Acidosis is responsible for catabolic state in dialysis patients and should be avoided or corrected. The survival of patients on peritoneal dialysis (PD) is as good as that of patients on hemodialysis—if not better—mainly because PD patients are rarely in an acidotic–catabolic state as compared with hemodialysis patients.

We investigated whether the use of sevelamer in PD patients contributes to significant acidosis as has been reported in the hemodialysis population. We compared serum bicarbonate in 12 PD patients on sevelamer and 77 PD patients not on that drug. Residual renal function, serum phosphate, and daily intake of calcium phosphate binder were also recorded.

Patients on PD who take sevelamer maintain a serum bicarbonate level in the normal range as compared with hemodialysis patients, who frequently become acidotic. Serum bicarbonate is only slightly lower in PD patients taking sevelamer than in those not taking that drug.

Key words
Acidosis, phosphate binder

Introduction
Persistent acidosis contributes to malnutrition in chronic renal failure (1,2). Szeto et al. (3) showed that peritoneal dialysis (PD) patients treated with oral sodium bicarbonate to obtain a higher serum bicarbonate level (26 – 28 mmol/L) had better subjective global assessment (SGA) scores and a higher normalized protein catabolic rate. Patients with a better serum bicarbonate level also had shorter hospitalization periods. The Kidney Disease Outcomes Quality Initiative guidelines (4) recommend bicarbonate supplements for patients with a plasma bicarbonate level below 22 mmol/L.

The PD solutions now used in most centers make severe acidosis or low bicarbonate a rare occurrence. Acidosis is usually adequately corrected by a high quantity of lactate or bicarbonate in the PD solution. The bicarbonate level in hemodialysis patients changes constantly and reaches its nadir just before a hemodialysis session. In PD patients, the continuous daily treatment prevents such fluctuations in serum bicarbonate. Most PD patients have a stable bicarbonate level in the normal range (5). In hemodialysis, the CARE study (6) showed significantly lower bicarbonate before a hemodialysis session in patients on sevelamer than in those on calcium acetate.

Our purpose in the present study was to investigate if sevelamer in PD patients produces the same decrease in bicarbonate seen in hemodialysis patients. Moreover, if such a decrease occurred, would it be significant in terms of acid–base adequacy in those patients?

Patients and methods
The study population included 89 PD patients, of whom 12 were taking sevelamer; the others were taking various phosphate binders of the calcium carbonate type. We compared serum bicarbonate levels, residual renal function (RRF), the amount of calcium phosphate binder ingested daily, and serum phosphate levels between the two groups. The statistical analysis used the t-test to compare values between the two groups.

Results
As shown in Figure 1, mean serum bicarbonate was within the normal range in both groups, with no
suggestion of any acidosis problem. Nevertheless, the patients on sevelamer had a lower serum bicarbonate than the patients not on sevelamer. The difference was statistically significant (Table I).

Because the patients on sevelamer remained well within the normal range of serum bicarbonate, we can probably presume that, although their serum bicarbonate was lower than that of patients not on sevelamer, their metabolic state should not be affected. In the PD patients taking sevelamer, only 1 of 12 patients had a serum bicarbonate below 24 mmol/L. In PD patients not on sevelamer, 2 patients of 77 had a serum bicarbonate below 24 mmol/L.

The amount of calcium carbonate ingested daily was quite different between the two groups ($p = 0.003$), which probably explains the higher serum bicarbonate in patients not on sevelamer (Figure 2). We cannot attribute the difference in bicarbonate level to RRF in the two groups, because the RRF in both groups was similar ($p = 0.748$). The serum phosphate was quite different in both groups, but that difference did not reach statistical significance ($p = 0.102$), probably because not enough patients were using sevelamer.

**Discussion**

Acidosis has many detrimental health effects in humans—particularly those with renal failure. More than seventy years ago, Lyon and colleagues (7) were the first to describe the relationship between acidosis and malnutrition. More recently, Mehrotra et al. (8) reviewed the deterioration caused by metabolic acidosis. Acidosis, which has catabolic and anti-metabolic effects, causes insulin resistance and affects bone metabolism. Fortunately, PD patients, because of their constant exposure to PD solutions with lactate and bicarbonate, rarely present an abnormal serum bicarbonate level.

Sevelamer has been reported to produce a quite significantly lower serum bicarbonate level in hemodialysis patients (5). In those patients, serum bicarbonate pre-dialysis reached approximately 19.5 mmol/L. Sevelamer contributes to low bicarbonate in two ways. First, it is an acidotic agent (it subjects patients to a chloride load of up to 45 mmol/L daily); second, it replaces calcium carbonate phosphate binders, which help dialysis patients to maintain a bicarbonate level in the acceptable range. Fortunately, our study proves that sevelamer does not present the acidosis problem in PD patients that it presents in hemodialysis patients. Our results permit us to conclude that, although PD patients taking sevelamer show a bicarbonate level that is significantly different from PD patients not taking sevelamer, the patients on sevelamer remain within the normal serum bicarbonate range (Figure 1).

![FIGURE 1](image1.jpg)

**FIGURE 1** Mean serum bicarbonate in peritoneal dialysis patients taking or not taking sevelamer.

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Results for peritoneal dialysis patients taking or not taking sevelamer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Sevelamer</strong></td>
</tr>
<tr>
<td>Patients ($n$)</td>
<td>77</td>
</tr>
<tr>
<td>Mean serum bicarbonate (mmol/L)</td>
<td>27.97</td>
</tr>
<tr>
<td>Residual renal function (mL/min)</td>
<td>3.45</td>
</tr>
<tr>
<td>Calcium phosphate binders (mg/day)</td>
<td>1932</td>
</tr>
<tr>
<td>Serum phosphate (mmol/L)</td>
<td>1.46</td>
</tr>
</tbody>
</table>

![FIGURE 2](image2.jpg)

**FIGURE 2** Mean use of calcium phosphate binders (expressed as the amount of elemental calcium used daily) in peritoneal dialysis patients taking or not taking sevelamer.
Conclusions
Constant exposure to PD solutions with high lactate or bicarbonate content prevents any ill effects of sevelamer hydrochloride on the acid–base status of PD patients. Sevelamer can be safely used in PD patients without creating the acidosis found in hemodialysis patients who use the drug.

References

Corresponding author:
Denis Pagé, MD, Ottawa Hospital, Riverside Campus, 1767 Riverside Drive, Ottawa, Ontario K1H 7W9 Canada.
E-mail: dpage@ottawahospital.on.ca