THE EFFECT OF ALUMINIUM HYDROXIDE ON ACIDOSIS AND PLASMA INORGANIC PHOSPHORUS IN RENAL FAILURE

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In severe oliguric renal failure the plasma inorganic phosphorus level is raised and there is a metabolic acidosis. It is held, particularly by workers in Scandinavia, that both these abnormalities can be corrected by giving aluminium hydroxide by mouth which both prevents the absorption of phosphate from the gut and acts as an antacid (Lindholm, 1962). The work reported below throws serious doubt on the clinical conclusions drawn from these facts.

Effect on acidosis
Ten patients with severe but stable uraemia (blood urea over 300 mg\%\) all of whom required sodium bicarbonate to control their acidosis, were given in addition, aluminium hydroxide gel 180 ml per day, i.e. 6 g aluminium, the dose recommended by Lindholm, for 2–4 weeks. In no case was there relief of acidosis as shown by lessening of the alkali requirements.

Effect on plasma inorganic phosphorus
Aluminium hydroxide will lower plasma inorganic phosphorus in severe oliguric renal failure as shown in Fig. 1, where the plasma level fell from 13.5 mg\%\) to 10.5 mg\%\) in two weeks. As is shown there was no alteration in the acidosis and the patient did not appear to benefit clinically.

![Graph](image_url)

*Fig. 1. Effect of aluminium hydroxide on plasma inorganic phosphate and plasma bicarbonate levels.*
Effect of acidosis on plasma inorganic phosphorus

Acidosis is inversely related to the level of plasma inorganic phosphorus. Changes in plasma inorganic phosphorus can occur quite rapidly as is shown in Fig. 2. The patient G. B. was admitted with chronic renal failure, dehydration and severe acidosis, arterial pH 7.08, bicarbonate less than 4 mM/litre and blood urea 350 mg%. He was treated with intravenous fluids including sodium lactate. Venous blood was taken at hourly intervals and plasma separated from the cells immediately. Bicarbonate was estimated with the Van Slyke apparatus and the plasma inorganic phosphorus on the AutoAnalyser.

Fig. 2. Effect of correction of acidosis on plasma inorganic phosphate level.

Plasma inorganic phosphorus fell rapidly with correction of acidosis and rehydration. During this time the urine volume was 320 ml containing a total of 86 mg of inorganic phosphorus, which would be insufficient to account for the fall in plasma inorganic phosphorus.

As shown in Fig. 1, a slow drop in plasma inorganic phosphorus occurs with the administration of aluminium hydroxide in patients with oliguric renal failure. However, much more rapid changes will occur with changes in acid-base balance. Patient T. F. had chronic

Fig. 3. Effect of production of a mild alkalosis on the plasma and urinary inorganic phosphate levels.
glomerulonephritis with oliguria. Throughout the period of study he was maintained on a constant protein diet (40 g/day) and his blood urea remained constant at $320 \pm 15$ mg%. No changes in treatment were made except for the giving of additional alkali. Fig. 3 shows the considerable drop in plasma inorganic phosphorus as the bicarbonate level increased and the rapid rise of plasma inorganic phosphorus as the bicarbonate level decreased after withdrawal of alkali therapy. Changes in urinary phosphate excretion paralleled changes in the plasma level.

Patient J. B. had subacute glomerulonephritis with oliguria and uraemia (plasma urea $350 \pm 15$ mg%). She was treated with basic aluminium carbonate (Basalgel) for 7 days during which time her plasma inorganic phosphorus fell from 11.2 to 10.0 mg%. She was then given sodium bicarbonate in addition to the Basalgel and plasma inorganic phosphorus fell as her acidosis was corrected (Figure 4). When the sodium bicarbonate was discontinued the plasma phosphates rose again in spite of continued treatment with Basalgel.

![Graph](image)

**Fig. 4.** Effect of basic aluminium carbonate and alkali on plasma and urinary inorganic phosphate levels.

**Conclusions**

1. Aluminium hydroxide and aluminium carbonate have no effect on the plasma bicarbonate level, the usual clinical index of acidosis in renal failure.

2. On a short term basis a decrease in plasma inorganic phosphorus is more easily effected by correcting acidosis than by preventing phosphate absorption and therefore aluminium hydroxide is not indicated in the treatment of acute oliguric renal failure. Its place in the therapy of chronic renal failure, e.g. with renal osteodystrophy, has not yet been determined.