Case Report

Successful treatment with artificial pancreas for a patient who attempted suicide using a high-dose insulin s.c. injection

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Background: Artificial pancreas is usually used to manage hyperglycemia. We controlled prolonged hypoglycemia induced by insulin overdose using artificial pancreas.

Case Presentation: A 56-year-old female patient with type 2 diabetes mellitus was admitted to the emergency department after overdosing on 1,800 units each of insulin aspart and insulin degludec. She had also ingested 2 weeks of anti-anxiety medication. When the patient arrived at the hospital, her blood glucose level was 30 mg/dL and she was in a coma. Artificial pancreas (STG-55; Nikkiso, Tokyo, Japan) was used to control blood glucose levels because we were unable to predict the duration or degree of hypoglycemia. Blood glucose levels were safely controlled without the development of hypo- or hyperglycemia. Finally, the patient was discharged without any complications on day 7.

Conclusion: The STG-55 artificial pancreas was very useful and convenient for controlling blood glucose levels in our insulin overdose patient.

Key words: Artificial pancreas, hypoglycemia, insulin overdose

INTRODUCTION

INTENTIONAL MASSIVE OVERDOSES of insulin cause severe hypoglycemia, and difficulties are associated with predicting its duration. Frequent blood glucose measurements and the administration of glucose are needed in order to treat these patients.

We herein present a case of a 56-year-old woman with type 2 diabetes mellitus who injected large amounts of rapid- and long-acting insulin in an attempt to commit suicide. We used artificial pancreas (STG-55; Nikkiso, Tokyo, Japan), which is more commonly used to control perioperative hyperglycemia, to control hypoglycemia in this patient.

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Received 23 Mar, 2020; accepted 30 Apr, 2020

Funding information

No funding information provided.

CASE REPORT

A 56-YEAR-OLD WOMAN with type 2 diabetes mellitus and depression was admitted to the emergency department after injecting herself with 1,800 units each of insulin aspart and insulin degludec. She also overdosed on 2 weeks of anti-anxiety and other medication (zolpidem, brotizolam, flunitrazepam, clonazepam, and trazodone). When the patient arrived at the hospital, she was in a coma with a score of 3 (E1V1M1) on the Glasgow Coma Scale and had sinking tongue root. Multiple needle injection scars were noted on her lower abdomen. We administered 20% glucose i.v. and started a continuous 50% glucose infusion because her blood glucose level was 30 mg/dL. As her consciousness did not improve with the amelioration of hypoglycemia, she was intubated and transferred to the intensive care unit.

We used the STG-55 artificial pancreas to control blood glucose levels because difficulties were associated with predicting the duration and degree of hypoglycemia. The target blood glucose level was set at 120 mg/dL, and, thus, 1,000 mU/mL human insulin and 20% glucose were

prepared. We gave 50 mEq potassium i.v. per day and checked potassium every 2 h, because insulin overdose is a risk for low potassium. Sulbactam/ampicillin were given simultaneously because she developed aspiration pneumonia.

Transient hyperglycemia was initially observed and attributed to the treatment with glucose in the emergency department. The artificial pancreas did not inject insulin consistently, and only injected 20% glucose when necessary. When blood glucose levels were controlled at nearly target levels, the i.v. administration of 50% glucose was tapered. Eight hours after the artificial pancreas used, we reduced the number of measurements to twice per day because potassium levels were not changed significantly. Tube feeding was started at 480 kcal/day on day 3 and was increased to 960 kcal/day on day 4. On the same day, the mechanical ventilator was removed and the patient was extubated because the course of aspiration pneumonia improved. We removed STG-55, started the ingestion of food, and controlled blood glucose levels using an insulin sliding scale on day 5. She was transferred to the psychiatric ward on day 6 following the discontinuation of the i.v. administration of 50% glucose. The patient was discharged without any complications on day 7. STG-55 was used for 96 h and 21 min, the total amount of insulin given was 80.20 units, and the total amount of glucose injected by STG-55 was 539.217 g. Her average blood glucose level was 116.6 mg/dL. Figure 1 shows the course of blood glucose levels, the insulin injection ratio, and glucose injection ratio.

DISCUSSION

ARTIFICIAL PANCREAS, STG-55, has the ability to monitor blood glucose levels continuously and

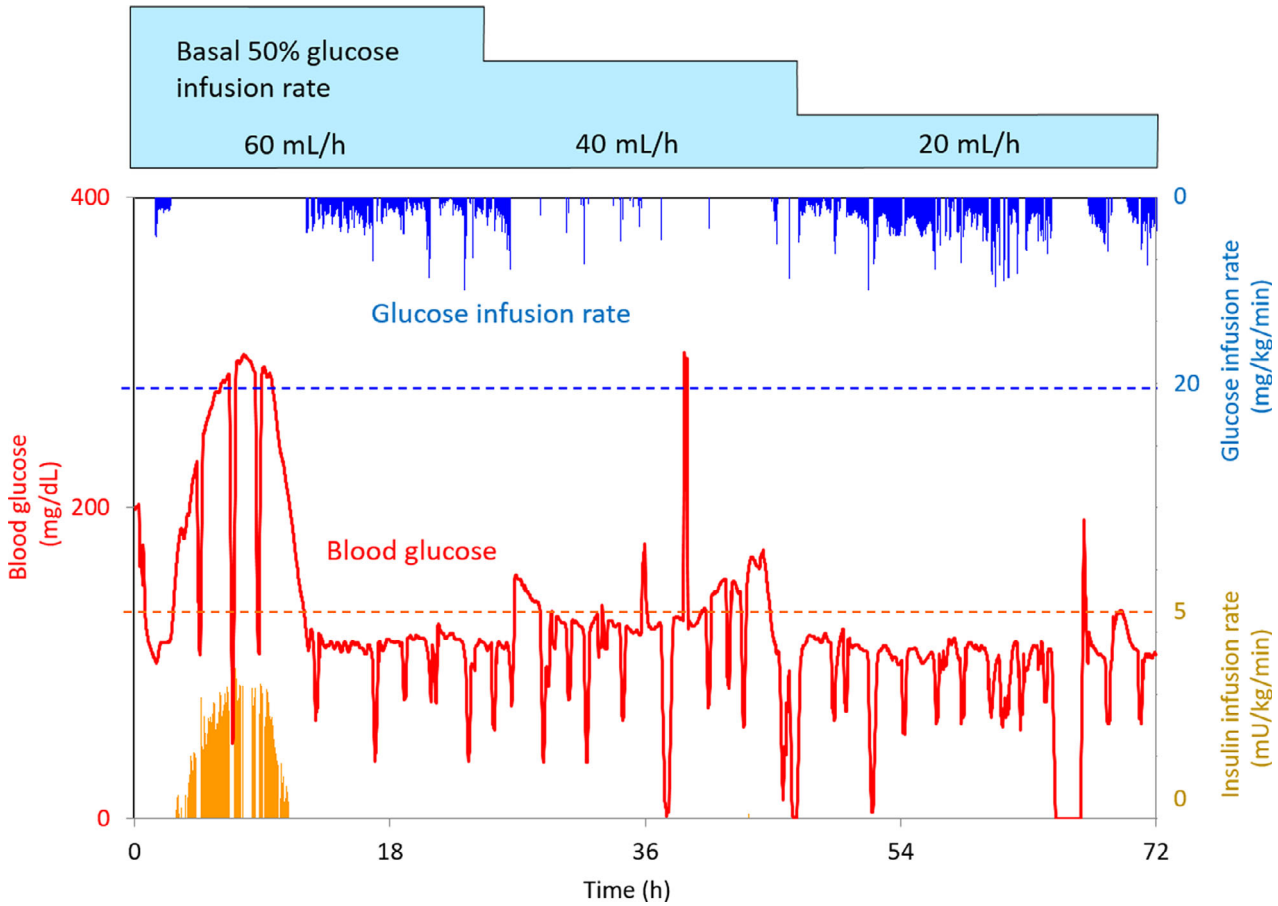

Fig. 1. Clinical course of a 56-year-old woman treated with an artificial pancreas following attempted suicide using a high-dose insulin injection. Blood glucose levels were controlled without the development of hypoglycemia or hyperglycemia. The outlier was caused by flashing to prevent blocking of the circuit.

maintain them at appropriate levels by injecting insulin or glucose where necessary. It is often used for diabetic patients in order to examine insulin resistance and insulin secretional capacity or treat hyperglycemia. Previous studies have reported the usefulness and importance of artificial pancreas in controlling perioperative blood glucose levels in patients who have undergone major surgery such as hepatic, pancreatic, and esophageal resection.[1]

Artificial pancreas could decrease total hospital costs and contribute to reductions in the incidence of surgical site infections in hepatectomized patients.[2] The application of artificial pancreas is expected to gradually increase; however, its main purpose is currently to treat hyperglycemia.

We herein presented a case of a patient with type 2 diabetes mellitus who injected large amounts of rapid- and long-acting insulin in an attempt to commit suicide, and STG-55 was very useful for safely controlling hypoglycemia in this patient. There has only been one case report on the treatment of persistent hypoglycemia due to an insulin overdose with artificial pancreas;[3] in that report, artificial pancreas controlled blood glucose levels in a patient who injected 400 units of rapid-acting insulin. Our patient injected a total of 3,600 units of insulin: 1,800 units of insulin aspart, which is rapid-acting, and 1,800 units of insulin degludec, which is long-acting. The peak blood concentration of insulin aspart is reached when 30.8 ± 13.8 min and 39.2 ± 18.8 min if 0.025 and 0.05 units/kg, respectively, are injected s.c.; therefore, the time to the peak blood concentration of insulin aspart is within 1 h.[4] In contrast, the half-life of insulin degludec is more than 25 h and its duration of action persists for more than 42 h.[5] The duration of hypoglycemia after an insulin overdose is proportional not only to the type of insulin, but also to its total dose.[6] We selected STG-55 to control blood glucose levels because hypoglycemia was expected to persist for a long time.

The following issues are associated with controlling blood glucose levels after an insulin overdose: (i) the appropriate frequency at which to measure blood glucose levels currently remains unknown, (ii) the appropriate rate of glucose administration is unclear, (iii) the appropriate dose of insulin is unknown if blood glucose levels become excessively elevated.

Longer intervals between blood glucose measurements have been shown to increase the risk of overlooking hypoglycemia or hyperglycemia, whereas very short intervals result in a greater workload. A previous study reported that the use of STG-55 could reduce the frequency of blood sampling as well as the number of calls made to the physician because it continuously measures blood glucose levels.[7]

The rate of glucose administration needs to be selected based on blood insulin levels; however, difficulties are associated with measuring insulin levels rapidly in most hospitals as well as insulin analog levels.[8] We were unable to measure insulin analog levels in the present case. We started to administer glucose i.v. from 10 mg/kg/min and attempted to achieve minor adjustments in blood glucose levels using STG-55. During the clinical course, the patient only required the administration of 20% glucose from STG-55.

Care is needed when selecting the dose of insulin in cases of hyperglycemia because of the recurrence of hypoglycemia. STG-55 has the ability to administer an optimal dose of insulin safely without the risk of hypoglycemia.

In patients with hypoglycemia caused by an insulin overdose, a delay of more than 6 h in the initiation of treatment and more than 48 h of ventilation are predictors of an unfavorable outcome.[9] STG-55 has the ability to control blood glucose levels safely and accurately and could have contributed to the good course observed in this patient, despite the need for ventilation for more than 48 h.

CONCLUSION

THE STG-55 ARTIFICIAL pancreas is often used to control hyperglycemia perioperatively, but is also very useful for safely controlling hypoglycemia caused by an insulin overdose.

DISCLOSURE

Approval of the research protocol: N/A.
Informed consent: Informed consent was obtained from the patient for publication of this case report.
Registry and registration no. of the study/trial: N/A.
Animal studies: N/A.
Conflict of interest: None.

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