Arch Clin Med Case Rep 2019; 3 (6): 418-421 *DOI: 10.26502/acmcr.96550114*

Case Report

Diabetic Ketoacidosis in A Person with Insulin Pump-Treated Type 1 Diabetes Mellitus while Following A Very Low Carbohydrate Diet – A Case Report

Emil Tikander MD[1], Ajenthen Ranjan PhD[1,2], Signe Schmidt PhD[1], Kirsten Nørgaard DMSc[1]

[1]Steno Diabetes Center Copenhagen, Gentofte, Denmark

[2]Danish Diabetes Academy, Odense, Denmark

[*]**Corresponding Author:** Dr. Emil Tikander, Steno Diabetes Center Copenhagen, Niels Steensens Vej 2, 2820 Gentofte, Denmark, Tel: +45 30911927; E-mail: emil.josef.tikander.02@regionh.dk

Received: 22 July 2019; **Accepted:** 05 August 2019; **Published:** 11 November 2019

Abstract

This report describes a male with insulin pump-treated type 1 diabetes mellitus admitted with diabetic ketoacidosis after a gastroenteritis while following a very low carbohydrate diet. Combining such diet, using an insulin pump and suffering a gastroenteritis may represent an increased risk of diabetic ketoacidose.

Keywords: Type 1 diabetes; Diabetic ketoacidosis; Very low carbohydrate diet; Continuous glucose monitoring; Gastroenteritis

1. Introduction

Reducing carbohydrate intake decreases glucose variability and reduces hypoglycemia in people with type 1 diabetes mellitus (T1D) [1]. However, a very low carbohydrate diet (VLCD), i.e. less than 50 g per day [2], will increase blood ketone levels and may raise the risk of diabetic ketoacidosis (DKA) [3]. These concerns, along with reports of increases in blood lipids, argue against the potential benefits of a VLCD [4]. We present a case of gastroenteritis induced DKA in a male with insulin pump-treated T1D, who had been following a VLCD for over a year.

2. Case Presentation

A 58-year-old man with T1D since 2002 treated with a sensor-augmented insulin pump (Medtronic Veo® and Enlite® sensor, Medtronic) with insulin aspart (NovoRapid®, Novo Nordisk). Latest HbA1c was 56 mmol/mol (7.3%), he attended regular diabetes visits and had no diabetes late complications. His total daily insulin dose was

20-30 IU with 73% used for basal and 27% for bolus insulin. For more than a year, he had been following a VLCD with an average intake of 10-50 g carbohydrate per day. He was satisfied with the diet, as he reported that glucose levels were easier to manage, and he had obtained a weight loss of 5.1 kg. During the same time period, his lipid levels had increased from total cholesterol 4.3 to 5.6 mmol/l and LDL from 1.9 to 3.5 mmol/l. Due to concerns from his physician, he routinely measured his blood ketone levels every morning.

The patient traveled abroad to Egypt for an 8-day vacation, and on day 3, he experienced nausea, vomiting and diarrhea. Ciprofloxacin was prescribed for the treatment of gastroenteritis, but had no effect on the symptoms. Until the return date, he only ate soup and similar light food items, which he estimated to zero carbohydrates. Therefore, he only administrated his usual basal rate of insulin and a few correction boluses.

He did not wear his continuous glucose monitor (CGM) due to the risk of losing it when swimming. However, he took frequent finger prick glucose measurements. Initially, glucose levels were fluctuating, but drastically increased to 29.4 mmol/l on the last day of his vacation. To manage this hyperglycemic state, he supplemented his basal insulin with insulin boluses via the pump or by insulin pen, but continued to have high blood glucose readings (Figure 1). Nonetheless, the patient boarded the return flight and the symptoms worsened. When the plane arrived in Copenhagen, Denmark, he was admitted directly to the nearest hospital and was treated for DKA.

On arrival, the blood glucose was 21.1 mmol/l, pH 7.17, HCO_{3-} 8.5 mmol/l, base excess -22.9 mmol/l, lactate 1.9 mmol/l, pO_2 17.3 kPa, pCO_2 1.8 kPa, plasma sodium 129 mmol/l, plasma potassium 4.3 mmol/l, and CRP 27 mg/l. The treatment of DKA followed local guidelines, and the patient was discharged after four days. The patient recovered fully without any sequelae.

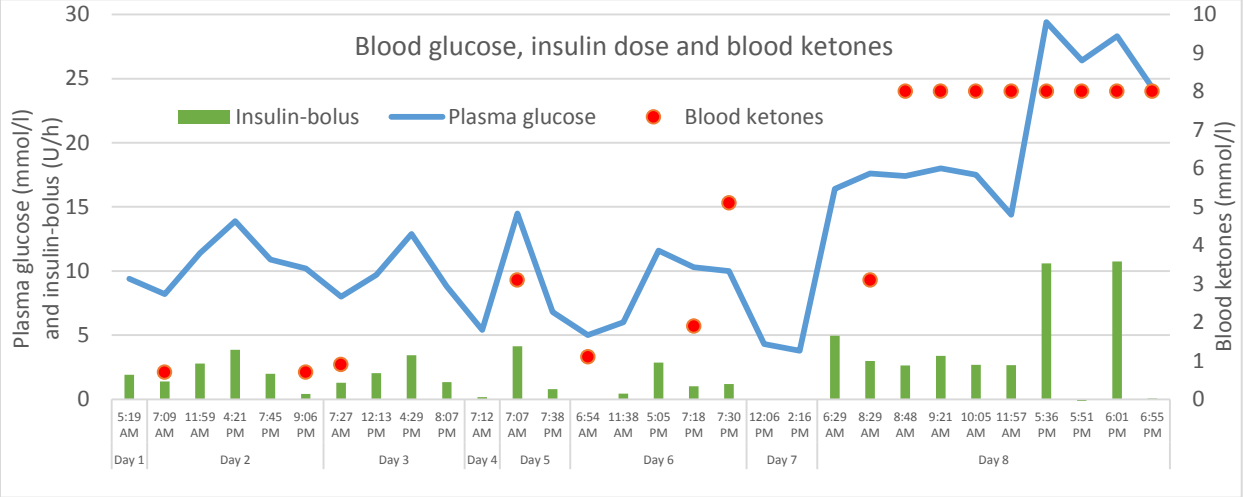

Figure 1: Patient blood glucose readings (the blue line), bolus insulin administration (green bars) and blood ketones (red dots). Besides bolus insulin, the patient received his usual basal insulin. (From 0.00 -2.00 AM: 0.55 U/h, 2.00-6.30 AM: 0.70 U/h, 6.30 AM-10.00 PM: 0.80 U/h and 10.00 PM- midnight: 0.75 U/h).

3. Discussion

We present a case of a male with insulin pump-treated T1D who followed a VLCD and was admitted due to DKA after a period with gastroenteritis. Even though, infection is the number one reason for development of DKA [5], the patient had two other concomitant risk factors for DKA. Firstly, he was treated with insulin pump which previously has shown to increase the risk of DKA in patients with insufficient education in management of insulin pumps [6]. However, it should be noted that modern pumps combined with correct education in management of the pump, has shown no elevated risk of DKA compared to pen treatment [7].

Secondly, his VLCD may put him at heightened risk of DKA due to increased lipolysis and ketogeneses [3, 8]. Numerous case reports have shown ketoacidosis in patients without T1D following a VLCD [9-11]. However, there are to our knowledge no clinical studies showing direct correlation between VLCD and the risk of DKA in patients with T1D. We report this case to illustrate a group of patients with an increased risk of DKA that needs to be considered by clinicians and patients. We can speculate whether the combination of VLCD, insulin pump treated T1D and infection may put patients in a high risk of developing DKA. The number of patients equipped with an insulin pump has for many years been increasing, which will most probably continue. Moreover, low carbohydrate diets are gaining more popularity among patients with T1D [1]. This can in many instances aide the patient to reach glycemic treatments goals and ease everyday challenges when dealing with diabetes. However, it also poses new challenges for clinicians and patients in terms of increased awareness of developing DKA. Moreover, the risk of euglycemic DKA should also be addressed as the combination of such diet, insulin pump and intercurrent illness, may increase the risk for that presentation of DKA. Patients should be educated about symptoms of DKA, especially during infections and increase awareness of the importance to accompany blood glucose measurements with regular blood ketones to avoid potential DKA.

Conflicts of Interest

None of the authors have conflict of interest regarding this case report.

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Citation: Tikander E, Ranjan A, Schmidt S, Nørgaard K. Diabetic Ketoacidosis in A Person with Insulin Pump-Treated Type 1 Diabetes Mellitus while Following A Very Low Carbohydrate Diet – A Case Report. Archives of Clinical and Medical Case Reports 3 (2019): 418-421.