Does Omentectomy Affect Ultrafiltration in Peritoneal Dialysis?

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An animal model was studied to test the effect of omentectomy on ultrafiltration. Two groups of white New Zealand female rabbits similar in age and weight were used. One group had omentectomy, the second control group had a sham operation. Peritoneal dialysis solution of 4.25% glucose concentration (50 ml/kg) was infused into the peritoneal cavity through a Tenckhoff catheter. \(^{131}\) tagged albumin (RISA) was used to assess the intraperitoneal fluid volume. It was found that the intraperitoneal volume in the omentectomy group increased from 118.6 ± 11.2 ml to 182.3 ± 24.4 ml while in the controls it increased from 118.3 ± 7.2 to 168.3 ± 18.2 ml. The difference was statistically significant (p < 0.025). Glucose absorption from the dialysis fluid was less in the omentectomy group than that of the control group but it did not affect either the dialysate osmolality or the serum osmolality in both groups. This suggests that omentectomy causes an increased ultrafiltration and a possible decreased reabsorption.

Dialysis apparently originates from Graham in 1854, \(^4\) who described *in vitro* diffusion of various solutes across a semipermeable membrane. The installation of fluid into the peritoneal cavity for the purpose of dialysis was first reported by Wegner in 1877, who noted that when hypertonic solutions containing sugar, salt or glycerin were injected into the peritoneal cavity of a dog, there was an increase in the volume of fluid which could be removed. \(^2\) Starling & Tubby in 1894 \(^3\) demonstrated that fluid transfer from the body into the peritoneal cavity is directly related to the osmolality of the peritoneal fluid. In 1922 Putnam demonstrated that urea, glucose, protein and various dyes which had been injected into the body could be recovered in the peritoneal fluid. \(^4\) Ganter was the first to apply this principle for the treatment of uraemia in 1923. \(^5\)

Dialysis across the peritoneal membrane is influenced by many factors, such as fluid temperature, frequency of exchanges, concentration of solution, addition of vasodilators and vasoconstrictors. \(^6-8\)

Commonly, the omentum wraps itself around the indwelling catheter during peritoneal dialysis and frequently causes outflow obstruction. Therefore, removal of the omentum might be expected to overcome this problem. This study was designed to evaluate the effect of omentectomy on peritoneal dialysis in experimental animals.

**Materials and Methods**

Twenty-four white female New Zealand rabbits, aged...
between 6 and 11 weeks with an average body weight of 2.5 kg were divided into two equal groups. The rabbits were anesthetized with an intravenous injection of valium and an intramuscular injection of ketamine. After a midline incision had been made, the omental blood vessels were dissected, ligated and cut, and the whole greater omentum was removed in the first group. The second group had a sham operation in which the midline incision was made and the omental vessels were exposed without ligation and no omentectomy was performed. Each rabbit had a paediatric Tenchhoff catheter inserted through the midline incision: 50 ml/kg of dialysis solution at 4.25% glucose concentration was instilled into each rabbit’s peritoneal cavity through the catheter. $^1$H labeled albumin (radioiodinated serum albumin: RISA) was administered with the infused solution to enable accurate assessment of the intraperitoneal fluid volume to be made at the time of sampling.

The dialysis solution was left in the peritoneal cavity for 5 h and was sampled at the beginning and at 15, 30, 60 min, and thereafter hourly. The samples were analysed for glucose, sodium, pH and osmolality. Serum sodium, glucose, osmolality and blood pH were estimated at the beginning and end of the experiment.

After 5 h, the abdominal cavity was drained as completely as possible and the animal was sacrificed by an intracardiac injection of "euthanasia solution" (ketamine hydrochloride: Ketalar; Parke Davis). The peritoneal cavity was opened and the remaining fluid was recorded to ensure a complete recovery. The position of the catheter was noted and the experiment was discarded if there was any evidence of gut abnormality, leakage around the catheter tear in the peritoneum or intestinal oedema around the catheter implantation site. Twelve rabbits were discarded leaving the two equal experimental groups of 12 each as described above.

The total volume of the dialysis solution in the peritoneal cavity at the end of the experiment was calculated from the sum of the dialysis solution samples taken, the amount drained from the abdomen and the fluid collected when the peritoneal cavity was opened at the end of the experiment.

The volume of the dialysate in the peritoneal cavity at each sampling time was calculated from the RISA dilution. The amount of RISA absorbed was calculated from the difference of the total radioactivity instilled and the total radioactivity in the complete collection at the fifth hour. Assuming the absorption of RISA from the peritoneal cavity was linear with time, the intraperitoneal volume of dialysate was calculated from the total radioactivity and the concentration of RISA in each sample. Ultrafiltration was the difference between the dialysis fluid volume instilled in the beginning and the residual volume at the end of the experiments.

Statistical analysis of all results expressed as mean \( \pm \) standard deviation was performed using Student’s $t$-test.

**Results**

Intraperitoneal volume in the omentectomy group showed a change from $118.6 \pm 11.2$ ml as the initial infused dialysate volumes to $182.3 \pm 24.4$ ml at the end of the experiment, while the control group showed a change from $118.3 \pm 7.2$ ml to $168.3 \pm 18.2$ ml. The net dialysate volumes were significantly different ($p < 0.0025$). There was an initial maximum ultrafiltration after the dialysis fluid infusion in both groups followed by a period of reabsorption which resulted in a statistically significant difference. Table 1 shows the changes of the intraperitoneal volumes at 0, 1, 2 and 5 h. Initially the absorption of RISA was almost the same in both groups, later the RISA concentration was less in the omentectomized group most probably due to dilutional effects.

Glucose maximum absorption occurred within 30 min, with the serum glucose level increasing from baseline of $105 \text{ mg/dl} \pm 8$ to a level of $325 \text{ mg/dl} \pm 12$ in the control group while the serum glucose level increased from $114 \text{ mg/dl} \pm 5.8$ to $301.6 \text{ mg/dl} \pm 7.8$ in the omentectomy group. This difference was significant ($p < 0.0025$). After 2 h, the serum glucose level decreased to $175 \text{ mg/dl} \pm 8$ in the control group and to $169 \text{ mg/dl} \pm 9.8$ in the omentectomy group. This is not a significant difference ($p = 0.069$).

The glucose concentration in the peritoneal dialysis fluid decreased rapidly during the initial 30 min after infusion. Only minimal additional glucose was absorbed in both groups thereafter. In the control group, it decreased from $4250 \text{ mg/dl}$ at the beginning of the infusion to $500 \text{ mg/dl} \pm 10.5$ at 2 h. In the omentectomy group, it decreased from $4250 \text{ mg/dl}$ to $800 \text{ mg/dl} \pm 9.8$ at 2 h. There was a statistically significant difference ($p = 0.0001$) when the two groups were compared.

The changes in the osmolality of the dialysis fluid are shown in Table 2. There was no statistically significant difference between the two groups at 0, 1, 2 and 5 h. After the end of the experiment the serum osmolality changed.

<table>
<thead>
<tr>
<th>Time (h)</th>
<th>The osmolality of the fluid in rabbits with omentectomy (n = 12)</th>
<th>The osmolality of the fluid in rabbits with sham operation (n = 12)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>484.75 \pm 1.8</td>
<td>481.75 \pm 2.5</td>
<td>—</td>
</tr>
<tr>
<td>1</td>
<td>348.15 \pm 6</td>
<td>338.2 \pm 5</td>
<td>NS</td>
</tr>
<tr>
<td>2</td>
<td>322.1 \pm 5</td>
<td>312.1 \pm 3</td>
<td>NS</td>
</tr>
<tr>
<td>5</td>
<td>299.5 \pm 5.96</td>
<td>295 \pm 4.1</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS not statistically significant.
from 291.4 ± 3.03 mosmol/l to 293.2 ± 5.3 mosmol/l in the omentectomy group, and from 290.9 ± 1.7 mosmol/l to 289.5 ± 3.97 mosmol/l in control group. There was no significant difference when the two groups were compared.

Discussion
Many factors influence peritoneal clearance during dialysis. An increased clearance is caused by dialysis fluid at room temperature, high concentration gradient, rapid exchanges or large dialysis fluid volume, hypertonic dialysis fluid 'solvent drag' and addition of vasodilators to the dialysis fluid. A decreased clearance may occur with cold dialysate and addition of vasoconstrictors. Patients with collagen vascular disease, systemic arterial hypertension and paralytic ileus show selective reduction in clearance of solutes with high molecular weight. This study indicates that omentectomy may be added to the list of the above-mentioned factors. As the serum glucose concentration decreased less in the omentectomy group than that of omentum, this suggests that the omental surface has a considerable contribution to the absorption of glucose from the peritoneal cavity. This finding is not surprising since the greater omentum does not compose a significant part of the peritoneal surface area especially in children. These findings are in support of the observation of Kohant & Alexander who found that glucose absorption from the peritoneal cavity varies inversely with age, and in support of the clinical observation of Grodstein et al. in patients on long-term dialysis who were omentectomized to overcome catheter obstruction. In the omentectomized group less glucose was absorbed into the blood from the peritoneal cavity. The resulting increased retention of glucose within the peritoneal cavity would then result in a decrease in the retained intraperitoneal fluid at the end of the experiment which translates into better ultrafiltration.

This is supported by finding an increased residual volume at the end of the experiment. This increase suggests that more liquid was extracted by the osmotic effect of the retained intraperitoneal glucose.

The combination of these effects would suggest that omentectomy may improve the efficiency of peritoneal dialysis as it decreases the chance of mechanical obstruction. If reproducible in man a predialysis omentectomy in a selected group might be useful in patients with poorly controlled diabetes mellitus and in patients who need improvement of ultrafiltration.

It was not an unexpected finding that the serum osmolalities were similar in both groups because serum glucose contributes relatively little to serum osmolalities. This finding suggests that omentectomy may not cause a significant change in the shift of electrolytes between blood and peritoneal cavity.

It is concluded that omentectomy improves the efficiency of peritoneal dialysis in rabbits. However, further trials are needed particularly in human subjects before firm conclusions can be drawn with regard to its applications in clinical situations.

References
