VISUAL FUNCTION CAN BE PRESERVED IN INSULIN-DEPENDENT DIABETIC PATIENTS TREATED BY MAINTENANCE HAEMODIALYSIS

Y El Shahat*, J Rottembourg*, P Bellio†, M C Guimont*, F Rousselie†, C Jacobs*

Departments of *Nephrology and †Ophthalmology, Groupe Hospitalier Pitié Salpêtrière, Paris, France

Summary

Evolution of visual function was assessed in 43 insulin-dependent diabetic (IDD) patients treated by maintenance haemodialysis (MH) for a cumulative duration of 1248 patient-months. At start of MH, 23 patients (46 eyes) still had good vision, 20 patients (40 eyes) were blind. All 40 blind eyes had severe proliferative retinopathy (PR) with additional irreversible complications in 32. Of the 46 eyes with preserved vision, PR was present in 24 (52.2%) with only 2 additional severe complications. Restoration of sight was obtained either spontaneously or after ophthalmic surgery in 6 eyes (7%). Stabilisation was achieved in 74% of eyes which retained vision at the start of MH. Two patients with eyesight at start of MH became blind (8.7%). Aggravation of visual function is mainly related to development of PR and not to haemodialysis per se. Careful ophthalmic follow-up, together with close control of diabetes, blood-pressure and uraemia can ensure preservation of vision in most IDD patients treated by MH.

Introduction

It has been reported in numerous studies that about 30% of the diabetic uraemic patients treated by maintenance haemodialysis (MH) experience severe deterioration or loss of vision [1]. In contrast preservation or improvement of sight is set forward as one of the major advantages that are offered to the diabetic patients treated by kidney transplantation [2], or, more recently, by chronic peritoneal dialysis [3,4]. Careful analyses and follow-up of ocular lesions allow a better understanding of the causes of deterioration of visual function. They may lead to selective therapeutic actions which, together with adequate management of diabetes and uraemia, may ensure stabilisation or improvement of visual acuity even in patients with severely deteriorated sight at the start of MH [5]. We report in this study the experience achieved in 43 insulin-dependent diabetics (IDD) who underwent MH treatment for more than 6 months at La Pitié Hospital in Paris.
Patients and methods

Between December 1973 and March 1980, 43 IDD patients have been treated for at least 6 months by MH at La Pitié Hospital. Cumulative duration of haemodialysis treatment was 1248 patient-months. There were 30 males and 13 females. At the start of dialysis, mean age of patients was 38.4 years (range 20-58) mean duration of diabetes was 20.2 years (range 9-32), mean duration of renal insufficiency (blood urea \( \geq 16 \text{mmol/l} \)) was 14 months (range 1-48) and mean residual creatinine clearance was \( 5.2 \pm 2.1 \text{ml/min} \). Patients received 14 to 16 hours of dialysis per week, 15 patients were dialysed twice weekly and 28 thrice weekly. Concentration of glucose in the dialysis fluid was maintained at 1.20g/L and the average dose of heparin used over the dialysis sessions was 5000 units. Dietary prescriptions comprised 35-40Kcal/kg body weight with 180 to 220g of carbohydrate. Forty patients received two injections per day of intermediate insulin, 3 patients were on a 3 injections regimen. Control of blood glucose level was carried out by the patients (or their relatives) twice daily with a dextrostix method (Ames Reflectance Meter®). Hypertension persisted in spite of dialysis in 21 patients who required complementary treatment with anti-hypertensive drugs.

All patients had baseline ophthalmic evaluation at the start of dialysis in the Department of Ophthalmology of La Pitié Hospital. Examinations were repeated serially thereafter, usually at 6 months intervals. Twelve patients have been followed-up for 3 years and 6 for more than 4 years: ophthalmic studies performed at each examination comprised determination of visual acuity (according to the Monoyer scale), examination of the anterior segment by biomicroscopy, measurement of intra-ocular pressure and examination of the retina by direct or indirect ophthalmoscopy. Fluorescein angiography was carried out in selected cases. Patients were distributed into 4 groups according to their degree of visual acuity: Group I: 20/20 \( \rightarrow \) 20/40, vision permitting a perfectly normal life; group II: 20/50 \( \rightarrow \) 20/200; impaired visual acuity interfering strongly with occupational capacity; group III: less than 20/200, legal blindness, with, however, minimal visual function (hand motion to light perception); group IV: total blindness with no residual visual function.

Results

As of 31st March 1980, 22 patients were alive on MH after an average period of treatment of 32 months per patient, 6 had been transplanted after an average dialysis period of 16.5 months and 15 had died after an average period of 26 months on dialysis. Cumulative survival rates on MH treatment were 86%, 66% and 59% at one, two and three years respectively. At the start of dialysis treatment, 20 patients (40 eyes) were blind (group III and IV) and 23 patients (46 eyes) had retained a good to fair visual acuity (group I and II). Baseline ophthalmic evaluations yielded the following results.

All of the 40 blind eyes were affected by proliferative retinopathy (PR). Moreover, irreversible ocular complications were present in 32 eyes (80%). Loss of vision could be attributed to neovascular glaucoma in 11 eyes, retinal detachment in 6, vitreous organisation in 2, deterioration of retinal neuroepithelium in 12.
One eye had been enucleated prior to the onset of dialysis. Potentially reversible complications were recorded in 8 eyes: intra-vitreous haemorrhage (IVH) in 3 and cataract in 5.

Of the 46 eyes with good or moderately impaired vision, proliferative retinopathy was present in 24 (52.2%) and non proliferative retinopathy in 22. Complications were recorded in 15 eyes: retinal detachment, 2, IVH, 9, macular oedema, 9.

At the time of final ophthalmic examination neovascular glaucoma had developed in 7 more blind eyes (group III + IV) with enucleation being required in 6. Some visual function (from less than 20/200 to 20/200 and even 20/40) had been restored in 2 eyes by absorption of IVH and in 2 others following cataract surgery. Progression towards PR was recorded in 3 eyes which had good visual function at the start of MH (group I + II). Improvement of vision could be obtained in two eyes following spontaneous absorption of IVH.

The outcome of visual function for all of the 86 eyes followed-up in this study is as follows. Improvement of ocular lesions resulted in restitution of some eyesight in 4 (10%) of the eyes that were legally or totally blind at the start of dialysis. Stabilisation, i.e. absence of additional complication, was observed in 24 (60%) and aggravation (mainly occurrence of neovascular glaucoma), occurred in 12 (30%). Among the 46 eyes which retained good or fair visual function at the onset of haemodialysis, improvement was achieved in 2 (4.3%), stabilisation of lesions in 32 (69.6%), aggravation in 26.1%. Twenty two out of these 46 eyes were treated by photocoagulation with Argon Laser during the course of MH. Stabilisation or improvement of sight occurred in all but 2 eyes which underwent laser treatment.

The final visual status of the 43 patients is the following. Among the 23 patients who retained good to fair vision at the start of MH, two monophthalmic patients became blind. Among the 20 blind patients, 3 progressed from legal to total blindness. Restoration of fair to good vision has been obtained in 3 patients out of whom 2 were legally blind at the start of MH. At the time of final examination blind patients (group III and IV) and patients with good or fair vision (group I + II) were identical in number (respectively 20 and 23) as found on baseline examination at the onset of MH treatment.

Discussion

Rapid deterioration of visual function is one of the major threats to diabetic uraemic patients who undergo MH treatment [1,6]. Among the 340 patients reviewed by Rubin and Friedman [1], 111 (32.6%) were reported as having visual deterioration whilst on MH treatment. In contrast, Rao et al reported no change of visual status in 83% of 60 patients treated with regular dialysis [7]. Poor control of hypertension and of the metabolic disturbances induced by diabetes and uraemia, together with the deleterious effect of heparin are claimed by most authors as being responsible for the progression towards blindness often encountered in these patients [8]. The precise reasons which lead to severe impairment or loss of vision remain however poorly analysed in most of the reports published in the literature. Current availability of efficient therapeutic procedures aimed at preservation or restoration of vision in diabetics demand a thorough
ophthalmic evaluation before the onset of MH and for a careful follow-up during the course of treatment. The first step aims at differentiating among severe ocular lesions, those which are potentially reversible as has been the case in 6 eyes in our series (7%). The second step aims at preserving visual function in patients who retain good or fair vision at the start of MH. To achieve this goal, close cooperation between the nephrologists and ophthalmologists is mandatory. Control of blood pressure by sodium restriction, adequate dialysis strategy and anti-hypertensive drugs have a beneficial effect on the hypertensive component of retinopathy. Both hypertensive and hypotensive episodes should be equally avoided since they may prompt intra-vitreous bleeding or retinal detachment [8]. Most ocular complications that lead to blindness are straight consequences of extensive PR rather than adverse effects of haemodialysis per se. In this series, progression of PR was followed by development of neovascular glaucoma in 7 eyes with the necessity of enucleation in 6. Extension of PR by far outweighs the role of heparin in generating irreversible ocular lesions since even in non-uraemic diabetics the frequency of complications is much higher in patients with PR than in those who are affected by non proliferative lesions [9]. Early focal or panretinal photocoagulation with Argon Laser is now advocated by many ophthalmologists as being the treatment of choice for preservation of vision in patients with PR, since photocoagulation prevents haemorrhagic complications [5].

Najarian et al have recently reported no deterioration or improvement of visual acuity in 89% of 214 eyes in a population of 107 diabetic patients who underwent renal transplantation and who had a minimal follow-up of one year [2]. The beneficial role of transplantation in preserving visual function has however still to be evaluated, taking into account that only 11% of eyes were affected by severe PR at the time of transplantation and that 78 eyes (36.4%) had been treated by focal or panretinal photocoagulation prior to transplantation. The results recorded in this study demonstrate that visual status can also be maintained in most IDD patients treated by MH, inasmuch as stabilisation or improvement of visual function could be achieved in 74% of the 46 eyes which retained vision at the start of MH, despite the existence of PR in 52% of them at the onset of dialysis. Progression of PR being closely related to persistent disturbances of blood glucose levels, the best possible management of diabetes by carefully monitored insulin-therapy and dietary prescriptions remains essential. A promising outlook is thus offered to the patients treated with continuous ambulatory peritoneal dialysis in whom improved control of blood glucose is achieved by intra-peritoneal administration of insulin [10]. Early adequate ophthalmic treatment and close control of diabetes, hypertension and uraemia should permit most of the uraemic diabetic patients to start MH with a good to fair visual acuity. Precise analysis of ocular lesions, adequate nephrological and ophthalmic follow-up and care can thereafter ensure preservation of sight for the majority of diabetic patients treated by MH.

References

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2 Najarian JS, Sutherland DER, Simmons RC, Howard RJ, Kjellstrand CM, Ramsay RC, Goetz FC, Fryd DS, Sommer B. *Arch Surg 1979; 190: 487*
Open Discussion

BROWN (Sheffield) Were the six transplanted patients included in the final estimation of visual function and did they influence the outcome in so far as they were better than the ones that were on dialysis?

ROTTEMBOURG The final examination of the six transplanted cases included in our results was the last examination performed before transplantation. Diabetics on our transplantation programme do not have better eye condition than the others.

PARSONS (London) Our experience mirrors yours. Now that photocoagulation is routine, the incidence of blindness on starting RDT has decreased. In those patients whose eyesight is deteriorating could some of the disease we have induced on dialysis be due not to heparin, but to hypotension. It is the ischaemic retina that bleeds and deteriorates rather than the haemorrhagic retina, because the patient is on dialysis.

ROTTEMBOURG I think the deterioration of visual function can be caused in three ways. The heparin dosage must not be too high during dialysis and we use low doses, no more than 5000 units for 5 hours. We try to avoid hypotension during the dialysis session using monitored control of ultrafiltration. Treatment of hypertension is also very important, either by drugs or if absolutely necessary by bilateral nephrectomy.

BAZZATO (Venezia-Mestre) Have you any experiences with uraemic diabetic patients treated with continuous ambulatory peritoneal dialysis?

ROTTEMBOURG The reported patients were all on haemodialysis. We have also 9 diabetic patients treated on continuous ambulatory peritoneal dialysis with a cumulative duration of treatment of about 80 months, using intra-peritoneal administration of insulin through the catheter before inflow of the dialysate. Blood sugar control is satisfactory. Blood pressure is also in most cases easily and efficiently controlled. Prognosis of eye lesions is mainly dependent on treatment before end stage renal failure. For many reasons, as far as eye problems are concerned CAPD should, of the various dialysis techniques, offer the best solution.

BAZZATO Do you think a stable blood sugar is the reason why there is improvement in these patients' visual function, treated with the intraperitoneal insulin and CAPD.
ROTTEMBOURG  Definitely good blood sugar control by day and night should be useful, but the fact they rarely develop hypotension could also be important.

SALTISI (Cardiff) You may have seen a letter in the Lancet about six months' or so ago reporting the use of continuous subcutaneous infusions of insulin with improvement in diabetic retinopathy. I wonder whether you have any experience with this at all?

ROTTEMBOURG  Yes, I read this letter. We haven't tried subcutaneous insulin continuously for our patients. But I think it is true that good glucose level control is one of the major factors to preserve the visual function of the diabetic, but I don't think it is sufficient. You must also maintain good blood pressure, and avoid hypotension and too much heparin.