VISUAL FUNCTION, BLOOD PRESSURE AND BLOOD GLUCOSE IN DIABETIC PATIENTS UNDERGOING CONTINUOUS AMBULATORY PERITONEAL DIALYSIS

J Rottembourg, *P Bellio, K Maiga, M Remaoun, *F Rousserie, M Legrain

Hôpital de la Pitie, Paris, *Hôpital Bichat, Paris, France

Summary

Over the last five years, 46 insulin dependent diabetic patients (mean age 52 ± 13 years) have been treated by continuous ambulatory peritoneal dialysis (CAPD). Fourteen patients have been on treatment for more than two years. Visual acuity assessed every six months showed that improvement has been observed in 14 eyes (19%), stabilisation in 36 eyes (46%), worsening in 17 eyes (21%), five eyes had a minimal function during the entire follow-up. Systolic blood pressure decreased from 173 ± 42mmHg at start of dialysis to 149 ± 30 and 146 ± 32 after one and two years. Mean fasting and post-prandial blood glucose assessed monthly in 36 patients treated with four daily intraperitoneal injections of insulin (660 determinations) were respectively 7.5 ± 3.5 and 8.5 ± 3.5mmol/L.

Introduction

Continuous ambulatory peritoneal dialysis (CAPD) is now considered as a satisfactory dialysis method for insulin dependent diabetic patients with end-stage renal disease. Encouraging results drawn from a rather large series were reported by Amair [1] and our group [2]. This paper is restricted to the analysis of the evolution of the following three important clinical parameters in insulin-dependent diabetic patients on CAPD treatment: visual acuity, blood pressure and blood glucose control.

Patients and methods

Patients

Between August 1978 and December 1983, 51 insulin-dependent diabetic patients were selected for treatment by CAPD. The CAPD technique was the first dialysis choice in 46 patients and five patients were transferred from haemodialysis, one because of ocular lesions, three because of cardiovascular problems
and one because of access difficulties. Six patients, mainly because of visual problems, were changed early to the so-called Continuous Cyclic Peritoneal Dialysis (CCPD). The data of the six patients on CCPD were included in the CAPD series. As of December 1983, the cumulative duration of treatment was 65.6 patient years with an average time per patient of 17.1±11 months (range 1 to 38 months). Fourteen patients had been treated for at least two years. At the beginning of treatment there were 27 males and 24 females whose mean age was 52.3 ± 13.5 years. The mean age when diabetes was discovered was 29.2 ± 15.2 years. The mean delay between discovery of diabetes and start of dialysis was 23 ± 17.6 years. All patients were treated with insulin when dialysis was started.

Extra-renal complications at the start of CAPD included hypertension in 49 cases (94%), proliferative retinopathy in 50 cases (5 patients were totally blind), a previous history of myocardial infarction in 26 cases (41%), severe peripheral vascular disease in 30 (50%) and clinical peripheral neuropathy in 38 cases (75%).

Methods

Technical details have been described elsewhere [3]. CAPD was carried out in most cases with four exchanges daily. Patients and their relatives were trained to measure the blood sugar with the finger prick technique on the glucometer Ames®. At home twice daily measurements were performed routinely. Once every two weeks, patients were asked to perform six serial measurements. In 36 patients on CAPD, insulin was administered four times daily exclusively through the peritoneal route by a special injection port in the line of the bag [4]. Four patients on CAPD treated at the early phase of this series were receiving insulin subcutaneously. The six patients on CCPD were treated with three daily subcutaneous injections of insulin. Frusemide was given to 32 patients during the first year to maintain residual renal function [2].

Results

Five patients were unable to handle the CAPD technique and were transferred early to haemodialysis. On peritoneal dialysis the overall patient survival was 85 per cent, 65 per cent and 57 per cent at one, two and three years respectively. The CAPD technique success rate was 88 per cent after one year and 78 per cent after two years in the younger age group (19 patients under 50 years old, mean age 39.1 ± 8 years) while it was only 70 per cent and 50 per cent in the older age group (27 patients over 50 years old, mean age 61.5 ± 8 years).

Visual status

Visual status was assessed at the start of treatment and every six months during treatment in 46 patients. At each ophthalmic visit the best corrected visual
acuity for each eye was determined, a thorough ophthalmic examination completed and retinopathy documented by a multiple field stereophotograph (one every year). Visual acuity was evaluated in five functional categories: 1) reading visual acuity 20/10 to 20/50; 2) impaired visual acuity 20/70 to 20/100; 3) ambulatory visual acuity 10/160 to counting fingers; 4) minimal visual function, hand motions to light perceptions; 5) no visual function, no light perception. All patients, except one, presented a proliferative retinopathy, 64 per cent in stages 1 and 2 and 36 per cent in stage 3. The evolution of visual acuity is summarised in Table I. The results are as follows: in the younger age group

<table>
<thead>
<tr>
<th>Group</th>
<th>Visual acuity</th>
<th>Baseline</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>1</td>
<td>20/10–20/50</td>
<td>30</td>
<td>34</td>
</tr>
<tr>
<td>2</td>
<td>20/70–20/100</td>
<td>26</td>
<td>29</td>
</tr>
<tr>
<td>3</td>
<td>20/160–counting fingers</td>
<td>22</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>light perception</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>totally blind</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>92</td>
<td>100</td>
</tr>
</tbody>
</table>

(19 patients), 16 eyes were in group 1 and 22 eyes in group 2. During treatment and at the final examination, visual acuity improved in 10 eyes (26%), stabilised in 21 (55%) and worsened in seven (19%). In the older age group (over 50 years old) 40 eyes could be studied over a year: 26 eyes were in groups 2 to 5 and only 14 in group 1. Visual acuity improved in only four eyes (10%), stabilised in 26 (65%) and worsened in 10 (25%).

Visual improvement was due to spontaneous resorption of vitreous haemorrhage and the beneficial effect of photocoagulation and vitrectomy. Deterioration of visual function occurred in 17 eyes due to multiple events, sometimes interrelated: recurrent vitreous haemorrhage (5 eyes), cataract (6 eyes), macular degeneration (3 eyes) and anterior segment neovascularisation (3 eyes).

**Blood pressure control**

At the start 43 patients (94%) were hypertensive and receiving drugs including diuretics (36 patients), beta blockers (25 patients), central sympathicoplegics (29 patients), vasodilators (18 patients) and converting enzyme inhibitors (5 patients). Mean supine blood pressure was $173 \pm 42/90 \pm 35$mmHg. After one year of dialysis 17 of 31 patients (55%) were normotensive without any treatment (if one excludes frusemide), 10 were normotensive on treatment and four remained hypertensive (systolic $169 \pm 36$mmHg and diastolic $109 \pm 21$mmHg). After two years 11 of 14 patients were normotensive without anti-hypertensive drugs: mean supine blood pressure was $146 \pm 32/144 \pm 28$mmHg
and erect 144 ± 28/86 ± 18 mmHg. In eight patients with major neurological disorders, severe postural hypotension was observed induced mainly by rapid ultrafiltration following the use of the high glucose concentration solutions (4.2 to 4.5 g/L).

**Blood glucose control**

In the 36 patients treated by CAPD and using intraperitoneal administration of regular insulin the mean total daily dose of insulin was 86 ± 32 IU. In this series the 660 monthly fasting and post-prandial blood glucose determinations performed in the out-patient clinic gave respectively the following mean results: 7.5 ± 3.5 mmol/L and 8.5 ± 3.5 mmol/L. The mean results of 132 serial determinations of blood glucose levels obtained in 21 patients were 7.7 ± 3.2 mmol/L at 8 a.m., 8.5 ± 3.5 mmol/L at 10 a.m., 7.1 ± 3.0 mmol/L at noon, 8.5 ± 3.5 mmol/L at 2 p.m., 7.3 ± 2.8 mmol/L at 4 p.m., 7.3 ± 3.2 mmol/L at 6 p.m., 8.0 ± 3.4 mmol/L at 8 p.m. The mean serum glycosylated haemoglobin HBA1c measured during the last year in 22 patients treated by CAPD for at least one year was 8.7 ± 1.3%.

**Discussion**

Over the past five years it has been shown that CAPD can offer excellent control of both diabetes and uraemia to insulin and non-insulin diabetics with end-stage renal disease [1–4]. For these reasons, since 1978, many institutions have selected CAPD as the first choice method of home dialysis for diabetic patients [5]. Despite some serious complications [6], the technique success rate obtained with CAPD can compete very favourably with those obtained in a diabetic population of the same mean age treated by haemodialysis [7], intermittent peritoneal dialysis [8] and even transplantation if one accepts the excellent results obtained with a living related donor [9]. The drop-out rate (including deaths and transfers) and morbidity are largely influenced by age, the major risk factor.

Good control of blood pressure is commonly observed and in our series the proportion of normotensive patients taking no anti-hypertensive drugs reaches 79 per cent after two years. However the incidence of symptomatic hypotension in few patients should be emphasised.

Rapid deterioration of visual function is one of the major threats to diabetic uraemic patients who undergo maintenance haemodialysis therapy [10]. Until now little data on the progression of visual morbidity among diabetic patients treated by CAPD has been available [1,2,10]. Our results are encouraging and either improvement or stabilisation are observed in about 75 per cent of the patients less than 50 years old. In the older age group improvement is seldom observed but stabilisation can be obtained. Because of the absence of follow-up studies on a large and comparable group, over a sufficient period of time, valid evaluation of the effect of CAPD on visual function, compared to the results obtained by haemodialysis or after transplantation, is too early. We agree with others [10] that visual loss relates to the stage of retinopathy rather than the duration of dialysis even on CAPD. Specialised ophthalmic care, including
scatter photocoeagulation and vitrectomy, are part of efficient treatment.

The excellent control of blood glucose achieved by the intraperitoneal
administration of insulin first claimed by Flynn [4] is confirmed by our own
results. The injection of insulin either into the dialysate bag or into the line
[3] is favoured by most patients. However the average total daily dose of
insulin is commonly two to three times the pre-CAPD dose partly because of
adsorption of insulin by the material and losses in the dialysate effluent. In our
experience, as in other series [1–3], the use of the intraperitoneal route does
not significantly increase the rate of peritonitis.

CAPD should be one choice in an integrated programme including all types
of dialysis and transplantation for insulin dependent diabetic patients. It offers
many patients, including the older age group, an adequate control of diabetes,
uraemia and hypertension.

References

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