CASE REPORT

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Fallaciously elevated glucose level by handheld glucometer in a patient with chronic kidney disease and hypoglycemic encephalopathy

Praveen Pratap Jadhav, Meera Praveen Jadhav

ABSTRACT

Introduction: The handheld glucometers are commonly used for glucose estimation in acutely ill patients, especially in those with neurological deficit. However, in a few conditions like chronic renal failure, it can give fallacious readings. This has serious implications in management of these patients, which can lead to misdiagnosis of the underlying hypoglycemia. **Case Report:** Here we present a case of a patient with hypoglycemia who had a fallacious normal glucose level when checked by a handheld glucometer (i.e., elevated on glucometer). The underlying pathology giving rise to this fallacy was presence of chronic kidney disease with high uric acid and low hematocrit. **Conclusion:** Treating physicians should be aware of such possibilities and take suitable steps for appropriate diagnosis of potentially life-threatening hypoglycemia.

Keywords: Hypoglycemia, Glucometer, Chronic kidney disease, Uric acid

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INTRODUCTION

Precise diagnosis of acute critically ill unconscious or mentally altered patient is very difficult. Care givers rely on history, examination, imaging and laboratory data for exact diagnosis. However, sometimes laboratory data could be misleading and can lead to hazardous consequences. One such condition, where laboratory results can mislead, is the diagnosis of hypoglycemia in patients with chronic renal failure. Here we present a case where widely used handheld glucometers provided a falsely high capillary blood sugar reading causing diagnostic problems.

CASE REPORT

A 54-year-old lady was presented with a short history, beginning with altered sensorium and drowsiness and leading to unconsciousness in one hour. She was a diabetic with history of chronic kidney disease on regular treatment. During the initial stages of symptoms, the relatives tried to feed her with oral glucose powder, presuming this to be a hypoglycemic attack. However, the patient was unable to ingest it. The blood sugar level checked on Accu-Chek glucometer (Roche Diagnostics) was 187 mg/dL. Since she did not respond to treatment

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in a few minutes, she was shifted to the hospital for further treatment. She was brought to the hospital deeply unconscious. Her vital parameters were normal, heart rate 100 per minute, blood pressure 110/70 mmHg and respiratory rate 18 per minute. She was not responding to deep pain, had flaccid paralysis of all four limbs, pupils were constricted but reacting to light, deep tendon reflexes were depressed and plantar reflexes could not be elicited. Respiratory, cardiac and alimentary system examinations were normal. Her capillary sugar checked on a different Accu-Chek glucometer (Roche Diagnostics) was 167 mg/dL. Differential diagnoses of brain stem cerebrovascular accident, metabolic encephalopathy and uremic encephalopathy were considered. Her blood sample was sent for investigations and her magnetic resonance imaging (MRI) scan of the brain was done. The MRI scan revealed bilateral symmetrical hyper intense lesions in the internal capsule, corona radiata and centrum semiovale, with reduced apparent diffusion coefficient. An hour later her blood reports showed hemoglobin 8.2 g/dL, normal blood counts, hematocrit 20%, creatinine 6 mg/dL, blood urea nitrogen 96 mg/dL, sodium 132 mEq/L, potassium 5.2 mEq/L, uric acid 9.2 mg/dL, normal hepatic enzymes and ammonia levels and plasma glucose 24 mg/dL. She was infused with 25% dextrose and then with 500 mL of 10% glucose infusion. She responded dramatically in a few minutes. She became conscious, started moving all the four limbs with complete recovery of all neurological deficit. Temporal event of positive neurological improvement after intravenous glucose suggested the diagnosis of hypoglycemic encephalopathy. Patient was treated with initial intravenous and later oral glucose till plasma

levels of sugar were stabilized. She was discharged asymptomatic within 24 hours.

DISCUSSION

Hypoglycemia is a common emergency situation in intensive care units. It is life-threatening, yet easily treatable. The most common way to diagnose this condition is with handheld glucometers. Some conditions, however, have the potential to interfere with glucose measurements by handheld glucometers and provide erroneous readings of blood glucose. This can lead to misdiagnosis and wrong treatment in patients with hypoglycemia. Various factors are attributed to altered glucose measurement on the strips. Some common reasons are given in Table 1.

Though most of these factors cause a minor variation in estimated glucose, sometimes, especially with extreme values of these factors, fallacious readings could be obtained and these could be hazardous. In this patient, though it was obvious that patient had hypoglycemia, it was not detected by glucometer testing.

Glucometers use glucose oxidase (GOD) or glucose dehydrogenase (GDH) enzymes to detect the presence of glucose in blood. In these reactions, glucose is metabolized by GOD or GDH to hydrogen peroxide or reduced nicotinamide adenine dinucleotide, respectively. The amount of hydrogen peroxide or rNAD can then be measured by oxidized dye color change or by electrochemical reactions to calculate the amount of glucose present [1]. The glucose oxidase method makes use of one or both of the following reactions:

Table 1: Sources of glucose monitoring inaccuracy

Factors	Variation	Mechanism
Strip factor	Strip-strip variation	Varying storage conditions. Variation of enzyme quantity in different strips.
Physical factors	Altitude	Increased sensitivity of GOD biosensor strip to oxygen concentration.
	Temperature	Unpredictable response. Brand specific errors
Patient factors	Meter-strip miscoding	Altered relation between electrical signal produced by strip and reported blood glucose.
	Hematocrit	Glucose in RBCs is in equilibrium with plasma glucose, but at lower levels. Extreme hematocrit alters the equilibrium.
	Triglycerides	Takes up volume, thereby reducing the amount of glucose in capillary volume.
	Uric acid	Uric acid is oxidized by the electrodes in the tip of the strip.
Pharmacological factors	L dopa, ascorbic acid, icodextrin in dialysate solutions	These drugs interact with the electrodes at the tip of the strip to give high false values.

GOD – glucose oxidase, RBC – red blood cells

Many conditions can interfere with these chemical reactions happening at the tip of the glucose measuring strip. High levels of uric acid, which is a reducing agent, may result in falsely high glucose readings [1]. Uric acid lowers the value for glucose as determined by the GOD-Perid method. Bleaching of the final color is the source of such interference in this reaction [2]. Reducing agents other than glucose, such as metabolites of icodextrin, may also be detected by these methods. This is a chemical used in the dialysate for patients with end stage renal failure on long-term peritoneal dialysis, and which is partly absorbed in the circulation. High or low hematocrit values can also lead to falsely abnormal glucose readings. Low hematocrit value has also been shown to increase glucose estimations on handheld glucometer [3]. Both, low hematocrit and high uric acid, are common in critically ill patients as well as in patients with renal failure. Hence, it can be seen that patients with chronic kidney disease may have multiple reasons to get falsely high glucose readings when handheld glucometers are used. This patient, though never dialyzed, had high uric acid and low hematocrit values, which could have led to falsely high glucose levels on the reagent strip. Since uric acid is a reducing agent and though it is implicated as an agent to give falsely elevated glucose in handheld glucometer, we did not come across any reference or case reports describing the same. The MRI scan of the patient was also highly suggestive of hypoglycemic encephalopathy [4].

CONCLUSION

Hence, we suggest that in patients with chronic kidney disease, especially due to diabetes, effort should be made to diagnose and treat hypoglycemia accurately when they present with altered mental status. This may involve not over-relying on handheld glucometer, using laboratory method to estimate blood glucose for confirmation or empirically treating these patients with intravenous dextrose without laboratory evidence of hypoglycemia.

Author Contributions

Praveen Pratap Jadhav – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Meera Praveen Jadhav – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be

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Guarantor

The corresponding author is the guarantor of submission.

Conflict of Interest

Authors declare no conflict of interest.

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