OBSERVATIONS

Severe Hypercalcemia in Diabetic Ketoacidosis: A Case Report

Tafadzwa Makaya, mbchb, mmedsci[1]
Sumana Chatterjee, mbbs[2]
Paul Arundel, mbchb[3]
Cliff Bevan, mbchb[4]
Neil P. Wright, mb bchir, md[1]

From the [1]Department of Paediatric Endocrinology and Diabetes, Sheffield Children's Hospital, Sheffield, U.K.; the [2]Department of General Paediatrics, Sheffield Children's Hospital, Sheffield, U.K.; the [3]Department of Metabolic Bone Disease, Sheffield Children's Hospital, Sheffield, U.K.; and the [4]Critical Care Unit, Sheffield Children's Hospital, Sheffield, U.K.

Corresponding author: Tafadzwa Makaya, makaya2@hotmail.com.

DOI: 10.2337/dc12-1845

A 12-year-old boy presented to a district hospital with diabetic ketoacidosis (DKA): pH, 6.97; base excess, −27.5 mmol/L; bicarbonate, 2.5 mmol/L; glucose 29 mmol/L. A urinalysis showed 4+ ketones (≥160 mg/dL). Standard DKA management according to U.K. guidelines was instituted (1). Fluid was replaced at maintenance plus 7.5% dehydration, with correction over 48 h.

Within 2 h, the boy developed signs and symptoms of cerebral edema and was treated with intravenous mannitol (5 mL/kg × 2), and fluids were decreased by one-third. A further fall in his Glasgow Coma Score was managed with hypertonic (2.7%) saline (5 mL/kg), intubation and ventilation, and transfer to the regional pediatric intensive care unit (PICU). At the PICU, a decision was made to give maintenance fluid plus 5% dehydration correction over 72 h as a neuroprotective strategy.

Within an hour of the boy's admission to the PICU, an elevated, corrected calcium of 2.96 mmol/L was noted (normal range [NR]: 2.10–2.56 mmol/L). Retrospective analysis of the district hospital's sample taken 4 h earlier showed a corrected calcium of 2.57 mmol/L. Over the next 24 h, the boy gradually developed acute, severe hypercalcemia with corrected calcium levels reaching a maximum of 3.75 mmol/L 33 h after the initial presentation. Parathyroid hormone was 8.3 ng/L (NR: 11–35), urine calcium/creatinine ratio, 0.17 (NR: 0–0.7), and maximum alkaline phosphatase 423 units/L (NR: 76–308).

He had significant hyperglycemia, requiring up to 0.2 units/kg/h of intravenous insulin. Severe metabolic acidosis persisted for 4 days. This was attributed to a combination of severe dehydration, combined ketoacidosis and lacticacidosis, and hyperchloremia (maximum chloride levels, 145 mmol/L). Other electrolyte imbalances included hypernatremia, hypophosphatemia, and hypermagnesemia. Creatinine kinase was moderately raised (maximum 1,497 IU/L) with myoglobinemia, suggesting rhabdomyolysis, and he developed moderate renal failure (maximum creatinine, 269 mmol/L). His urine output in the first 24 h on the PICU was 0.4 mL/kg/h.

Fluid was increased by 10%, but further rises in sodium levels and worsening renal function were noted. It was decided that dehydration was the key factor driving the hypercalcemia. Dehydration at presentation was reestimated at 10%. Fluid was changed to 4% dextrose with 0.18% saline and recalculated at maintenance plus 7.5% correction over 48 h. A furosemide infusion was commenced to maintain a urine output of 3–4 mL/kg/h. Adjunct intravenous hydrocortisone was added. Renal ultrasonography (day 2) excluded nephrocalcinosis. Bisphosphonate therapy was considered, but it was felt this would not address the underlying problems and was not without risk given the renal function.

The boy's blood glucose levels stabilized by day 3 (<10 mol/L). Hypercalcemia, renal function, and hypernatremia normalized within a week. His serum calcium concentration 9 days after initial presentation was 2.46 mmol/L. He made a full recovery with no neurologic deficit.

DKA as a cause of severe hypercalcemia has not previously been described. Hypercalcemia in DKA is likely secondary to severe metabolic acidosis and insulin deficiency (2). Other DKA-related factors are IGF-1 deficiency (3) and hyperglycemia (4). Potential factors in our case also include hypophosphatemia, rhabdomyolysis with acute renal failure (5), and immobilization.

Management proved challenging, recognizing both the need for adequate fluid replacement to treat the hypercalcemia, and also the need for fluid restriction to manage the cerebral edema.

In conclusion, hypercalcemia in DKA requires prompt identification and treatment to avoid life-threatening complications. We recommend that calcium levels are checked routinely in all patients with DKA.

Acknowledgments—No potential conflicts of interest relevant to this article were reported.

T.M. and S.C. drafted the manuscript with comments and review by P.A., C.B., and N.P.W. N.P.W. is the guarantor of this work and, as such, had full access to all the data in the case and takes responsibility for the integrity of the data and the accuracy of the data analysis.

This case was presented in electronic poster form at the 51st Annual Meeting of the European Society for Paediatric Endocrinology, Leipzig, Germany, 20–23 September 2012, and as a paper poster at the 40th Annual Meeting of the British Society for Paediatric Endocrinology and Diabetes, Leeds, U.K., 7–9 November 2012.

References

1. Edge JA. BSPED recommended DKA guidelines 2009 [Internet], November 2009. Available from www.bsped.org.uk/clinical/docs/DKAGuideline.pdf. Accessed 30 June 2012
2. Topaloglu AK, Yildizdas D, Yilmaz HL, Mungan NO, Yuksel B, Ozer G. Bone calcium changes during diabetic ketoacidosis: a comparison with lactic acidosis due to volume depletion. Bone 2005;37:122–127
3. Bereket A, Wilson TA, Kolasa AJ, Fan J, Lang CH. Regulation of the insulin-like growth factor system by acute acidosis. Endocrinology 1996;137:2238–2245
4. Balint E, Szabo P, Marshall CF, Sprague SM. Glucose-induced inhibition of in vitro bone mineralization. Bone 2001;28:21–28
5. Akmal M, Bishop JE, Telfer N, Norman AW, Massry SG. Hypocalcemia and hypercalcemia in patients with rhabdomyolysis with and without acute renal failure. J Clin Endocrinol Metab 1986;63:137–142