CASE REPORT

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Maltodextrin May Be a Promising Treatment Modality After Near-total Pancreatectomy in Infants Younger Than Six Months with Persistent Hyperinsulinism: A Case Report

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What is already known on this topic?

Congenital hyperinsulinism (CHI) is the most common cause of persistent hypoglycemia in newborns and infants. While several medical treatment agents are used to treat infants with CHI, hypoglycemia management has been quite difficult to date.

What this study adds?

In those cases with CHI, maltodextrin addition in the early period enables us to achieve more stable serum glucose. Maltodextrin addition also shortens the patient's discharge period, prevents complications, and protects the patient from treatment side effects. Continuous glucose monitoring systems help to manage the patients' follow-ups more efficiently in this group.

Abstract

Persistent hypoglycemia in infants with congenital hyperinsulinism (CHI) can be challenging in approximately half of these cases, even after undergoing a near-total pancreatectomy. While maltodextrin has been recommended in the nutritional management of CHI cases younger than six months, information regarding its efficacy in managing hypoglycemia are not yet clear. Here, we present a male infant with CHI who experienced persistent hypoglycemia even after undergoing a near-total pancreatectomy and despite multiple medical treatments. The infant's hypoglycemic episodes were successfully controlled by adding maltodextrin to his diet.

Keywords: Congenital hyperinsulinism, *ABCC8* gene, maltodextrin, near-total pancreatectomy, continue glucose monitoring systems

Introduction

Congenital hyperinsulinism (CHI) is the most common cause of persistent hypoglycemia in newborns and infants (1). While several medical treatment agents are used to treat these infants, the management of hypoglycemia has been quite difficult (2). It has been reported that persistent hypoglycemia can be seen in approximately 50% of cases with diffuse forms where a near-total pancreatectomy is performed (3).

Adzick et al. (4) reported that of the CHI cases who underwent a near-total pancreatectomy in their series, 31% had euglycemia, 20% had hyperglycemia, and 49% had hypoglycemia requiring treatment. Moreover, it has been emphasized that surgery for the diffuse form is not a cure, but only helps hypoglycemia control.

Nutritional support is a critical factor, alongside medical treatment, in cases with CHI. Frequent feeding with breast milk or formula is recommended for those who do not have oral intake problems (5). Uncooked cornstarch helps with

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the stabilization of serum glucose in cases above six months, but it is not recommended for cases under six months because of its side effects. A small number of studies have reported on the use of maltodextrin (Malt Extract, Wakodo, Fantomalt Nutricia) added to breast milk or formula in the nutritional management of cases younger than six months. However, none of these studies clearly demonstrated the effectiveness of maltodextrin in controlling hypoglycemia (6).

In this article, we present a male infant with CHI who was experiencing persistent hypoglycemia even after undergoing a near-total pancreatectomy and despite multiple medical treatments and whose hypoglycemic episodes were successfully controlled by adding maltodextrin to his diet.

Case Report

A male patient was born with a weight of 4,020 grams in the 37th week of pregnancy from a twenty-seven-year-old mother's first pregnancy. Critical blood samples taken due to seizure at the 3rd hour of life revealed a serum glucose level of 22 mg/dL, and a serum insulin level of 288 µU/mL. An intravenous (IV) dextrose infusion at a rate of 6 mg/kg/min was initiated along with frequent breastfeeding. Due to persistent severe hypoglycemia in the follow-up, the IV infusion rate was gradually increased to 14 mg/kg/min. Due to the recurrence of hypoglycemia and the persistence of hyperinsulinism during hypoglycemia, CHI was considered a factor and diazoxide treatment was started at a dose of 10 mg/kg/day. Subsequently, his hypoglycemic episodes persisted and he was transported to our clinic on the 30th day of life.

Preparation for surgery immediately began, diazoxide treatment was increased to 15 mg/kg/day, and octreotide was started at a dose of 5 mcg/kg/day and was gradually increased to 40 mcg/kg/day. Hypoglycemic episodes persisted during this treatment, and an IV infusion of glucagon was added. Facilities to carry out ^{18}F-L-DOPA PET imaging were not available and so could not be performed on our patient and transfer to another center was considered inappropriate. A near-total pancreatectomy (95-98% resection) was performed on the 35th day of life. Histopathological samples showed diffuse nesidioblastosis. Genetic analysis revealed a previously reported heterozygous c.2113 C>T mutation in the *ABCC8* gene which is known to be associated with diazoxide unresponsiveness.

After the surgery, octreotide and glucagon were continued, nifedipine was added, and the dextrose infusion was continued at a dose of 14 mg/kg/min. Despite full enteral nutrition and other parenteral treatments, the hypoglycemic episodes continued. Since the IV dextrose infusion could not be reduced, oral maltodextrin (1 measuring spoon of Fantomalt Nutricia® contains 5 grams of CHO) was added to each meal (12 times per day) at a total dose of 5 gram/kg/day. After this, the addition of maltodextrin significantly controlled the patient's hypoglycemic episodes, and dextrose support was gradually decreased. Dextrose treatment was discontinued on the 7th day following the addition of maltodextrin, and the patient was discharged.

Serum glucose monitoring was enabled using a continuous glucose monitoring system (CGMS) (Medtronic Guardian Connect CGM, Ca, USA) during both the inpatient and outpatient periods. This system was used off-label after receiving informed consent from the parents to monitor glucose variability in order to prevent hypoglycemia using trend arrows, and to improve the efficacy of treatments. CGMS of the patient revealed that the hypoglycemic episodes decreased significantly after the addition of maltodextrin (Figures 1 and 2). It was noticed that the percentage of serum glucose, which was below 70 mg/dL per day, decreased significantly after the addition of maltodextrin.

Glucagon and nifedipine treatments were discontinued after maltodextrin treatment, in the first and the fourth months, respectively. The octreotide dose was reduced to 14 mcg/kg/day.

The patient's neurological examination was comparable to his peers, while his body weight was 14 kg [standard deviation score (SDS): 2.63], his height was 84 cm (SDS: 2.31), his body mass index was 19.8 (SDS: 1.5) and his head circumference was 47 cm (SDS: -0.01) at the age of 12 months. He is still receiving octreotide and maltodextrin treatment while not experiencing any hypoglycemic episodes.

Discussion

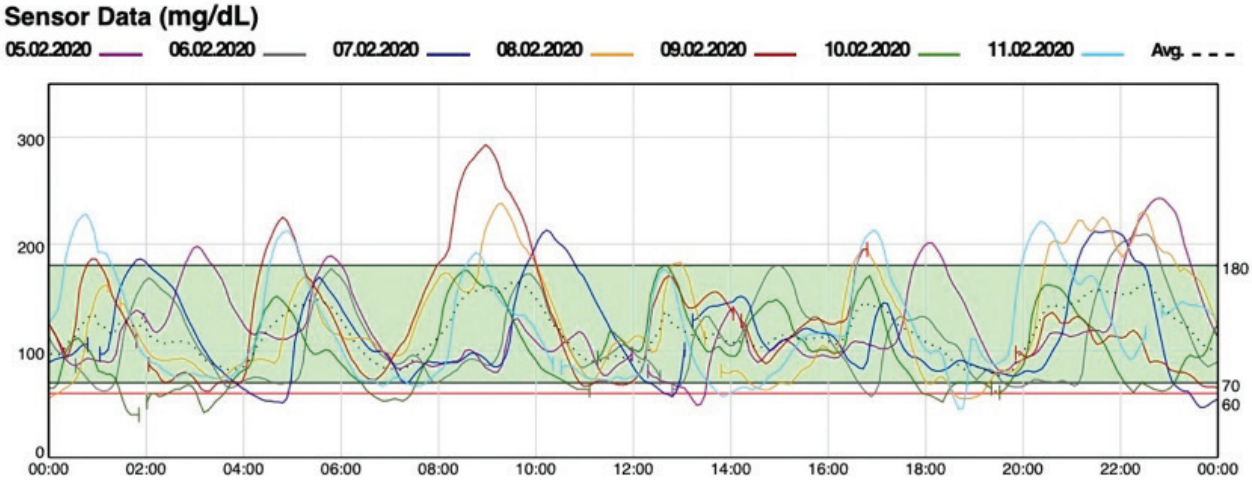
CHI is a rare glucose metabolism disease which most frequently causes persistent hypoglycemia in the neonatal period. Early diagnosis is essential in order to prevent neurological damage due to hypoglycemia (7). It is emphasized that frequent feeding with high-caloric carbohydrates can reduce hypoglycemia attacks (5). Xu et al. (6) stated that maltodextrin, a glucose polymer, can be used in the first six months of life. In contrast, uncooked corn starch is not used for the first six months due to its side effects. Cappella et al. (8) reported that adding maltodextrin to the diet instead of increasing IV glucose infusion is an effective procedure in cases of CHI. De Cosio and Thornton

(9) recommended that patients with CHI should be supported with maltodextrin.

In the literature, a limited number of articles regarding maltodextrin use in CHI were found. In one report, it was stated that maltodextrin was given to 4 CHI patients without any explanation regarding its efficacy (10).

Although maltodextrin is one of the most commonly known high-calorie formulae already being used in the feeding plans of CHI patients, the efficacy of maltodextrin on the hypoglycemic control of patients with CHI has not yet been studied in detail. There is no data on how adding maltodextrin to the diet effects the course of hypoglycemic episodes, the dosage, the feeding intervals or CGMS reports. Meanwhile, the possible side effects of maltodextrin are weight gain, gas, bloating and allergic reactions; however, none of these side effects were observed in our case (11).

In our case, the maltodextrin addition enabled us to achieve more stable serum glucose, to change the treatment modalities and to shorten the discharge period of the patient. CGMS also helped us to manage the patient's in/outpatient follow-ups more efficiently. The importance and efficacy of adding maltodextrin in the early period of hypoglycemia management was demonstrated in this CHI case by CGMS.



	Wed 5 Feb	Thu 6 Feb	Fri 7 Feb	Sat 8 Feb	Sun 9 Feb	Mon 10 Feb	Tue 11 Feb	Average / Total
# Sensor Values	285	284	285	283	249	287	284	1.957
High SG (mg/dL)	243	209	213	238	293	180	228	293
Low SG (mg/dL)	49	57	47	55	62	40	45	40
Average SG (mg/dL)	122	111	116	128	130	99	121	118
Standard Dev.	41	38	43	50	54	36	47	45
MAD %	3,8	1,8	3,3	9,9	8,4	20,9	6,3	8,9
# Valid Calibrations	1	2	2	2	3	4	2	16

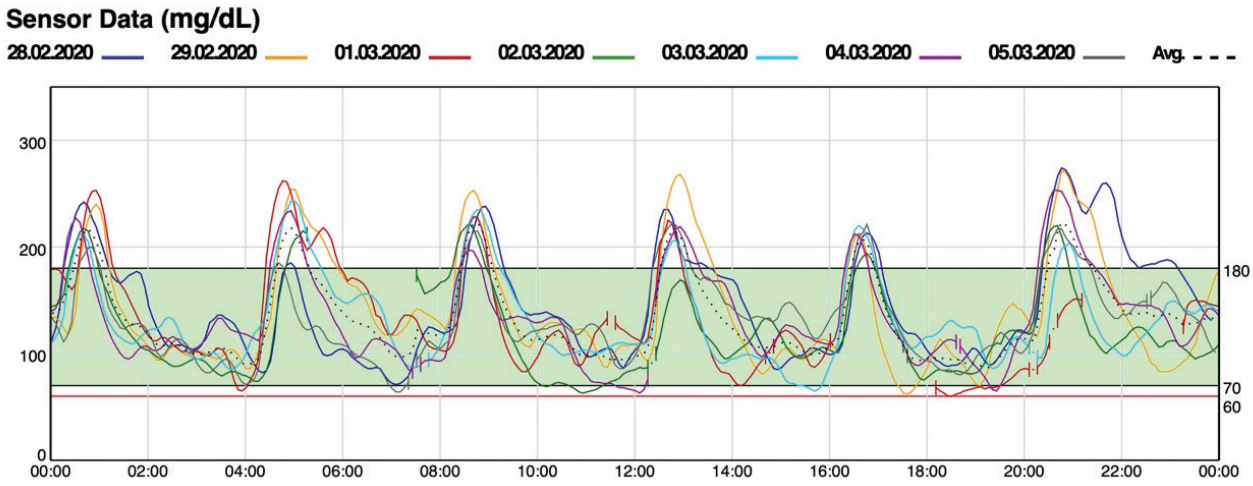
Excursion Summary

	Wed 5 Feb	Thu 6 Feb	Fri 7 Feb	Sat 8 Feb	Sun 9 Feb	Mon 10 Feb	Tue 11 Feb	Average / Total
# Excursions	5	2	5	5	4	4	7	32
# High Excursions	4	1	3	4	4	0	5	21
# Hypo Excursions	1	1	2	1	0	4	2	11
AUC Above Limit	3,1	1,0	2,1	5,0	7,7	0,0	3,5	3,1
AUC Below Limit	0,3	0,4	1,3	0,7	0,2	2,8	0,6	0,9

Duration Distribution (hh:mm)

Above 180	3:00	13%	1:05	5%	2:40	11%	4:40	20%	3:20	16%	0:00	0%	3:40	15%	18:25	11%
Within (70 - 180)	20:00	84%	20:10	85%	18:30	78%	16:40	70%	16:10	78%	17:15	72%	17:55	76%	126:40	78%
Below 70	0:45	3%	2:25	10%	2:35	11%	2:15	10%	1:15	6%	6:40	28%	2:05	9%	18:00	11%

Figure 1. Continuous glucose monitoring system report: Before the addition of maltodextrin (it is noted that time in below range was 11 %, the ratio of below < 70 mg/dL)

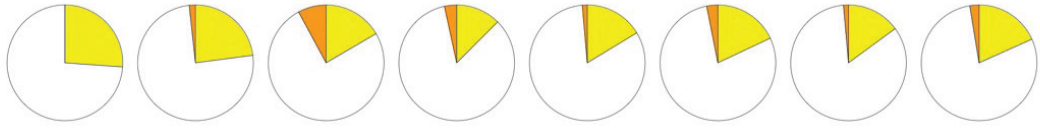


	Fri 28 Feb	Sat 29 Feb	Sun 1 Mar	Mon 2 Mar	Tue 3 Mar	Wed 4 Mar	Thu 5 Mar	Average / Total
# Sensor Values	287	288	241	264	288	289	288	1.945
High SG (mg/dL)	274	271	262	222	243	253	222	274
Low SG (mg/dL)	71	62	60	63	65	63	64	60
Average SG (mg/dL)	145	141	130	121	132	135	133	134
Standard Dev.	50	53	49	42	41	44	38	46
MAD %	8,1	6,0	2,0	8,7	1,6	5,0	2,8	4,7
# Valid Calibrations	2	2	3	2	2	2	2	15

Excursion Summary

	Fri 28 Feb	Sat 29 Feb	Sun 1 Mar	Mon 2 Mar	Tue 3 Mar	Wed 4 Mar	Thu 5 Mar	Average / Total
# Excursions	2	2	1	4	4	4	5	22
# High Excursions	2	2	1	4	4	4	5	22
# Hypo Excursions	0	0	0	0	0	0	0	0
AUC Above Limit	9,2	10,3	6,5	2,9	4,4	5,3	3,1	6,0
AUC Below Limit	0,0	0,1	0,3	0,1	0,0	0,1	0,1	0,1

Duration Distribution (hh:mm)



Above 180	6:15	26%	5:30	23%	3:20	17%	2:45	12%	3:55	16%	4:20	18%	3:35	15%	29:40	18%
Within (70 - 180)	17:40	74%	18:05	75%	15:10	75%	18:30	85%	19:45	83%	19:00	79%	20:05	84%	128:15	79%
Below 70	0:00	0%	0:25	2%	1:35	8%	0:45	3%	0:20	1%	0:45	3%	0:20	1%	4:10	3%

Figure 2. Continuous glucose monitoring system report: After the addition of maltodextrin (it is noted that time in below range was 3 %, the ratio of below < 70 mg/dL)

Conclusion

The management of CHI requires a multidisciplinary approach. Hypoglycemia can persist, even after a near-total pancreatectomy, especially in patients with diffuse form and potassium channel mutations. Our case suggests that the addition of maltodextrin in the early pre-op or post-op period may shorten hospitalizations, prevent complications, and even protect the patient from the side effects of treatments. However, more case series or case-control studies are needed in order to determine the efficacy of maltodextrin supplementation in the management of infants with CHI.

Ethics

Informed Consent: The consent form was filled out by the parent.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: Yasemin Denkboy Öngen, Erdal Eren, Halil Sağlam, Concept: Yasemin Denkboy Öngen,

Design: Halil Sağlam, Data Collection or Processing: Yasemin Denkboy Öngen, Erdal Eren, Analysis or Interpretation: Erdal Eren, Literature Search: Yasemin Denkboy Öngen, Erdal Eren, Halil Sağlam, Writing: Yasemin Denkboy Öngen, Erdal Eren, Halil Sağlam.

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