PERITONEAL EXTRACORPOREAL RECIRCULATION DIALYSIS

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Peritoneal extracorporeal recirculation dialysis (RPD) was described by Shinaberger, Shear and Barry (1965), looking for improvement of the efficiency of intermittent peritoneal dialysis (IPD) without sacrificing its advantages, by increasing solute extraction clearances and reducing time, dialysate and protein loss. They also suggested that with an adequate ultrafiltration, the dialysing fluid at the end of the RPD could be concentrated and reinfused into the peritoneal cavity to avoid any protein loss.

In this series 3 patients with chronic glomerulonephritis in terminal stage were treated alternately with IPD and RPD. 15 IPD’s were performed with an average duration of 40 hours with a flow rate of about 35 ml/min and 8 RPD’s usually lasting 16 hours with a flow rate of 300 ml/min. This last value was approximate, because although a Sigmamotor pump was adjusted to obtain this flow rate, no constant values were achieved. Stylet-catheters were used. The puncture for the efferent catheter was performed in the middle line under the umbilicus and the abdominal cavity was filled with 3 litres of dialysate. This catheter was connected with the arterial tubing of a Travenol twin-coil kidney. The coils were also primed with dialysing fluid. After recirculation through the artificial kidney, the dialysate came back into the peritoneal cavity by a catheter inserted 4 cm above the umbilicus, whose tip was placed in the direction of the spleen. The first RPD was performed with 40 mg heparin in the dialysate. Because coagulation in the 12th hour occurred, at the next RPD 10 mg heparin per hour were added to the dialysing fluid, using an infusion pump. BUN clearances were determined 4 hourly in RPD. In IPD three clearances were measured: during the first 4 hours, the next 4 hours and the last 32 hours. This last one was performed to evaluate the efficiency of IPD during the night when we have a limited nursing staff who also undertake general ward duties. With these three values a ‘true’ total BUN clearance in IPD was calculated.

Protein loss was measured chemically with the Kjeldahl’s method and albumin contents determined by paper electrophoresis and by means of I\textsuperscript{131} labelled radioactive albumin.

BUN clearances are shown in Figure 1. Empty circles represent the 4 hourly clearances and the full ones the values obtained during the night. The solid bars indicate the mean values in IPD and RPD.

The relation between these clearances is shown in Table I. These relative values agree with those found by Shinaberger but the absolute ones are rather lower, perhaps because of the difficulties with the flow rate. It must be emphasized that this factor (flow rate) was eliminated to calculate the clearances which were determined in RPD by dividing BUN content of the kidney bath by mean BUN serum concentration and dialysing time. The IPD clearances are according to the values given by Boen (1961).

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TABLE I

<table>
<thead>
<tr>
<th>Patient</th>
<th>IPD</th>
<th>RPD</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.St.</td>
<td>15.7</td>
<td>33.4</td>
<td>212</td>
</tr>
<tr>
<td>Y.K.</td>
<td>9.9</td>
<td>32.2</td>
<td>325</td>
</tr>
<tr>
<td>G.B.</td>
<td>14.4</td>
<td>22.2</td>
<td>154</td>
</tr>
</tbody>
</table>

The protein loss found in IPD and RPD is shown in Table II. After 40 hours IPD with an exchange of 79.5 l the average loss of protein was 86.4 g. This value agrees with those of Berlyne et al. (1964a) who found 65.4 g in 60.7 l dialysate. In RPD a loss of 59.8 g was found. The albumin loss was 57.5 g in IPD and 29.6 in RPD.

TABLE II

<table>
<thead>
<tr>
<th></th>
<th>Number of patients</th>
<th>Time hours of dialysis</th>
<th>Volume of dialysate</th>
<th>Protein loss (Kjeldahl's method)</th>
<th>Albumin loss (Kjeldahl + electrophoresis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPD</td>
<td>3</td>
<td>15</td>
<td>39.9 h</td>
<td>79.6 litres</td>
<td>86.4 g ± 44.4</td>
</tr>
<tr>
<td>RPD</td>
<td>3</td>
<td>8</td>
<td>16 h</td>
<td>4 litres</td>
<td>59.8 g ± 26.5</td>
</tr>
</tbody>
</table>

To relate the albumin loss with the total exchangeable body albumin, determinations using I$^{131}$ albumin were performed. Table III shows that with this method the total albumin loss detected agreed with the chemical determinations, and that the albumin loss in IPD amounted to 23.4% and in RPD 13.7% of the total exchangeable body albumin. In a pre-
TABLE III
Relation between albumin loss and total exchangeable body albumin

<table>
<thead>
<tr>
<th></th>
<th>Number of dialyses</th>
<th>Time hours of dialysis</th>
<th>Volume of dialysate</th>
<th>Albumin loss evaluated by I(^{131})-albmin-method</th>
<th>Albumin loss in % of total exchangeable albumin</th>
<th>Total exchangeable albumin</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPD</td>
<td>3</td>
<td>39.2 h</td>
<td>71.3 litres</td>
<td>57.4 g ± 28.6</td>
<td>23.4% ± 8.7</td>
<td>234.9 g ± 69.2</td>
</tr>
<tr>
<td>RPD</td>
<td>3</td>
<td>16 h</td>
<td>4 litres</td>
<td>24.0 g ± 13.4</td>
<td>13.7% ± 9.9</td>
<td>234.9 g ± 69.2</td>
</tr>
</tbody>
</table>

Fig. 2. Disappearance of I\(^{131}\)-albumin from plasma in 2 patients treated with peritoneal dialysis.

vious paper, Berlyne et al. (1964b) reported a loss of 21-35% of the initial total intravascular albumin pool.

The I\(^{131}\) albumin half life time in these patients was reduced to about half the normal. So a value of 10 days was observed. The normal half life time is about 21 days (Fig. 2).

To minimize the protein loss, dialysing fluid volume was reduced by means of ultrafiltration at the end of the dialysis and reinfluenced into the peritoneal cavity in these 3 patients. No ascending curve was observed after reinfusion.

Two of these patients died within 7 weeks after the first reinfusion. Autopsy revealed peritoneal absesses and adhesions. The third is in a chronic peritoneal dialysis programme since February 1966; the reinfusions were performed in March and he feels well and receives a weekly IPD without complications.

REFERENCES


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DISCUSSION

BOEN (Amsterdam): I would like to ask Dr. Fernandez: how can one lose protein if the bath fluid is recirculating in the artificial kidney?

My second question is: how have you regulated the body volume of the patient? How is it possible to prevent fluid from being absorbed into the blood compartment of the kidney from the dialysate?

FERNANDEZ (Berlin): We could not detect radioactive albumin in the bath. We have not lost proteins into the bath.

To your second question, we have made the regulation by controlling the weight of the patient.

BOEN (Amsterdam): It is not quite clear to me. What do you mean then by 'protein loss during the recirculation' in the peritoneal dialysis. And secondly, how do you add fluid to the patient?

FERNANDEZ (Berlin): Protein loss was the total quantity of protein that was found in the circulating fluid.

MACDONALD (Brooklyn): Your figures for recirculating peritoneal dialysis more closely agree with Merrill's than is reported in the ASAIO transactions in 1966.

The average, I believe, is 33 millilitres/minute per urea clearance. I think it is unfair to compare recirculated peritoneal dialysis with intermittent peritoneal dialysis of low volume; it should be compared with intermittent peritoneal dialysis of high volume, say 8 to 10 litres/hour, with which we showed last year, and also Dr. Boen showed last year; an average urea clearance of 40 millilitres/minute.

I think that to show protein loss with the same clearance and the same period of time would be a better study than showing protein loss of intermittent peritoneal dialysis done relatively inefficiently for a long-term period of time, 48 hours, versus recirculated peritoneal dialysis for a short period of time.

FERNANDEZ (Berlin): We have not performed a peritoneal dialysis with such a volume per minute.