following cataract surgery was not significantly different from that noted preoperatively ($P > 0.10$). When evaluated by change in glaucoma control, however, as demonstrated by alteration of mean intraocular pressure of 3 mm

TABLE VII: CATARACT SURGERY. CHANGE IN MEAN IOP

Glaucoma control	Present series (23 eyes)	Bigger and Becker[5] (100 eyes)
Improved	8 (35%)	23%
Unchanged ± 3 mm Hg	12 (52%)	66%
Worse	3 (13%)	11%

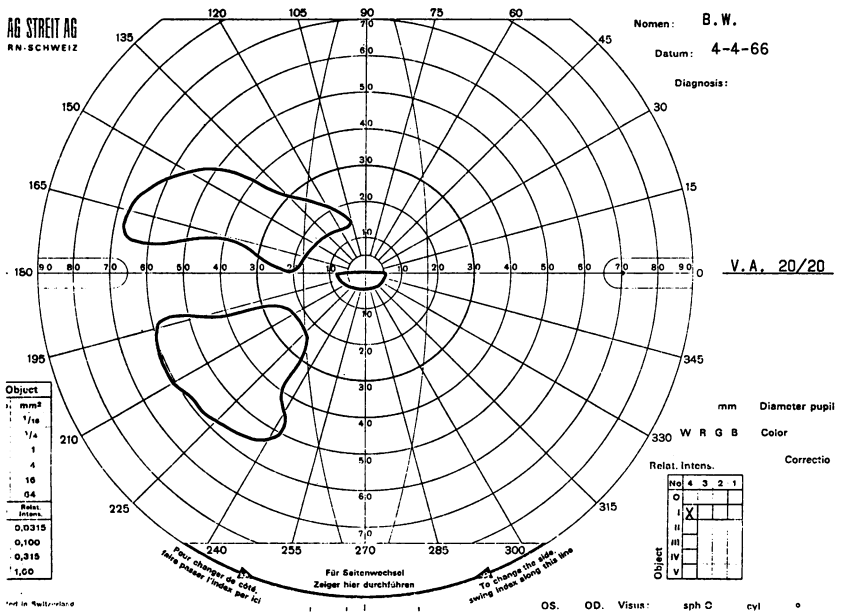

FIGURE 4
Opposite eye of the patient in Figure 3. Fixation is split, but central vision has been maintained for over 10 years on medical treatment.

Hg or greater, interesting differences are noted (Table VII). Over one-third of the eyes demonstrated a reduction in mean intracocular pressure of > 3 mm Hg, while only 13% had a mean intraocular pressure > 3 mm Hg higher postoperatively. In several instances where the mean intraocular pressure was unchanged, it was noted that this level of control was achieved with a reduction in the amount of glaucoma medication required. If the change in mean intraocular pressure or reduction in glaucoma medication are combined (Table VIII), improvement in glaucoma control was noted in 15 of the 23 eyes (65%). Using either of the above criteria, 87% of these eyes with advanced glaucomatous field loss were as well or better controlled postoperatively following cataract surgery. These findings are almost identical to those of Bigger and Becker[5] in which 89% of glaucomatous eyes demonstrated the same or improved pressure control one year after cataract extraction.

One patient had combined surgery for cataract and glaucoma in one eye after 6½ years of medical therapy. Vision has remained 20/30 for three years following surgery with good control of intraocular pressure

TABLE VIII: CATARACT SURGERY. CHANGE IN MEAN IOP, ADJUSTED FOR CHANGE IN MEDICATION*

Glaucoma control	Present series (23 eyes)	Bigger and Becker (100 eyes)
Improved	15 (65%)	56%
Unchanged ± 3 mm Hg	5 (22%)	36%
Worse	3 (13%)	8%

*Same control with less medications = improved
Same control with more medications = worse, etc.

without medical therapy. The findings regarding this case have been included in the statistics only as a surgical procedure with maintenance of fixation after operation.

DISCUSSION

The present study was undertaken to provide information on the prognosis for retention of good visual acuity in patients with advanced open-angle glaucoma and to evaluate medical versus surgical therapy in their management. This is believed to represent the largest series of its kind to be reported.

Loss of central vision with reduction of visual acuity to ≤ 20/200 occurred in 17.8% of the patients studied. This, combined with the cases that demonstrated progression of field loss even when central vision was retained, illustrates the rather guarded prognosis in these advanced cases of glaucoma. One of the most important observations obtained from review of the patients that lost central vision is the demonstration that fixation becomes "split" before it is "lost." In no case did a pateint lose central acuity directly from a stage of "sparing" without first going through the intermediate phase where the field defect reached or split the point of fixation. This may prove to be especially valuable in evaluating patients that require surgery. When central vision is spared, the likelihood of loss of central acuity is very low. Most patients will

TABLE IX: VISUAL LOSS: MEDICAL THERAPY VS SURGERY

	Medical Therapy	Glaucoma Surgery	All Surgery
Loss of Central Vision	12/76 (16%)	3/22 (14%)	5/46 (11%)
Field Loss Progression	20/42 (48%)	2/19 (10%)	—
Either or Both	32/54 (59%)	5/22 (23%)	—
Cataract	16/76 (21%)	6/19 (32%)	—

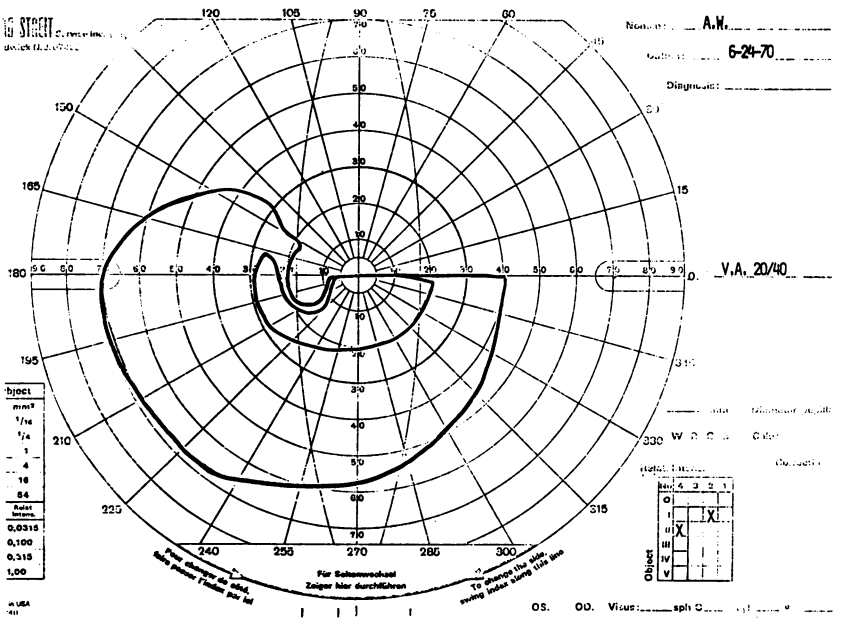

FIGURE 5
Advanced field loss with fixation split. This eye lost central vision after four years of medical therapy with average intraocular pressure about 20 mm Hg.

retain central vision even when it is split, but virtual assurance can be given when sparing can be demonstrated — even if only by a couple of degrees. This observation has been made before[6] but not previously documented.

Among the 76 eyes treated medically for at least four years, loss of central vision occurred in 12 (15.8%). Progression of field loss developed in 48% of the remainder. The average intraocular pressure in those eyes that lost central vision was statistically slightly higher than in the remainder, but clinically insignificant. What is important is the demonstration that loss of central vision is extremely rare (4%) when the average intraocular pressure is maintained below 18 mm Hg. This increases to about 30% when the average intraocular pressure is above 22 mm Hg. Thus, in the presence of extensive field loss, every effort must be made to keep the pressure well controlled. When this is not possible, and pressures are consistently above the low 20's, serious consideration must be given to surgical intervention. Chandler[7] has stated: "In advanced glaucoma, I have not seen preservation of field in eyes with a tension

of 20 mm Hg or over." While not in total agreement, the present findings lend partial support to this statement.

Surgical intervention, of course, also carries a risk. In the present series this risk was loss of central vision in the immediate postoperative period of approximately 14% (3/22 operative procedures). Nevertheless, over 85% of such eyes maintain central vision, and surgery for glaucoma can provide effective control of intraocular pressure even in eyes with severe damage. Medical therapy was required in only five of the 22 eyes filtered, and only one had an average intraocular pressure > 21 mm Hg. This was one of only two cases in which further progression of visual field loss occurred. None of the other patients demonstrated progression of their field loss following surgery. These findings are quite similar to those of Kronfeld and McGarry[8] who noted persistence of good visual acuity for five years in 15/18 eyes with field defects to within 5° of fixation after surgical normalization of intraocular pressure. Furthermore, once an eye maintains central vision after filtering surgery it is very likely to retain it if cataract extraction should become necessary. This is significant since cataract formation is one of the more frequent complications of filtering procedures. Of the 19 eyes that maintained central vision after glaucoma surgery, 6 (32%) developed sufficient lens changes to warrant cataract extraction. Surgery has been performed with good results in four and is planned in the other two. This incidence of late cataract development is essentially the same as noted by Sugar,[9] who found an incidence of 30% in 83 cases of glaucoma requiring filtration surgery. He also noted an 8% incidence of cataracts in a control group of patients with medically treated glaucoma. In the present series, cataracts requiring surgery developed in 16/76 eyes (21%) treated medically for four years or longer (Table IX).

In one of the three eyes that lost central vision after filtering surgery, the operation was performed while the patient was under treatment with demecarium bromide (Humorsol). Postoperatively, this eye developed a severe fibrinous iritis, posterior synechiae and cataract. Cataract surgery was unsuccessful in restoring central vision and the visual acuity remained < 20/400. This eye was operated upon in 1960 before it was learned that surgery on an eye treated with cholinesterase inhibitors may be complicated by such a reaction. Such violent reactions can be prevented merely by discontinuing the cholinesterase inhibitor for two to four weeks before surgery.[10]

Cataract surgery in eyes with advanced glaucoma may also be complicated by immediate loss of central vision. Such loss of visual acuity was noted in 2/23 (8.7%) cataract extractions. In two other eyes, central

vision was lost several years following surgery from macular degeneration. It is, of course, possible that the surgery in some way increased the susceptibility of these eyes to macular disease, and these examples may represent surgical complications. This is impossible to prove, however, and loss of central vision in these patients was not considered to be related to surgery. As noted previously by Bigger and Becker,[5] glaucoma control is often favorably influenced by cataract surgery. The findings in the present series confirm their observations. Only rarely is the intraocular pressure more difficult to control after a cataract extraction.

As noted by Lichter and Ravin,[1] various authors are divided as to whether sudden loss of vision occurs after surgery in eyes with severe glaucomatous damage. The present series indicates that such loss does occur, at least with respect to loss of fixation and central visual acuity, and that it is seen with a frequency of approximately 10-15%. Furthermore, it may develop with equal incidence after either glaucoma or cataract surgery, and may also occur with essentially the same frequency in similarly damaged eyes treated without surgery. The major difference would appear to be that central vision is lost suddenly following surgical intervention and occurs more gradually in eyes treated medically. This, of course, is a significant consideration when faced with a patient with advanced visual field loss. Also to be considered is the finding that patients surgically treated are much more likely to retain their remaining visual field, assuming central vision is not lost at the time of surgery. Medically treated patients, on the other hand, stand almost a 50% chance of losing peripheral visual field in addition to the 15% likelihood of loss of central vision. Ultimate verification of these findings will require a prospective study with similar patients having medically treated glaucoma with pressures of 22-30 mm Hg randomly allocated to continued medical or surgical management.

There are several reasons postulated for the sudden loss of vision associated with surgery in eyes such as those in this study. Optic nerve or intraocular hemorrhage, sudden hypotony when entering the globe, toxic or direct injury to the optic nerve from administration of retrobulbar anesthesia, systemic hypotension during general anesthesia, and macular edema from postoperative hypotony have all been considered. Further detailed review of the cases reported here, plus other instances of sudden loss in similar patients that did not meet the study criteria are in progress. Determination of the effects of epinephrine in retrobulbar anesthesia during surgery on eyes with split fixation is also being done. Results of these studies will be reported in future publications.

SUMMARY

A detailed analysis of 101 eys of 76 patients with advanced glaucomatous visual field loss but with retention of good visual acuity is presented. Patients were followed for a minimum of 4 years with an average duration of follow-up of 7.1 years. Loss of central vision, defined by permanent reduction of visual acuity to ≤ 20/200, occurred with equal frequency in eyes treated medically (15.8%) or surgically (13.6%) for glaucoma. Sudden loss of central vision also occurred following cataract extraction (8.7%).

No patient lost central vision suddenly following surgery when central vision was spared at the time of operation. In addition, all cases that eventually lost central vision, either medically or surgically, demonstrated field defects which split fixation prior to its loss.

Loss of central vision is seen rarely when medical therapy maintains the average intraocular pressure below 18 mm Hg, but increases markedly with higher pressures, reaching approximately 30% when average intraocular pressure is above 22 mm Hg.

Progression in field loss is rare after successful glaucoma surgery, although cataracts develop in about 32% of such eyes. Cataracts also develop in 21% of medically treated eyes. In addition, about 50% of unoperated eyes demonstrate further field loss even when central vision is maintained.

In spite of very definite risks, serious consideration should be given to glaucoma filtering surgery when the intraocular pressure is consistently over 22 mm Hg in patients on medical therapy with advanced glaucoma.

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