CRYOSURGERY FOR THE TREATMENT OF GLAUCOMA

BY *Andrew de Roetth, Jr.*, M.D.*

CRYOSURGERY FOR THE TREATMENT OF GLAUCOMA was first reported by Bietti[1] in 1950. Last year Polack and de Roetth[2] and also McLean and Lincoff[3] published their experiences with this new method; these authors showed that when subfreezing temperatures are applied to the area of the ciliary body of normal rabbit eyes the intraocular pressure of these eyes will fall due to a partial destruction of the ciliary epithelium. Most of this work was done on rabbit eyes; only a few human eyes were included in these early publications. Therefore it seemed that a clinical evaluation of this new technique was indicated and with that purpose in mind the following investigation was undertaken. The present paper is an initial clinical report; it describes the fate of 133 human glaucomatous eyes treated with subfreezing temperatures in order to decrease the intraocular pressure. The technique, the postoperative course, and the complications are discussed and the proper significance of this new antiglaucomatous method is evaluated in this report.

MATERIALS AND METHODS

The majority of the patients were from the Glaucoma Clinic of the Institute of Ophthalmology; some were private patients referred to the clinic for the cryosurgical treatment. All patients were carefully evaluated clinically before and after the treatment and whenever possible, applanation tensions were employed; 95 per cent of the tensions referred to in this investigation were taken with the applanation tonometer. The main reason for this preference for the applanation tonometer was an attempt to eliminate the effect of possible changes in the scleral rigidity; during the early part of this work, it was thought

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that these subfreezing temperatures might influence the scleral rigidity of the treated eyes.

During the first year of this investigation, cryosurgery was performed with a simple, homemade metal tube (Figure 1) containing a mixture of dry ice and absolute alcohol as the cooling agent. This cold "cocktail" had a constant temperature of —79° C.; the tip of the probe was oval-shaped, flat, with a surface area of 12 square millimeters. This was placed directly on the conjunctival surface of the eye (Figure 2) with the center of the tip about 4 mm. from the limbus, the tip thus being directly over the ciliary body. Six such applications were made, each lasting for one minute (Figure 3).

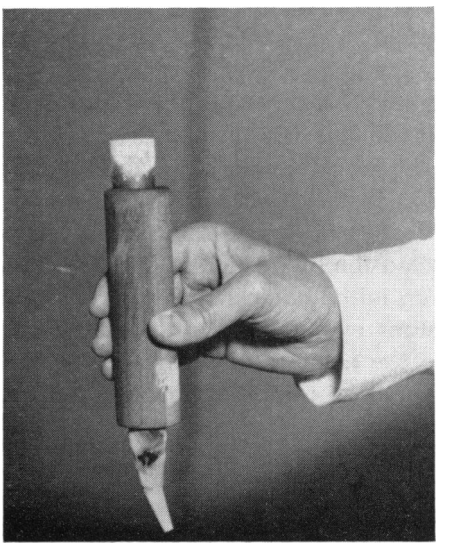

FIGURE 1
Metal tube containing mixture of dry ice and absolute alcohol.

This treatment was performed under local anesthesia, consisting of Ophthaine drops and retrobulbar injection of 2% Xylocaine. One of the advantages of cryosurgery is that it can be done as an outpatient procedure. Only ten of the patients studied were hospitalized. Four of these hospitalized patients were children and the treatment was given to them under general anesthesia for obvious reasons. Following cryosurgery the eyes were patched for two days and then treated daily with Neocortef ointment and homatropine drops for two to three weeks.

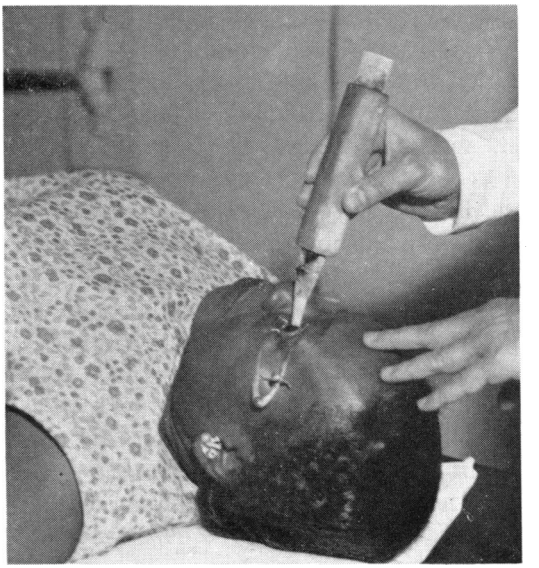

FIGURE 2
Application of metal tube, containing dry ice and absolute alcohol, to patient's eye.

PROCEDURE

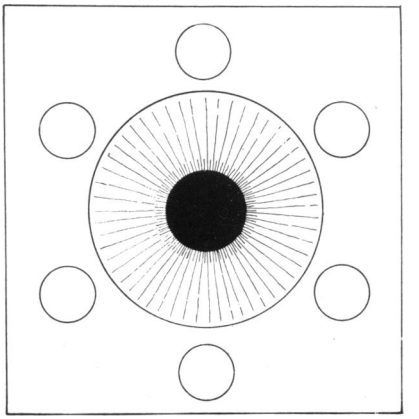

FIGURE 3
Diagram showing position of six freezing applications on the eye.

During the second year of this study the Union Carbide Company's cryosurgical unit was employed with a specially constructed probe (Figures 4 and 5); this hand-held probe contained liquid nitrogen as the coolant and it had a circular, flat-surfaced tip, with a diameter of four millimeters and a surface area of 12 square millimeters. This unit was described in great detail last year by McLean and Lincoff.[3] Its main advantage is that one can vary the temperature from +4° to —190° C. and one can maintain any desired temperature with great accuracy. The main disadvantage of the homemade metal tube containing the dry ice-alcohol mixture is that one cannot vary its temperature; it always stays at —79° C. Preliminary experiments indicated that for our purposes, that is, in order to safely and efficiently lower the intraocular pressure, the optimum probe temperature is —80° C. Therefore, during the course of this study the Union Carbide unit was set at —80° C. In all other respects the method was the same as described above for the dry ice and absolute alcohol mixture.

A note of caution should be expressed here concerning the temperatures mentioned. For instance, the temperature of —80° C. that was employed with the Union Carbide machine merely indicates that the tip of the probe which was in contact with the conjunctiva, maintained a temperature of —80° C. throughout the treatment. This does not

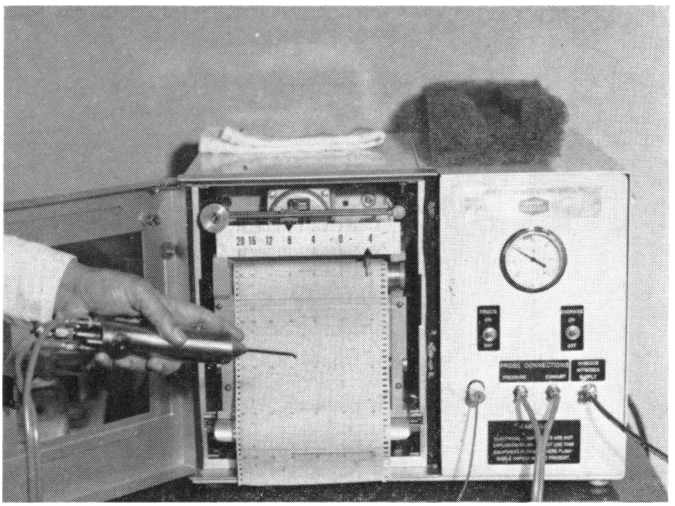

FIGURE 4

Cryosurgical unit manufactured by Union Carbide Company, showing control box and hand-held probe.

FIGURE 5
Application of cryosurgical hand-held probe, containing liquid nitrogen, to patient's eye.

mean that the temperature at the affected site, the ciliary body, was also —80° C. The fact is that we do not know what the temperature was at the ciliary body or at any other place inside the eye. The temperatures mentioned here merely indicate the temperatures at the tip of the probe, the part of the instrument that comes in contact with the eye.

All the standard glaucoma diagnostic tests were carried out on these patients, such as Schiotz and applanation tonometry, tonography, gonioscopy, visual fields, provocative tests, etc. A great many of these patients had had one or more glaucoma operations in the past, and their medical treatment included a large variety and combination of antiglaucomatous drugs. Most of these eyes had advanced disease with only limited vision remaining; some were blind; and a few had only early disease. An attempt was made to include as many types of glaucoma and as many degrees of disease in this study as possible in order to evaluate the usefulness of this new method for all varieties of glaucoma.

RESULTS

During the past two years 165 human glaucomatous eyes were treated with cryosurgery in order to help control their tension; the procedure was done a second time on 12 eyes but none was treated for a third time. Because of insufficient follow-up visits, 32 eyes were

not included in this evaluation. The remaining 133 eyes were followed after treatment for an average of 14 months, the longest follow-up being 24 months and the shortest 6 months. Practically all of these eyes showed a marked conjunctival reaction, chemosis, injection, tearing, and a mild iritis for two to three weeks after treatment, requiring conservative medical treatment. Invariably, their tension fell soon after surgery and remained below pretreatment levels for several weeks or months; then slowly the tension began to rise in many eyes and ended up at the same level as before cryosurgery. However, in none of these eyes did the tension rise above the pretreatment levels.

TABLE 1. EFFECT OF CRYOSURGERY ON THE INTRAOCULAR PRESSURE OF GLAUCOMATOUS EYES

Type of glaucoma	*Number of eyes*	*Intraocular pressure**		
		Normal	*Elevated*	*Borderline*
Chronic simple	96	57	23	16
Chronic narrow angle	12	4	5	3
Congenital	5	1	2	2
Secondary	20	4	8	8
TOTAL	133	66	38	29

*Normal indicates tensions consistently below 20. Elevated means pressures usually above 20 and borderline signifies tensions varying from normal to elevated, back and forth.

Table 1 shows the effect of cryosurgery on the intraocular pressure of these 133 glaucomatous eyes; the tension was normalized in 66 eyes and it was not improved in 38 eyes. The remaining 29 eyes showed labile tensions after treatment; occasionally they were in the normal range, but often they showed elevated tensions. For the purposes of this discussion 20 was taken arbitrarily as the dividing line between normal and elevated tensions. Repeated checks with both the Schiotz and applanation tonometers failed to indicate any change in scleral rigidity following cryosurgery. In other words, the tension readings taken with these two methods agreed with each other; the difference between the two methods was never more than three or four millimeters of mercury.

Table 1 also indicates that as far as these tensions are concerned, cryosurgery seems to be more effective in chronic simple glaucoma than in the other categories listed, that is, chronic narrow-angle, congenital, and secondary glaucomas. There were 20 eyes with secondary glaucoma in this investigation, representing about 10 different varieties of disease. To list them individually would have been useless; com-

bined, however, they represent a mathematically significant group.

Patients with early or acute angle-closure glaucoma were not included in this study. Since the primary surgical treatment (iridectomy) of this disease is so obvious nowadays and also most satisfactory, it was thought best not to try cryosurgery in such eyes. However, once iridectomy had been performed on these cases, and they thus became eyes with chronic angle-closure or narrow-angle glaucoma, the situation looked entirely different. Cryocautery was done on 12 of these eyes with chronic disease where the tension remained elevated even after iridectomy and medical treatment. The freezing treatment served a secondary, supplemental role in these eyes with limited success. In four eyes the tension was normalized, in five eyes it remained elevated, and three were borderline.

There were only five eyes with congenital glaucoma in this study; the intraocular pressure remained normal in only one of these five following freezing.

TABLE 2. EFFECT OF CRYOSURGERY ON THE INTRAOCULAR PRESSURE OF EYES WITH CHRONIC SIMPLE GLAUCOMA

Extent of disease	*Number of eyes*	*Intraocular pressure*		
		Normal	*Elevated*	*Borderline*
Advanced disease	75	49	15	11
Early disease	21	8	8	5
TOTAL	96	57	23	16

*Normal indicates tensions consistently below 20. Elevated means pressures usually above 20 and borderline signifies tensions varying from normal to elevated, back and forth.

Table 2 shows the effect of cryosurgery on the intraocular pressure of 96 eyes with chronic simple glaucoma. This table illustrates that the best results were obtained in eyes that had advanced disease; 49 of them showed normal tensions, 15 had elevated pressures, and 11 were borderline.

CASE HISTORY

Eye #12 illustrates this point well. This was a 58-year-old woman with advanced chronic simple glaucoma; she first knew of her disease in 1950. She had wide open angles without any synechia, marked cupping, and visual field loss when first seen in our clinic in 1956. Iridencleisis was performed on this eye in 1959 with no success. By 1963 her visual acuity was reduced to 20/70 and the visual field was markedly constricted as shown in Figure 6.

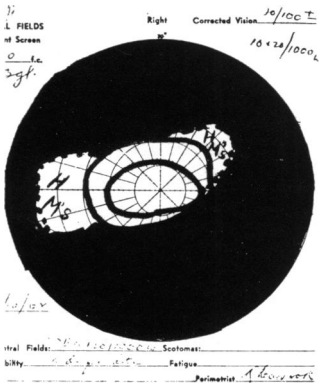

FIGURE 6
Visual field of eye #12—patient with advanced chronic simple glaucoma—showing marked field loss.

Her medical treatment consisted of Phospholine Iodide 0.25% and Eppy drops twice daily and 1000 mg. of Diamox daily; in spite of all this her tension ranged around 28–30. Cryosurgery was performed on this eye in June of 1963. For the past 22 months her tensions have been maintained around 14–17, her visual field changes have not progressed, and she is taking Phospholine Iodide drops only, but no Eppy or Diamox. In other words, cryosurgery helped to control the glaucoma in this eye with advanced disease for almost two years; furthermore, her glaucoma is better controlled now, even though she is using less medication than before treatment.

In eyes with early chronic simple glaucoma on the other hand, cryosurgery produced normal tensions in eight eyes only, while eight had elevated pressures and five were borderline.

CASE HISTORY

Eye #38 illustrates the fate of cryosurgery in an eye with early chronic simple glaucoma. This patient is 40 years old now and has known of his disease for six years. In 1960 iridencleisis was performed on this eye without any improvement in the glaucoma; he has used a large variety and combination of drops but could not tolerate any carbonic anhydrase inhibitory agents. His visual acuity and visual fields were normal as seen in Figure 7 and his tensions ranged around 26–30. Cryosurgery was done on this eye in November, 1963, with good initial result; tension stayed down around 15 for two months and then went back up to 28 again. This case illustrates that cryosurgery is usually not effective in early chronic simple glaucoma, particularly when the patient is relatively young.

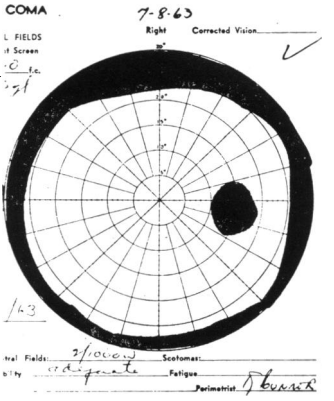

FIGURE 7
Visual field of eye #48—patient with early chronic simple glaucoma—showing normal field.

The two case histories described above were selected because they illustrate so nicely the results shown in Table 2. Needless to say there were many eyes that did not demonstrate such clear-cut results; there were some "borderline" or "in-between" cases. This was the main reason for including a so-called "borderline" group of results, next to the well-controlled or obviously uncontrolled glaucomas.

Another problem of classification must be mentioned at this point. While it was relatively easy to place eye #12 in the group of eyes with advanced chronic simple glaucoma and eye #38 in the category of early chronic simple glaucoma, there were many eyes that defied simple classification. The very nature of chronic simple glaucoma is so variable, that practically every eye is a separate group by itself. Therefore, many arbitrary decisions had to be made during the course of this investigation, in order to put all eyes with chronic simple glaucoma in two groups, namely early and advanced. The chief criteria for this classification were the visual field and cupping of the optic disk, indicating the functional loss due to the disease.

Besides lowering the intraocular pressure, cryosurgery also lessened the need for medication in these eyes, many of the treated eyes requiring substantially less medication after freezing. Forty-five of the eyes in this study were treated by one of the carbonic anhydrase inhibitory agents at the time of cryosurgery; following freezing only 12 of these eyes still needed Diamox or an allied drug. In other words the need

for a carbonic anhydrase inhibitor agent was eliminated in 33 eyes following cryosurgery.

The reason for employing the intraocular pressure as the main guide line, indicating the level of glaucoma control in this study, was that in glaucoma work in general the tension is still considered one of the most important criteria. Other parameters of this disease, such as visual acuity, visual field, etc., are more difficult to compare for research purposes because they are difficult to report objectively. Nor do they lend themselves conveniently for the purposes of preparing tables or charts. Furthermore, other ocular diseases, such as cataracts, macular degeneration, etc., will also produce changes in visual acuity and visual fields, thus complicating the picture. The intraocular pressure, on the other hand, is affected only by the glaucoma itself, as a rule, thus making it a better criterion in trying to evaluate the effect of cryosurgery. As far as could be determined, cryosurgery itself had no effect on the visual acuity and visual fields of these eyes. Tonography was of little interest in this study; there was considerable individual variation both before and after freezing and therefore tonography was not used in the evaluation of this new method.

The complications of this new procedure were minimal, consisting mainly of an iridocyclitis in about 25 per cent of the treated eyes, which lasted for several weeks and responded well to conservative treatment. In five of these eyes the iritis was not recognized or properly treated; they developed posterior synechias and secondary cataracts. However, these were secondary cataracts due to the synechia and not produced by the freezing itself. During the period of this study, two years, cataracts were not produced by the subfreezing temperatures applied to these eyes. In some of the treated eyes biomicroscopic examination showed a slight flare in the anterior chamber which sometimes persisted as long as one year after treatment. However, these eyes were white, not tender or painful, and showed no other sign of inflammation.

Serious complications such as soft, atrophic eyes, malignant glaucoma, or intraocular infections were not encountered in this study. One patient had an extensive choroidal separation, probably due to a hemorrhage.

DISCUSSION

One of the reasons for the development of cryosurgery in the treatment of glaucoma has been the failure of cyclodiathermy to live up to its early expectations. Lately it has fallen into relative disuse. At the Institute of Ophthalmology in New York 166 cyclodiathermies were

performed in 1947, at the peak of the method's popularity; in 1963 only eight cyclodiathermies were done at our hospital, illustrating the lack of enthusiasm for this procedure.

Cryosurgery cannot be compared to the filtering operation; this attempts to improve the outflow facility of the eye and thus is, and probably will remain, the primary choice in glaucoma surgery. Cryosurgery and cyclodiathermy are secondary procedures, since they do not attack directly the mechanism that is responsible for the elevated tension in practically all types of glaucoma. They act indirectly, lowering the intraocular pressure by decreasing the aqueous inflow. Therefore, at best, they will remain secondary surgical procedures in the treatment of glaucoma. However, as such they can still perform a useful function, since so often the primary surgical procedure, the filtering operation, is a failure.

Thus it is important to place cryosurgery in proper perspective and compare it to the only other antiglaucomatous surgical procedure of its kind, namely cyclodiathermy. The present study indicates that it compares quite favorably with cyclodiathermy; the subfreezing temperatures, as described above, are considerably less destructive to the eye than the diathermy treatments. For instance, the conjunctiva and the sclera are not injured by this new method, whereas with cyclodiathermy both of these tissues show evidence of considerable damage at times. Also, none of the cold-treated eyes had to be removed; it is a well-known fact that a number of the eyes treated by diathermy had to be enucleated eventually.

A word of caution should be expressed at this time. Just because no major complications were seen so far in this clinical study does not necessarily mean that they will not happen in the future; it only means that they have not occurred up to this point. This is one more reason why a long follow-up period is essential in order to evaluate a new surgical method; the present report is merely a preliminary one, describing the results observed during the first two years of this investigation.

Besides being less destructive than cyclodiathermy, cryosurgery appeared to be more useful than the diathermy method in the treatment of glaucoma. It is most effective in eyes with advanced chronic simple glaucoma, eyes that have marked glaucomatous cupping and advanced visual field loss. In many of these eyes cryosurgery can control the pressure and thus may help to ward off complete blindness. Cryosurgery can be helpful also by decreasing the amount of medication used by the patient. This can be of real practical importance when

one considers some of the patients who need as much as 1000 mg. of Diamox daily; eliminating the necessity to take Diamox can be a real blessing to these patients. Even if cryosurgery would do nothing else, that by itself would make this new method very worthwhile.

It is interesting to speculate about the mechanism of action of this new technique and why it appears to be effective in advanced disease. It is well known that in advanced chronic simple glaucoma one often sees atrophy of the ciliary body; cryosurgery then is carried out on an eye that already has damaged ciliary body function. This added insult to the ciliary body will result in a decreased rate of aqueous secretion and thus a fall in the intraocular pressure ensues. Conversely, in eyes with early disease, good visual fields and presumably normal ciliary body function, cryosurgery will often be ineffective or only of minimal help, because the amount of ciliary body destruction resulting from the freezing procedure is apparently not sufficient to significantly lower the rate of aqueous production. This can be seen also in many of the younger eyes included in this series: e.g., young adults with early chronic simple glaucoma or secondary glaucoma of various types, or children with congenital glaucoma. All of these eyes presumably had normal or near normal ciliary body function and therefore they were not substantially affected by the cryosurgery.

This hypothesis might explain the reason why the results were relatively poor in eyes with secondary glaucoma, of almost any cause, young or old. Although many of these eyes with secondary glaucoma were practically blind by the time cryosurgery was performed on them, their glaucoma often was of relatively short duration, consisting of a few months only. This length of time might not be sufficient to affect the ciliary body and thus cryosurgery was done on relatively healthy ciliary bodies in this group of eyes with secondary glaucoma.

However, when one contrasts this with chronic simple glaucoma, the situation is entirely different. In the first place, many of these patients were old, but most important of all, their disease usually was present for many years before the freezing treatment was applied. Therefore, one might assume that these eyes had considerable ciliary body atrophy already by the time cryosurgery was done on them.

Of course, one could overcome this difficulty in young eyes or eyes with early disease by substantially lowering the temperature—using −140° C. instead of −80° C., by employing more than six applications, and by increasing the time of applications. Such a change in the technique would result in the destruction of even the healthiest of ciliary bodies and thus lower the intraocular pressure. However, such

methods would be extremely hazardous; they could result in serious complications and even loss of the eye, as described last year by McLean and Lincoff.[3] To maintain cryosurgery as a relatively safe method it is imperative that these extreme temperatures should be carefully avoided. From the practical, clinical point of view, it is more important to have a safe, albeit limited procedure, than a method that is more effective but also much more dangerous.

There is another possible explanation for the mechanism of action of this new procedure. Many of the treated eyes showed a slight flare in the anterior chamber, indicating an increased amount of protein in the aqueous; occasionally this flare persisted for as long as a year or more after cryosurgery. This probably indicates that freezing partially destroyed the blood-aqueous barrier. Such partial breakdowns in the blood-aqueous barrier usually result in lowered intraocular pressures. Therefore, one might say, that this so-called minor complication is actually a blessing in disguise, since it might be partly responsible for the lowered intraocular pressure after freezing.

There is a further possible explanation for the mechanism of action of this new technique. Polack and de Roetth[2] demonstrated last year that when cryosurgery was performed on normal rabbit eyes, the ciliary body atrophy was followed by regeneration of most of the damaged ciliary epithelial cells. These rabbits were young, healthy animals with presumably normal ciliary bodies. If this information is applied to human eyes, we might expect some regeneration to take place in the ciliary bodies of healthy, young individuals following cryosurgery. This might explain why in young patients with early disease the tension lowering effect of cryosurgery was so short-lived, often lasting only one or two months, and was followed by a rise in tension to pretreatment levels, indicating a possible regeneration of the damaged ciliary body. In elderly individuals, however, the damaged ciliary body is less likely to regenerate; therefore the pressure lowering effect of cryosurgery will be more lasting in this older age group.

SUMMARY

Cryosurgery was performed on 133 glaucomatous eyes and these eyes were followed clinically for an average of 14 months. As far as the effect on the intraocular pressure is concerned, the best results were obtained in eyes with advanced chronic simple glaucoma. In eyes with early disease, in eyes of younger individuals, and in many secondary glaucomas this new procedure was less effective. The complications so

far were only minor, mainly because the temperature was never lowered below —80° C.

This preliminary clinical report indicates that cryosurgery will probably displace cyclodiathermy and that it will become a useful, although somewhat limited adjunct in our armamentarium of anti-glaucomatous procedures.

REFERENCES

1. Bietti, G., Surgical interventions of the ciliary body, J.A.M.A., 142:88, 1950.
2. Polack, F. M., and A. de Roetth, Jr., Effect of freezing on the ciliary body (cyclocryotherapy), Invest. Ophth., 3:164, 1964.
3. McLean, J. M., and H. A. Lincoff, Cryosurgery of the ciliary body, Tr. Am. Ophth. Soc., 62:385, 1964.

DISCUSSION

DR. JOHN M. MCLEAN. As Dr. Roetth pointed out in his introductory remarks, last year on this subject I was the speaker and he was the discusser, and this year the roles are reversed. So, too, is the subject matter. For last year we talked about the animal experimental results. This year we are talking about clinical results.

I must say that today's speaker is shot through with luck. He began with one temperature range which was conveniently available to him, and happened to light on almost exactly the best one. As it happens, if one wishes to use this approach to human glaucoma, a simple, homemade gadget such as he showed you can be put together inexpensively and do a perfectly adequate job.

But how useful is this approach in human glaucoma? I am not yet sure that it has much of a role to play. Our animal work indicated that there is a very narrow margin between undertreatment that provides only temporary reduction of pressure and overtreatment that results in phthisis. Both our clinical trials and those reported to you this morning seem to have one finding in common. Early glaucomas, which presumably have relatively healthy ciliary bodies, are not benefited very much by cyclocryosurgery. Advanced glaucomas, that presumably have partially atrophied ciliary bodies, are more readily affected. This would seem to relegate the procedure to operations of desperation. The experimental animals, of course, have had healthy ciliary bodies. The whole picture seems to fit together.

I wonder if Dr. de Roetth has noted any racial difference in his clinical cases? Our animal studies show a substantial difference between densely pigmented, lightly pigmented, and albino animals. The heavier the pigmentation, the greater the effect. It would indeed be fortunate if the more pigmented humans who tend to respond less well to filtering operations would react better with cryosurgery.

Our studies are continuing and any remarks I make today must be considered as based on incomplete evidence. At the moment, I am sorry to say, I must regard ciliary freezing as in the same class with ciliary cooking—cyclodiathermy or cycloelectrolysis. These operations do produce conjunctival and scleral scarring while freezing does not. If one wishes to use a cyclodestructive maneuver, therefore, freezing is probably to be preferred on these grounds. So far as the primary purpose is concerned I see little to choose between them.

I hope Dr. de Roetth and his co-workers will continue this interesting work and be able to prove conclusively that the pessimistic attitude which I feel compelled to take on the basis of currently available information is unwarranted.

DR. FREDERICK W. STOCKER. It is now exactly 25 years since, at the Academy meeting, I proposed to use cyclodiathermy for chronic, simple glaucoma particularly in the colored race. Up to that time it had been used almost exclusively for desperate cases. It is very interesting to me to see that now, 25 years later, a similar principle of treating the ciliary body to reduce the inflow of aqueous has come up in the reverse way, by freezing rather than burning.

Now, what are the results if we compare them? Just recently Dr. G. T. Kiffney compiled the results in a fairly large series of cases treated by cyclodiathermy done by our group since 1945, and we were very much surprised that the long-range results actually were in general quite good, much better than we had expected. The results reported by other surgeons differ greatly. We think that they are very much dependent on the proper technique.

Whether the freezing technique will be ultimately preferable to diathermy, we cannot tell yet, but so far the results presented from freezing are certainly not better, and I believe not as good as we had with diathermy.

If the proper technique is used with diathermy, we have not seen any undue amount of conjunctival and scleral scarring. Nor did we see phthisis of the bulbus except in cases of acute hemorrhagic glaucoma or thrombosis of the central vein. But in the cases of chronic, simple glaucoma and aphakic glaucoma cyclodiathermy applied in the proper way does not cause phthisis of the bulbus. So far, at least, I have not been convinced that the freezing is better than the cyclodiathermy, although it works on a somewhat similar principle.

But I shall be open-minded and, if, in the future, freezing proves to be preferable, I shall be glad to switch to freezing.

DR. JAMES W. JERVEY, JR. I listened to Dr. de Roetth's paper with a great deal of pleasure. I am delighted to know that at least some effort is being made in New York City to treat some of these surgical patients on an outpatient basis.

I noticed the eye was patched for two days following this procedure, yet

we are told that the eyes are quiet and comfortable and white, and I would ask Dr. de Roetth, please, to let me know why the eye was patched at all?

DR. RAMÓN CASTROVIEJO. My experience with cyclodiathermy coincides with that of Dr. Stocker. I have been using it for 18 years and I have found it to be a very useful procedure. Years ago I used it in 500 unselected glaucomatous eyes to determine the indications for its use in narrow-angle, deep-angle, and secondary glaucoma.

For the past fourteen years I have not used it as a primary procedure as I now prefer filtering sclerectomies for the treatment of deep- and narrow-angle glaucomas. Between 10 and 15 per cent of the eyes treated are not controlled with filtering operations. This 10 to 15 per cent of uncontrolled glaucomas treated in this manner usually end in absolute glaucoma if the residual ocular hypertension is not controlled with cyclodiathermy.

In cases of aphakia, if it is observed immediately after operation as the result of anterior synechias to the incision, I use cyclodialysis to separate the iris from the incision and open the angle, but, if the aphakic glaucoma is discovered months, or even years, after the operation, cyclodiathermy is the operation of choice and superior to cyclodialysis which is more likely to cause intraocular hemorrhage.

As Dr. Stocker noted, when the results obtained by different surgeons vary so greatly, some finding that the effects of cyclodiathermy last only a few months while others find the effect to be permanent, it must mean that they are not using the same surgical procedure. Therefore, the term cyclodiathermy should be standardized to give the same values to all those participating in the statistical survey of this method.

DR. DE ROETTH, JR. I would like to thank all the discussers for their gracious comments.

Dr. Jervey, we patched the eyes because they are not white at the time we finish the procedure. These are injected eyes; there is a considerable amount of conjunctival edema. These eyes are painful, and that is why we patch them for a few days.

Dr. McLean is probably right in his assumption that pigmentation plays a part in this procedure. We used only albino rabbits in our experimental work, and our results were so poor at first in these albinos that we almost abandoned the whole project at that time. Our clinical results, however, were much better than our laboratory studies. The main reason for this was probably the fact that many of our patients were negroes, particularly the patients with advanced chronic simple glaucoma, and this was the group which responded best to this new procedure. Therefore, I believe that Dr. McLean is right when he states that the amount of pigment in the eye plays an important role in this new method.

As far as his pessimism is concerned, I believe only time will tell. He is an opponent of this new procedure, I am a proponent, and the rest of you will have to decide.