IS CONTINUOUS AMBULATORY PERITONEAL DIALYSIS THE BEST DIALYSIS CHOICE FOR INSULIN DEPENDENT DIABETICS?

J Rottembourg, F de Groc, J L Poignet, M Legrain

Service de Néphrologie, Hôpital de la Pitié, Paris, France

Summary

In the last eight years 100 insulin dependent diabetics (IDD) have been dialysed at the Hôpital de la Pitié. Since August 1978 31 have been started on continuous ambulatory peritoneal dialysis (CAPD). Cumulative duration of treatment was 336 patient months, with an average time of 10.8 months. The actuarial technique success rate was 82 per cent at one year and 65 per cent at 18 months. Causes of drop out were seven deaths and six transfers to haemodialysis. The peritonitis rate was one episode every year. For some IDD patients and within the period of observation, CAPD offers a unique opportunity to be dialysed at home with excellent clinical and biological results.

Introduction

Diabetic nephropathy is a growing cause of end-stage renal disease (ESRD) in all industrialised countries [1] and the exclusion of insulin-dependent diabetics (IDD) is no longer acceptable when treatment facilities are available. Continuous ambulatory peritoneal dialysis (CAPD) is currently quoted as a satisfactory dialysis method perhaps the best for IDD patients [2–5]. In this study we report our experience with 31 IDD patients treated by CAPD over a four year period.

Patients and methods

In the last nine years 100 IDD patients with ESRD have been treated by dialysis and/or kidney transplantation in our Hospital. Sixty-six of them have been haemodialysed, three have been treated by intermittent peritoneal dialysis and, from August 1978 to August 1982, 31 have been started on CAPD. In 27 patients CAPD was the treatment of first choice, four were transferred from haemodialysis because of ocular (one case) or cardiovascular complications (three cases).
At start of treatment by CAPD there were 16 males and 15 females whose mean age was 53.9 (range 28–71). Mean duration of diabetes was 24.2 ± 16.8 years and mean residual creatinine clearance was 5.2 ± 1.7 ml/min. All patients had multiple extrarenal complications. Severe arterial hypertension was present in 28 cases. Diabetic retinopathy was present in all cases. Two patients were totally blind and seven legally blind. Severe peripheral vascular lesions were present in 20 cases. Walking impairment was present in 16 cases. As of 31 July 1982 cumulative duration of CAPD treatment was 336 patient/months. The average time on CAPD was 10.8 months (range 1–36). Thirteen patients were on CAPD for at least 12 months and three from more than two years.

CAPD training was performed in a separate unit with specialised medical and nursing staff. The composition of the dialysate and the equipment used have been described previously [6]. Mean duration of training period was 19 days (range 12–28 days). Most patients during the period under study performed four exchanges per day using three 2L bags with a 1.5 per cent dextrose concentration during the day and one 2L bag with a 4.5 per cent dextrose concentration overnight. Since October 1981, three legally blind patients performed continuous cyclic peritoneal dialysis (CCPD) with the help of their relatives, using a ‘cycler’ dispensing 2L bags three times overnight while 2L of 4.5 per cent dextrose dialysis fluid was left in the peritoneal cavity during the daytime.

The patients were asked to eat a diet with a carbohydrate content, ranging between 130 and 150g/day and a protein content of about 1.5g/kg body weight/day. Frusemide, 500mg/day, was administered orally to 25 patients with the aim of preserving residual urinary output. Patients and their relatives were trained to measure blood sugar concentrations with a reflectance Ames ‘Dextrometer’. In 23 out of 31 patients regular insulin was injected into the connecting tube after the drainage of a bag and immediately before instillation of the following one. On average 15–20 units of insulin were needed with the 1.5 per cent dextrose concentration bags and 30–40 units with the 4.5 per cent dextrose concentration. Insulin requirements were determined to avoid two hours post-prandial sugar concentrations greater than 11mmol/L.

**Results**

The actuarial technique success rates on CAPD were 82 per cent at one year and 65 per cent at 18 months. Causes of drop out were death in seven cases and transfer to haemodialysis (HD) in six cases. Causes of death were stroke in one case, myocardial infarction in one case, sepsis following lower limb amputation in three cases, peritonitis from bowel perforation in one case, severe malnutrition in another. Transfers to HD were decided because of malnutrition in one case, recurrent peritonitis in two cases, a perforated sigmoid diverticulum in one case and inability to handle the technique in two cases.

The overall incidence of peritonitis was 28 episodes in 28 patient/years. Twenty-three episodes yielded a pathogen: Staphylococcus was responsible in nine episodes (four *Staph. Aureus*, five *Staph. Epidermitis*), Streptococcus in five, Actinobacter in three, Aspergillus in three, *Escherichia Coli, Klebsiella Pneumonii* and *Pseudomonas* in one.
<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>12</th>
<th>18†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight kg</td>
<td>63.3 ± 7.6</td>
<td>63.4 ± 8.5</td>
<td>64.4 ± 9.3</td>
<td>66.9 ± 10</td>
<td>61.6 ± 6.9</td>
</tr>
<tr>
<td>Blood pressure mmHg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>systolic</td>
<td>208 ± 24</td>
<td>155 ± 9.3</td>
<td>169.6 ± 28</td>
<td>160.4 ± 21</td>
<td>159 ± 27</td>
</tr>
<tr>
<td>diastolic</td>
<td>119 ± 14.5</td>
<td>86.6 ± 4.3</td>
<td>89.1 ± 16</td>
<td>81.6 ± 9.3</td>
<td>100 ± 16.3</td>
</tr>
<tr>
<td>Creatinine µmol/L</td>
<td>1007 ± 393</td>
<td>712 ± 240</td>
<td>708 ± 233</td>
<td>756 ± 236</td>
<td>694.5 ± 1.8</td>
</tr>
<tr>
<td>Haemoglobin g/dl</td>
<td>8.8 ± 1.9</td>
<td>11.26 ± 1.9</td>
<td>11.4 ± 1.3</td>
<td>11.5 ± 1.4</td>
<td>12 ± 1.9</td>
</tr>
<tr>
<td>Albumin g/L</td>
<td>34.4 ± 4.4</td>
<td>33.4 ± 3.3</td>
<td>32 ± 3.7</td>
<td>31.5 ± 5</td>
<td>32.4 ± 1.6</td>
</tr>
<tr>
<td>Cholesterol mmol/L</td>
<td>5.8 ± 1.2</td>
<td>6.95 ± 1.56</td>
<td>6.9 ± 1.2</td>
<td>6.4 ± 1.3</td>
<td>6.8 ± 1.5</td>
</tr>
<tr>
<td>Triglycerides mmol/L</td>
<td>2.44 ± 1.15</td>
<td>2.7 ± 1.22</td>
<td>3.2 ± 1.4</td>
<td>2.9 ± 1.7</td>
<td>2.2 ± 1.2</td>
</tr>
<tr>
<td>Bicarbonate mmol/L</td>
<td>22.9 ± 3.8</td>
<td>25.2 ± 2.8</td>
<td>24.4 ± 3.2</td>
<td>24.16 ± 2.7</td>
<td>25.5 ± 2.6</td>
</tr>
<tr>
<td>Potassium mmol/L</td>
<td>4.6 ± 0.6</td>
<td>4.5 ± 0.6</td>
<td>4.4 ± 0.3</td>
<td>4.18 ± 0.4</td>
<td>4.5 ± 0.4</td>
</tr>
<tr>
<td>Calcium mmol/L</td>
<td>2.22 ± 0.3</td>
<td>2.40 ± 0.17</td>
<td>2.34 ± 0.15</td>
<td>2.32 ± 0.1</td>
<td>2.38 ± 0.1</td>
</tr>
<tr>
<td>Phosphorus mmol/L</td>
<td>2.04 ± 0.5</td>
<td>1.40 ± 0.3</td>
<td>1.42 ± 0.32</td>
<td>1.5 ± 0.3</td>
<td>1.5 ± 0.23</td>
</tr>
<tr>
<td>Residual renal creat. clear. ml/m</td>
<td>4.74 ± 0.31</td>
<td>4.2 ± 2.2</td>
<td>4.2 ± 2.9</td>
<td>4.6 ± 2.9</td>
<td>5.3 ± 3.8</td>
</tr>
<tr>
<td>Peritoneal creat. clear. ml/min</td>
<td>4.2 ± 0.96</td>
<td>4.3 ± 1.33</td>
<td>4.2 ± 0.7</td>
<td>3.6 ± 1.1</td>
<td></td>
</tr>
</tbody>
</table>

* All values expressed as mean ± SD. Differences evaluated by the paired Student's t test between the third and the twelfth months are not statistically significant
† Eight patients only
The main clinical and biological parameters in 13 patients treated by CAPD for at least one year are summarised in Table I. Cure of hypertension was obtained in most cases and only four of 13 patients were still receiving antihypertensive drugs after one year on CAPD. Severe hypotensive episodes were observed in seven cases. Visual status was assessed in 22 patients treated by CAPD for at least six months. A deterioration was observed in three cases due in two to the extension of proliferative retinopathy and in one to severe intravitreous haemorrhage. Three amputations, two of a lower limb and one of toes, were required during the period of observation. Of the 16 patients unable to walk initially, nine improved, three remained stable and three deteriorated.

Peritoneal and residual renal creatinine clearance remained stable during the period of observation.

Control of diabetes was easy. Only two clinical acute hypoglycaemic episodes were observed in patients receiving betablockers. The daily dose of insulin administered intraperitoneally was between 60 and 130 units. The doses were increased during peritonitis episodes. The mean serum glycosylated haemoglobin (HbA1) in 13 patients dialysed for at least a year remained stable: 10.06 ± 1.6 at start of treatment and 10.1 ± 2.2 at one year. The mean values of fasting blood glucose decreased rapidly during treatment with CAPD and values at one year in nine patients using intraperitoneal administration of insulin were 5.8 ± 0.7 mmol/L.

Discussion

The results of kidney replacement in IDD patients with the exception of recent data observed with kidney transplantation by Sutherland et al (in seven) have been inferior to those achieved in a non-diabetic population of the same age range. Even if kidney transplantation is likely to be the first choice treatment for the younger age group of IDD patients, the shortage of cadaver kidneys and the difficult ethical problems involved with related donor transplantation mean that most diabetics with ESRD will rely for treatment in the coming years on dialysis methods, even if they are at high risk.

The technique success rate for our IDD patients with a mean age of 54 years was 82 per cent at one year and 65 per cent at 18 months. Such results compare very favourably with the 85 per cent survival rate at one year and 75 per cent at two years observed in 66 IDD patients with a mean age of 41 years treated by HD in the same hospital. They are either superior or similar to the best results reported for centre haemodialysis in patients of the same age group [4, 8].

The main causes of death are vascular. It is too early to determine if control of hypertension and blood glucose will have in the long term a beneficial effect on the vascular death rate in comparison with patients treated by HD. Peritonitis remains a serious technical complication and was in this series the cause of death in one case and of three transfers to HD. But in our experience as in others [2, 3], the incidence of peritonitis among diabetic patients is not increased in comparison with a non-diabetic population treated in the same unit.

Good control of blood glucose was obtained in our IDD patients on CAPD. We favour the administration of insulin by the intraperitoneal route [9]. Such a
protocol in our experience as others [2, 8] does not significantly increase the risk of peritonitis. Careful dietary control, including daily protein intake between 1.2 and 1.5g/kg, and adequate insulin management are required to avoid increase in body weight and protein depletion in relation with peritoneal protein losses. Particular attention should be paid to malnutrition the onset of which can be quite insidious in anorectic patients. Monitoring of serum albumin values is required.

The clinical and biological status of most of our IDD patients treated by CAPD can be judged as very good. CAPD offers to many high risk diabetic patients and even in the older age group a unique opportunity to be dialysed at home. CAPD technique success rate within a period of two years compares favourably with any other replacement therapy if groups of similar age are compared. Nevertheless some diabetic patients and mainly those with impaired sight will never handle the technique adequately. We do not consider that the burden of the daily exchange of the bags should be imposed on the relatives. In such circumstances in patients in whom home dialysis seems indicated, other forms of peritoneal dialysis either intermittent or continuous cyclic can be an adequate alternative. In the younger age group CAPD should be considered as part of an integrated CAPD-transplantation programme. To conclude, we must avoid making an issue of either transplantation, haemodialysis or peritoneal dialysis, for some diabetic patients CAPD can offer the best.

Acknowledgment

This study was supported by a grant from the Association pour l'Utilisation du Rein Artificiel.

References

3 Flynn CT, Hibbard J, Dohrman B. Proc EDTA 1979; 16: 184
8 McCrory RF, Pitts TO, Puschett JB. Am J Nephrol 1981; 1: 206

Address for correspondence: J Rottembourg, Service de Néphrologie, Hôpital de la Pitié, Paris, France

Open Discussion

TARABA (Chairman) May I ask why did you treat three patients with IPD instead of CAPD?
ROTTEMBOURG These patients were treated between 1976 and 1978 when the CAPD technique was not established.

TARABA Do you think the IPD was as efficient as the CAPD?

ROTTEMBOURG I think it is less efficient because it is more difficult to control blood glucose concentrations in these patients treated three times weekly with high amounts of glucose.

GABRIEL (London) A naive question, simply because I have almost no experience of patients with diabetes mellitus in terminal renal failure. The residual renal function was about 4.5ml/minute for the whole of that period. Is this usual for diabetic patients in terminal renal failure, or is it something special about your management of them?

ROTTEMBOURG We described yesterday that in patients on continuous ambulatory peritoneal dialysis the residual renal function over a period of eighteen months remained stable. It is also true for diabetic patients treated by CAPD. I think that it can be beneficial in the control of their hypertension and maybe in controlling their hyperglycaemia, if they are not well controlled by s.c. insulin. I think that 6 to 8ml/min of creatinine clearance should be considered the lowest value to establish a diabetic patient on CAPD. CAPD or any other mode of therapy for their end stage renal disease must control, in the best possible way, hypertension and blood glucose concentrations.

OHNO (Tokyo) Is there some difference in the requirements for 1,25(OH)D₃ (between haemodialysis and CAPD, in the treatment of diabetics?)

ROTTEMBOURG Quite, all the patients were treated with 1,25(OH)D₃ and calcium. I don't think there is any difference between the diabetic and the non-diabetic group in CAPD.

OHNO I am asking if there is a difference between haemodialysis and CAPD in the requirement for vitamin D because of the great loss by CAPD?

ROTTEMBOURG I have not here clear in my mind the data about the requirement between haemodialysis and CAPD group. I cannot answer today your question.

CONDE (Toledo) I would like to ask you how you assess the visual status of your patients?

ROTTEMBOURG Our patients are seen every three months by the same ophthalmologist and fluorescent angiography is performed once per year.