LETTER

ACUTE EFFECT OF PARATHYROIDECTOMY ON RENAL TUBULAR REABSORPTION OF PHOSPHORUS IN RATS

To the Editors:

Beutner and Munson (1960) reported immediate changes in urinary phosphorus excretion in rats in response to parathyroidectomy or the injection of parathyroid extract and re-evaluated the report of Albright and Ellsworth (1929). Furthermore, it was confirmed recently that the purified parathyroid hormone has a direct effect on renal tubules to decrease the net reabsorption of phosphorus (Samiy et al., 1960; Pullman et al., 1960). On the other hand, effects of parathyroidectomy on the tubular functions have not yet been studied thoroughly with renal clearance techniques. Foulkes and Perry (1959) failed to demonstrate the effect of parathyroidectomy on renal tubular phosphate reabsorption in the dog. This is not consistent with the clinical observation of Sirot'a (1953) who reported the increase in tubular reabsorption of phosphate after removal of parathyroid adenoma in 2 patients.

The authors established a method to catheterize the ureters of rats and to estimate the glomerular filtration rate in a short term experiment. This enabled us to study the acute effect of parathyroidectomy on the tubular function in the rat with a series of 3 experiments.

In the 1st experiment 12 female rats of Donryu strain (3 months old, 195～202 g) were fed on calcium deficient diet for the preceding 2 days. They were anesthetized by intraperitoneal injection of 0.1 ml of Nembutal solution (Na-pentobarbital 5 mg), fasted on board and prepared by a lower mid-line abdominal incision of about 3 cm. Bilateral ureters were catheterized with polyethylene tubes, then the ventral cut was sutured. Thirty mins. later, a half of the animals were parathyroidectomized by cautery, and the other half sham operated. Four hrs. after parathyroidectomy every rat received a single intravenous injection of 10 mg of creatinine via femoral vein. The urine from the catheters was introduced into soft polyvinyl-chloride tubes. The vinyl tubes were changed every 5 mins. Thirty mins. after the injection, the carotid arteries were cut and the animals were sacrificed. Creatinine and phosphorus were determined in every 5 mins. urine and in serum; creatinine by the method of VanPilsum et al. (1956), phosphorus by the method of Gomori (1942). Serum calcium was titrated with Na₂-EDTA using Dotite-NN as the indicator.

A straight line was obtained when urinary creatinine (µg/min.) in log scale was plotted against time. The line was extrapolated and the rate of creatinine excretion at the time of sacrifice was obtained on the line. Glomerular filtration rate (GFR), filtered phosphorus load and the rate of tubular reabsorption of phosphorus (TRP) were calculated in the conventional way.

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Table 1. Effect of parathyroidectomy on the glomerular filtration rate (GFR) and the renal tubular net reabsorption of phosphorus (TRP) in rats

<table>
<thead>
<tr>
<th>Expt.</th>
<th>Time after parathyroidectomy</th>
<th>No. of animals</th>
<th>GFR (ml/min.)</th>
<th>TRP (μg/min.)</th>
<th>Serum P (mg/dl)</th>
<th>Serum Ca (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>4.5 hrs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sham</td>
<td>6</td>
<td>1.55±0.10</td>
<td>68±5</td>
<td>6.7±0.3</td>
<td>11.1±0.2</td>
</tr>
<tr>
<td></td>
<td>PTXed</td>
<td>6</td>
<td>1.60±0.06</td>
<td>133±12***</td>
<td>8.8±0 6*</td>
<td>8.8±0.2***</td>
</tr>
<tr>
<td>II</td>
<td>2 hrs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sham</td>
<td>6</td>
<td>1.41±0.10</td>
<td>69±7</td>
<td>7.5±0.5</td>
<td>10.9±0.1</td>
</tr>
<tr>
<td></td>
<td>PTXed</td>
<td>6</td>
<td>1.38±0.10</td>
<td>107±4***</td>
<td>8.7±0.2*</td>
<td>10.1±0.3**</td>
</tr>
<tr>
<td>III</td>
<td>1 hr.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sham</td>
<td>6</td>
<td>1.35±0.14</td>
<td>66±7</td>
<td>7.8±0.4</td>
<td>10.4±0.1</td>
</tr>
<tr>
<td></td>
<td>PTXed</td>
<td>6</td>
<td>1.53±0.10</td>
<td>113±8**</td>
<td>8.4±0.8</td>
<td>10.0±0.1**</td>
</tr>
</tbody>
</table>

The stars mean that the difference between the parathyroidectomized (PTXed) animals and the corresponding controls is statistically significant at 5% (*), 1% (**) or 0.1% (***) level.

The experiment was repeated with other 12 female rats (3 months old, 191~204 g), except that the animals were parathyroidectomized or sham operated 3 hrs. after catheterization, received creatinine injection 90 mins. later and sacrificed 30 mins. later, i.e. 2 hrs. after parathyroidectomy.

In a 3rd experiment, similarly to the above experiments, 12 female rats (3 months old, 191~208 g) were fed on the calcium deficient diet for the preceding 2 days and ureterally catheterized. After standing for 4 hrs., a half of them were parathyroidectomized and the other half sham operated. Ten mins. later, the collection of urine was set out. The animals received creatinine injection 30 mins. after parathyroidectomy. Urine was collected for the following 30 mins. and then,
i.e. 1 hr. after parathyroidectomy, the animals were sacrificed.

The summarized results of the 3 experiments are shown in Table 1 and Figure 1.

It is noted that parathyroidectomy had no influence upon GFR, whereas marked increase in TRP was observed in every experiment. As early as 30 mins. after parathyroidectomy, urinary phosphorus excretion decreased approximately 40% below the controls (Fig. 1). This is consistent with the result reported by Beutner an Munson (1960), though they neglected the diurnal change in phosphorus excretion. One hr. after parathyroidectomy, serum calcium, serum phosphorus, GFR and TRP in the parathyroidectomized animals were 96.3%, 108.3%, 113.2%, and 171.2% of the corresponding values in the controls. The influence on TRP is most profound and seems to be the primary effect of parathyroidectomy.

Further experiments are now being carried out and the details will be reported in the near future in this journal.

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REFERENCES