# The Visual Status of Diabetics on Renal Replacement Therapy (RRT)

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**Summary**

The visual status of 48 patients with end-stage diabetic nephropathy who were undergoing treatment either by dialysis or transplantation was assessed. At the time of starting dialysis, the vision was good in 27 (56 per cent), impaired in 7 (15 per cent) and of navigating standard only in 12 (25 per cent) while the remaining 2 (4 per cent) had no useful vision. During the time on dialysis and/or following transplantation, vision improved in 6 patients (12 per cent), deteriorated in 9 (19 per cent) and remained unchanged in 33 (69 per cent). Changes in the degree of retinopathy in the 96 eyes resulting either from treatment of the renal failure or laser therapy were noted. The reasons for any changes in vision and the effect of ophthalmic treatment will be discussed.

Micro-angiopathy is responsible for the nephropathy and retinopathy of diabetes mellitus. The combination of progressive renal failure and visual loss is a well recognised entity which has been called, 'The Diabetic Renal-Retinal Syndrome'[1] and the diabetic with end-stage renal failure commonly has, in addition, retinopathy and a variable degree of visual loss.

Haemodialysis (HD), continuous ambulatory peritoneal dialysis (CAPD) and successful renal transplantation are grouped together under the heading of renal replacement therapy (RRT). Previous studies of patients being treated by RRT have shown that between 78 per cent and 100 per cent had retinopathy and 23 per cent to 50 per cent were blind.[2-9] In the majority of those on CAPD and with transplants the mode of treatment of their renal failure had little effect on visual function while those on HD generally suffered further visual deterioration.

Little attention has been paid to the effect of ophthalmic treatment on the visual status during RRT. In previous studies the application of laser photocoagulation was either not documented,[2-5] considered not to alter significantly the visual outcome,[6,7] or lacked specific details of the effect of treatment.[8,9] Also the type of retinopathy being treated was not clearly delineated in many of these studies.

We have looked at the ocular status and results of ophthalmic treatment in a series of 48 patients during RRT for diabetic nephropathy in an area where most diabetic patients, regardless of visual function, are offered treatment for renal failure.

**Patients and Methods**

Between January 1979 and July 1986 sixty-one diabetic patients were treated by RRT at the Western Infirmary, Glasgow. Thirteen were excluded

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because of inadequate evidence that renal failure was due to diabetic nephropathy. Thus 48 patients remained to form the study group.

Six patients were on HD, 22 on CAPD and 20 had functioning transplants at the end of the study. Details of visual acuity and degree of retinopathy at the time of starting dialysis and any changes in these during the study period were retrieved from the case notes.

In assessing visual function the patients were considered as individuals rather than taking each eye separately. Group 1, 'good vision', 6/6–6/12; Group 2, 'impaired vision', 6/18–6/36; Group 3, 'navigating vision', 6/60—hand movements (HM) and Group 4, 'blind', perception of light (P of L) to no perception of light (NP of L).

It was felt more appropriate to consider the retinopathy in each eye separately: Group A, 'background changes only'; Group B, 'Maculopathy'; Group C, 'active' (pre-proliferative or proliferative', eyes with vitreous haemorrhage were also included in this group); Group D, 'stable treated proliferative', and Group E 'end-stage proliferative' (failed treatment or no treatment).

The reasons for alteration in vision and efficacy of ophthalmic treatment were examined.

## Results

There were 16 females and 32 males of whom 36 were Type I diabetics and 12 were Type II. At commencement of RRT the average age of patients was 46.2 years (range 20 to 64 years) and the mean duration of diabetes was 22 years (range 6 to 40 years). In 28 cases there was specific mention by the referring physician of poor metabolic control. The number of patients receiving each form of treatment was as follows: CAPD 22, HD 6 and 20 had functioning renal transplants. The mean duration of treatment for the 22 CAPD patients was 16.7 months, for the 6 on HD, 17.1 months while the mean duration of graft survival for the 20 transplanted patients was 27.4 months. The transplanted patients had previously been dialysed for a mean of 13.9 months (1 HD, 19 CAPD). One patient had received his second transplant and 3 in the CAPD group had previously had an unsuccessful transplant. Fourteen patients died during the study period (1 HD, 12 CAPD and 1 transplanted).

### Visual Function

The patients were grouped according to visual function. At the time of commencing RRT

there were 27 patients (56 per cent) in Group 1, 'good vision', 6/6 to 6/12; 7 patients (15 per cent) in Group 2, 'impaired vision', 6/18–6/36; 12 patients (25 per cent) in Group 3, 'navigating vision', 6/60–HM and 2 patients (4 per cent) in Group 4, 'blind', perception of light to no perception of light. At the end of the study there were 25 patients (52 per cent) in Group 1, 9 patients (19 per cent) in Group 2, 8 patients (17 per cent) in Group 3 and 6 patients (12 per cent) in Group 4.

Thus over the period of RRT the vision of 33 patients (69 per cent) remained stable, 6 (12 per cent) improved and 9 (19 per cent) deteriorated (scattergram).

One patient's vision improved following surgery for removal of vitreous haemorrhage, one after spontaneous clearance of vitreous haemorrhage, another 2 following cataract extraction and the remaining 2 improved after laser treatment with improvement of macular function. Deterioration was due to progression of retinopathy to rubeotic glaucoma in 3 cases, following unsuccessful vitreous surgery in 2 cases, increasing cataract in another 2 and increasing maculopathy in the remaining patient.

Of the 14 patients who died, all remained visually stable from the beginning of the study until the time of death. Nine were in Group 1, 3 in Group 2 and 1 in Group 3.

### Retinopathy and Treatment

Retinopathy was reviewed with respect to individual eyes (Table I). During the time of RRT 2 eyes regressed from preproliferative, 'active', changes to 'background'; 3 deteriorated from 'active' retinopathy to 'end-stage'; 13 were modified by laser treatment from 'active' to 'stable', and 77 eyes did not change with respect to retinopathy.

There was no progression to proliferation in the eyes with background changes or maculopathy. All eyes with active neovascularisation received laser treatment. Thirty-three eyes had been satisfactorily treated for active retinopathy in the past and they all remained under observation: no treatment being required. As would be expected the eyes in Group E 'end-stage', remained unchanged.
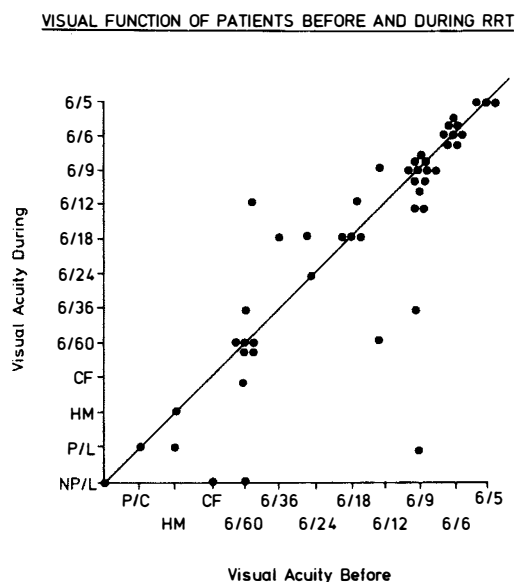
VISUAL FUNCTION OF PATIENTS BEFORE AND DURING RRT



**Fig. 1.** *Graph illustrating the visual function before RRT and at the end of the study.*

## Visual Results and Treatment Given
### Laser

The 16 eyes with background changes requiring no laser treatment retained good acuities (Table II). Eleven of these eyes had vision in the Group 1 category and the remainder had reduced acuities because of amblyopia in one case, cataract in 3 cases and long standing traumatic retinal detachment in the remaining case.

Twelve eyes were too advanced to benefit from laser therapy when first seen; of the 7 in Group 3, 4 had maculopathy and 3 traction retinal detachment and all 5 in Group 4 had rubeotic glaucoma.

The other 68 eyes all received laser treatment at some point. Of these, 29 retained vision in the Group 1, 6/6–6–12 range; including one who had spontaneous clearance of vitreous haemorrhage and one following vitreous surgery. Seven eyes had 'impaired vision' in the Group 2 range. Four of these had minimal changes of maculopathy, 2 had excessive gliosis and one had recurrent haemorrhage. Of the 19 eyes in Group 3, the reduction in vision was due to maculopathy in 12 cases, cataracts in 5 cases and vitreous haemorrhage in 2. Thirteen eyes which had undergone laser treatment finished with very

poor vision in the Group 4 range. Seven of these had rubeotic glaucoma, 5 traction retinal detachment and one maculopathy. In 9 cases particular problems accounted for the lack of success in treatment. In 5 cases, the patients were initially seen at a stage when extensive gliosis and aggressive new vessel were present, but despite this treatment was attempted. In a further three cases, recurrent vitreous haemorrhage prevented adequate treatment at the appropriate time and in one further case recurrent illness prevented the patient from attending, with subsequent loss of useful vision in one eye. The four remaining eyes were seen at the appropriate time; however extensive treatment with argon, xenon and cryo-therapy was not adequate to prevent the progression of retinopathy.

### Surgery

Four vitrectomies were performed. One was successful, 2 advanced to rubeotic glaucoma after surgery and the other was considered an inoperable retinal detachment at the time of surgery. All patients had pre-operative ultrasound and electro-physiology. Two operations were performed for long standing vitreous haemorrhage (longer than 1 year) and 2 for haemorrhage with associated retinal detachment in an only eye. One had surgery prior to starting RRT and the other 3 were carried out while the patients were maintained on CAPD. Once RRT had been commenced surgery was only considered if the prognosis for life was good and the patient had no useful vision.

**Table I** *Retinopathy grading in each eye at the beginning and end of the study*

|  | Beginning | End |
|---|---|---|
| Group A | | |
| Background | 14 | 16 |
| Group B | | |
| Maculopathy | 9 | 9 |
| Group C | | |
| Active | 21 | 3* |
| Group D | | |
| Stable | 33 | 46 |
| Group E | | |
| End-Stage | 18 | 21 |

\* Presumed active due to persisting vitreous haemorrhage precluding treatment.

**Table II** *Final visual function in relation to laser therapy applied*

|  | Laser | No laser | |
| --- | --- | --- | --- |
|  |  | Not required | Too advanced |
| Group 1 | 29 | 11 | 0 |
| Group 2 | 7 | 3 | 0 |
| Group 3 | 19 | 1 | 7 |
| Group 4 | 13 | 1 | 5 |
| Total | 68 | 16 | 12 |

### Other Ocular Conditions

Other ocular complications of diabetes mellitus and treatment for renal failure occurred in 17 eyes (Table III).

### Discussion

Since the introduction of insulin 60 years ago and with improving standards of diabetic care the quality and duration of life for the diabetic has improved. There remain, however, important long term complications. The major causes of morbidity and mortality are accelerated arteriosclerosis of the coronary and cerebral circulations and microangiopathy affecting the kidney and retina.[10-13]

The pathogenesis of diabetic micro-angiopathy is complex; basement membrane thickening, mural cell dysfunction and capillary occlusion all play a part.[14-17] Alteration in blood rheology with abnormal platelet adhesion and aggregation,[18] reduced red cell deformability,[14,19] and increased viscosity[14,19] contribute to the final pathway of increased vessel permeability and ischaemia which result in the characteristic changes of diabetic retinopathy and nephropathy.

It is thought that diabetic control influences the progression of micro-angiopathy although this is still a source of some debate,[14,19-36] while the duration of the disease process is also felt to be important.[20,28] Complications affecting different systems of the body occur at variable times but tend to run a parallel course.[12,36,37]

Renal failure is a risk factor for progressive retinopathy because of its associated hypertension and possibly also the multiple metabolic abnormalities, and it has been suggested that in the late stages there may be a rapid deterioration in patients' ocular status.[38] It is common practice to start dialysis at an earlier stage in diabetics than in other patients with renal failure. Some studies have shown stabilisation of retinopathy following RRT,[7,9] but progression may nevertheless occur.[6,37] Improvement in the control of uraemia and hypertension lead to an improvement in retinopathy but this situation was observed in only one patient in this series who regressed from pre-proliferative to background retinopathy. While the relationship of diabetic control to the development of micro-angiopathic complications is still debatable, the evidence is increasing that strict metabolic control is desirable,[20-29] although sudden 'tight control' following a long period of hyperglycaemia may be harmful.[32-35] One explanation is that this causes a reduction in blood flow to organs which have become accustomed to a high flow rich in nutrients, thus causing ischaemic damage. This situation could arise at commencement of dialysis because of improved general health of the patient and closer supervision of blood glucose control. Twenty-eight patients in this study group had previously been noted to have a poor blood glucose control. Two patients (4 eyes) had been under observation with pre-proliferative changes but developed ischaemia requiring laser treatment after starting RRT and 4 eyes with regressed new vessels required further laser treatment after starting CAPD. Therefore it is important that all patients are seen by an ophthalmologist at the start of dialysis before rapid changes take place.

Treatment for diabetic nephropathy remains purely supportive—'renal replacement therapy'—either in the form of CAPD, HD or transplantation. Since CAPD was

**Table III** *Other ocular complications of diabetic patients on dialysis*

| Complications | Eyes |
| --- | --- |
| Cataract | 10 |
| Band keratopathy | 2 |
| IIIrd N. palsy | 1 |
| Ischaemic optic neuropathy | 2 |
| Vitreous Hge* (anaemia/hypertension) | 2 |

* Haemorrhage thought to be due to a combination of anaemia and hypertension.

introduced into clinical practice this has allowed a rapid expansion in the number of diabetics being treated for renal failure.[39] Previously haemodialysis, as the only dialysis choice available, posed particular problems in the diabetic patient,[5,37,39] because of poor blood glucose control, difficulties in blood pressure control resulting from rapid fluid shifts and the requirement of heparinisation. CAPD does not have these problems while it is also cheaper and allows greater patient independence. The main complication of CAPD is peritonitis[40-42] but most reports show that diabetics have only a slightly higher incidence than non-diabetics.[2,43,44] Social rehabilitation is the aim of RRT in all patients and poor vision will hamper this objective. Blindness is still sometimes regarded as a contraindication to RRT,[45] although nowadays, particularly with the introduction of CAPD, this is becoming much less common. Renal transplantation offers a considerably better quality of life in comparison with dialysis as well as being much cheaper. Also graft survival is almost as good in young insulin dependent diabetics as in non-diabetics of similar age range.[9]

In contrast to this supportive therapy modern management of diabetic retinopathy aims at both preserving and restoring vision in early and late stages of disease using laser photocoagulation[46-52] and vitreoretinal surgery[53-57] respectively. Laser photocoagulation has proved its efficacy, but only when given at the appropriate time.[46] Diabetic retinopathy remains the commonest cause of blindness in the working population in the West of Scotland.[58] This was reflected in our series in that 8 eyes were not identified as having retinopathy until they were untreatable and 5 eyes which did receive laser treatment were not seen at the optimum stage and they all had poor visual results. Two patients (4 eyes) first saw an ophthalmologist after commencement of RRT and both had extensive new vessel formation by that time. The importance of screening programmes and education must be emphasised to reduce the morbidity from this complication which is the most amenable to treatment.[59-61] Fewer diabetics should lose sight in the future with the introduction of such screening programmes.

Vitreo-retinal surgery is time consuming and expensive and in this high risk group has an improvement rate of only between 46 to 75 per cent.[53-57] It is therefore only directed at the poorly sighted diabetic patient with long standing vitreous haemorrhage or 'straightforward' traction retinal detachment which has developed a tear or involves the macula. The duration of the anaesthetic may be extensive and the general condition of the patient must be relatively good. Four patients in this series underwent surgery, but only one patient did well. In this case the vision was improved from 6/60 to 6/12 in the better eye allowing the patient to return to work. The success rate of surgery is normally higher and this difference probably reflects the small number of patients in this study.

The ocular complications of renal failure and its treatment which are well documented[62-65] also occur in diabetics and must be treated appropriately. There was no case of steroid induced glaucoma or CMV retinitis; however corneal calcification occurred in one patient and cataract developed in 10.

## Conclusions

Diabetics are not all blind by the time they reach end-stage renal failure. Patients should be seen by an ophthalmologist on commencement of RRT as sudden changes in metabolic control may have detrimental effects on retinopathy which require treatment. However in the majority RRT does not cause visual deterioration and may result in improvement.

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