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## **A case of a patient with type 1 diabetes mellitus and anorexia nervosa with changes to the central nervous system**

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### **Abstract:**

Co-occurrence of anorexia nervosa (AN) and diabetes mellitus type 1 (T1DM) is an uncommon disease combination in clinical practice. Treatment of T1DM may affect outcomes in AN patients due to self-modification of insulin dosage. In the presented case 14-year-old patient diagnosed with both T1DM and AN has been modifying her insulin-dependent treatment to prevent gaining weight. Undercontrolled glucose levels resulted in early-stage diabetic vascular complications in the central nervous system found in MRI. Due to higher T1DM morbidity of eating disorders patients, adjustments and special control of insulin treatment and blood glucose levels as well as HbA1c should be maintained in the prevention of diabetic complications, especially in individuals with lower treatment compliance. As AN may lead to structural changes and a decrease in cognitive functions, increased supervision of AN patients with T1DM can lower the risk of cumulative negative effects on the brain.

**Keywords:** eating disorders; anorexia nervosa; diabetes mellitus type 1; vasculogenic changes; MRI

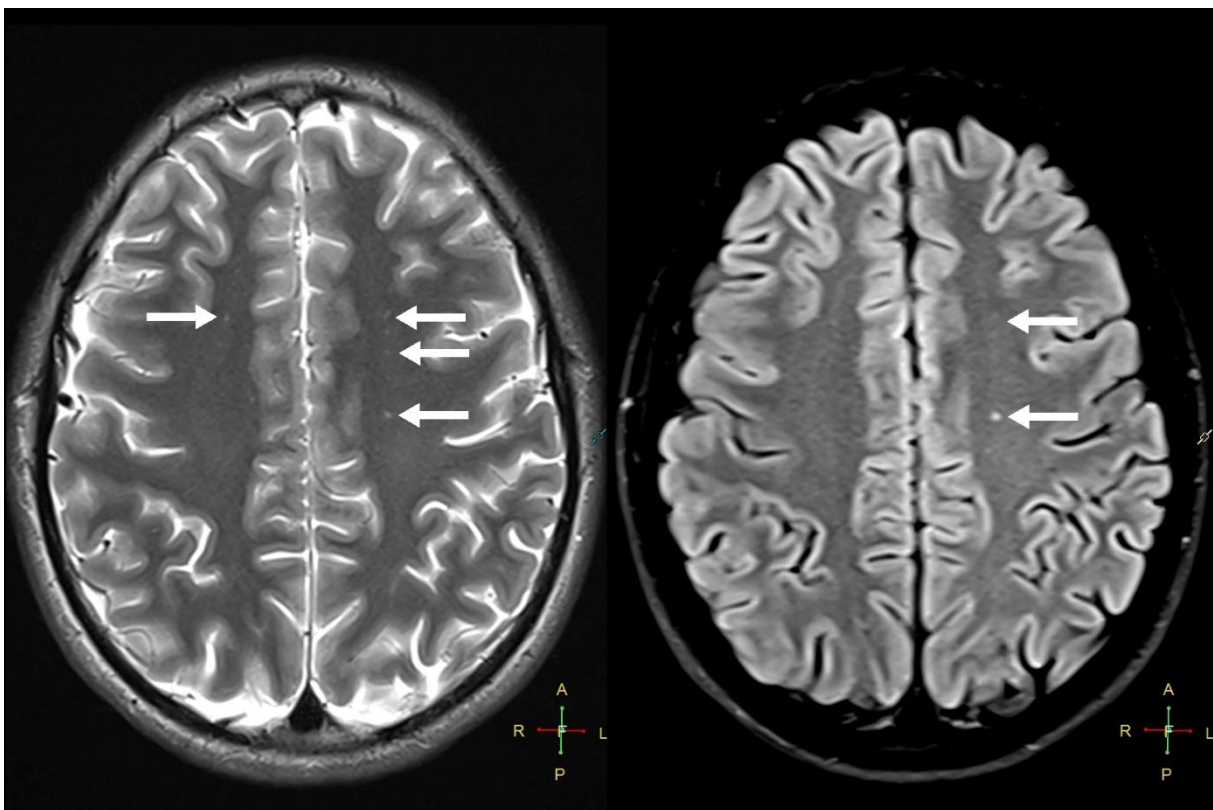
**Introduction:**

The frequency of eating disorders (ED) in type 1 diabetes mellitus (T1DM) patients (female) equals up to 10%, which is significantly higher than in the general population, which is at 4% [1]. Research suggests an influence of dietary restrictions in T1DM female patients from an early age, which increases the risk of ED development. Furthermore, one of the factors leading to weight gain can be insulin treatment, which is stated as primary therapy in T1DM [2,3]. At the beginning of the disease, T1DM patients present significant weight loss and when diagnosed, subsequent weight gain due to insulin treatment and the tendency towards higher body mass index [1,4]. An unintended, insulin-associated increase in body mass, may lead to dissatisfaction and an attempt at its reduction by restricting calorie intake and modification of set treatment [1,3,5,6]. ED-T1DM patients are at an increased risk of exhibiting early diabetic complications due to insulin underdosing as a purging behaviour to reduce or prevent body weight gain [1], among others cardiovascular, renal and complications affecting retina are the most common [7].

**Case report:**

During 03/2019, a 14-year-old patient was admitted to a developmental age psychiatry ward, diagnosed with anorexia nervosa (AN), as well as T1DM, treated with continuous subcutaneous insulin infusion (CSII) (insulin: Lispro Sanofi). She has been additionally diagnosed with Asperger's syndrome, obsessive-compulsive disorder and hypothyroidism. At admission, her BMI was 14.5 kg/m<sup>2</sup>, HbA1c: 7.1 (4.5-6.2) [%]. Due to the specificity of the ward, during her hospitalization period, in accordance with the diabetologist's recommendations, her treatment has been changed to multiple daily injections (MDI) (insulin: Lispro, Lantus). Due to the patient's incomppliance and refusal to meal consumption, multiple treatment corrections have been applied. The patient attempted to negotiate the volume of insulin administered and avoided taking it. She has been discharged from the ward with a BMI of 17.5 kg/m<sup>2</sup>. In line with the diabetologist's recommendations, after hospitalization, the treatment has been reverted to an insulin pump: 27.67 IU per day. The patient remained under the diabetologist's care, with mean glycaemic values: 137 ± 61 mg/dl, 42% above, 11% below target values, HbA1c: 7.2% (4.5-6.2) [%]. Due to severe body mass deficiency (BMI: 14.9 kg/m<sup>2</sup>), as well as glucose level fluctuations – HbA1c: 7.1%, another hospitalization was required during 04/2021 in a diabetologist department. The patient admitted insulin underdosing, to reduce hunger sensation. The patient's mother showed difficulty in the control of insulin administration.

Despite continuous, parental, and professional personnel supervision, the patient did not ingest the recommended food portions. Intense exercises led to a glycaemic decrease to 44 mg/dl. Due to causing insulin leakages at administration, multiple increases in glucose levels have been observed, up to 440 mg/dl. To investigate the complications of diabetes, MRI of the brain has been performed. The results showed vasculogenic changes in the posterior left side of the frontal lobe (Fig.1). Despite multiple psychiatric and diabetologist hospitalizations, a glycaemic value between the years 2021-2023 remained at a constant level of  $157 \pm 63$  mg/dl, HbA1c:  $7.8 \pm 0.3$  (4.5-6.2) [%]. In 11/2022, a month before the patient's 18th birthday, she was admitted to the pediatric diabetology ward for the last time, with a BMI of  $13.4 \text{ kg/m}^2$ , HbA1c: 7.7 (4.8-5.9) [%].



**Figure 1.** In the white matter of the semioval center of the left cerebral hemisphere, non-specific hyperintense changes are visible (arrows) in MRI T2-weighted sequences (left side of the figure) and MRI T2-FLAIR (right side of the figure).

The patient has been influenced by many unfavourable factors of T1DM and AN. An early onset of T1DM increases the risk of vascular complications, compared to patients diagnosed later in life [5]. On average, significant changes are observed 7 years after developing it. The most sensitive predictor of vascular changes is believed to be HbA1c, which in this patient was heightened in every test [8].

**Discussion:**

Inters of the combined effect of diabetes and anorexia nervosa on the brain is growing over time. Type 1 diabetes has its association with slight declines in cognitive functioning, where most marked decreases were observed in patients with diabetes onset in early childhood [9,10]. Although structural changes and their correlation with domain-wise cognitive z-scores or cognitive decrement progression, when tested in a group of patients with type 1 diabetes, in comparison to people without diabetes have not shown any statistically significant effect, the subgroups within T1DM patients with marked microvascular complications may show more distinct drop in cognitive functions [9,10,11]. Observed anomalies may affect both white or grey matter of the brain [10].

On the other hand, one of the most noticeable structural changes within the central nervous system that can be observed in anorexia nervosa is an acute reduction of brain tissue. Reduced brain volume and accompanied increase in cerebrospinal fluid (CSF) volume have been reported in other studies as an effect of starvation [12-19]. Cerebral magnetic resonance imaging (MRI) in the AN patients group showed a reduction of total gray matter and white matter volumes resulting in ventricular enlargement and sulcal widening [19,20]. On the functional side, the decrease in grey matter density in the brain has a negative effect on the emotional and cognitive perception of the disease [19].

In the case described, the changes observed in the MRI are most likely caused by the overlap of negative effects of both AN and T1DM. Underestimating the combined effect of both AN and T1DM may result in earlier and more significant structural rearrangements and cognitive decrees in those patients. Better control of insulin-dependent diabetes therapy, including glucose monitoring, HbA1c control and insulin dosage compliance may prevent microvascular changes within all T1DM patients but in co-morbidity cases with AN necessity for more frequent imaging monitoring or neurological assessment may be required.

**Disclosure:****Author's contribution:**

Conceptualization: Armand Bajaka

Methodology: Armand Bajaka

Software: Armand Bajaka

Check: Armand Bajaka

Formal Analysis: Armand Bajaka

Investigation: Armand Bajaka

Resources: Armand Bajaka

Data Curation: Armand Bajaka

Writing-Rough Preparation: Armand Bajaka

Writing-Review and Editing: Armand Bajaka

Visualization: Armand Bajaka

Supervision: Armand Bajaka

Project Administration: Armand Bajaka

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