meals, with suppression of insulin secretion, which was suggested to be initiated several weeks before admission and continued after admission. Dumping syndrome was easily suspected as causing the latter type because of the patient's history of total gastrectomy. Actually, MTT clearly showed oxyhyperglycemia with subsequent hyperinsulinemia and reactive hypoglycemia. However, it was impossible to explain the cause of the former hypoglycemia as dumping syndrome because such severe glucopenia seldom occurs, except by repression of insulin secretion, which was not observed even upon arrival at the hospital. Therefore, we tested whether the inappropriate insulin secretion was persistent, and no hypoglycemia was observed during 72 h of fasting. There were also no abnormal findings in diagnostic imaging and no other abnormal laboratory data that may indicate a secondary cause, such as hepatic failure. We considered that the initial hypoglycemia occurred just after he took garenoxacin mesilate hydrate, and that new quinolone was reported to accelerate insulin secretion in a concentration-dependent manner by inhibiting the adenosine triphosphate (ATP)-sensitive potassium channel [1]. Therefore, garenoxacin mesilate hydrate was a possible cause of the initial hypoglycemia. Irbesartan is reported to inhibit CYP3A-4; however, garenoxacin mesilate hydrate is not metabolized by P450, and therefore, it was not likely that irbesartan accelerated the effect of garenoxacin mesilate hydrate.

We next considered why reactive hypoglycemia due to dumping syndrome manifested about 14 years after gastrectomy. Hypoglycemic symptoms began after oral administrations of irbesartan, which is an angiotensin-2 receptor blocker (ARB). ARB not only improves insulin resistance by increasing the expression of glucose transporter (GLUT4) and enhancing glucose uptake by muscle [2, 3], it also facilitates insulin secretion [2, 3]. Although the symptoms of hypoglycemia were not seen following cessation of irbesartan after admission, MMT showed that unsymptomatic reactive hypoglycemia continued. Therefore, it was suggested that subclinical dumping syndrome had been occuring for a long period after gastrectomy, and reactive hypoglycemia became symptomatic only 14 years after gastrectomy, in this case due to irbesartan consumption. Although there are no reports of cases like this, careful attention to hypoglycemia is necessary when drugs that increase insulin sensitivity, such as ARBs, are prescribed for patients at risk of reactive hypoglycemia.

In this patient anti-insulin autoantibody was detected. There was no history of insulin use, drugs, or supplements containing thiol, such as α-lipoic acid. Scatchard plot analysis showed that this autoantibody had low-affinity and high-binding capacity (Table 1). Also human leukocyte antigen (HLA)-DRB1-0406 was detected in our patient. All these findings indicated the presence of insulin autoimmune syndrome (IAS). Although IAS was thought to be the cause of inappropriate hyperinsulinemia, it was not likely that IAS induced recent hypoglycemia because the blood glucose profile after admission showed only oxyhyperglycemia and subsequent reactive hypoglycemia.

Dumping syndrome, originating from the rapid elevation of blood glucose level after a meal without retention of food in the stomach, causes inappropriate hyperinsulinemia with subsequent reactive hypoglycemia. For preventing this initial postmeal hyperglycemia, increasing meal frequencies to reduce the amount of food intake per meal is commonly performed. In addition to this dietary approach, α-glucosidase inhibitor (α-GI) is sometimes prescribed for dumping syndrome [11]. Carbohydrates in meals are degraded by α-glucosidases, such as disaccharide hydrolases such as sucrase and maltase, to monosaccharide. Monosaccharide is absorbed from the small intestinal epithelial cells, where α-glucosidases are present. All α-glucosidases delayed absorption of carbohydrates by inhibiting these enzymes and suppressing postprandial hyperglycemia. Among the three α-glucosidases miglitol, acarbose, and voglibose, only miglitol suppressed postmeal glycemic level at 30 and 60 min after the meal and suppressed subsequent hyperinsulinemia during MMT in this case. Whereas acarbose and voglibose are not absorbed from intestinal mucosa, 50–90 % of the administered miglitol is absorbed in the upper area of the small intestine. Therefore, the common dosage of miglitol is prescribed at a relatively higher rate, , and these differences could explain why miglitol inhibited glucose absorption more in the upper area of the small intestine than the other medications [4, 5], as well as better efficacy than voglibose [6–8] and acarbose [9, 10] for postmeal hyperglycemia suppression , as in this case.

In conclusion, we report a rare case of symptomatic reactive hypoglycemia due to dumping syndrome 14 years after total gastrectomy and severe hypoglycemia, which occurred separately. The cause of the former is thought to be due to the use of irbesartan, an ARB, which increases insulin sensitivity. The cause of the latter might be prior consumption of garenoxacin mesilate hydrate, which increases insulin secretion. Finally, symptomatic dumping syndrome was successfully controlled by adding miglitol three times a day to meals. which were divided into six smaller meals a day, not by adding another α-glucosidase inhibitor.

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