Nonperforating Thermometric Cyclodiathermy in Treatment of Hypertensive Uveitis

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NONPERFORATING THERMOMETRIC CYCLODIATHERMY IN TREATMENT OF HYPERTENSIVE UVEITIS

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IN 1942 we recommended the use of nonperforating cyclodiathermy in treatment of various forms of intraocular hypertension. Since then, we have endeavored to improve this operation and to determine its indications and the mechanism of its hypotensive effect.[1]

During this period, while all scientific exchanges between the United States and Belgium were cut off, Albaugh and Dunphy [2] described a similar operation. This, however, differs from ours in several points, which we shall comment on later.

NONPERFORATING THERMOMETRIC CYCLODIATHERMY

Diathermy Apparatus.—A diathermy electrode is applied to the eyeball at the posterior edge of the ciliary body, and the heating of the tissues (fig. 1) is effected with the high frequency current.

The apparatus has two circuits: One, the diathermy circuit, generates the high frequency current and produces the heating of the tissues; the other, the thermometer circuit, provides for the measurement of the tissue temperature.

It is not necessary to describe the diathermy circuit, as it has no special features. We use a bipolar current. The passive electrode is placed on the patient's back. The active electrode, placed on the eyeball, is made of a copper cylinder, 0.6 or 0.8 by 1 mm.

The thermometer circuit is made according to Coppez' [3] diagram (fig. 2). It includes a cold thermoelectric couple, immersed in ice, and a hot thermoelectric couple, placed on the eyeball at the same place as the active diathermy electrode. The manufacture of small thermoelectric couples presents difficulties. We shall briefly describe the hot couple.

It is made of two wires—one of copper, the other of constantan. The diameter of the copper wire is 0.6 or 0.8 mm. This is the active electrode described in the

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1. Weekers, L., and Weekers, R.: Ophthalmologica **104**:1, 1942; **109**:218, 1945; Acta ophth. **24**:1, 1946; Ann. d'ocul. **180**:10, 1947; Bull. Soc. belge d'opht. **81**:50, 1945; **85**:38, 1946.

2. Albaugh, C. H., and Dunphy, E. B.: Cyclodiathermy: Operation for Treatment of Glaucoma, Arch. Ophth. **27**:543 (March) 1942.

3. Coppez, L.: (*a*) Ophthalmologica **109**:80, 1945; (*b*) Bull. et mém. Soc. franç. d'opht. **59**:237, 1946.

diathermy circuit. It therefore belongs both to the thermometer and to the diathermy circuit. The diameter of the constantan wire is 0.1 mm. It belongs to the thermometer circuit only. These two wires are welded to form the thermoelectric couple. This welding was carried out in two ways, and both were satis-

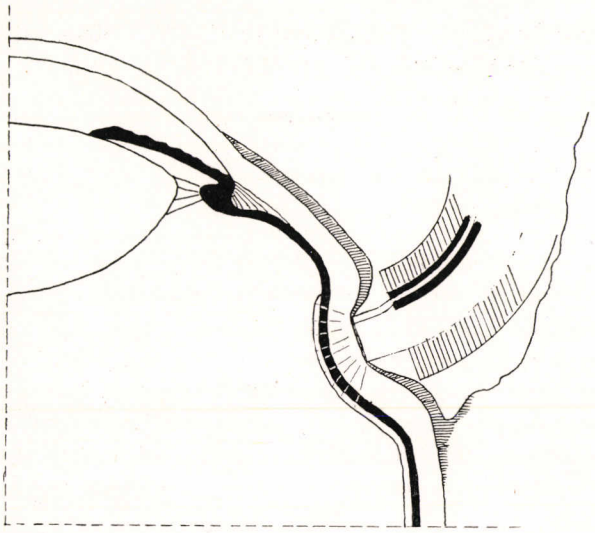

Fig. 1.—Scheme showing the place of application of the thermometric electrode, on the posterior edge of the ciliary body, 8 mm. from the limbus.

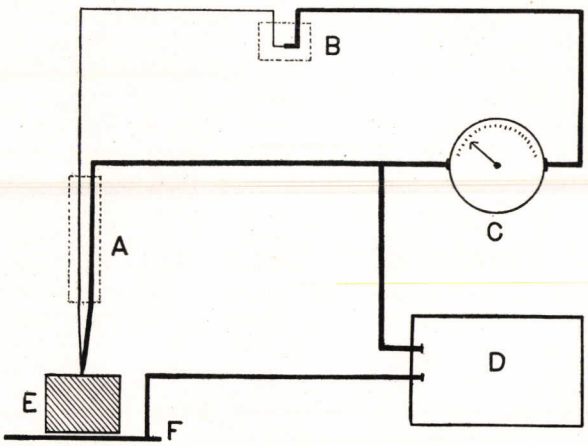

Fig. 2.—Scheme of the diathermic and thermometric circuits (from Coppez [3b]). *A* indicates hot thermoelectric couple (active electrode); *B*, cold thermoelectric couple (immersed in ice); *C*, millivoltmeter, used as a thermometer; *D*, diathermy apparatus; *E*, patient; *F*, passive electrode.

factory (fig. 3). When the two couples of the thermoelectric circuit have different temperatures, there is a difference of potential between them. The latter is proportional to the difference of temperature. It is measured by the millivoltmeter placed

in the circuit. The latter is graduated empirically in degrees centigrade and serves as a thermometer.

Technic of the Operation.—The anesthesia of the eyeball is obtained by instillations of cocaine and epinephrine and by a retrobulbar injection of 2 cc. of 4 per cent

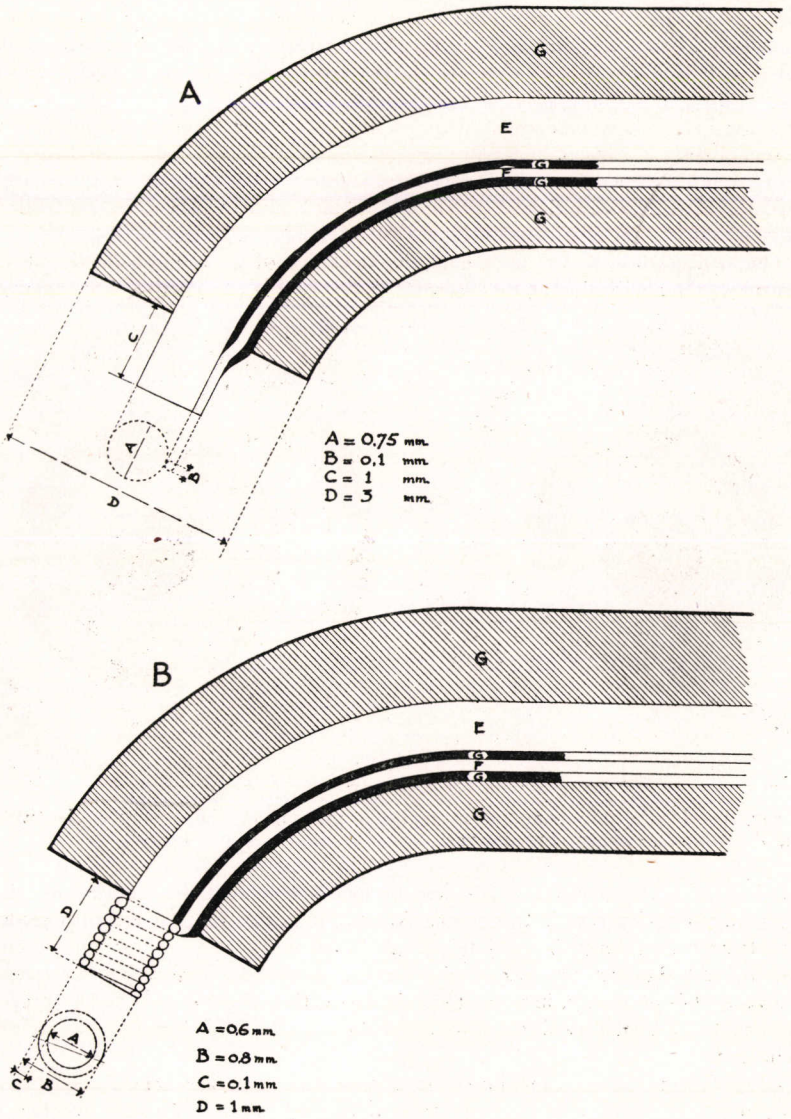

Fig. 3.—Thermometric electrodes.

In both diagrams, *E* indicates the copper wire; *F*, the constantan wire, and *G*, the insulation.

procaine hydrochloride. If sufficient time elapses (ten minutes at least), this anesthesia renders the operation painless.

The lids are held open with a blepharostat. The electrode is placed directly on the eyeball, without dissection of the conjunctiva. The use of forceps is not necessary. The pressure of the electrode fixes the eyeball.

The place where the electrode is applied should be carefully chosen. The effects on tension and the risk of complications are greater the nearer this site is to the limbus. The electrode must be placed, at the ora serrata, at the back of the ciliary body, 8 mm. from the limbus (fig. 1). The number of applications varies from twelve to twenty (fig. 4). Twelve to sixteen applications are, as a rule, sufficient to normalize the ocular pressure permanently in cases of hypertensive uveitis. When the electrode is applied twelve times, the coagulated areas in the conjunctiva are separated by a band of apparently normal tissue. When the electrode is applied twenty times, the coagulated areas touch one another. It is the same with the areas of postoperative chorioretinitis, as shown by the ophthalmoscope; these will be described later. Each application lasts fifteen seconds.

The temperature shown by the millivoltmeter used as a thermometer at the moment of the application of the electrode is that of the conjunctiva, i. e., approxi-

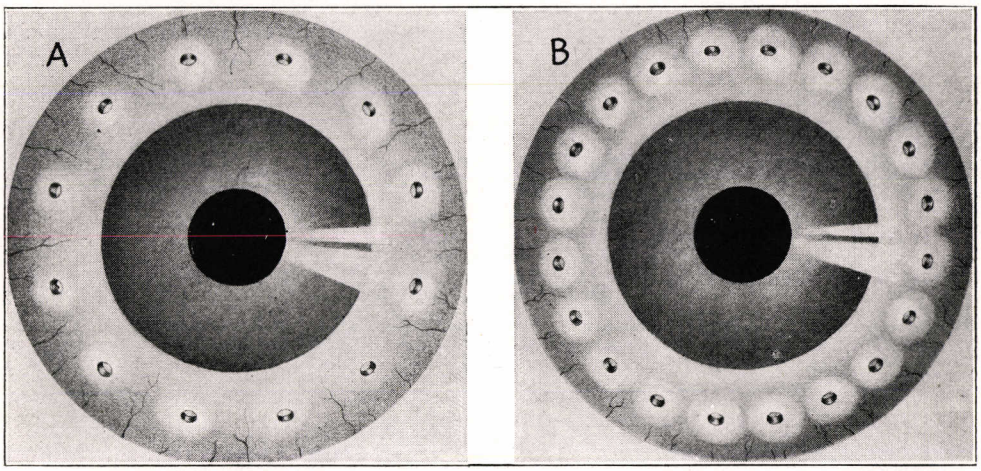

Fig. 4.—Diathermic coagulation made 8 mm. from the limbus. *A,* twelve coagulations; *B,* twenty coagulations.

mately 30 C. The rheostat is adjusted in such a way that the temperature rises rapidly when the current is turned on. We try to reach 90 C. at the fifth second. This temperature must be maintained as constant as possible for ten seconds (fig. 5). At the fifteenth second, the current is turned off and the electrode is removed. It is necessary, in order to avoid desiccation of the cornea and to prevent a lesion, to close the eyelids for a few moments after three or four consecutive applications.

After the operation, penicillin ointment and a dressing are applied three times a day for forty-eight hours. After that, it is sufficient to wash the eye two or three times a day with a solution of tepid isotonic sodium chloride solution U. S. P. as long as the postoperative reaction lasts, that is, for two or three weeks. In case of hypertensive uveitis, we carry on the treatment with atropine when necessary.

Observations.—After the operation, when the pupil is wide, the chorioretinal lesions caused by the diathermy burn can be observed with

the ophthalmoscope. For six to seven days, the ophthalmoscopic image consists of a ring of retinal edema. Each patch of edema is circular, slightly raised, 3 or 4 papillary diameters in width and close to the next patch. The edema is white, with a few hemorrhages; the retinal vessels are bent when passing from the normal to the edematous retina (fig. 6 *A*). Ten days after the operation, the edema is less, and the patches are smaller and less prominent. Brownish, irregularly distributed pigmentary spots appear in the retina, and the hemorrhages are less visible (fig. 6 *B*).

Twenty to thirty days after the operation, the patches have a new aspect and the chorioretinal scars are now formed; they are flat, circular, with sharp edges; the diameter is less than 3 papillary diameters, and the retina and choroid are atrophic. A few vessels of the retina and choroid remain, clearly visible against the white background of the

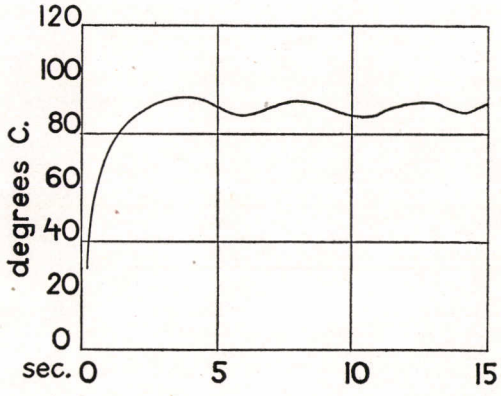

Fig. 5.—Increase in the tissue temperature produced by the diathermic current.

sclera. There are dense pigmented spots, with irregular edges. The chorioretinal patches along the ora serrata are somewhat similar to the postoperative scars after retinal dialysis (fig. 6 *C*).

The successive improvements in the technic of nonperforating cyclodiathermy have made it an easy and well controlled operation, the effects of which can be graduated at will. When correctly performed, it is quite without danger. Its hypotensive effect is considerable and lasts according to the degree of the intraocular hypertension. Its indications have become precise. In addition to the hypertensive uveitis studied in this paper, nonperforating cyclodiathermy should also be used in treatment of (*a*) hypertension persisting after a filtering operation; (*b*) absolute glaucoma, especially when the eyes are painful, and (*c*) intraocular hypertension following corneal transplantation.

The operation described by Albaugh and Dunphy [2] presents features which are similar to ours, namely, the use of a nonperforating, flat

electrode, and the application of this electrode to the posterior extremity of the ciliary body. It differs from our operation, however, in three points. 1. Albaugh and Dunphy perform a dissection of the conjunctiva, which we do not regard as necessary. 2. They operate on one-half the circumference of the ciliary body. Previous experimental researches have demonstrated that when the operation is performed in a small territory it becomes necessary to use a more intense diathermy current to obtain a sufficient effect on the ocular pressure (Weekers and Weekers [1]). 3. They do not use a thermometer electrode, which enables us to regulate our intervention and to repeat it under identical conditions.

Thermometric nonperforating cyclodiathermy, carried out in the way we have described, does not lead to postoperative complications. From this point of view, it is quite different from Vogt's perforating

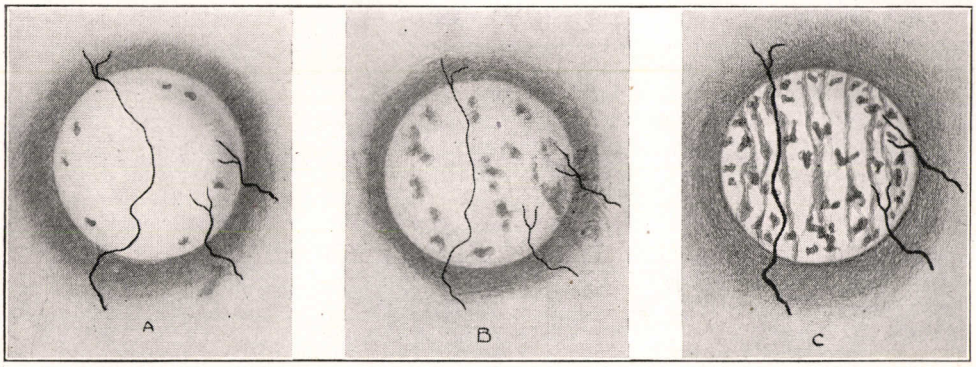

Fig. 6.—Ophthalmoscopic images of the diathermic coagulation at the ora serrata. *A* (twenty-four hours after operation): white, salient edema 4 papillary diameters wide; a few small blood suffusions. *B* (ten days after operation): The edema allows the retinal pigment to show through. *C* (thirty days after operation): Atrophy of the retina and choroid and persistence of the vessels; irregular distribution of the retina and choroid pigments. The sclera is visible.

cyclodiathermy (*Diathermiestichelung*), the complications of which are known (corneal ulcer, iritis, cataract and sympathetic ophthalmitis). Sugar [4] observed that Vogt's cyclodiathermy leads to synechias in the iridocorneal angle. Gonioscopic observations, now in progress, demonstrate that such is not the case after nonperforating thermometric cyclodiathermy. In the case of iritis, this operation does not even stimulate the formation of preexisting synechias in the angle of the iris.

Results of Treatment of Hypertensive Uveitis with Nonperforating Thermometric Cyclodiathermy.—Treatment of ocular hypertension complicating various forms of iridocyclitis and uveitis is a difficult problem.

4. Sugar, H. S.: Gonioscopy and Glaucoma, Arch. Ophth. **25**:674 (April) 1941.

Miotics (pilocarpine, physostigmine and dis-isopropyl fluorophosphate [DFP]) are contraindicated; they increase the ocular congestion, facilitate the appearance of synechias and jeopardize the future of the eye and its functions.

Mydriatics, on the other hand, have a favorable influence on the uveitis and, consequently, on the intraocular hypertension. The instillation of drops of atropine (1 per cent) in an eye with hypertensive uveitis is without danger. We often use it, and the results are most favorable. The instillation of drops of epinephrine hydrochloride, 2 per cent, is useful to break down recent synechias in cases of the acute form (Weekers, Joiris and Bonhomme [5]).

When the mydriatic treatment is insufficient to decrease the tension, we practice a retrobulbar injection of alcohol (1.5 cc. of 40 per cent alcohol); this reduces the ocular pressure and has a favorable action on the iridocyclitis (Weekers,[6] Magitot and Morax [7]).

An eye with iridocyclitis can often bear a moderate increase of tension for a long period without any visual decrease.[8] Later, temporizing becomes dangerous, and the operation can no longer be postponed. In such cases, we used to practice iridencleisis ab externo, as described by L. Weekers in 1936.[9] The results were satisfactory. They have recently been confirmed by Kalt.[10] This author operated in 22 cases of hypertensive iridocyclitis. The ocular tension was definitely normalized in 86 per cent and the visual acuity was improved in 60 per cent of the cases.

We now prefer nonperforating cyclodiathermy in the treatment of hypertensive uveitis. This new operation has been performed on 12 patients with uveitis complicated by ocular hypertension, including 10 patients with uveitis of tuberculous origin, 1 patient with diabetic uveitis and 1 patient with Besnier-Boeck-Schaumann disease (generalized sarcoidosis).[11] In other words, all the patients had chronic, malignant types of uveitis, complicated by a definite and dangerous rise in ocular pressure.

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5. Weekers, L.; Joiris, P., and Bonhomme, F.: Arch. d'opht. **3**:97, 1939.

6. Weekers, L.: Ann. d'ocul. **176**:81, 1939.

7. Magitot, A., and Morax, P.: Bull. Soc. d'opht. de Paris **49**:617, 1937.

8. The visual functions must be tested with the most sensitive methods: angioscotometry; campimetry in weakened light; perimetry with luminous spots of low brilliance, and measurement of fusion frequency and of dark adaptation.

9. Weekers, L.: Arch. d'opht. **53**:166, 1936.

10. Kalt, M.: Bull. et mém. Soc. franç. d'opht. **59**:230, 1946.

11. Recently, we have treated several more patients, among whom were one with Fuchs's heterochromia and one with syphilitic uveitis, both complicated by hypertension. The immediate results were favorable, and the patients are being kept under observation for further study.

The results are presented diagrammatically (fig. 7). The initial tensions, before the cyclodiathermy, vary from 30 to 50 mm. of mercury. The intervention in most cases produces a rapid and considerable fall of the ocular pressure. Fifteen days after the cyclodiathermy, the ocular pressure is in the majority of cases lower than 23 mm. of mercury. The hypotensive effect of cyclodiathermy lasts a long time and is generally sufficient to neutralize the phase of hypertension due to the uveitis. In 1 case (Besnier-Boeck-Schaumann disease) a relapse of the uveitis, complicated by further hypertension, compelled us to repeat the operation three months later. This was followed by an immediate and lasting fall in tension. These results are satisfactory, considering the serious nature of the uveitis and the usual

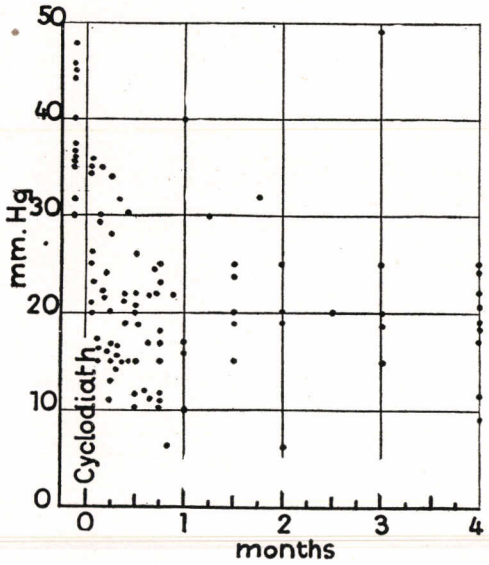

Fig. 7.—Hypotensive effects of thermometric nonperforating cyclodiathermy in 12 cases of hypertensive uveitis.

malignancy of the resulting hypertension. We now apply cyclodiathermy very early, without even carrying out the preliminary retrobulbar injection of alcohol.

When there is pupillary seclusion, cyclodiathermy is contraindicated. It is necessary in such cases to reestablish the passage of the aqueous humor through the diaphragm of the iris. Iridencleisis is indicated in these cases. The only object of cyclodiathermy is to relieve ocular hypertension; the local treatment with mydriatics and the general treatment should not be interrupted.

It is difficult to judge the influence of cyclodiathermy on the inflammatory process. The anatomic changes are often serious at the time

of intervention (synechias, cloudiness of ocular media, cataract). Sometimes one has the impression that, apart from its hypotensive effect, cyclodiathermy influences favorably the inflammatory process of the uveitis. One thing is certain: It removes the immediate and serious threat of hypertension.

CONCLUSIONS

Thermometric nonperforating cyclodiathermy should be used in treatment in certain cases of ocular hypertension. Its main advantages are as follows: (*a*) It is easy to perform; (*b*) opening of the sclera is avoided; (*c*) the operation can be regulated at will; (*d*) it does not lead to any complications.

The hypotensive effect of nonperforating diathermy is definite and lasting in accordance with the nature of the glaucomatous process. It is less than that of iridencleisis and is of shorter duration.

The main indications for thermometric nonperforating cyclodiathermy are as follows: (*a*) uveitis complicated by intraocular hypertension; (*b*) hypertension persisting after a filtering operation; (*c*) painful, absolute glaucoma, and (*d*) intraocular hypertension after corneal transplantation.

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