LATE FISTULIZATION OF OPERATIVE WOUNDS: DIAGNOSIS AND TREATMENT*

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Among the postoperative complications of intra-ocular surgery, those of late fistula formation and hypotony have received relatively little attention. We desire to emphasize a type of slowly leaking cicatrix, to describe the associated symptom complex, and to present a method of therapy which we have found successful.

Due to imperfect closure, any penetrating wound of an eyeball, either traumatic or surgical, may be followed by a cystoid scar. The creation of such a cicatrix is in some instances the aim of the surgeon, while in others it occurs when least desired. If such a cicatrix opens to the surface a fistula is produced. This fistulous tract may be large or small. It may be constantly open or it may be closed at times and open at others. The clinical appearance of the usual form in which the fistula is large and open at all times is well known. The eye is congested and soft. The cornea is often hazy with stromal striae and folds in Descemet's membrane. The anterior chamber is absent and the iris is in contact with the posterior surface of the cornea. Either the anterior surface of the lens or of the vitreous is often in apposition to the endothelial surface of the cornea. A choroidal detachment is usually present. This condition is most commonly seen soon after operation, but occasionally it occurs later in the post-

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operative course. The diagnosis, treatment and consequences of this condition are well recognized and will not be discussed further at this time.

In those cases in which there is slow or intermittent leakage of the aqueous, the signs and symptoms, while less obvious than those just described, are nonetheless characteristic. A survey of the literature shows that little attention has been directed toward the diagnosis and treatment of this group. Kirby[1] has related the symptoms along with those associated with delayed wound healing after cataract extraction. Barkan[2] has described similar findings in connection with late hypotony after trephining but he did not attribute them to the presence of a leaking cicatrix. O'Brien[3] has referred to the minuteness of the opening in the wound in some cases of choroidal detachment. A brief report on this symptom complex was made by one of us (J. H. D.)[4] as part of a discussion on hypotony at a meeting of the American Academy of Ophthalmology and Otolaryngology in 1947.

SIGNS AND SYMPTOMS

The usual history in such cases is that of an uneventful intra-ocular operation and a quiet postoperative course. Often a slightly irregular pupil or an incarcerated iris pillar and a small cystoid scar are present, but the visual acuity after operation is good and the general appearance of the eye is satisfactory. Such a state may continue for weeks or even months. Then the patient returns, complaining of tearing, intermittent blurring of vision and a dull ache about the eye. The symptoms are often transient in nature and occasionally, as noted in one of the cases, they are worse on awakening in the morning. In the beginning the outstanding complaint is a watery eye while later blurring of vision and actual discomfort are frequently noted.

In the early stages the findings are: profuse lacrimation in an eye that to casual inspection appears normal. The globe is not injected, the cornea is clear, the anterior chamber is

normal in depth and free of cellular deposits. By digital palpation, however, the ocular tension is reduced and slight ciliary tenderness is present. In some instances the hypotony is so profound that the tonometer does not register. Examination of the wound frequently reveals a cystoid area of the conjunctiva that is soft and pits on pressure, while in others the wound appears flat and the tiny opening escapes detection. If one places a drop of fluorescein on the suspected area and then applies gentle but firm pressure to the globe, a leakage of aqueous is usually demonstrable. Since these fistulous cicatrices are at times covered by a thin layer of conjunctival epithelium, this test is not invariably positive. Repeated examinations are occasionally required to establish the intermittent nature of the leakage of aqueous. In a few instances it is even necessary to dissect up the conjunctiva to be certain of the exact site of drainage. If the anterior chamber becomes shallow with the application of pressure to the globe it is corroborative evidence of slow fistulization.

Should such a situation be permitted to continue, the visual acuity will decrease and the patient's symptoms will become more severe, resembling in every detail those found in a low-grade iridocyclitis. At this stage examination with the corneal microscope will reveal a slight flare and a few cells in the anterior chamber. There may be an increase in the number of opacities in the anterior vitreous. These findings have led many to diagnose the condition as iridocyclitis and to persist in the treatment of the secondary uveal inflammation without taking into account the primary cause for this continued irritation. If the hypotony persists, an edema of the optic nerve may ensue, or, as in one of our cases, there may be sufficient edema of the retina in the macular region to simulate a flat detachment of the retina. It is interesting to note that in none of the 15 cases herein reported was a detachment of the choroid present. A late complication of more serious import is epithelization of the anterior chamber. This was seen in one of the cases reported here. Both Vail[5] and Dvorak-

Theobald and Haas[6] have emphasized the importance of delayed wound healing in the production of epithelization of the anterior chamber and Calhoun[7] has reported that in 10 of the 19 cases of epithelization which he observed, a positive fluorescein test was present at some time. Late infection is always a danger in the presence of a fistula. In two cases in our series an early endophthalmitis was observed, and in a third case, not included because treatment was not given, the eye was lost because of panophthalmitis.

TREATMENT

Discussions of the treatment of fistulizing wounds and especially the late treatment have appeared sporadically in the literature for many years. Earlier writers spoke of filtering cicatrices after cataract operation as "safety valves" for the prevention of glaucoma (Ayers[8]). Both Spaeth[9] and Kirby[10] have pointed out the danger of glaucoma resulting from closure of a slowly leaking fistula. Furthermore, Kirby[10] has stated that if a fistula is present and the ocular tension normal, glaucoma will occur if the opening is obliterated. In our experience postoperative glaucoma has not been an important factor, and the sequelae of an untreated filtering cicatrix are such that closure should be considered carefully in all cases.

The following methods of treatment of fistulizing wounds with hypotony have been proposed:

1. *Medical or expectant treatment.* This has been suggested by Gradle,[11] Spaeth[12] and Wright[13] in the form of local applications of dionin, atropine sulfate, hot compresses and pressure dressings. However, since these medications do not help the primary difficulty, namely imperfect closure of the wound, it is unlikely that they will be efficacious, and watchful waiting is too dangerous a policy to follow.

2. *Cautery.* The application of some form of cautery to flatten the cystoid area has been advised for many years. Meller[14] recommends the use of a hot probe in cases of delayed reformation of the anterior chamber and a positive fluorescein

test after cataract extraction. The electric cautery for iris prolapse has been advocated by Gala[15] and many others. Bulson,[16] Magitot,[17] Bothman[18] and others prefer to cauterize with trichloracetic acid. Gifford[19] and Gradle[11] have both warned that with the use of this acid sympathetic ophthalmia may occur and suggest that it never be employed in the treatment of iris prolapse unless the treated area is covered with a conjunctival flap. Weiner and Alvis[20] favor repeated applications of 10% silver nitrate to cystoid scars producing hypotony. Albrich[21] has reported successful results following diathermic applications to the area of filtration when vitreous is beneath the conjunctiva. Barkan[2] has found treatment of the cystoid cicatrix with Shahan's thermophore helpful in cases of late hypotony after trephining. There is no doubt that cauterization of the wound will in certain instances produce a firm cicatrix, but it is not an exact method.

3. *The free graft.* The difficulty in securing permanent closure of these fistulous tracts has caused some surgeons to advocate suturing a free graft of tissue subconjunctivally over the area of drainage. Such treatment has been used chiefly to correct hypotony after trephine operation. For this purpose Bothman[18] has used a graft excised from the superior rectus muscle near its insertion, while Wilmer[22] and Magitot[17] grafted a piece of Tenon's capsule over the trephine opening. We have had no experience with this form of therapy.

4. *Conjunctival flap.* Probably the most widely accepted method of treating a filtering cicatrix is the use of a Kuhnt, or Van Lint type of conjunctival flap. Many writers, including Herbert,[23] have advocated the use of such a flap for the repair of a cystoid cicatrix. The method described by Wheeler[24] has been recommended by Goar,[25] Kirby,[10] Cornet,[26] Workman[27] and others. In 1936 Verhoeff[28] wrote of using a large Van Lint flap to correct retraction of the conjunctival flap occurring after trephining. This method will doubtless cure many of these cases, but in our hands it has not proved uniformly successful.

5. *Suturing of the fistula.* It is our belief that a successful closure of a fistula is more certain if in addition to covering the wound with a conjunctival flap the corneal and scleral lips of the tract are approximated by suturing. This is not a new method of therapy, but it has received relatively little attention. In 1920 Gradle[11] described its use in the late treatment of two cases of traumatic fistula. His technique is very similar to the one we suggest. The attention of one of us (J. H. D.) was first called to the value of such suturing in 1929. At that time, some months after an uneventful cataract extraction, a patient developed a fistulizing cicatrix in which leakage was demonstrable by the fluorescein test. Two attempts were made to close the fistula by the usual conjunctival flap method. Then the late Dr. John M. Wheeler successfully closed the fistula by combining a conjunctival flap with suturing of the fistulous opening.

TECHNIQUE

A conjunctival incision is made immediately surrounding the fistulous opening (Figure 1). After outlining in this manner the area of the fistula, a conjunctival flap is dissected up from the limbus. This flap is made large enough to cover the upper corneal limbus for about 2 mm. Upon the completion of this dissection a conjunctivo-episcleral suture is placed near the limbus below the limit of the flap and then passed through the corresponding edge of the prepared flap. This suture is then held taut to be certain that the flap will cover the fistula and the upper corneal margin. The suture is then released and the originally outlined fistulous tract with the surrounding conjunctival epithelium excised. At this point the fistulous opening is inspected—should iris be prolapsed, it is excised. The edges of the opening are then freshened up and usually touched with a hot probe, and a double-armed fine black silk suture is passed through the lips of the fistula (Figure 2). The conjunctival flap is next drawn down and the traction sutures tied. The double-armed

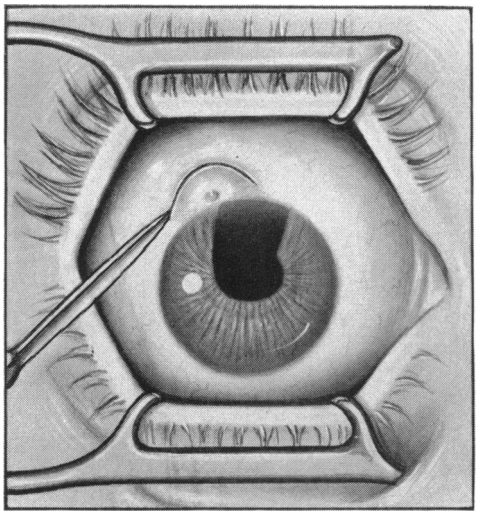

Fig. 1.

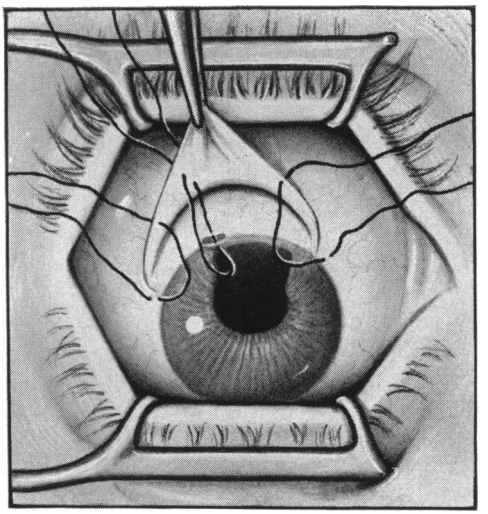

Fig. 2.

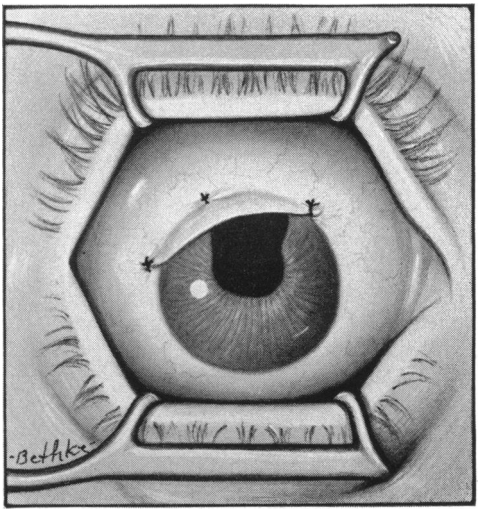

Fig. 3.

corneoscleral suture is then passed through the overlying conjunctiva and tied (Figure 3). A monocular dressing is applied and changed every 48 hours. The sutures are removed on the fifth day. The postoperative course has been quiet in all cases.

Case Reports

Case 1.—V. M., aged 56, was first seen in April, 1937, complaining of a blurred, sensitive right eye. He gave a history of having had an extracapsular cataract extraction with complete iridectomy in September, 1935, and an apparently uneventful recovery until May, 1936, when a conjunctival flap was drawn over a fistulous wound. Examination showed: vision = hand movements with accurate light projection, cornea clear, anterior chamber clear and of normal depth, faint secondary membrane, nasal iris pillar incarcerated with an area of subconjunctival infiltration above, tension too low to be recorded. The next day the cicatrix was excised, the edges of the wound curetted and a conjunctival flap drawn over the area of filtration. The edges of the fistula were not sutured. Tension remained low and 1 week later another conjunctivoplasty was performed, with suturing. Tension rose to normal, vision = 20/40, but a cystoid scar remained. The patient returned in November, 1938, complaining of blurred vision for 3 days. Examination showed: edema of the lids, conjunctival injection with a probable abscess under the flap at 12 o'clock, radial white lines in the deeper layers of the cornea, tension normal. Injection subsided quickly under treatment and vision = 20/40. The flap was very thin, a fistula was present, and another conjunctivoplasty with suturing of fistula was done December 14, 1938. Six days later there was a rise in tension, controlled by pilocarpine hydrochloride 2% q.i.d. Two weeks later vision = 20/40 and tension was normal, without miotics. Findings were unchanged until patient's death in 1945.

Comment: The interesting features of this case are: (1) two conjunctival flaps failed to close the fistula, (2) first suturing partially closed the fistula for 2 years, (3) resuturing obliterated it and the eye retained normal ocular tension and vision of 20/40+.

Case 2.—A. E. P., aged 74, had an intracapsular cataract extraction, right eye, May 26, 1943 (preliminary iridectomy elsewhere), an uneventful convalescence, and postoperative vision of 20/20. November 23, 1943, he complained of intermittent blurring of vision and a watering eye on awakening. Examination revealed a

filtering cicatrix around the temporal pillar. December 1, 1943, the patient complained of a painful right eye. The bleb had ruptured, and signs of an early endophthalmitis were present. These subsided following antibiotic therapy and 20/30 vision was obtained. The cystoid cicatrix remained and the eye continued to water. Operation was refused until September 10, 1945, when a conjunctivoplasty with suturing of the fistula was done. Patient was asymptomatic, tension normal and vision was 20/30 after closure of the fistula.

Comment: The details of this case are given as illustration of the rapidity with which exogenic infection can occur upon rupture of the bleb. Furthermore it is interesting to note that with the subsidence of the infection there was a prompt return of the annoying symptoms, from slow leakage of aqueous. All discomfort quickly disappeared with closure of the fistula.

CASE 3.—H. H., aged 64, was first seen on September 17, 1946, complaining of tearing and loss of vision and field, left eye. He gave a history of extracapsular cataract extraction with complete iridectomy, April 25, 1946, and corrected postoperative vision of 20/50. On examination he was found to have corrected vision of 10/200, tension of 5 mm. Hg. (Schiötz), a white eye, a few fine deposits on the posterior surface of the cornea, a few floaters in the anterior chamber, a secondary membrane with good central opening, many moderate-size vitreous opacities, some old chorioretinitis nasal to the disc, retinal edema and elevation below and temporal to the disc, and constriction of the field—marked above. In the center of the wound at 12 o'clock was a filtering cicatrix (fluorescein test). Conjunctivoplasty with suturing of the fistula on September 20, 1946, resulted in a tension of 22 mm. Hg. (Schiötz) and a vision of 20/50. Vision is now 20/40, tension is still normal, and the defect in visual acuity was due largely to an old chorioretinitis.

Comment: This instructive case is an illustration of the changes that may occur in an eye with prolonged hypotony. Correction of this condition brought about prompt restoration of function.

CASE 4.—S. N., aged 68, had an intracapsular cataract extraction with peripheral iridectomy, left eye, December 19, 1945. Postoperative course was uneventful and corrected vision 20/25+. One year later he complained of blurred vision, but the eye appeared normal and vision was still 20/25+. November 7, 1947, he returned because of tearing and difficulty in reading. Corrected vision was 20/50, tension was low, the lips of the incision were not

in good apposition at 11 o'clock. The nasal pillar of the iris was adherent to the cornea there, and a fine, thin membrane was seen on the posterior cornea at 11 to 12 o'clock. One month later the tension was still low and, on pressure, aqueous was seen to escape from the wound at 11 o'clock. Conjunctivoplasty, suturing of the fistula and an iridectomy were done. Examination of the excised iris tissue showed epithelization of the anterior chamber. Tension remained about 12 mm. Hg. (Schiötz), there was no evidence of filtration, and in July of 1948 a series of x-ray treatments was given because of increased epithelization. A bullous keratitis developed and vision was 3/200.

Comment: This case is presented to show the necessity of early diagnosis and prompt treatment. Failure to recognize the initial symptoms led to this unsatisfactory result.

CASE 5.—E. O., aged 55, had a preliminary iridectomy, right eye, in December, 1928, and an extracapsular cataract extraction in February, 1929. A large postoperative hyphemia gradually absorbed and vision of 20/20— was obtained. In April, 1929, the patient complained of tearing and failing vision. Tension was too low to register, there was slight pitting edema at the limbus superiorly and leakage of aqueous occurred through this fistulous tract. Two attempts to cover the fistula with a conjunctival flap were unsuccessful, and on May 16, 1929, Dr. John M. Wheeler performed a conjunctivoplasty combined with suturing of the fistula. The tension rose to 17 mm. Hg. (Schiötz), vision improved to 20/15—2 and the eye has remained in this condition.

CASE 6.—C. L., aged 68, had an iridencleisis, right eye, for chronic wide-angle glaucoma, September, 1943. A shallow anterior chamber and choroidal detachment persisted for 6 weeks. Then the eye became quiet, tension was normal and preoperative vision of 15/200 was unchanged. Six months later the vision became more blurred. Examination showed a large, thin cystoid cicatrix above the scar, a tension of 12 mm. Hg. (Schiötz) and no demonstrable aqueous leakage. Conjunctivoplasty with suturing of the fistula found at the time of operation was done. Tension rose to 34 mm. Hg. (Schiötz) but was easily controlled by pilocarpine hydrochloride 2% t.i.d. Since May, 1944, tension has remained normal but visual acuity has decreased to 3/200.

CASE 7.—Mrs. D. D., aged 66, had a trephining with peripheral iridectomy, left eye, for chronic wide-angle glaucoma, May, 1942. Ten months later she complained of tearing, but examination

showed a quiet eye with a tension of 19 mm. Hg. (Schiötz). In April, 1945, she again complained of tearing and also of blurred vision. Examination revealed no change in visual acuity; ocular tension was 10 mm. Hg. (Schiötz), there was mild circumcorneal injection, the anterior chamber was shallow and leakage of aqueous from the filtering cicatrix could be demonstrated with fluorescein. A conjunctivoplasty with suturing of the wound was done. Tension rose to 53 mm. Hg. (Schiötz) but was controlled by pilocarpine hydrochloride 2% t.i.d. The patient was not seen again until November, 1948 (in the interim she had had an iris inclusion operation, a cataract extraction and a cyclodialysis performed elsewhere), at which time she was using furmethide q.i.d. and eserine ointment at night. Tension was 20 mm. Hg. (Schiötz), corrected vision was 20/40, the anterior chamber contained vitreous, iris pillars were incarcerated, optic disc and visual fields were unchanged.

CASE 8.—G. W., aged 50, had a trephining with peripheral iridectomy, both eyes, for chronic wide-angle glaucoma, November, 1939. Anterior chamber, left eye, did not re-form for 14 days. In April, 1945, the patient complained of pain, left eye. Examination showed mild conjunctival injection, vision 20/15−, tension 6 mm. Hg. (Schiötz) and a filtering cicatrix with a very thin covering of conjunctiva. Silver nitrate 1% was applied to the cicatrix. The eye became white, there was no evidence of leakage of aqueous, but the tension was too low to register on the tonometer. On May 9, 1945, a conjunctivoplasty with suturing of fistula disclosed at operation was performed and the tension became 15 mm. Hg. (Schiötz). Vision and tension have remained normal and there has been no field change since then.

CASE 9.—C. D., aged 52, had an intracapsular cataract extraction with two peripheral iridectomies, left eye, on June 23, 1943. Anterior chamber did not re-form until the seventh postoperative day and an anterior synechia extending from 12 to 1:30 o'clock and involving full radius of the iris developed. Tension was normal and vision was 20/15. In December, 1943, the patient complained of tenderness and blurring of vision, left eye. The eye appeared quiet, vision was 20/15 and tension was normal. In May, 1944, tension was very low but other findings were unchanged. Symptoms persisted, but tension and appearance of the eye remained normal until October 31, 1945, when the patient complained of pain, photophobia and blurred vision. Examination revealed a cystoid cicatrix extending from 2 to 3 o'clock at the limbus, normal interior of the

eye and very low tension, but no definite leakage of aqueous. Six weeks later the tension was still low, vision was 20/70−, the anterior chamber was shallow and leakage of aqueous from the filtering cicatrix was demonstrable by fluorescein. On December 7, 1945, a conjunctivoplasty with suturing of the fistula was done. One month later tension was 41 mm. Hg. (Schiötz). Miotics have been used successfully with only occasional rises in pressure. Vision is 20/20−, there is cupping of the disc and a nasal step is present in the field.

CASE 10.—Mrs. A. M., aged 62, had an attempted intracapsular cataract extraction with complete iridectomy, right eye, July, 1944. There was difficulty in placing a corneoscleral suture at 11 o'clock. In November, 1944, the patient complained of intermittent pain and tearing. Examination revealed a very small, thin, filtering cicatrix at the limbus at 11 o'clock with the temporal iris pillar incarcerated here. Symptoms persisted but tension remained normal and leakage of aqueous could not be demonstrated by fluorescein. In December, 1945, tension was low, vision was 20/20−2 and there was a fistula in the area of the cicatrix through which leakage of aqueous was shown by fluorescein. A conjunctivoplasty with suturing of the fistula was performed. Tension rose to 35 mm. Hg. (Schiötz) but returned to normal without the use of miotics. Patient is now comfortable, tension is normal, vision is 20/20−2, and there has been no recurrence of the filtering cicatrix.

CASE 11.—Mrs. A. H., aged 65, had an intracapsular cataract extraction with peripheral iridectomy, left eye, January, 1946. A small anterior peripheral synechia developed at 1:30 o'clock. In September, 1946, the patient complained of pain, irritation and black spots. Vision was 20/25+, tension was 13 mm. Hg. (Schiötz), there were fine vitreous opacities and a filtering cicatrix was present at 11 o'clock. Examination was unchanged but the patient complained of blurred vision and tearing until July 2, 1947, when a conjunctivoplasty was performed. After excising the cicatrix, a fistula seen at the limbus was sutured. The cicatrix has not recurred, the patient is comfortable, tension is normal and vision is 20/15.

CASE 12.—Mrs. J. S., aged 47, was first seen in November, 1947, complaining of failing vision, discomfort and tearing. Two years previously she had had an extracapsular cataract extraction with complete iridectomy elsewhere. Examination showed vision of 20/40+ and tension of 5 mm. Hg. (Schiötz). Both iris pillars were

incarcerated in the cataract section, there was a large filtering cicatrix with a thin conjunctival covering above the superior limbus, but no leakage of aqueous was demonstrable. Conjunctivoplasty was performed on December 10, 1947. A fistula found beneath the conjunctiva in the area of the old cataract section was sutured. Tension rose to normal, vision is 20/25 and there has been no recurrence of the cicatrix.

CASE 13.—Mrs. J. N., aged 62, had an intracapsular cataract extraction with peripheral iridectomy, left eye, May, 1947. Pupil was updrawn at the first dressing and a small subconjunctival iris prolapse was present in the wound at 1 o'clock on the eighth day. A cystoid cicatrix developed in the area of the prolapsed iris, vision was 20/40 and the patient could read the smallest print. In February, 1948, she returned, complaining of tearing and difficulty in reading. Vision was 20/70 and she could read Jaeger 9 with difficulty. Tension was low, anterior chamber and fundus were normal. In the area of the cystoid scar at 12 o'clock a leaking fistula was demonstrated by fluorescein. Conjunctivoplasty with suturing of the fistula and a complete iridectomy of the prolapsed iris were done. Tension is now normal, vision is 20/40 and there has been no recurrence of the cystoid cicatrix.

CASE 14.—Mrs. N. T., aged 72, was first seen in December, 1948, complaining of tearing and aching of the left eye. She gave a history of intracapsular cataract extraction with complete iridectomy in May, 1948. Examination showed a corrected vision of 20/20, tension of 10 mm. Hg. (Schiötz), deep anterior chamber and temporal iris pillar incarcerated in the wound. A cystoid cicatrix, 5 by 3 mm. was present between 11 and 12 o'clock at the limbus, and through this an opening in the wound could be seen. Gonioscopy showed the synechiae to be present only at the edges of the pillar and iris stump. Conjunctivoplasty with suturing was done on December 15, 1948. When last seen 2 months postoperatively the patient was comfortable, vision was 20/20, tension was 15 mm. Hg. (Schiötz), the conjunctiva at the upper limbus was flat and the wound firmly closed.

CASE 15.—Mrs. C. W., aged 64, was first seen in January, 1949, complaining of tearing, blurred vision and some intermittent photophobia. She gave a history of intracapsular cataract extraction with complete iridectomy in May, 1948. Examination showed a vision of 20/25−, low tension, and incarcerated iris pillars. A large filtering cicatrix extended from 12 to 2 o'clock, where the edges of the

cataract section were in poor apposition and were lined with iris tissue. Vitreous filled most of the anterior chamber but was not in contact with the cornea. Leakage of aqueous was demonstrated with fluorescein after which the vitreous was seen in apposition to the posterior surface of the cornea. Conjunctivoplasty with suturing of the fistula was done. The patient is now comfortable, tension and vision are normal and there has been no recurrence of the filtering cicatrix.

Results

This surgical procedure has been used in 15 cases. In one of them the original operation was an iridencleisis, in 2 a trephining and in 12 a cataract extraction. Analysis of the results obtained shows that in 13 cases the fistula was closed and useful vision restored. In one instance a cystoid scar persisted and 18 months later fistulization recurred. A second conjunctivoplasty with suturing resulted in firm closure with obliteration of the filtering cicatrix. In 2 other cases satisfactory closure of the fistula was effected but the vision gradually failed. In one of them, a coexisting epithelization of the anterior chamber was responsible for the visual loss while in the other one, an advanced glaucoma, the vision continued to deteriorate in spite of restoration of normal ocular tension. In 5 instances the operation was followed by glaucoma. In 2 of these 5 cases the rise in ocular tension was evidently transitory, because after a few days' use of miotics the ocular tension became normal and has remained so without medication. In 2 others the ocular tension has been controlled by the continued use of miotics, while in 1 it has been normalized by a second glaucoma operation (the original procedure was a trephining) performed elsewhere 2 years after the closure of the fistula.

Summary

The signs and symptoms of slow or intermittent leakage of aqueous are characteristic. Lacrimation, blurred vision and hypotony, all of which may be intermittent, are most sugges-

tive of fistulization even though the anterior chamber is normal in depth. Since the fluorescein test is not always positive, repeated examinations may be necessary to establish the diagnosis. Prompt treatment effects a cure. In our hands the method of choice has been a combination of cauterizing the opening, suturing its edges and covering it with a conjunctival flap.

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DISCUSSION

DR. PETER C. KRONFELD, Chicago, Ill.: The paper by Drs. Dunnington and Regan deals with unintentional filtering scars which interfere with the normal function of the eye by causing subjective discomfort and, in some cases, visual impairment. Subjective discomfort, that is, a mild intermittent eye ache associated

with tearing, is a fairly common and generally recognized symptom of overefficient filtering scars. I like to use the word overefficient; I like to think of these filtering scars as scars that function just a little too well, better than we expect them to work, and I would not use the word slight fistulization because the actual output of fluid of these scars is considerably greater than in the type of scars we produce ordinarily. This is a filtering scar of greater efficiency—using Dr. Verhoeff's terminology, of greater capacity. Very little, however, has been known about visual disturbances related to overefficient filtering scars. Here the observations of Drs. Dunnington and Regan fill an important gap. The evidence presented, I believe, proves conclusively the existence of a characteristic visual impairment related to marked ocular hypotony. Some of the observations made on these patients are very interesting and I believe for the first time in the literature a comprehensive and complete picture of the visual disturbances related to ocular hypotony has been drawn in this paper. As a matter of fact, the visual impairment is more definitely related to persistent ocular hypotony than the ocular discomfort which, in part at least, may be due to periodic sudden escape of considerable amounts of fluid ("bursting of the bubble"). Visual disturbances of this type have been described before, chiefly after perforating injuries in eyes in which papilledema was a conspicuous sign of the ocular hypotony. I wonder if papilledema was present in any of the essayists' cases.

I remember a case of the late Dr. Sanford Gifford's which he quoted, and I believe he quoted it before this Society, in which he did not become aware of the fistulization until he used a subconjunctival injection of novocain prior to retinal detachment operation. It was a type of retinal edema which Dr. Dunnington describes very well, but not until the anterior chamber disappeared, and as Dr. Gifford started to inject the novocain under the conjunctiva, did he become aware of the fistulization.

In about half of these cases the filtering scar was of such size that it was easily detected. In the other half the filtering scar was very inconspicuous and could easily have been overlooked. How many of such cases I have missed only my colleagues in Chicago can tell. I would think that careful biomicroscopic examination of the area of operation would be more reliable and give more consistent results than the macroscopic fluorescein test.

The essayists have obviously been very successful in the treatment of this condition. If the object of the treatment is the permanent elimination of the filtering scar anything short of actual

closure of the scleral fistula will rarely be effective. I learned that lesson in China where corneal fistulas, because of their frequency, are much more of a problem than the unintentional filtering scars after cataract extraction. After trying cauterizations and conjunctivoplasties of various kinds without appreciable success we finally resorted to closure of the fistula by keratoplasty and solved our problem.

Before plugging or suturing a corneal or scleral fistula we should ask ourselves whether the eye in question will be able to get along without it. A well-functioning filtering scar is such an asset to an eye that needs it that overaction of any such scar calls for careful estimation of the state of dependency of the eye in question upon the filtering scar. I am not sure that this can be done in every case. In cataract cases gonioscopy should be helpful in making such estimates. In glaucoma cases a modified ocular compression test (Transactions Pacific Coast Ophthalmological Society, 1949) may be of value. In the essayists' cases there were eyes that proved dependent upon the filtering scar. In such cases I would prefer repeated heat coagulations of the borders of the thin portions of the bleb. In our hands this method has proved satisfactory for the purpose of reducing the efficiency of a filtering scar. If, after careful examination, the eye in question appears not to need a filtering scar, I am entirely in accord with the essayists as to the advisability of radical closure of the scleral fistula.

There is perhaps one small point on which I differ with Drs. Dunnington and Regan. Dr. Dunnington implied that a positive fluorescein test is dependent on an epithelial leak, in the absence of epithelium over at least one small area. I feel that a positive fluorescein test is the result of the ready passage of watery aqueous through a surface which in most instances carries intact epithelium, but that is a very small point. I believe that Drs. Dunnington and Regan have made a very important contribution by calling our attention to cases of very small, inconspicuous leaks. I am sure I have overlooked such cases, and by having been made aware of this condition I think quite a few of our operative failures will become successful.

DR. WILLIAM M. BANE, Denver, Colo.: Possibly these remarks may not be entirely applicable to this paper, which I enjoyed very much, but there is one thing that occurred to me, which may have some practical value in the prevention of fistulization at the site of an operative wound. We usually inspect the operated eye the day after surgery has been performed, and in an occasional case have

found a drawn-up pupil and a small prolapse of the iris into the wound under the conjunctival flap. I believe it is very important not to watch such a condition for any length of time, nor wait for it to heal spontaneously and flatten out. It is a comparatively simple matter, and a perfectly safe procedure when a prolapse is discovered, to return the patient to surgery, release the conjunctival flap from the bulging iris and replace the iris into its normal position if possible, otherwise excise it. It will be found that the scleral incision is fairly solidly healed except for the narrow slit through which the iris has prolapsed. With a small curette or the blade of a needle knife any remains of adherent iris are removed from the lips of the scleral aperture, and then the edges of this aperture are sutured together, as described by Dr. Dunnington. If more of such cases were repaired within 24 or 48 hours after the condition is discovered, we might have fewer cases of fistulization to deal with at a later date.

DR. JOHN H. DUNNINGTON, closing: I want to thank the discussers for bringing out some of these points.

As stated in the paper, papilledema may result from prolonged hypotony. One of our cases was referred with the diagnosis of flat detachment of the retina and edema of the optic nerve. These findings promptly disappeared with closure of the fistula.

The possibility of preventing the condition by prompt treatment of iris prolapse is an interesting speculation. In none of our cases was there an actual prolapse although in most of them the iris was sufficiently incarcerated to produce a slight irregularity of the pupil.

There was no causal relationship between the type of suture used and the kind of extraction performed. Dr. Kronfeld has raised an interesting question as to whether or not the conjunctival epithelium is intact. Clinically these wounds show external fistulization, and a positive fluorescein test can be demonstrated in the vast majority of them. Many patients with large cystoid cicatrices and low ocular tension (5 to 7 mm. Hg. Schiötz) without external fistulization have no discomfort and do not belong to this group. In my opinion, the symptom complex which we are discussing arises only when there is external fistulization.