Peritoneal ultrafiltration and treatment-resistant heart failure

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Introduction

One of the consequences of ageing in the general population is the increased frequency of ischaemic and/or hypertensive cardiac failure. Early initiation of medical treatment associating healthy and dietary measures, digitalo-diuretic treatment and angiotensin-converting enzyme inhibitor (ACEI) is the rule [1]. Indeed, ACEI adjunction has improved morbidity and mortality, as confirmed by the Consensus study where mortality figures were found to be 31% with enalapril treatment, compared with placebo [2,3]. However, cardiac insufficiency can be severe and treatment-resistant, corresponding to NYHA class IV with poor prognosis.

Peritoneal dialysis was proposed by Schneier son in 1949 in a patient under temporary treatment. Sufficient regression of cardiac failure was obtained, followed by restored sensitivity of the oedematous syndrome to diuretics [4]. Mailoux et al. in 1967 [5] confirmed the effectiveness of intermittent peritoneal dialysis in 15 patients. Further encouraging results were recorded later, both with intermittent peritoneal dialysis and with continuous ambulatory peritoneal dialysis [6–12]. A recent literature review counted 115 published case reports which gathered patients with congestive heart failure, either isolated or associated with chronic renal failure [13].

The aim of this study was to assess the effectiveness and tolerance of peritoneal ultrafiltration and to specify the morbidity linked to cardiac failure, or to the intercurrent pathology or peritoneal ultrafiltration.

Patients and methods

Patients

From April 1993 to April 1996, we conducted a prospective, non-randomized study involving patients with cardiac failure refractory to maximal tolerable drug treatment, including dietary salt restriction (40–50 mmol Na+/day), frusemide (500 mg/day max) sometimes associated with hydrochlorothiazide (25 mg) and spironolactone (50 mg), an ACEI and digoxin treatment episodically. Fifteen patients (11 men and four women) whose mean age was 66.7 years (range: 56–81) were included in the study. The incriminated cardiopathy was of ischaemic and/or hypertensive origin in eight cases, valvular in three cases and undetermined in four cases. Cardiac failure was isolated in 12 cases, whereas in three cases it was associated with end-stage chronic renal failure. One patient had been treated previously by haemodialysis for 17 years. According to the NYHA classification, 11 patients were in class IV and four were in class III. Chronic hypotension (systolic pressure <100 mm at rest) was noted in five patients, making them bed-ridden.

Medical treatment details are shown in Table 1. Only one anuric patient previously treated by haemodialysis did not take diuretics. An ACEI could be used only in eight patients because of severe hypotension (n=5) or major renal function impairment following treatment initiation (n=3).

Methods

We used hypertonic (Dianeal Baxter dextrose 3.86%, 486 osmol/l) or isotonic (Dianeal Baxter dextrose 1.36%, 347 osmol/l) peritoneal dialysis solutions. A single-use, disconnectable double bag device was used in eight patients, and a UV Flash system in six patients. Bags were distributed as follows: one hypertonic bag every 24 h in seven patients, one hypertonic bag every 48 h in four patients, three isotonic bags per day in one patient and three isotonic + one hypertonic bags.

<table>
<thead>
<tr>
<th>Patients (n=16)</th>
<th>Frusemide*</th>
<th>ACEI</th>
<th>Digoxin</th>
</tr>
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<tbody>
<tr>
<td>15</td>
<td>8</td>
<td>6</td>
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</table>

ACEI, angiotensin-converting enzyme inhibitor.

*One anuric patient, previously on haemodialysis.

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in two patients. One patient was under automated peritoneal dialysis (intermittent nocturnal peritoneal dialysis) on a cycler for 10–12 h per session.

Five patients were independent, whereas 10 needed the help of a relative \((n = 3)\) or a visiting nurse \((n = 7)\).

**Parameters studied**

The following parameters were monitored in the course of the study. (i) Duration of patient follow-up and cause of withdrawal if treatment was stopped; (ii) evolution of cardiac failure (NYHA class); (iii) body weight (kg), diuresis (l/24 h), weekly peritoneal ultrafiltration (l/week), daily sodium removal (mmol Na\(^+\)/day); (iv) echocardiography at inclusion and repeated between the third and sixth month of treatment (seven patients); and (v) the frequency and causes for hospitalization in relation to peritoneal ultrafiltration, cardiac failure or intercurrent pathology.

**Results**

Nine of the 15 patients were still undergoing treatment at the end of follow-up. The mean duration of treatment by ultrafiltration or peritoneal dialysis in cases of end-stage renal failure was 12.7 months (range 4–28), including eight patients who were or had been undergoing treatment for > 12 months.

Six patients dropped out during the experimental period. Withdrawal causes are detailed in Table 2. Two patients received cardiac transplantation after, respectively, 6 and 15 months of peritoneal ultrafiltration although they previously had been excluded by the surgical team. Four patients died after 4, 10, 11 and 12 months, respectively all from heart failure, including one myocardial infarction, one sudden death and two heart failures.

Clinically, regression or disappearance of oedema or even ascitis were associated with an improvement of the cardiac failure class. Out of 10 initially class IV patients, six became class II and four became class III, and five initially class III were class II at the end of follow-up. Rapid clinical improvement was noted, within 2–3 weeks following treatment initiation.

Weight loss was recorded in all patients, from 72.2 kg (range 52–102) to 66.7 kg (range 50–80). Mean weekly ultrafiltration volume was 3.74 l per patient (range 2.2–6.5). Diuresis (24 h) was stable, from 1.35 (range 0.5–2.5) to 1.48 (range 0.45–3.2) litres in the 14 patients whose diuresis was maintained. Sodium removal was 79 mmol Na\(^+\)/24 h, including 45 mmol (range 29–92) peritonally (57%) and 34 mmol (range <10–81) in urine (43%). Echocardiography was performed in seven patients. The left ventricular ejection fraction was either stable \((n = 2)\), improved \((n = 3)\) or aggravated \((n = 2)\).

The breakdown of hospital days is shown in Table 3. The total number of hospitalization days was 241, including 86 days (36%) due to heart failure, 116 days (48%) for intercurrent pathology and 39 days (16%) for complications of peritoneal dialysis. Morbidity, expressed as the number of hospitalization days per patient per month, was compared between two periods, i.e. 6 months before the beginning of peritoneal ultrafiltration and the whole period of follow-up. It decreased from 3.7 to 1.2 days/patient/month, equivalent to a 67% decrease in hospitalization time. Complications related to the peritoneal dialysis technique (16%) were peritoneal infection \((n = 2)\), abdominal wall infection \((n = 1)\), lack of transient drainage \((n = 3)\) and catheter displacement requiring its replacement \((n = 2)\).

**Discussion**

Intermittent peritoneal dialysis was prescribed initially in sessions of 24–48 h, using hypertonic glucose solutions during treatment-resistant congestive heart failure in 15 patients [5]. Weight loss of 5.2 kg was achieved with 7.2 l of ultrafiltration, and it was followed by restored sensitivity to diuretics in 12 of the 15 patients. These results were confirmed by two other studies in eight and 10 patients, respectively [6,7]. Raja et al. monitored hydric and sodium inflation during eight

**Table 2. Outcome (cardiac transplantation and death)**

<table>
<thead>
<tr>
<th>Outcome (n=9)</th>
<th>Time on ultrafiltration (months)</th>
<th>Cause of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac transplantation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>Heart failure</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>Myocardial infarction</td>
</tr>
<tr>
<td>3</td>
<td>11</td>
<td>Sudden death</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>Heart failure</td>
</tr>
<tr>
<td>5</td>
<td>6 (APD)</td>
<td>Heart failure</td>
</tr>
<tr>
<td>6</td>
<td>30</td>
<td>Heart failure</td>
</tr>
<tr>
<td>7</td>
<td>33</td>
<td>Heart failure</td>
</tr>
</tbody>
</table>

APD, automated peritoneal dialysis.
peritoneal dialysis sessions over 21 months in a patient with refractory heart failure. Each session lasted between 48 and 96 h, with an average weight loss of 16.9 kg and mean hospitalization time of 18.7 days per patient [14].

In 1983, continuous ambulatory peritoneal dialysis (CAPD) was prescribed in three patients with congestive cardiac failure refractory to a daily dose of 1 g of frusemide. Associating one hypertonic bag with three isotonic bags ensured satisfactory control of hydric and sodium inflation but aggravated functional renal failure and reduced diuresis by 35–80%. Frequent peritonitis required the treatment to be discontinued, and death occurred within the following 2 weeks. This will constitute a limiting factor to the use of that therapeutic strategy [8]. In our experiment, peritoneal infections were very rare because of the very small number of bag changes during isolated cardiac failure.

More recently, other experiments over longer periods and involving a greater number of patients have been described [12,13,15]. Of the 19 patients under long-term follow-up by Konig et al., three had a heart on the NYHA scale [9]. The survival rate of patients transplanted while five were able to discontinue CAPD (mean treatment duration 10.7 months (range 1–24). In our study, only one patient could suspend CAPD for 8 months when diuretic treatment became sufficient. At the end of that period, cardiac failure recurred, accompanied by severe chronic renal failure.

Improvement of the functional tolerance of cardiac failure was constant in the literature series (Table 4).

A reduction in the cardiothoracic index was observed frequently in 18 of the 19 patients and in seven of the eight patients in the two studies [11,15].

Haemodynamic analysis is rarely performed, and peritoneal ultrafiltration inconsistently improves the recorded parameters [11,16]. However, a significant decrease in mean pulmonary blood pressure was evidenced in eight patients, from 35 to 20 mmHg without any change in cardiac index or echographic data [16]. Our results and those published did not reveal any correlation between functional improvement and that of the left ventricular ejection fraction (LVEF), as assessed by echocardiography [9,11]. Kim et al. reported an increase in LVEF from 19 to 34% and from 24 to 36% in two patients, stability in one patient and deterioration in one patient, although all of them exhibited functional improvement by one or two classes on the NYHA scale [9]. The survival rate of patients treated by CAPD is usually correlated with LVEF at the beginning of treatment. It is 90, 79 and 64% at 24 months if LVEF is normal, between 35 and 55% or <35%, respectively [17]. Isotopic evaluation would undoubtedly be more accurate [9,18].

A baseline cardiothoracic index >0.70, the need for ventilation support, the presence of cardiovascular collapses and amyloidosis are pejorative prognosis factors [10,11].

Morbidity, expressed as the number of days of hospitalization per patient per month, was high and unchanged before and after ultrafiltration in earlier studies [10,11]. This has not been confirmed recently, and the frequency of hospitalization decreased from 12.7 to 3.4 for Freida et al. and from 3.7 to 1.2 days per patient per month according to our own data,

Table 3. Hospitalization (days) according to cause

<table>
<thead>
<tr>
<th>Cause</th>
<th>Cardiac failure</th>
<th>Complications related to peritoneal ultrafiltration</th>
<th>Miscellaneous</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalization (days)</td>
<td>86</td>
<td>39</td>
<td>116</td>
<td>241</td>
</tr>
<tr>
<td></td>
<td>36%</td>
<td>16%</td>
<td>48%</td>
<td>100%</td>
</tr>
</tbody>
</table>

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Table 4. Clinical improvement of heart failure according to NYHA class

<table>
<thead>
<tr>
<th>Reference and year</th>
<th>Patients (NYHA class)</th>
<th>Clinical improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kim et al. [9], 1985</td>
<td>4</td>
<td>IV to II (2) and III to II (2)*</td>
</tr>
<tr>
<td>Rubin and Ball [10], 1986</td>
<td>8</td>
<td>IV to IV (4) and IV to III (3)</td>
</tr>
<tr>
<td>Mousson et al. [11], 1988</td>
<td>19</td>
<td>IV to IV (3) and IV to III (6)</td>
</tr>
<tr>
<td>Freida et al. [13], 1995</td>
<td>10</td>
<td>IV to II (6)</td>
</tr>
<tr>
<td>Stegmayr et al. [15], 1996</td>
<td>16</td>
<td>IV to II (9) and III to II (3)</td>
</tr>
<tr>
<td>Ryckelynck, 1997</td>
<td>16</td>
<td>IV to II (6) and III to II (5)</td>
</tr>
</tbody>
</table>

*(*) Number of patients.
which would have a favourable impact on the overall cost of treatment [13].

Lastly, peritoneal ultrafiltration could be prescribed in patients awaiting heart transplantation. Two initially excluded patients were able to receive transplantation following improvement of their haemodynamic and general conditions. These data had already been reported by Konig et al. in three patients [12].

Peritoneal ultrafiltration, with or without dialysis, appears to be a recommendable alternative in cases of congestive cardiac failure refractory to high-dose, well-tolerated drug treatment. Beside the functional benefits, morbidity can be improved. Taking into consideration the clinical condition of patients at the beginning of treatment, a decreased mortality can be expected, but this would have to be confirmed. However, patient selection remains difficult and the exact criteria for treatment initiation remain to be defined.

References