Letter to the Editor

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

Dear Editor,

We read with great interest an article published in *Acute Medicine and Surgery* by Toshihiro Sakurai *et al*. entitled "Successful treatment with artificial pancreas for a patient who attempted suicide using a high-dose insulin s.c. injection".[1] This article states that artificial pancreas (AP) systems can control blood glucose (BG) concentrations without a risk of hypoglycemia.

We would like to share our understanding of the differences between APs intended for hospitalized patients and wearable APs intended for diabetes outpatients. To aid our discussion, we would consider a case published by Shah *et al*. in which a wearable AP, the MiniMed 670G (Medtronic Diabetes, Northridge, CA, USA) failed to prevent a suicide caused by an intentional insulin overdose. This wearable, insulin-only AP system not only failed to prevent the patient's suicide from multiple large insulin boluses, but it actively contributed to the suicide. This is because the system continued administering prescheduled basal insulin even after the patient had become extremely hypoglycemic.[2]

It is important to distinguish between hospital APs for inpatients and wearable APs for outpatients. A hospital AP, like the STG-55 used by Sakurai *et al*., can deliver glucose i.v. Another AP intended for hospital use is being developed by Admetsys. This system, like the STG-55, is intended to deliver both insulin and glucose i.v.[3] Almost every marketed wearable AP system delivers only insulin to lower elevated BG concentrations and nothing to raise the BG concentration in the event of hypoglycemia. These systems respond to hypoglycemia by halting insulin delivery, but they do not administer any agent to actively raise the BG concentration. An investigational wearable AP for outpatients containing two hormones from Beta Bionics (Boston, MA, USA), currently in development, could deliver glucagon s.c. to raise the BG concentration in the case of hypoglycemia.[4] However, this agent would still be less effective than i.v. glucose, which is available with a hospital AP. Sakurai *et al*.'s patient benefitted from a hospital AP because they could receive glucose i.v., which is the best method for raising BG levels after an intentional insulin overdose. In the case reported by Sakurai *et al*., we believe a wearable AP would not have saved the patient.

Recently a glucagon-only closed-loop system was proposed by Mulla *et al*.[5] to treat hypoglycemia in hospitals. This system might seem promising for treating a hypoglycemic patient like the case reported by Sakurai *et al*. However, this system has drawbacks. These include: (i) this system cannot lower elevated BG concentrations, so it is not a true AP, (ii) this system is experimental and not cleared.

In conclusion, we recommend that if a hypoglycemic patient appears to have taken an intentional insulin overdose, then the patient should be immediately brought to a hospital where i.v. glucose is available either through a hospital AP system or through standard treatments and monitoring. A patient using a wearable AP system should not depend on this device to correct their hypoglycemia from an insulin overdose.

DISCLOSURE

Approval of the research protocol: N/A.
Informed consent: N/A.
Registry and registration no. of the study: N/A.
Animal studies: N/A.
Conflict of interest: David C. Klonoff is a consultant for Dexcom, Eoflow, Fractyl, Lifecare, Novo, Roche Diagnostics, and Thirdwayv. The other authors have no conflict of interest.

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4 El-Khatib FH, Balliro C, Hillard MA, *et al*. Home use of a bihormonal bionic pancreas versus insulin pump therapy in adults with type 1 diabetes: a multicentre randomised crossover trial [published correction appears in Lancet. Lancet 2017; 389: 369–80. 2017 Jan 28;389(10067):368] [published correction appears in Lancet. 2017 Feb 4;389(10068):e2].
5 Mulla CM, Zavitsanou S, Laguna Sanz AJ, *et al*. A randomized, placebo-controlled double-blind trial of a closed-loop glucagon system for Postbariatric Hypoglycemia. J. Clin. Endocrinol. Metab. 2020; 105: e1260–e71.

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