Catastrophic hypercalcemia as a technical complication in home hemodialysis

Praveen Murlidharan, Christopher T. Chan and Joanne M. Bargman

Division of Nephrology, Department of Medicine, University Health Network, University of Toronto, Toronto, Ontario, Canada

Abstract
Life-threatening hypercalcemia in dialysis patients is very unusual. We present a case where life-threatening hypercalcemia in a home hemodialysis patient resulted from a technical mistake. A 46-year-old woman, on home nocturnal hemodialysis, presented to the emergency room with history of altered sensorium, vomiting and sweating, which started 1 h after initiation of dialysis the previous night. Serum calcium was 6.5 mmol/L. She improved with 10 h of low-calcium hemodialysis. Investigation revealed that the drain port of the reverse osmosis machine was connected to the dialysis machine and the product water was connected to the drain leading to acute hypercalcemia.

Keywords: dialysate; hemodialysis; hypercalcemia; reverse osmosis

Background
Life-threatening hypercalcemia in dialysis patients is unusual. A syndrome of symptomatic hypercalcemia and hypermagnesemia has previously been described in dialysis patients in the 1960s. It was attributed to failure in water treatment systems of that era and was termed the ‘hard water syndrome’ [1, 2]. Severe hypercalcemia has also been reported due to unrecognized ‘deionizer failure’ in home hemodialysis patients [3]. Severe hypercalcemia as a result of human error has been reported previously [4]. Here, we present a case of life-threatening hypercalcemia in a home nocturnal hemodialysis patient that resulted from a technical error.

Case report
The patient is a 46-year-old woman with diabetic nephropathy on home nocturnal hemodialysis for 6 years. Her comorbidities included hypertension, hypothyroidism, peripheral vascular disease and atrial fibrillation. She was not on calcium or vitamin D supplements. She presented to the emergency room with a history of vomiting, profuse sweating and progressive deterioration in sensorium, which started 1 h after initiation of dialysis the previous night.

Discussion
In this case, the patient presented with acute life-threatening hypercalcemia related to human technical error. In a dialysis patient, common causes of hypercalcemic crisis

Because of the change in her status, her husband stopped the dialysis 3 h after initiation. In the emergency room, she was stuporous, had a heart rate of 48 b.p.m. and blood pressure of 98/56 mmHg. She had no focal neurological deficits and systemic examination was otherwise normal. Her laboratory investigation showed a serum sodium of 128 mmol/L, potassium 4.7 mmol/L and creatinine 266 μmol/L (3.02 mg/dL). Serum calcium was 6.5 mmol/L (26 mg/dL). The serum magnesium was also elevated at 2.09 mmol/L (5.1 mEq/L). Her blood work 1 month prior to the present episode showed a serum calcium of 2.18 mmol/L (8.7 mg/dL), serum phosphate of 1.26 mmol/L (2.18 mg/dL) and an intact parathyroid hormone 22.85 pg/mL. The corrected QT interval was shortened on the electrocardiogram (Figure 1). She was initiated on urgent hemodialysis with a low-calcium bath. Over a period of the next 6 h, her clinical status improved and at the end of 10 h of dialysis, her calcium had normalized to 2.57 mmol/L (10.3 mg/dL). A serum calcium and magnesium repeated on the next day was normal.

Investigation as to the cause of the hypercalcemia revealed that the reverse osmosis machine used for dialysis at home was changed 1 day prior to the patient’s presentation to the hospital. It was found that the drain port of the reverse osmosis machine was mistakenly connected to the dialysis machine and the product water for dialyzate was connected to the drain (Figure 2). The conductivity of the water samples was checked. The results from the reverse osmosis drain that was incorrectly connected to the dialysis machine input showed a conductivity of 400–416 μs, caused by the high calcium concentration in the sample. The reading, if correctly connected, should have been <10 μs. Thus, the drain water from the reverse osmosis machine that contained a very high concentration of calcium was used in the dialyzate, resulting in acute hypercalcemia.

Discussion
In this case, the patient presented with acute life-threatening hypercalcemia related to human technical error. In a dialysis patient, common causes of hypercalcemic crisis.
include malignancy, excessive calcium supplementation and hypervitaminosis D [5]. These were excluded in our patient as the sequence of events suggested that the hypercalcemia was acute and had developed soon after initiation of dialysis. As the patient had been well before the start of dialysis, it was very likely that the dialysis process was responsible for the change in clinical status. The reverse osmosis machine had just been replaced at the patient’s home, which also heightened our suspicion of a technical fault in the dialysis process as the underlying cause of the patient’s problem. The detection of the reversal of the connections in the reverse osmosis machine confirmed our suspicion.

Kettritz et al. [4] reported a patient who developed severe hypercalcemia due to an inadvertent hose reversal in the reverse osmosis machine used for dialysis in hospital. In our case, when the reverse osmosis machine used for the patient’s dialysis at home was examined, we discovered that the ports for connection of the processed and drain water were similar in appearance and close to each other. Unfortunately, this leaves the connection setup vulnerable to error.

This case led us to evaluate the quality assurance aspect of our home hemodialysis programme. As nocturnal hemodialysis is a novel form of therapy, there are few validated benchmarks to evaluate a program from a patient or technical perspective [6]. Most of the quality assurance guidelines for nocturnal home hemodialysis programs focus on outcomes from a patient’s perspective [7]. Technical guidelines for setting up home dialysis units are lacking.

Human error led to the problem in this case. We reevaluated the training program for our technicians and mandated all dialysis setups to be cross-checked by another technician before any clinical use. We also ensured that the ports for connection of the hoses to the reverse osmosis machines were color coded so as to avoid a similar incident in the future.

This case illustrates the complexities involved in the care of a patient on home hemodialysis and how a human error can lead to catastrophic events emphasizing the importance of quality assurance in the delivery of complex medical care in the home setting.

Conflict of interest statement. None declared.

References

Document references