Silent Danger: Euglycemic Ketoacidosis in Pregnancy and the Critical Role of Carbohydrate

Case Report

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Abstract—Introduction: Euglycemic diabetic ketoacidosis (EDKA) is an acute complication seen in insulin-deficient patients, occurring in only 2.6-3.2% of those with diabetic ketoacidosis (DKA). However, its incidence is significantly higher in pregnant diabetic patients, reaching up to 50% of DKA cases. These differences may be attributed to the specific characteristics of pregnancy, including increased counter-regulatory hormones, hyperketonemia, and limited nutritional intake. This case discusses the diagnosis, treatment, and frequency of this condition. **Case Report:** We present the case of a 37-year-old woman with type 1 diabetes, 33 weeks pregnant, who developed EDKA due to hyperemesis gravidarum. Metabolic acidosis was confirmed despite a serum glucose level of 175 mg/dL. Treatment included intravenous insulin, bicarbonate and appropriate intravenous glucose administration. Correct carbohydrate replenishment improved the patient's clinical condition, leading to stabilization. **Conclusions:** Prevention, early diagnosis, and proper treatment, including adequate carbohydrate management, are crucial to preventing complications for both the mother and the fetus. **Rev Med Clin 2025;9(2):e21072509015**

Keywords—Pregnancy, Type 1 diabetes, Insulin therapy, Metabolic acidosis, Carbohydrate

Resumen—Peligro Silencioso: Cetoacidosis Euglucémica en el Embarazo y el Papel Crítico de los Carbohidratos
Introducción: La cetoacidosis diabética euglucémica (CADE) es una complicación aguda que se observa en personas con deficiencia de insulina, presentándose solo en el 2.6-3.2% de quienes desarrollan cetoacidosis diabética (CAD). Sin embargo, su incidencia es significativamente mayor en pacientes gestantes con diabetes, alcanzando hasta el 50% de los casos de CAD en este grupo. Estas diferencias pueden atribuirse a características propias del embarazo, como el aumento de hormonas contrarreguladoras, hiperquetonemia y restricción de la ingesta nutricional. En este caso se aborda el diagnóstico, tratamiento y frecuencia de esta condición. **Reporte de caso:** Se presenta el caso de una mujer de 37 años con diabetes tipo 1, embarazada de 33 semanas, quien desarrolló CADE secundaria a hiperémesis gravídica. Se confirmó acidosis metabólica a pesar de una glucemia sérica de 175 mg/dL. El tratamiento incluyó infusión intravenosa de insulina, bicarbonato y administración adecuada de glucosa intravenosa. La correcta reposición de carbohidratos permitió la mejoría del estado clínico de la paciente, logrando la estabilización. **Conclusiones:** La prevención, el diagnóstico precoz y el tratamiento oportuno, incluyendo un manejo adecuado de carbohidratos, son fundamentales para evitar complicaciones tanto maternas como fetales. **Rev Med Clin 2025;9(2):e21072509015**

Palabras clave—Embarazo, Diabetes tipo I, Terapia de insulina, Acidosis metabólica, Carbohidrato

Introduction

Diabetic ketoacidosis (DKA) is an emergency marked by hyperglycemia, hyperketonemia, and metabolic acidosis, that usually happens in patients with insulin-dependent diabetes mellitus (DM), typically in type 1 diabetes.[1] The annual incidence is 4,6-8 episodes per 1,000 diabetic patients, with a mortality rate between 1% and 5%.[2] Euglycemic DKA (EDKA) differs from typical DKA in that glucose levels remain below 200 mg/dl in the presence of ketosis and metabolic acidosis (bicarbonate levels 10 mEq/l),[3] EDKA is less common, occurring in only 2.6%-3.2% of hospitalized DKA cases.[1,4,5] This is because the development of ketoacidosis without hyperglycaemia requires a situation that promotes hyperketonemia. Factors contributing to EDKA include treatment with SGLT2 inhibitors, low caloric intake, active alcoholism, and pregnancy.[6,7] Pregnancy is a risk factor for EDKA due to increased insulin resistance caused by elevated cortisol and placental lactogen levels, often accompanied by vomiting or fasting. Additionally, respiratory alkalosis during pregnancy, which leads to bicarbonate loss through urine, further predisposes to acidosis-[4,5,7,8]

DKA is rare during pregnancy, occurring in 1%-3% of diabetic pregnancies, typically in the second and third trimesters.[5,9] However, records show that up to 50% of DKA cases in pregnancy are euglycemic, contrasting with the lower prevalence of EDKA in the general diabetic population, as discussed above.[1] This discrepancy may be due to the specific metabolic conditions at the end of pregnancy, such as increased counter-regulatory hormones, hyperketonemia, and dietary limitations.[5] Furthermore, EDKA in pregnancy requires prompt diagnosis and treatment as it is associated with increased fetal mortality, ranging from 27% to 35%.[4,9]

This report presents a case of a type 1 diabetic patient under basal-bolus insulin therapy with good metabolic control, who developed EDKA in the third trimester of pregnancy due to a hyperemesis gravidarum. The report discusses the diagnosis, treatment, and incidence of EDKA.

Case Report

A 37-year-old woman, 33 weeks pregnant with type 1 diabetes, went to the emergency department with dyspnea, tachypnea, gastroesophageal reflux sensation, vomiting, and significant general deterioration.

The patient had type 1 diabetes since the age of 15, treated with basal-bolus insulin therapy (12 units of insulin Degludec and 8 units of Aspart) and was using flash glucose monitoring. Prior to pregnancy, she had excellent glycemic control with hemoglobin A1c (HbA1c) around 6%, without associated chronic complications.

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During pregnancy, her HbA1c was 6.6%, with 54% time in range (TIR: 63-140 mg/dl) (Figure 1). She was under close obstetric monitoring due to a large-for-gestational-age fetus, polyhydramnios, and fetal transposition of the great arteries.

Upon arrival at the emergency department, tests revealed the following: D-dimer 23194 ng/mL, activated partial thromboplastin time 21.8 s, lactate dehydrogenase 302 U/L, and venous blood gas (VBG) analysis showing metabolic acidosis with undetectable bicarbonate (HCO3) (pH 7.20, pCO2: undetectable, HCO3 undetectable, glucose 175 mg/dl, lactic acid 1.4 mmol/L) and positive urine ketones. These findings confirmed the presence of euglycemic diabetic ketoacidosis (EDKA). Chest X-ray and lower limb Doppler ultrasound were performed to rule out other urgent pathologies, both of which were normal.

Due to the diagnosis of EDKA treatment was initiated with intravenous insulin infusion (0.05 units/kg/h), bicarbonate, and electrolyte replacement with physiological saline solution. Following the initiation of treatment, the patient showed clinical improvement, with resolution of the general deterioration and tachypnea. However, oral intake remained limited because of the vomiting, and metabolic acidosis persisted (VBG: pH 7.33, pCO2 20.5 mmHg, HCO3 11 mmol/L), with positive urine ketones (+++).

Endocrinology was consulted, and it was decided to optimize glucose administration, suspending bicarbonate supplementation. Intravenous glucose was administered at a rate of 150 grams over 24 hours using 10% dextrose, and the patient was encouraged to maintain adequate carbohydrate intake, aiming for at least 150-175 grams per day. This approach led to the recovery of oral tolerance and normalization of blood gas parameters, allowing for the transition from intravenous to subcutaneous insulin therapy (15 units of Degludec and Aspart 1,5 units per ration).

During hospitalization, the patient maintained an average blood glucose level of 134 mg/dl, with a TIR of 60% and no significant hypoglycemic events. The resolution of the EDKA episode allowed a cesarean section at 37 weeks gestation with postpartum congenital cardiac pathology intervention of the baby, both of them happened without incident.

Obstetric care planned delivery at 37 weeks, with postpartum congenital cardiac pathology intervention. Post-hospital discharge, the patient was followed up in endocrinology consultations, where she demonstrated complete oral tolerance and good metabolic control, with a TIR of 71% (70-180 mg/dl), although hypoglycemia was noted in association with breastfeeding (Figure 2).

Discussion

As outlined in the 2024 Standards of Diabetes Care, achieving a TIR of 70% (63-140 mg/dl) during pregnancy is crucial,[10] Our patient maintained a TIR of 60% during pregnancy, it is unclear whether this may have contributed to the development of EDKA.

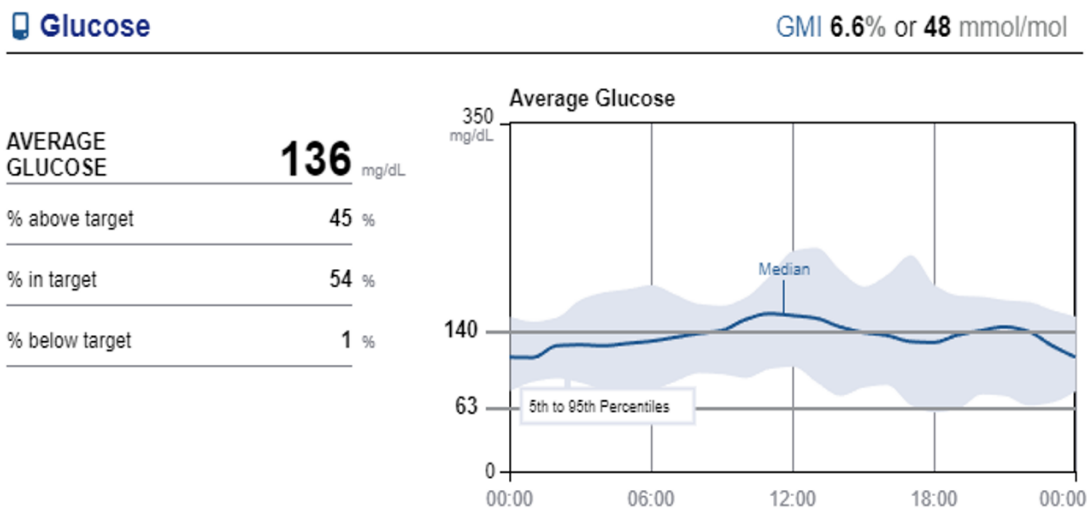

Figure 1: Glucose monitoring 15 days before hospitalisation, in the third trimestre of pregnancy.

DKA during pregnancy is a medical emergency that can result in fatal outcomes for both the fetus and the mother.[11] The rarity of DKA in pregnancy, with half of the cases presenting as EDKA or with minimal hyperglycemia, coupled with nonspecific initial symptoms (nausea or vomiting), may lead to underdiagnosis and limited therapeutic options for the patient.[9,12] In our case, the patient's general deterioration was initially attributed to hyperemesis, and the normoglycemia made it challenging to consider a blood gas analysis for DKA exclusion, delaying the diagnosis.

In general, DKA is uncommon during pregnancy, likely due to the stringent control required for a favorable pregnancy outcome. However, half of these cases are EDKA, according to the literature. We found 64 reported cases of EDKA in pregnancy, affecting both type 1 and type 2 diabetes, which were more frequently reported in type 2 diabetes.[1,9,11]

These data suggest that the prevalence and causes of EDKA during pregnancy differ from those in the general diabetic population. In the third trimester, a hyperketonemic state is common due to increased glucose absorption by the fetus and heightened maternal carbohydrate requirements. This necessitates an average intake of 150 grams of carbohydrates per day.[11,12] Additionally, the 60% increase in glomerular filtration rate leads to increased glucose excretion, and maternal estrogen and progesterone promote glucose degradation. These factors contribute to a hyperketonemic state, which, combined with limited oral intake, can lead to ketoacidosis.[9]

The clinical presentation of EDKA in pregnant patients is similar to that in the general population, according to the literature, with a higher risk of lower blood glucose levels, which can complicate the diagnosis. The main symptoms include gastrointestinal distress (nausea, vomiting) and general malaise.[11] Considering these peculiarities, treatment should not only include fluid resuscitation, potassium replacement, and intravenous insulin as established by various guidelines but also adequate glucose administration to limit ketogenesis. It is recommended to provide glucose to fulfil minimum daily carbohydrate requirements of 150-175 grams.[13] In our case, although the initial treatment improved the clinical picture, full resolution was not achieved until appropriate carbohydrate replacement was provided, initially intravenously and later orally.

Conclusions

Appropriate treatment of EDKA during pregnancy involves both metabolic control and adequate carbohydrate intake, which are crucial to avoiding the morbidity and mortality associated with this condition.

Additionally, it is essential to identify at-risk patients with vomiting, nausea, or limited oral intake who may have symptoms consistent with EDKA, as normal blood glucose levels do not exclude the presence of severe acute diabetic complications.

Finally, in terms of prevention, it is crucial to identify at-risk patients, provide adequate nutritional education to meet carbohydrate requirements, and implement effective diabetes education for early identification of acute complications.

Author Contributions

Dr Zambrano attended the patient, collected the patient's data and drafted the manuscript. Dr Piñar critically read the manuscript and contributed substantially to its revision. Dr Remón attended the patient, collected the patient's data, read the manuscript and contributed substantially to its revision.

Data availability statement

Data available on request from the authors.

Consent for publication

The patient has consented to the publication of this case report.

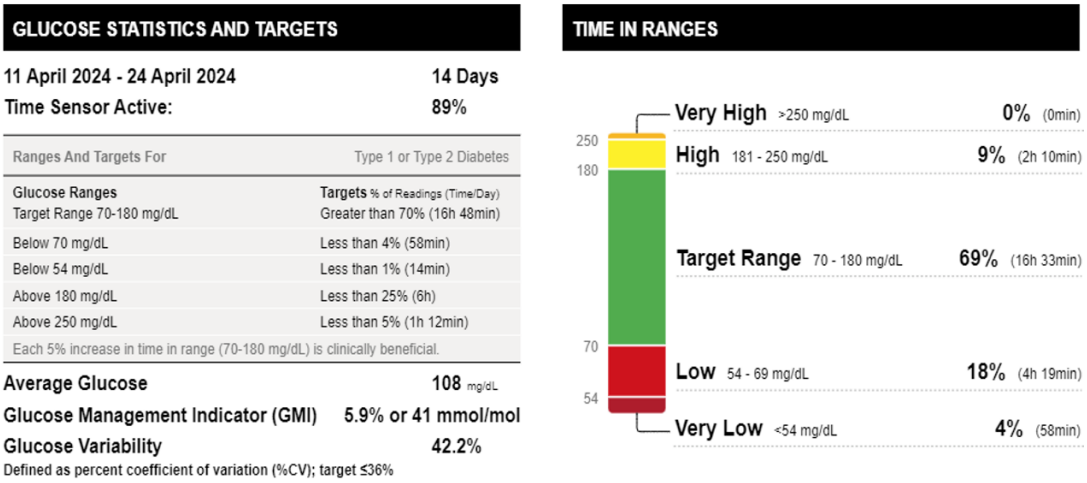

Figure 2: Glucose monitoring one month post hospitalisation.

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Conflicts of Interest

The authors declare no conflicts of interest.

Ethics approval and consent to participate

The patient has consented to participate in this case report.

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