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Brief report

Treatment of severe hypercalcemia with peritoneal dialysis in an infant with end-stage renal disease

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Abstract. Recurrent and unusually severe hypercalcemia was observed in an infant undergoing continuous cyling peritoneal dialysis and receiving oral calcitriol and calcium carbonate. Rapid correction was achieved with peritoneal dialysis using a calcium-free dialysis solution.

Key words: Hypercalcemia – Calcitriol – Calcium carbonate – Peritoneal dialysis

Introduction

It has been shown that oral therapy with calcium carbonate and vitamin D preparations can adequately control serum phosphorus levels in pediatric patients treated with maintenance dialysis [1–4]. Mild hypercalcemia (serum calcium >11 mg%) is a frequently observed side effect [1–4], necessitating dosage reduction. Severe hypercalcemia (serum calcium >13 mg%), associated with cardiac arrhythmias, metastatic calcifications, gastrointestinal and neuropsychiatric symptoms, is a less frequent but serious complication described in adult patients [5].

This report describes a case of recurrent severe hypercalcemia secondary to oral therapy with calcium carbonate and $1,25(OH_2)D_3$ (calcitriol) in an infant undergoing continuous cyling peritoneal dialysis (CCPD), and the successful management with vigorous peritoneal dialysis utilizing a calcium-free dialysate.

Case report

A 6-month-old infant with end-stage renal disease secondary to obstructive uropathy was referred for dialysis treatment with severe fluid overload and pulmonary edema. CCPD was initiated using five 2-h exchanges nightly with 275 ml (45 ml/kg) of a 1.5% dextrose solution. The patient received a low phosphate formula (Similar PM 60–40; Ross Laboratories, Columbus, OH, USA) supplemented with MCT oil and Polycose (Ross Laboratories) providing 80 calories/kg per day, 2 g/kg per day of protein, 45 mg/kg per day of calcium (Ca) and 23 mg/kg per day of phosphorus (P). Calcium carbonate was commenced at 450 mg/kg per day and $1,25(OH_2)D_3$ at 0.25 µg (37 ng/kg) per day.

Two months after starting CCPD, asymptomatic hypercalcemia developed; the serum Ca was 16.2 mg/dl and serum P was 1.6 mg/dl. Calcium carbonate and calcitriol were discontinued for 1 month, after which the serum Ca and P levels were 9.4 and 11.8 mg/dl respectively. After reinstitution of therapy with calcium carbonate (300 mg/kg per day), the serum Ca and P levels ranged between 9.3 and 10 mg/dl and 3.5 and 4.1 mg/dl respectively, and treatment with calcitriol (0.25 µg/day) was resumed.

Two months later the infant's mother noticed a decrease in appetite with infrequent vomiting and constipation for 3 days. These non-specific symptoms had been occasionally observed in the past and usually resolved spontaneously. Physical examination revealed bilateral inguinal hernias. Weight was 6.7 kg and height 69.7 cm. Blood pressure was 102/60 mmHg and respiratory rate 32/min. Laboratory investigations were as follows: serum Ca level 19.8 mg/dl, serum P level 1.5 mg/dl, serum creatinine 5.8 mg/dl, BUN 57 mg/dl, sodium 133 mEq/l, potassium 4.8 mEq/l, chloride 97 mEq/l, total protein 5.2 g/dl, albumin 3.4 g/dl, alkaline phosphatase 355 IU/l and serum bicarbonate 22.6 mEq/l. The white blood count was 12,100/mm^3, hemoglobin 8.0 g/dl and hematocrit 23.8%. An electrocardiogram was normal. The serum level of immunoreactive parathyroid hormone (chicken 9 antibody assay) was 51 µlEq/ml) (normal 4–10 µlEq/ml) [6] and the $1,25(OH_2)D_3$ serum level (calf thymus receptor assay) was 28 pg/ml (normal 50.5 ± 5.5 pg/ml) [7].

Treatment. Peritoneal dialysis was started with 1-h exchanges of a Ca-free dialysate solution, supplied by the hospital pharmacy using distilled water, 50% dextrose, sodium chloride and sodium bicarbonate to yield a 1.5% dextrose solution (sodium 130 mEq/l, chloride 100 mEq/l, bicarbonate 30 mEq/l). Treatment with calcium carbonate and calcitriol was discontinued and the child was given parenteral fluids only.

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The serum Ca level decreased to 16.2 mg/dl after 8 h, 14.9 mg/dl after 24 h and 11.2 mg/dl after 48 h. The serum P level rose to 2.2 mg/dl after 48 h. Treatment was tolerated well and the infant remained free of complications of hypercalcemia. On discharge from the hospital after 3 days, the serum Ca and P levels were 10.7 mg/dl and 2.9 mg/dl, respectively. Treatment was resumed with the previous CCPD regimen, calcium carbonate (180 mg/kg per day) and a reduced dose of calcitriol (0.125 μg/day).

Follow-up. Two weeks after discharge the serum Ca and P levels were 12.7 mg/dl and 5.6 mg/dl, respectively. Clinically only loss of appetite was noted. Calcium carbonate and calcitriol were stopped, but the patient's mother erroneously resumed giving the medications after the child's appetite had improved. Four weeks after discharge the patient was electively admitted for bilateral inguinal hernia repair. The child was symptom-free and physical examination was normal. Laboratory data were as follows: serum Ca 17.8 mg/dl, serum P 1.5 mg/dl, serum creatinine 6.6 mg/dl and BUN 33 mg/dl. Treatment with Ca-free dialysate again resulted in a prompt decrease in the serum Ca level: 17.4 mg/dl after 12 h, 14.2 mg/dl after 24 h and 12.8 mg/dl after 72 h. Hernia repair was performed without complications and the patient was discharged with a serum Ca level of 10.7 mg/dl and a serum P level of 2.9 mg/dl. Treatment with 0.125 μg of $1,25(OH_2)D_3$ (18 ng/kg) daily was resumed without further use of calcium carbonate. During 12 months of follow-up the serum Ca and P levels have remained between 9.6 and 10.8 mg/dl and between 4.2 and 6.8 mg/dl, respectively and X-ray examinations have shown no evidence of metastatic calcifications.

Discussion

The occurrence of hypercalcemia in a patient on maintenance dialysis is often associated with severe secondary hyperparathyroidism, aluminum (AL)-related bone disease, or therapy with vitamin D metabolites and/or calcium carbonate [5]. In the present case, the patient's parathyroid hormone level on admission, as well as previously obtained levels, was not characteristic of overt hyperparathyroidism, and in addition, bone radiographs showed no evidence of subperiostal erosions. Secondly, AL-related bone disease was excluded because the patient never received AL-containing gels and had normal blood AL levels.

Treatment with $1,25(OH_2)D_3$ alone is associated with a high incidence of hypercalcemia in adult patients treated with hemodialysis [5]. Although in the present case the serum level of $1,25(OH_2)D_3$ was low [7] on admission, this does not rule out a role of calcitriol in the pathogenesis of hypercalcemia, since it is likely that calcitriol facilitated intestinal absorption of calcium carbonate. It is difficult to differentiate between the role of calcium carbonate and calcitriol in the development of hypercalcemia in the present case. However, treatment with calcitriol alone has not resulted in further episodes of hypercalcemia during follow-up, suggesting that severe hypercalcemia was "triggered" only in conjunction with calcium carbonate. The dosage of calcium carbonate is highly variable in pediatric patients undergoing CAPD/CCPD [2, 3]; in the present case, hypercalcemia occurred in spite of comparatively moderate doses. This illustrates that combined therapy with calcium carbonate and calcitriol is not without serious risks and that individual tailoring and close monitoring are important, especially in infants.

Severe hypercalcemia is an emergency and should be treated immediately. Hemodialysis is the most effective way of treatment [8, 9], but in this case peritoneal dialysis was considered the method of choice since the infant had a functioning Tenckhoff catheter and no available vascular access. Clinical experience with peritoneal dialysis for treatment of severe hypercalcemia has been described only in adults [10, 11]. The most important consideration with this method of treatment is the use of a Ca-free dialysate to establish a high concentration gradient.

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References

1. Mak RHK, Turner C, Thompson T (1985) Suppression of secondary hyperparathyroidism in children with chronic renal failure by high dose phosphate binders: calcium carbonate versus aluminum hydroxide. Br Med J 291: 623–627
2. Salusky IB, Coburn J, Foley J, Nelson P, Fine RN (1986) Effects of oral calcium carbonate on the control of serum phosphorus and changes in plasma aluminum levels after discontinuation of aluminum containing gels in children on dialysis. J Pediatr 108: 767–770
3. Andreoli SP, Dunson JW, Bergstein JM (1987) Calcium carbonate is an effective phosphorus binder in children with chronic renal failure. Am J Kidney Dis IX: 206–210
4. Tamanaha K, Mak RHK, Rigden SPA, Turner C, Start KM, Haycock GB, Chantler C (1987) Long-term suppression of hyperparathyroidism by phosphate binders in uremic children. Pediatr Nephrol 1: 145–149
5. Massry SG, Kaptein E (1985) Hypercalcemic and hypocalcemic states. In: Seldin DW, Giebisch G (eds) The kidney: physiology and pathophysiology. Raven Press, New York, pp 1337–1364
6. Coburn JW, Slatopolsky E (1986) Vitamin D, parathyroid hormone and renal osteodystrophy. In: Brenner BM, Rector FC (eds) The kidney. Saunders, Philadelphia, p 1672
7. Reinhardt T, Horst RL, Orf JW, Hollis BW (1984) A microassay for 1,25 dihydroxyvitamin D not requiring high performance liquid chromatography: application to clinical studies. J Clin Endocrinol Metab 58: 91–98

8. Selby PC, Peacock D, Marshall H (1984) Hypercalcemia. Management. Br J Hosp Med 186–197
9. Nolph KD (1978) Peritoneal dialysis. In: Drukker W, Parsons FM, Mahu JF (eds) Replacement of renal function by dialysis. Nijhoff, Dordrecht, p 296
10. Hamilton JW, Lasrich M, Hirszel P (1980) Peritoneal dialysis in the treatment of severe hypercalcemia. J Dial 4: 129–138
11. Heyburn PJ, Selby PL, Peacock M, Sandler LR, Parsons FM (1980) Peritoneal dialysis in the management of severe hypercalcemia. Br Med J 280: 525–526

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