

# Proliferative diabetic retinopathy

## Regression of optic disc neovascularization after retinal photocoagulation

ENID TAYLOR

*Ophthalmic Department, St. Bartholomew's Hospital, London, E.C.1*

Photocoagulation is an accepted method of local treatment for proliferative diabetic retinopathy. It has been shown that 73·25 per cent. of eyes with proliferative diabetic retinopathy have new vessels on the optic disc at the initial visit (Taylor and Dobree, 1970). These vessels cannot be treated directly by photocoagulation. Aiello, Beetham, Balodimos, Chazan, and Bradley (1969) treated all grades of proliferative diabetic retinopathy by multiple choroido-retinal burns using the ruby laser, and in a preliminary communication they reported regression of optic disc neovascularization in some cases.

The purpose of this paper is to report the regression of new vessels on the optic disc after extensive retinal photocoagulation.

### **Clinical material and method**

The present series (consisting of 31 eyes in 25 patients) was taken from a larger group of patients, all of whom have proliferative diabetic retinopathy, and are under regular ophthalmoscopic and photographic review.

The cases selected for review all fulfilled the following criteria:

- (1) There was neovascularization associated both with the retinal veins and with the vessels on the optic disc.
- (2) The areas of neovascularization associated with the retinal veins had been treated by photocoagulation at one or more sessions.
- (3) The number of choroido-retinal burns had been recorded on each occasion so that the total number of coagulations given was known.
- (4) There were complete preoperative and postoperative fundus photographic records.

The preoperative and postoperative photographs were used to compare the disc neovascularization before and after retinal photocoagulation. The vessels on the optic disc were assessed in respect of:

- (a) Area.
- (b) Total number of vessels crossing the disc margin.
- (c) Absence or presence of supporting fibrous tissue, *i.e.* Stage I or Stage II (Dobree, 1964).
- (d) Whether the neovascularization was flat or elevated *i.e.* lay immediately in front of the disc and retina or anterior to the retina by at least  $\frac{1}{4}$  disc diameter.

The Zeiss photocoagulator was used in all cases, usually with a light intensity setting of Green II and an aperture of 4·5° giving a 1·35 mm. choroido-retinal burn. In the two exceptions, namely Eyes 10 and 22 (Table I), an aperture of 3·0° was selected to give a smaller burn to some areas with

a greater light intensity of Green III. The smaller area was selected to give multiple scattered burns, as well as directly treating groups of new vessels associated with the retinal veins in the usual manner. Photocoagulation was carried out in one to four sessions, the maximum interval between treatments in any case being 7 months. The number of coagulations given was recorded automatically using the electronic coagulation counter (Dobree, Gaye, and Wiggins) at each treatment session, so the total number of burns given to each eye was known. The follow-up period varied from 2 to 24 months.

### Results (Table I, opposite)

Retinal new vessels were treated by photocoagulation in 31 eyes, and in five eyes regression of the new vessels on the optic disc resulted (Figs 1 and 2). In two of these five eyes, there were no residual new vessels on the disc, and in the other three the new vessels were reduced in number and appeared more tenuous. Of the remaining 26 eyes, twelve showed no change in the appearance of the proliferation on the optic disc, and fourteen showed marked progression of proliferation with increase in the new vessels and fibrous tissue on the disc.

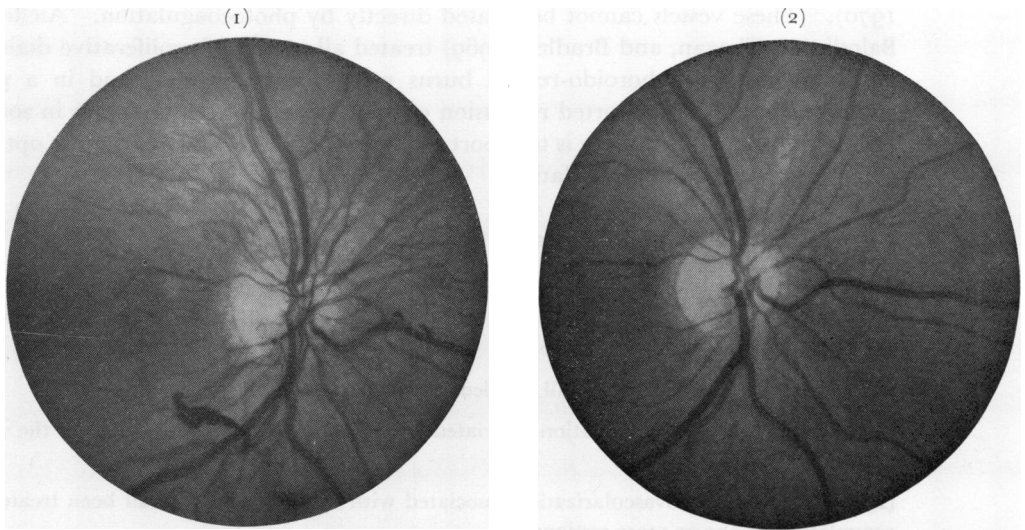


FIG. 1 *Eye 19, before retinal photocoagulation*

FIG. 2 *Eye 19, 3 months after retinal photocoagulation showing regression of the new vessels on the optic disc*

Two aspects of these results call for more detailed examination with regard to their relationship to the subsequent changes in the disc vessels: the type of neovascularization present on the optic disc before treatment and the total number of coagulations given.

Table II shows that the only category in which regression of optic disc neovascularization occurred was that in which the new vessels were flat and unsupported by visible fibrous tissue. In the remaining categories regression did not occur.

The total number of coagulations given varied from 18 to 250, which is a very wide range. Ten eyes received over 100 coagulations. The eyes showing regression of optic disc new vessels had 250, 114, 136, 236, and 102 coagulations respectively. Assuming that there is no overlap of coagulation burns and knowing the number of burns with both  $4.5^\circ$  and  $3.0^\circ$  apertures, these eyes had  $209.170$  sq. mm.,  $163.202$  sq. mm.,  $194.698$  sq. mm.,

**Table I** Details of disc neovascularization and total number of retinal photocoagulation burns in relation to subsequent disc neovascularization changes

Patient no.	Eye	Neovascularization of optic disc		Photocoagulation		Optic disc neovascularization after treatment
		Stage I or II	Flat or elevated	Number of sessions	Total number	
1	R	II	Elevated	1	12	No change
2	R	II	Elevated	3	83	Progressed
3	R	I	Elevated	1	60	No change
4	R	I	Flat	2	61	Progressed
5	L	II	Elevated	2	54	No change
6	R	II	Elevated	4	196	No change
7	R	I	Flat	1	66	No change
8	R	II	Elevated	2	49	No change
9	R	I	Flat	2	66	No change
10	L	I	Flat	3	250	Regressed
11	L	II	Elevated	1	18	No change
12	L	II	Elevated	2	172	Progressed
13	L	I	Flat	1	47	No change
14	R	II	Elevated	4	68	Progressed
	L	II	Elevated	2	81	Progressed
15	L	II	Elevated	2	59	Progressed
16	R	II	Elevated	2	28	Progressed
17	R	II	Flat	2	142	Progressed
18	R	II	Elevated	1	49	Progressed
	L	I	Elevated	3	139	Progressed
19	R	I	Flat	3	114	Regressed
	L	I	Flat	2	136	Regressed
20	R	II	Elevated	3	103	Progressed
	L	II	Elevated	2	93	Progressed
21	R	I	Flat	2	31	No change
	L	I	Flat	3	79	No change
22	L	I	Flat	3	236	Regressed
23	L	II	Elevated	1	40	No change
24	R	I	Flat	1	92	Progressed
25	R	I	Flat	1	36	Progressed
	L	I	Flat	2	102	Regressed

**Table II** Results of treatment in the four preoperative categories of disc neovascularization

Disc neovascularization	No. of eyes showing:		
	Regression	No change	Progression
Stage I Flat	5	5	3
Elevated	—	1	1
II Flat	—	—	1
Elevated	—	6	9

158.110 sq. mm., and 146.023 sq. mm. of retina destroyed. The minimum area of choroido-retinal damage which was associated with regression of new vessels on the disc was 146.023 sq. mm. This is approximately 14 per cent. of the total retinal area.\*

### Discussion

Spontaneous regression of small areas of retinal neovascularization is well documented by those who have studied the natural history of proliferative diabetic retinopathy (Larsen, 1960; Dobree, 1964; Davis, 1967). It was also reported by Dollery and Oakley (1965) that retinal neovascularization in a diabetic might be completely reversible with improvement in diabetic control, but they were referring to dilated retinal hairpin capillary loops. Spontaneous regression of new vessels on the optic disc is not recorded.

Aiello and others (1969), after treatment of proliferative diabetic retinopathy by multiple laser burns to the retina, found regression of disc vessels in 26 out of 36 eyes with "early disc neovascularization". In eleven of these 26 eyes there were no residual new vessels visible clinically. In contrast, in those eyes where the disc neovascularization was advanced and elevated the response to laser coagulation was poor. In our series, five eyes showed regression of new vessels on the optic disc, and I would agree with Aiello that this favourable response is obtained in those eyes with early, flat neovascularization. Moreover, Okun and Johnston (1969) documented regression in one case of new formed vessels some distance from zones of photocoagulation and from the accompanying photographs it would seem that the disc vessels were flat and without visible fibrous tissue support before treatment.

The exact mechanism causing regression of new vessels is unknown, but the theory favoured by Aiello and others (1969) is that the multiple choroido-retinal scars reduce the metabolic requirements of the retina. They usually give 600 to 800 burns with a diameter of 0.75 mm. and Okun and Johnston (1969) give 100 to 300 burns with a diameter of 1.35 mm., so that the areas of retinal scarring are comparable to those in our series. It is reasonable to suppose that as results become available from other centres they may also show that regression of early disc neovascularization is dependant on the extent of the choroido-retinal burns, by either laser or light coagulation. It may even be possible to show that this regression follows a critical area of retinal destruction.

### Summary

Neovascularization on the optic disc was studied in 31 eyes before and after retinal photocoagulation. There was regression of the new vessels on the optic disc in five eyes. The significance of the stage of disc neovascularization and the area of choroido-retinal scarring from photocoagulation is discussed.

I wish to thank Mr. J. H. Dobree both for permission to study these patients under his care and for his helpful advice. I also wish to thank Dr. Alan Jennings for his mathematical assistance and Miss Christine Otway for secretarial help.

### References

- AIELLO, L. M., BEETHAM, W. P., BALODIMOS, M. C., CHAZAN, B. I., and BRADLEY, R. F. (1969) *In* "Symposium on the Treatment of Diabetic Retinopathy, Warrenton, Virginia, 1968", ed. M. F. Goldberg and S. L. Fine, p. 437. Public Health Service Publication No. 1890, U.S. Dept. of Health, Education and Welfare
- DAVIS, M. D. (1967) *In* "Vascular Complications of Diabetes Mellitus", ed. S. J. Kimura and W. M. Caygill, p. 139. Mosby, St. Louis

\* I could find no reference to total retinal area. Duke-Elder and Wybar (1961) give the measurements for the diameter of the globe, the diameter of the cornea, and the position of the ora serrata in each quadrant in an emmetropic eye. A calculation based on these measurements gave an approximate retinal area of 1,050 sq. mm.

- DOBREE, J. H. (1964) *Brit. J. Ophthalm.*, **48**, 637  
———, GAYE, P., and WIGGINS, K. (In preparation)  
DOLLERY, C. T., and OAKLEY, N. W. (1965) *Diabetes*, **14**, 121  
DUKE-ELDER, S., and WYBAR, K. C. (1961) In "System of Ophthalmology", vol. 2, "The Anatomy of the Visual System". Kimpton, London  
LARSEN, H. W. (1960) *Acta ophthal (Kbh.)*, Suppl. 60  
OKUN, E., and JOHNSTON, G. P. (1969) In "Symposium on the Treatment of Diabetic Retinopathy, Warrenton, Virginia, 1968", ed. M. F. Goldberg and S. L. Fine, p. 523. Public Health Service Publication No. 1890, U.S. Dept. of Health, Education and Welfare  
TAYLOR, E., and DOBREE, J. H. (1970) *Brit. J. Ophthalm.*, **54**, 11