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Diabetic Ketoacidosis Among Patients Treated With Continuous Subcutaneous Insulin Infusion

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In a Danish survey from the beginning of this millennium many Danish endocrinologists considered treatment with continuous subcutaneous insulin infusion (CSII) to be dangerous due to an increased risk of ketoacidosis and hypoglycaemia.[1]

In 2005 we resumed therapy with CSII in the outpatient diabetes clinic, Fredericia Hospital. Data from our patients treated with CSII have been stored in a clinical database.[2,3] Here we report data on the incidence and causes of diabetic ketoacidosis (DKA) in patients treated with CSII with a follow-up period of 10 years.

The database was established in 2009-2010. Data from 2005 to 2009 are retrospective, after 2009 prospective. Data were registered yearly in the database by the diabetes nurse.

All 205 patients treated with CSII during the years 2006-2015 were included in the database. Eight patients stopped CSII due to bad compliance and 6 patients stopped by their own choice. Sixteen patients moved away from the area. One patient died due to malignant disease. By the end of 2015, the database contained data on 174 patients treated with CSII. The median duration of CSII therapy was 5.6 years (range 0, 1-30 years) and the observation period 974 years.

The database was approved by the local authorities, but approval of local ethical committee was not relevant.

DKA was defined according to the American Diabetes Association diagnostic criteria.[4]

Only 10 cases of DKA occurred in 9 patients during the years 2006-2015 (Table 1) corresponding to a low incidence of 1.0 case/100 patient years.

In 7 cases kinking of the tubing and in 1 case leakage of insulin at the infusion site were contributing to development of DKA (Table 1).

The low incidence of ketoacidosis was probably explained by our focus on patient education.

Thus, all our patients are informed to change the infusion set in case of 2 consecutive high blood glucose measurements, and they receive telephone numbers on staff members to contact 24 hours per day in case of problems with the infusion set or with the pump, that they cannot solve themselves. However, despite focus on infusion set failures in the education programs, our findings show, that infusion set failures are still the most important factor in development of DKA in CSII users.[5]

One patient with tonsillitis and kinking of the tubing was readmitted to the hospital due to continued kinking of the tubing. The infusion set had not been checked during the first hospitalization. Before admission from hospital, patients with possible pump failures shall be seen by staff-members experienced in pump therapy.

In no case, failures of the pump contributed to DKA.

A learning curve probably exists to omit ketoacidosis, since the median time of development of ketoacidosis was 8 months, while the median duration of CSII was 5.6 years.[6]

In conclusion, treatment with CSII can be associated with a low incidence of DKA. Infusion set failures is still the most important reason to development of DKA and further

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Table 1. Patients Treated With CSII, Developing DKA.

Patient number	Age (years)	Sex	Duration of diabetes (years)	Duration of CSII therapy at DKA episode	Biochemical variables at hospital admission			Degree of DKA	Reason for development of DKA
					pH	BG (mmol/l)	HCO3- (mmol/l)		
1	26	F	14	4 months	7.22	23	10.8	Moderate	Psychiatric disease
2	52	M	50	5 months	7.40	30	16.1	Mild	Tubing kinked
3 a	36	M	21	8 months	7.08	>30	8.2	Severe	Tubing kinked + tonsillitis
3 b					7.17	31	21	Moderate	Tubing kinked
4	45	F	13	87 months	7,15	31	9.9	Severe	Tonsillitis
5	25	F	23	0.5 months	7.17	34	10	Moderate	Infusion needle leakage + gastroenteritis
6	41	F	6	30 months	7.23	19.6	12.5	Moderate	Tubing kinked
7	21	M	9	48 months	7.26	35.5	15.4	Mild	Tubing kinked
8	36	F	37	2 days	7.28	22.2	13.5	Moderate	Tubing kinked
9	32	F	19	60 months	7.35	23.2	16.3	Mild	Tubing kinked + knee operation

Mild DKA: pH 7.25-7.30, serum bicarbonate 15-18 mEq/l. Moderate DKA: pH 7.00-7.25, serum bicarbonate 10-15 mEq/l. Severe DKA: pH<7.00, serum bicarbonate < 10 mEq/l.

education to handle this problem should be included in the education programs.

Abbreviations

CSII, continuous subcutaneous insulin infusion; DKA, diabetic ketoacidosis.

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