

Recurrent ketosis after prolonged exercise in type 1 diabetes – the need for glycogen replacement strategies.

Case report

Mirjam van Albada ¹, Willie Bakker-van Waarde ¹

1. Department of Pediatric Endocrinology, Beatrix Children's Hospital
University Medical Center Groningen, The Netherlands

Topic: Diabetes Mellitus, Glycogen

Background:

In diabetic athletes, glycogen depletion can contribute to the early development of starvation ketones as is demonstrated by our patient.

Case presentation:

Our patient, a 15 year old male triathlete with type 1 diabetes for five years was referred to our tertiary center because of suboptimal regulation on continuous subcutaneous insulin infusion (CSII). He frequently awoke with nausea and ketosis, which was initially attributed to failure of insulin delivery. With optimisation of administration materials and initiation of concomitant subcutaneous injections of a long acting insulin analogue, morning ketosis persisted on a weekly basis.

After thorough examination of his insulin pump records, it stood out that ketosis developed when few carbohydrates were consumed after exercise. Rapid ketosis developed in the early morning hours when physical activity was resumed before breakfast.

Discussion:

To rule out other metabolic causes of ketosis, the patient was admitted. During the first day, he performed physical activity comparable to his normal activity level, took a last meal at 7h pm and fasted afterwards. The fasting would be stopped when ketones > 1 mmol/l developed or in case of complaints.

After 13 hours of fasting, ketone bodies developed in the presence of relatively normal glucose levels and normal fasting insulin levels. Serum acylcarnitines were normal and urine organic acids confirmed diabetic keto-acidosis.

Our working diagnosis was ketosis due to glycogen depletion, and 2 grams/kg corn starch late in the evening was added to his diet. Consecutively, no ketosis occurred.

	(Normal values)	8.00 AM	10.00 AM	11.00 AM
WITHOUT CORNSTARCH				
Glucose (mmol/l)		7,7	9,7	11,6
Ketones (mmol/l)	(<0,6)	0,6	0,8	1,1
Insulin (mU/l)	(fasting 4 – 25)	12	7,2	5,2
Acetoacetate (mmol/l)	(0,02-0,08)	0,08	0,19	0,24
Beta-hydroxy (mmol/l)	(0,00-0,42)	0,18	0,56	0,73
FFA (umol/l)	(0-600)	710	875	1013
WITH CORNSTARCH				
Glucose (mmol/l)		5,7	6,2	6,6
Ketones (mmol/l)	(<0,6)	0,1	0,0	0,0
Insulin (mU/l)	(fasting 4 – 25)	36,8	24	14,2
Acetoacetate (mmol/l)	(0,02-0,08)	0,01	0,01	0,01
Beta-hydroxybutyrate (mmol/l)	(0,00-0,42)	0,01	0,02	0,04
FFA (umol/l)	(0-600)	39	244	301

Table 1: Levels of glucose, ketones, insulin, ketone bodies and free fatty acids (FFA) during hospital admission on exercise days, without and with corn starch in the evening. Orange values are outside the hospital reference range.

Conclusion:

In diabetic athletes, glycogen depletion can contribute to the early development of starvation ketones as is demonstrated by our patient.

Therefore, glycogen replacement strategies need to be discussed with our diabetic athletes.

✉ m.e.van.albada@umcg.nl



University Medical Center Groningen

