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PHOTOCOAGULATION OF EYE MEMBRANES

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If one looks directly at the sun an inflammatory hearth will appear on the macula, which may completely disappear if fixation has been fugacious and there was only little luminosity but otherwise will produce a retinochoroidal scar with a permamente pigmentation, causing the retina to adhere more intimately to the choroid. Te so-called photocoagulating apparatuses (so far it seems there are only two of the kind, one in Bonn and the other in Milan) by producing a light beam similar to that of the sun may provoke, at libitum and in any point of the retina, some scars which are like those produced by the sun; they are therefore used for treating the detachment of the retina or for destroying the centre of retinal diseases.

Raverdino's photocoagulating apparatus has been constructed by Messrs. Prevost in Milan and is providing a ligth beam strong enough to cogulate more or less intenseley the retina according to the time of exposure, producing round white spots with a diameter smaller than the papilla. A light flash of ¼ of a second already produces a slight discolouration of the retina; in the rabbit a 10 seconds exposure provokes an intense coagulation which may result in the perforation of the retina during the following days. In view of the quasi identity between the solar spectrum and that of the Prevost apparatus the pathogenic problem of the sun retinitis may be considered to be similar to the ons of artificial coagulations. The problem not yet resolved is whether the coagulation is due to the heat produced by the light beam (Duke Elder) or to a thermic storage at the level of the retinal pigment (Leplat) or if it is not a matter of heat action but of a puraly photodynamic action (Cirincione, Cioceri, Seidenari).

Raverdino is inclined to support this latter opinion as the measurements of these latter Authors, carried out under different circumstances, never have shown on the retina a temperature over 40° C. The use of a photocoagulator may supply some probative data for this problema, while it may also raise many problems for the biologist as well as for the practical oculist. Among these problems the main ones are the following.

1. Which curgical problems of the oculistic speciality may be resolved by means of the photocoagulator?
2. The so-called photocoagulation phenomena in the eye membranes and specially in the retina, are they only due to the heat or to other agents?
3. What kind of modifications may take place, especially in the dioptric means of the eye or in other membranes too, which are crossed by a light beam having a spectrum similar to that of the sun?

As for the first point, Meyer Schwickerath (Bonn), taking advantage of his vast clinical experience, has by now resolved nearly all problems regarding the retina and iris membrane. There is no doubt that only after publication of the complete documentation of the many Authors already employing photocoagulation, oculists will have an idea of the great advantages offred by photocoagulating apparatuses.

Indication of photocoagulation for retinal diseases may thus be summarized: Photocoagulation can be employed for coagulating the rims of any retinal rupture (using a particular care one may even attain very peripheral ruptures), proviedad the reina is adhering to the choroid and the dioptric means are sufficiently transparent. Photocoagulating treatment is therefore particulary indicated:

1. For retinal ruptures not yet followed by detachment.
2. Whenever there are some areas of the retina subject to rupture or areas of atrophic chorioretinitis liable to form ruptures or detachments. This is more indicated as a prophylactic measure in order to avoid the detachment in the second eye, when there has already been a detachment in the first one.
3. For macular or paramacular ruptures or any other rupture at the back pole nearly unapproachrable by the usual surgical means.
4. In the case of multiple ruptures having different seats, anh here photocoagulation will follow immediately a first operation for reapplying the retina.
5. For retinal ruptures not yet followed by detachment, in the presence of an actual exudative, inflammatory chorioretinitis, provided the dioptric means are transparent enough in the rupture area.
6. In reoperations which are necessary after an operation which achieved only a partial reapplication of the rupture rim, or whenever there is a new retinal rupture immediately after a first intervention, situated near the coagulated area or far from it, provided the retina is attached.

Finally it can be said, that this new method is liable to bring about a revolution in the classical principles for the treatment of retinal detachment. In the end it would no longer be necessary to reach by surgical means and with some difficulties the ruptures distributed here and there, and specially in the back pole, in

order to coagulate their rims, as photocoagulation will simplify the surgical problem due to the fact that its will be sufficient to reattach the retina and then photocoagulate the rupture. Consequently those methods which were considered exceptional or too simple, like the excision of sclera flaps, the evacuations of subretinal liquids, air injections, will acquire a greater value and more frequent application, a fact which also represents a technical revolution.

Some other indications for photocoagulation in retinal diseases, besides the detachment, are: retinal agiomathosis, which cannot be trated medically but may be cured by massive photocoagulations. Not pre-eminent, superficial retinal tumors, specially if they are not very large and if they are pigmented. Haemorrhagic hearths of the retina with a character of recidivism (haemorrhages of young people, periphlebitis, etc.) and whenever medical treatments have shown to be not sufficient. Meyer Schwickerath, by focussing the light of the apparatus on the iris has been able to pierce this membrane without damaging the cornea. In order not to alter the crystalline these artificial pupils can only be executed in aphacic subjects.

Raverdino has used photocoagulation for the treatment of skin diseases, of diseases of the conjunctiva and the cornea, by focussing the beams for destroying the small xanthelasma or cutaneous neoformations, insisting for some seconds. These coagulations take place due to the heat and are cratershaped. With the same system also the cornea can be cauterized spot by spot, but coagulation is too fast that one could control its effect. That is why this method is not useful in practice and it is more advisable to concentrate the beams on the conjunctiva or on the cornea through a filter glass, as it will be seen later on.

The essence of the problems inherent to the second point consists in establishing whether all coagulations are due to the heat or wether some of them represent the result of a photodynamic phenomenon, considering the fact that usually coagulation by heat only takes place between 60 and 70° C. Now, with the photocoagulator we obtain, on the conjunctiva as well as on the cornea, some whitish coagulation at temperatures which are much lower than those above mentioned. This phenomenon cannot be observed very well when we concentrate by a lens the light on the conjunctiva or on the cornea, as after one second temperature on the point of concentration already reaches 55° and will attain 60 after 2 seconds and 71° after three sec., but if temperature is reduced by means of a small filter glass having a laminated surface in touch with the tissue, it will be possible to observe some clear and evident superficial white spots event at temperatures which are much lower than those mentioned above. Between 37 and 50°C, according to lenght of exposure, some white spots being more or less and deep will appear, and their histologic examination will show that they are regressive

cellular alterations. This is more easy to demostrate on the corneal epithelium and the phenomenon is so distinct that, by varying exposure times, it is possible to obtain a really separated coagulation of the various layers of cell in the corneal epithelium. A veritable coagulation (with the forming of the usual coagulated gelatinous layer) will be attained only when —insisting in coagulating— temperature is over 60°C. But even in this case the Bowmann membrane and the last layer of the corneal epithelium can be maintained unimpaired. As the first regressive alterations of the cells start at sub-fever temperatures it is clear that they cannot be ascribed to heat but to photodynamisms only. From the therapeutic point of view these superficial or adjustable in depth photocoagulations have shown to be useful in the case of keratitis bullosa, of dentritic and viral keratitis, as they are remarkably shortening the course of illness and destroying the ill epithelium without producing deep scars, which may in fature be responsible for visual dameges. Of course the photodynamic phenomenon is more visible in the case of photocoagulation of the retina, due to the great quantity of photodynamic substances of the retina itself (Santamaria, De Vincentiis). But also with these applications it can be shown that, by introducing a thermoelectric bit in a sac between sclera and choroid in a rabbit, during a coagulation protracted even for 4 seconds, temperature never surpasses 40°C. This is confirming the experiences made by Ciaceri, Cirincione, Seidenari's observations and Duke Elder's studies.

All this is therefore indicating that on the retina as well as on the cornea and on the conjuntiva a very intense light beam may produce well visible cellular alterations.

The third point is comprising already ascertainable phenomena and problems arising when consider the many reactions intense light is able to produce on the different chemical componets of substances and liquids contained in the eye liquids in a normal pathologic stage.

It is difficult to foresee what difficult experiments biologist may organize in order to study the behaviour of the different organic liquids, of the blood and the manifold tissues under the influence of a long and protracted illumination. Thanks to the photocoagulator Viale's wellknown investigations on the biologic actions of radiations are subject to be widened and to become more exact, considering that whole body of doctrine which has now been elaborated by various Institutes and particularly by Ciaranfi's School about the action of photodynamic substances.

Nor is it possible to tell at present what advantages will be offred to the studies and applications of the oculistic speciality. But it may already be stated that in

some cases irradiation of the vitreum being turbid for one reason or the other and stuffed with pigmented corpuscles has brought about a modification and even a clearing of the vitreum itself. Nor can we doubt of this action if we know the greatactivity of light on colloids (and cornea as well as vitreum are colloids) and if we know that many of the substances contained in the turbid vitreum are extremely sensitive to light, like, for instance, cholesterol.

That is why apparatuses which are simple and handy like the photocoagulatos already used are representing not only a definite progress for the oculistic speciality, but also a useful instrument for investigating fundamental biologic problems.

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