Effect of Potassium-Chelating Resins on Phosphorus Absorption

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K

P, Ca and K are expressed in mg/100 ml. *p < 0.05; **p < 0.01, versus baseline.

Dear Sir,

Calcium-containing resins are frequently used to prevent the inordinate increase of plasma potassium in dialysis patients. The mechanism of action of these resins, which are insoluble and nonabsorbable, is the exchange of one cation for another [1, 2]. The resins used orally for the routine prevention of potassium increase usually contain calcium for exchanging with potassium [2]. Sodium-containing resins are also available, but are less frequently prescribed on a routine basis [1, 2]. The occupancy of the cationic site of the resin by K⁺ displaces and releases Ca²⁺ from the resin and the Ca²⁺ released from the resin appears not to be absorbed in significant amounts [2]. Therefore, the possibility exists for this Ca²⁺ to combine with phosphorus within the intestine, to produce low-solubility Ca²⁺ phosphate compounds.

We tested this hypothesis in two ways. First, we mixed different amounts of Ca resin (calcium polystyrene sulfonate, Resin-Ca®, Rubió, Barcelona, Spain) with a fixed quantity of P_{0.4}K₂H solution (5.8 mg/10 ml). According to the information provided by the manufacturer, each gram of resin contained approximately 70-90 mg of Ca element. As shown in table 1, the phosphorus and potassium content of the solution decreased proportionally to the amount of the resin included in the mixture. Although the results shown in table 1 were obtained after a 20-min incubation at room temperature, the observed effect was almost complete at 5 min of contact between the resin and the P_{0.4}HK solution [data not shown, p < 0.05 with respect to the baseline].

To address the putative effect of the resin on phosphorus absorption, we administered the resin orally to a group of normal male Wistar rats, on a diet with a known amount of phosphorus (4.9 mg/g diet, Panlab, Barcelona, Spain), with the resin mixed into the powdered rat chow. The amount of food and

Resin

Table 1. Levels of P, Ca and K in the supernatant of a P_{0.4}K₂H solution, in the presence of different amounts of Ca-containing resin

the feces were weighed and the latter were dried in an electric muffle (500 °C, 48 h). The ashes were dissolved in 35% HCl, and Ca, P and Mg were measured by atomic absorption spectrometry (Perkin Elmer 305B).

In these conditions, a clearly increased phosphorus elimination was observed when the resin to food proportion was 1:3 (dietary phosphorus elimination; 92.5 ± 6.3 vs. $50.5 \pm 5.2\%$ with or without resin, respectively; $n = 8$, $p < 0.01$ by ANOVA). An increased fecal excretion of both Ca and Mg was also observed in the same animals [data not shown]. This proportion is obviously beyond any therapeutic range for the use of the resin in humans. A tendency to the increase of P excretion was observed with a 1:30 proportion (68.9 ± 8.6 vs. $55.6 \pm 6.1\%$; $n = 18$, $p < 0.07$ by ANOVA).

Our observations therefore suggest that a previously nondescribed role of Ca resin may exist in reducing the absorption of phosphorus. However, the in vivo experiments suggest that high amounts of resin may be needed to produce a clinically relevant effect. Such a high quantity of resin cannot even be considered for its use in humans, since it would not only be unpalatable but also potentially hazardous [3]. However, since our experiments have been done only in short periods of

time, the possibility exists that the prolonged use of a Ca-containing resin would result in an increased elimination of dietary phosphorus. In this regard, and taking into account the more recent tendencies to liberalize as much as possible the diet of dialysis patients, a more generalized use of Ca-containing resins may be useful not only to control dietary potassium, but perhaps also phosphorus. The hypothesis of a relevant role of Ca resins on limiting phosphorus absorption needs to be tested in clinical situations using Ca²⁺-containing resins over longer periods of time.

References

- Mudge GH: Agents effecting volume and composition of body fluids; in Goodman Gilman A, Goodman LS, Gilman A (eds): *The Pharmacological Basis of Therapeutics*. New York, McMillan Publishing, 1980, pp 848-884.
- Berlyne GM, Janabi K, Shaw AB, Hocken AG: Treatment of hyperkalemia with a calcium-resin. *Lancet* 1966;i:169-172.
- Lillemoe KD, Romolo JL, Hamilton SR, Pennington LR, Buddick JE, Williams GM: Intestinal necrosis due to sodium polystyrene in sorbitol enemas. *Surgery* 1987;101:267-272.