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Continuous subcutaneous insulin infusion during total parenteral nutrition after gastroscopy complicated by duodenal intramural haematoma in a patient with type 1 diabetes – case repor

Insulinoterapia w żywieniu pozajelitowym u chłopca z cukrzycą typu 1 po gastroskopii powikłanej wystąpieniem krwiaka śródściennego dwunastnicy – opis przypadku

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Abstract
We present the course of the insulin therapy during total parenteral nutrition (TPN) after gastroscopy complicated by duodenal intramural haematoma, in a boy with type 1 diabetes treated with the insulin pump. There is a lack of guidelines regarding the insulin therapy during TPN in children. Additionally, duodenal intramural haematoma is a very rare complication of diagnostic gastroscopy. There are only few cases reported so far.
Key words
intramural haematoma, parenteral nutrition, insulin therapy, type 1 diabetes, insulin pump

Streszczenie
Przedstawiamy przebieg insulinoterapii w trakcie całkowitego żywienia parenteralnego zastosowanego u chłopca z cukrzycą typu 1, leczonego osobistą pompą insulinową (OPI), u którego doszło do powstania śródściennego krwiaka dwunastnicy (ŚKD) jako powikłania diagnostycznej gastroskopii. W dotychczasowych opracowaniach brak jest wytycznych co do terapii insuliną w żywieniu pozajelitowym u dzieci. Dodatkowo ŚKD to bardzo rzadkie powikłanie endoskopii górnego odcinka przewodu pokarmowego. Do tej pory opisano w literaturze nieliczne przypadki.
Słowa kluczowe
krwiak śródścienny, żywienie pozajelitowe, insulinoterapia, cukrzyca typu 1, pompa insulinowa

Case report – summary

We present the case of a 11-year old boy, diagnosed with type 1 diabetes (T1D) in June 2012, confirmed with positive diabetes – related autoantibodies: anti – GAD 1.22 U/ml (negative result< 0.9), IA2 27.9 (negative result< 0.75), ICA +++ ("-" for negative result), c – peptide 0,23 ng/ml (norm 1.06 – 3.53 ng/ml). He was treated with the continuous subcutaneous insulin infusion (CSII), with very good metabolic control of T1D (HbA1c 5.6%), and without any history of acute or chronic complications of T1D. Additionally, the patient was diagnosed with idiopathic neutropenia and chronic thrombocytopenia and for that reason he has been followed up by since 2013.

The patient was qualified for diagnostic gastroduodenoscopy when routine laboratory tests revealed positive antibodies characteristic for the celiac disease (IgA antibodies tTG-A, with an exclusion of IgA deficiency). Gastroscopy was performed in a standard way, with the biopsy of the duodenum performed under short intravenous general anaesthesia. The qualification for the intervention was performed by the anesthesiologist. The concentration of PLT and WBC close to the lower limit, was not a contraindication for the biopsy. There were no macroscopical changes revealed during the endoscopy. Shortly after the endoscopy, the patient was in good general condition. A few hours later he presented with acute upper and middle

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abdominal pain as well as vomiting. On physical examination we observed negative peritoneal sings. Abdominal ultrasound was performed. Based on the ultrasound image, we suspected a haematoma, thus we also conducted computer tomography (CT) of the abdomen with contrast. The CT imaging revealed a large duodenal intramural haematoma (12x 3.6x 12 cm). The results of CT imaging are shown in Figure 1.

After a consultation with a paediatric gastroenterologist, we decided to start total parenteral nutrition (TPN), which caused acute hyperglycaemia – above 200 mg/dL. Usually, the intravenous insulin therapy is used in acute conditions or TPN. In the case of our patient, we decided to sustain CSII. In accordance with the International Society for Pediatric and Adolescent Diabetes (ISPAD) reccommendations, we performed more frequent self-monitoring blood glucose (SMBG, more than 10 measurements per day), so we were able to keep glucose levels within the target range. Unfortunately, the patient developed yet another complication. He presented with fever and exacerbating general condition. Microbiological tests confirmed sepsis, due to Staphylococcus warneri (catheter – drawn culture). The boy was treated with broad-spectrum antibiotics – the initial empirical treatment with vancomycin and meropenem, and then due to lack of clinical effects, the therapy was modified to amicacine, metronidazol with piperacyline and tazobactam. Even during that general inflammatory condition, we managed to maintain a good glycaemic profile with subcutaneous insulin pump infusions only. This kind of insulin therapy is unique. The basal rate of insulin is extremely high because of TPN instead of standard meals. On the other hand, this was the optimum method in the context of the quality of life. The data both from the insulin pump software and from the blood glucose meter (Care Link Professional, Medtronic) are presented in Figure 2.

The duodenal haemangioma was controlled with daily ultrasounds and with magnetic resonance imaging (MRI). After 20 days, we observed a total evacuation of the haematoma, probably into the interior of the intestine.

Case report – analysis

The intramural duodenal hematoma is a very rare complication of gastroscopy. Its etiology is unknown, but the possible risk factors are: haematological coagulation disorders, specific anatomy of the duodenum and the biopsy technique. Haematological abnormalities constitute potential risk factors. Interestingly, on the day of the endoscopy, our patient had complete blood count values within normal limits. The intramural duodenal hematoma was reported for the first time in 1838. From that time only a few more cases have been reported, and most of them (60%) were observed in the paediatric population. Despite the fact that the most

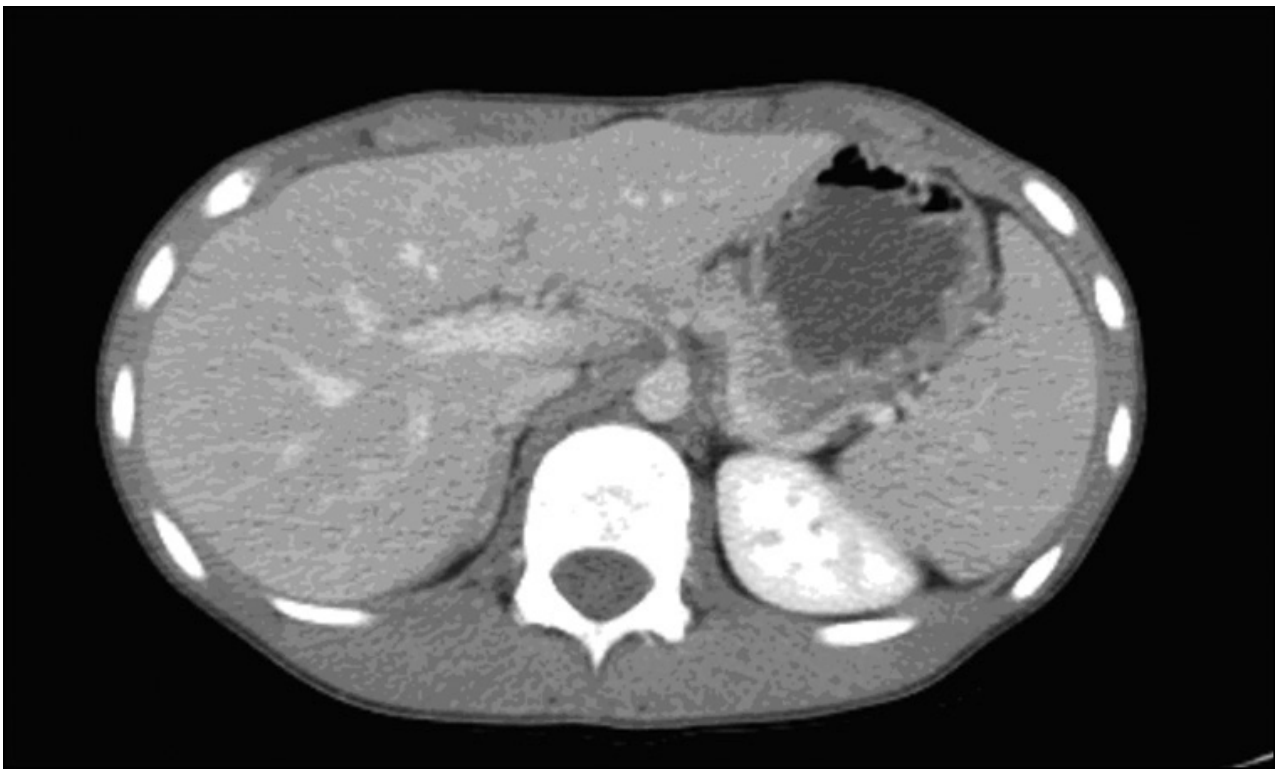

Fig. 1. CT imagining of duodenal haematoma.
Ryc. 1. *Obrazowanie krwiaka śródściennego dwunastnicy w badaniu TK*

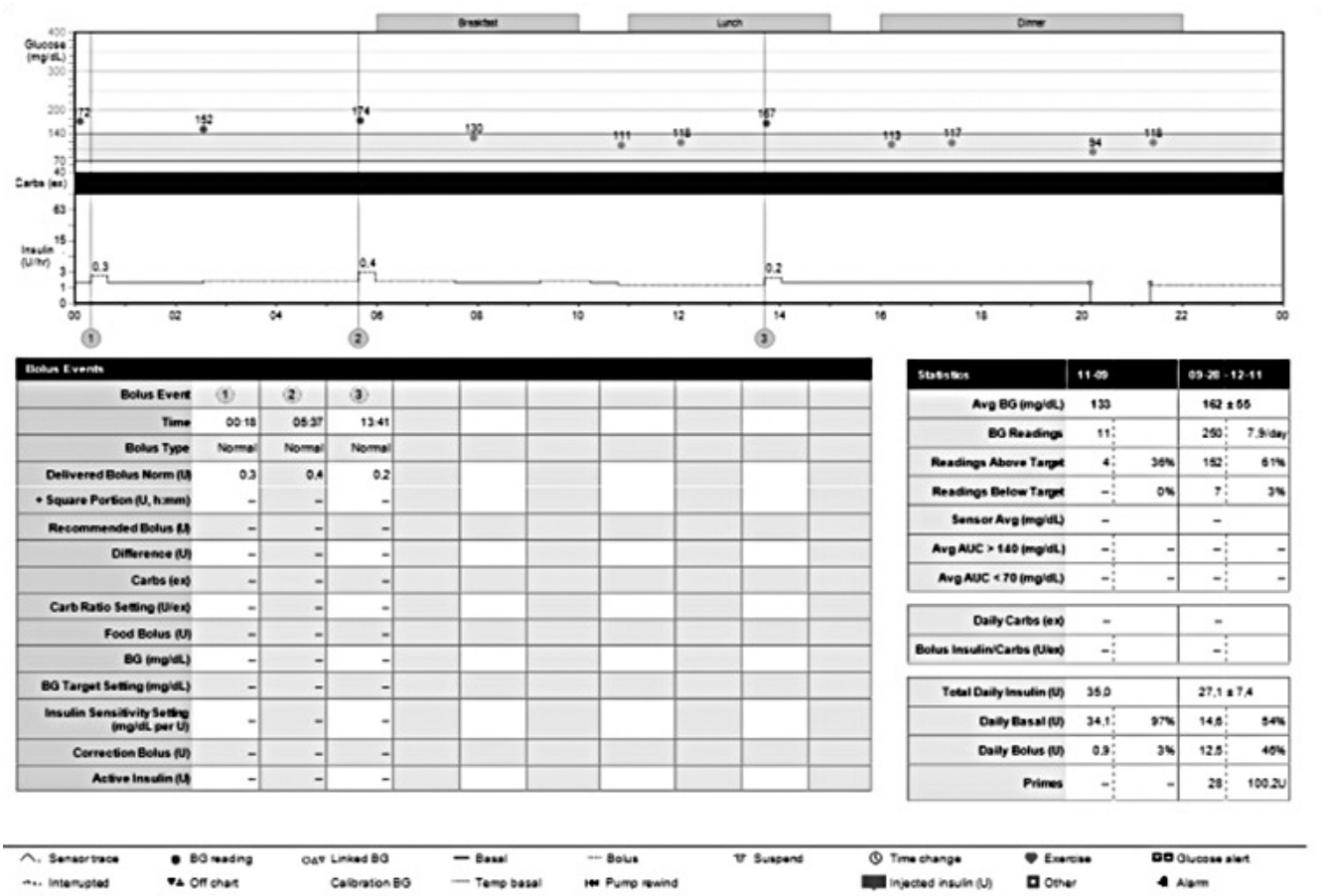

Fig. 2. Insulin therapy and blood glucose measurements during the total parenteral nutrition (TPN)
Ryc. 2. *Insulinoterapia i glikemia w czasie żywienia pozajelitowego*

common etiology of that type of hematoma is the injury of the abdomen, it is being more and more frequently described as an endoscopy-related complication. According to the Polish Diabetes Association (Polskie Towarzystwo Diabetologiczne, PTD) patients with T1D should undergo routine tests once a year, to early detect chronic complications of diabetes and/or additional diseases, most often Hashimoto disease or celiac disease (CD). CD is diagnosed based on the European Society for Paediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) guidelines. Summarised laboratory tests of our patient are presented in Table 1.

After the diagnosis of the haematoma we started TPN. Composition of TPN was standardised and it included carbohydrates, protein and fat mixture. TPN was composed daily, with mean amount of macroelements as follows: 8 g/kg/24hrs of glucose, 2g/kg/24hrs of aminoacids and 2 g/kg/24hrs of lipids. Total daily energy intake was about 58 kcal/kg and 49 kcal/kg came off the aminoacids. The most common way of the insulin therapy under parenteral nutrition are intravenous. However, there is some evidence showing that subcutaneous infusions are better. We decided to sustain CSII with the insulin pump therapy for the whole hospitalisation period. Before the endoscopy, an insulin dose in our patient was 0.7u/kg/24 hour and the basal rate comprised of 10% of total daily dose of insulin. Basal rates recommended in children treated with insulin pumps are between 20 and 40% of total daily dose of insulin (TDD). After the start of TPN insulin requirement increased rapidly. Because of the type of nutrition, we mainly modified the basal rate of insulin. The correction boluses were administered when despite of the increasing base, glucose levels were above 180 mg/dL. There are different target glucose levels during the TPN recommended in the studies so far. In general, the insulin therapy in acute conditions is well researched but there are no recommendations for the population with already existing T1D. There is also lack of research describing insulin treatment in children. Our empiric target range of glucose levels was 90–180 mg/dL. Below glycemia 90–100 mg/dl we stopped the insulin pump. During the treatment, total daily requirement of insulin in our patient was 70% greater than initially (1.2 u/kg/24 hours, 90% of the daily dose of insulin was dedicated for the base). In this case we had

Table I. Laboratory tests at the begining, durig and at the end of hospitalization
Tabela I. *Badania laboratoryjne na początku, w czasie i na końcu hospitalizacji*

	29.10.2013 (before gastroscopy)	31.10.2013 (during the treatment)	5.11.2013 (during the treatment)	22.11.2013 (at the end of the hospitalization)
WBC ($10^3/\mu L$)	3,6	15,7	1,6	3,2
PLT ($10^3/\mu L$)	87	135	47	130
CRP (mg/dl)	0,3	0,2	5,3	0,4
Procalcytonine (ng/ml)	1,62	-	-	1,37
Urea (mg/dl)	20,1	16,8	29,4	35
Creatinine (mg/dl)	0,4	0,3	0,4	0,3
Aspat (U/L)	15	65	52	50
Alat (U/L)	19	33	92	74
Amylase (U/L)	45	100	211	101
Lipase (U/L)	167	1022	693	282
Total bilirubine (mg/dl)	0,8	0,0	0,0	0,5
Albumine (g/dl)	3,7	3,8	3,2	3,4
APTT (sec)	30,7	-	-	31,5
INR	1,03	-	-	1,1

Table II. Comparison of insulin doses and BG levels before gastroscopy, during and after the treatment
Tabela II. *Porównanie dawek insuliny glikemii przed gastroskopią, w czasie i po leczeniu krwiaka*

	Before gastroscopy		During the treatement (total parenteral nutrition, TPN)		After the treatment (standard enteral nutrition)
Total daily dose of insulin (TDD) (u)	20,9	24,1	34,6	36,8	20
Percentage of prandial boluses in TTD (%)	88	90	12	6	76
Percentage of basal insulin in TDD (%)	12	10	88	94	24
Insulin requirement (u/kg)	0,65	0,7	1,05	1,2	0,7
Mean blood glucose values mg/dl (± SD)	112 (50)	151 (50)	199 (55)	169 (55)	125 (55)

at least two factors resulting in an increased insulin requirement. Apart from TPN, a general inflammation state generates raised BG levels, in the mechanism of higher concentrations of stress hormones, which promote gluconeogenesis and insulin resistance. The comparison of the insulin doses before and after the hematoma is presented in Table 2.

In the case of our patient, despite a large duodenal hematoma and sepsis, CSII was successfully used, resulting in target glucose levels. What is interesting, the frequency of self-monitoring blood glucose had to be more than 10 measurements per day to reach this target. To prevent hypoglycaemia we had to stop the insulin pump. Summary of SBGM and time of pump suspension is presented on Figure 3. In cases like this, with recurring hypoglycemia (2–3 events of hypoglycaemia, defined as glycemia < 70 mg/dl, per week and total time of pump suspension 19 hours per two weeks), the perfect solution would be using the integrated system of continuous glucose monitoring (CGM) and the insulin pump. It

is the newest commercially available system, where the pump reacts (stops insulin infusions) based on the trends of CGM, even before glycaemic levels reach hypoglycaemia.

Finally, on almost 30 consecutive days of observation, the overall condition of the patient improved. Enteral nutrition was conducted step by step. We also observed normal levels of inflammatory markers. Histopathological pictures did not confirm the celiac disease (reported as Marsh 0). After 3 weeks the boy was discharged from the hospital.

Conclusions

Despite the existing recommendation to use intravenous insulin injections in acute conditions or parenteral nutrition, it is possible to achieve target blood glucose levels using a subcutaneous insulin pump. The total daily dose of insulin can increase even by 70%. The optimum method to control blood glucose levels and to prevent hypoglycaemia is the use of the new system, with the CGM integrated with insulin pump.

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