

Significant Hypoglycemia Secondary to Icodextrin Peritoneal Dialysate in a Diabetic Patient

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Icodextrin, a peritoneal dialysate commonly used in the renal failure patient with diabetes, may lead to an overestimation of blood glucose levels as determined by bedside glucometers. This spurious hyperglycemia can lead to significant morbidity if unrecognized. We describe a case of severe hypoglycemia caused by an unappreciated overestimation of blood glucose in a diabetic patient with concomitant chronic renal failure requiring peritoneal dialysis with icodextrin.

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Continuous ambulatory peritoneal dialysis (CAPD) is a common treatment for endstage renal disease (ESRD) used by approximately 12% of dialysis patients in the United States (1). Icodextrin (7.5% wt/vol) (Extraneal™; Baxter Healthcare, Chicago, IL), a peritoneal dialysate used in patients with concomitant diabetes, may cause an overestimation of blood glucose values, resulting in potentially dangerous errors in diabetic insulin management (2–6). Icodextrin consists of a glucose polymer derived from cornstarch that is hydrolyzed in the systemic circulation to maltose metabolites (2). These metabolites may affect the enzymatic glucose determinations used in many bedside glucometers and lead to erroneously elevated glucose measurements. We present a case report of one such instance, in which a patient with insulin-dependent diabetes with ESRD, treated with icodextrin peritoneal dialysis, suffered significant hypoglycemia secondary to inaccurate glucose determinations with a bedside glucometer.

CASE REPORT

A 59-yr-old female patient with a medical history of insulin-dependent type II diabetes mellitus, hypertension, and ESRD who was undergoing CAPD treatment with icodextrin dialysate presented for a thyroidectomy for Hurthle cell carcinoma. The patient had been dialyzed the night before surgery, and on the day of surgery was awake, alert, oriented, and neurologically intact. She did not take

any insulin on the morning of surgery. During the preoperative evaluation, the patient stated that she felt symptoms of “low blood sugar.” A capillary blood glucose value of 184 mg/dL was attained using a bedside glucometer (AccuCheck Inform; Roche Diagnostics, Mannheim, Germany). After the patient questioned the accuracy of our glucometer, an additional two measurements were taken on a separate AccuCheck Inform glucometer. The values attained were 219 and 182 mg/dL, respectively. The patient still questioned the accuracy of the measurements, and requested that further measurements be taken using her own home glucometer (One Touch Profile; Lifescan, Milpitas, CA). The One Touch Profile glucometer measured a blood glucose level of 105 mg/dL. Because of the difference in readings between the AccuCheck Inform and the One Touch Profile, the patient’s venous blood glucose was measured in the hospital’s central laboratory (Synchron LX20 Pro Clinical System; Beckman Coulter, Fullerton, CA), which determined a blood glucose of 77 mg/dL.

The patient was taken to the operating room, and the preoperative venous blood glucose of 77 mg/dL was used as our baseline measurement. Our laboratory informed us that the peritoneal dialysate icodextrin used by our patient can falsely increase capillary blood glucose determinations made by the AccuCheck Inform glucometer, and that the only accurate method to ascertain her blood glucose levels would be by central laboratory determination. The surgery proceeded uneventfully under general endotracheal intubation, and the patient remained hemodynamically stable, with no intraoperative complications. No intraoperative insulin was administered. At the end of surgery, the muscle relaxant was reversed with neostigmine and glycopyrrolate, but the patient did not meet extubation criteria and remained on mechanical ventilation, sedated with lorazepam.

On arrival at the postanesthesia care unit (PACU), a blood glucose of 127 mg/dL was measured by the Synchron LX20 Pro Clinical System. The patient received no insulin while in the PACU. At the time of transfer of care to the PACU, the necessity of ascertaining blood glucose levels by central laboratory determination was communicated verbally to the PACU nurse and the surgical resident involved with the patient’s care, and in writing on the PACU order form.

That night, the intubated and sedated patient was transferred to the 40-bed surgical intensive care unit. Ninety

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minutes after arrival at the surgical intensive care unit, using the unit's AccuCheck Inform glucometer, the patient's capillary glucose was measured to be 300 mg/dL, and an insulin infusion was initiated in accordance with the unit's tight glycemic control protocol.

On the first postoperative day, the surgical team noted that, despite overnight weaning from sedation, the patient exhibited symptoms of encephalopathy. A head computed tomography scan revealed no intracranial pathology. The patient remained intubated, on an insulin infusion with tight glycemic controls using the Accucheck Inform glucometer, for 24 h, until the first blood glucose measurement was obtained using the Synchron LX20 Pro Clinical System. It revealed a blood glucose of 7 mg/dL.

The patient was treated for severe hypoglycemia with IV dextrose. Despite treatment, she remained comatose secondary to a severe hypoglycemic encephalopathy. She underwent a percutaneous tracheostomy and percutaneous endoscopic gastrostomy and was discharged to a specialized extended care nursing facility, where she later died.

DISCUSSION

Icodextrin, a glucose polymer derived from cornstarch, is used as an alternative to glucose for maintaining an osmotic gradient for dialysis. Although icodextrin is not metabolized in the peritoneum, it may be absorbed by the lymphatic system into the systemic circulation, where it is hydrolyzed by circulating α -amylase into the oligosaccharides maltose and maltotriose (3). Maltose, consisting of two glucose molecules, accumulates in the systemic circulation because of the normal deficiency in humans of circulating maltase (3).

Many bedside glucometers, including the Accu-Check Inform, use glucose dehydrogenase with coenzyme pyrroloquinolinequinone in their test strips, to catalyze the conversion of glucose to gluconic acid and

reduced nicotinamide adenine dinucleotide (NADH) (7). The amount of NADH measured by the glucometer is directly proportional to the blood sample's glucose concentration. Glucose dehydrogenase with coenzyme pyrroloquinolinequinone, however, can react with the free reducing group of glucose located at the end of the maltose molecule, a breakdown product of icodextrin, producing additional NADH, and thus yielding an overestimation of blood glucose levels.

This case report highlights an additional, underappreciated, perioperative risk present in the ESRD patient undergoing CAPD. Icodextrin dialysate can lead to falsely elevated glucose measurements with bedside glucometers. Therefore, to prevent similar catastrophic outcomes, only central laboratory determination of blood glucose levels should be obtained for ESRD patients undergoing CAPD.

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