



AN UNUSUAL CASE, SEVERE HYPERTRIGLYCERIDEMIA IN AN 11-YEAR-OLD GIRL WITH DIABETIC KETOACIDOSIS

Dr. Esraa M. Shatnawi*

(Pediatric Endocrinologist), Department of Pediatric, Jordan Ministry of Health, Princess Rahma Hospital, Irbid, Jordan.



***Corresponding Author: Dr. Esraa M. Shatnawi**

(Pediatric Endocrinologist), Department of Pediatric, Jordan Ministry of Health, Princess Rahma Hospital, Irbid, Jordan.

Article Received on 03/02/2024

Article Revised on 23/02/2024

Article Accepted on 14/03/2024

ABSTRACT

We present a case of a previously healthy 11-year-old girl who presented to the emergency department (ER) complaining of vomiting and mild abdominal pain for two days, preceded by polydipsia, polyuria, and weight loss over the previous 3 weeks. Initial laboratory parameters were consistent with DKA. Additionally, her blood appeared lipemic (milky-white) with an extremely elevated triglyceride level (11,000 mg/dL), indicating severe hypertriglyceridemia. However, the amylase level was normal, indicating that there was no concomitant pancreatitis. Insulin and intravenous (IV) fluid were the only interventions needed to successfully treat both conditions.

KEYWORDS: DKA, hypertriglyceridemia, children.

INTRODUCTION

Diabetic ketoacidosis (DKA) is an acute metabolic complication that occurs primarily in type 1 diabetes mellitus (T1DM)^[1] and has been reported in various studies as being the first presentation of childhood T1DM, with rates ranging from 15% to 67%.^[2]

Elevated TG levels are observed in 30% to 50% of cases.^[3] However, severe hypertriglyceridemia causing lipemia is an exceedingly rare complication in the pediatric population^[4] and can increase the risk of developing acute pancreatitis, especially when TG levels are higher than (1,000–1,772) mg/dL.^[5,6] Such hypertriglyceridemia is largely caused by insulin deficiency, which does so through a number of mechanisms such as promoting lipolysis and inhibiting lipoprotein lipase (LPL).^[7,8]

CASE REPORT

An 11-year-old girl presented to the ER complaining of mild abdominal pain and vomiting that had persisted for two days. A history revealed that she had been complaining of polyuria, polydipsia, and weight loss over the previous three weeks. Her family history was negative for both T1DM and hypertriglyceridemia. At the time of admission, her weight was 22 kg (0.1th centile), her height was 134 cm (10th centile), and her BMI was 12.3 kg/m² (0.1th centile). She was conscious and alert despite appearing extremely ill. Her initial vital

signs were as follows: respiratory rate of 22 breaths per minute, body temperature of 37°C, blood pressure of 80/55 mmHg, and a pulse rate of 100 beats per minute. During physical examination, there was a fruity acetone breath odor along with signs of dehydration. On the other hand, there was no sign of eruptive xanthoma, xanthoma, xanthelasma, or acanthosis nigricans. On abdominal examination, the abdomen was soft and lax with no hepatosplenomegaly, and the bowel sound was normoactive.

Following the patient's blood draw, which revealed a turbid and milky appearance that suggested a lipemic state, we requested a venous blood gas (VBG) and some laboratory tests to get the following results: pH (7.01), HCO₃⁻ (7 mmol/L), serum glucose (600 mg/dL), and TG (11,000 mg/dL). While the amylase level was within the normal range (40 U/L).

The lipemic state interfered with other biochemical blood tests. Additionally, a urine test revealed the presence of ketonuria (+3) and glucosuria (+4). In the intensive care unit, we began our treatment with the DKA protocol, which involves vigorous hydration with IV fluid and insulin. Continuous laboratory testing was conducted while the patient was being monitored, and the results showed that all prior readings gradually improved within 36 hours, becoming as follows: pH 7.35, HCO₃⁻ 16 mmol/L, TG 5757 mg/dL, and nil ketone in urine.

Following the resolution of DKA, several laboratory tests were performed, including HbA1C (13.3%), Anti-glutamic acid decarboxylase antibody (positive), thyroid function test (normal), and anti-tissue transglutaminase antibody (tTg-IgA)(negative). Based on these results, the patient started to be treated as a case of T1DM according

to basal bolus insulin regimen; with long acting insulin (Glargine) and rapid acting insulin (Aspart).

The TG level returned to the normal range after three weeks of follow-up. See [Table- 1].

Table 1: Follow-up TGlevel.

Time (days)	zero	2nd	3rd	4th	10th	20th
TG level (mg/dl)	11000	8237	4871.3	2912.2	1178	155

DISCUSSION

While severe hypertriglyceridemia is a rare consequence of DKA, particularly in children, there have been many cases documented in the literature with severity varying from asymptomatic to acute pancreatitis.^[9,10,11]

An important factor in raising TG levels is insulin deficiency, which in our study was indicated by an HbA1c level of 13.3. This is because insulin deficiency activates lipolysis in adipose tissue, increasing FFA and speeding up the formation of VLDL in the liver^[7]. It also reduces LPL activity in peripheral tissues, which lessens the removal of VLDL and chylomicrons from the plasma and ultimately leads to the development of hypertriglyceridemia.^[8] A co-existing genetic tendency to hypertriglyceridemia, particularly mutations in the chromosome 8-based LPL gene, may worsen the pathophysiology in cases of severe hypertriglyceridemia, which cannot be entirely explained by insulin insufficiency alone.^[12] Possible devastating consequences may follow, such as acute pancreatitis and lipidemia retinalis.^[8,13] Prolonged elevation of blood lipid levels to more than 2500 mg/dl is hypothesized to impact measured electrolytes, causing a subsequent drop of over 5%. Pseudohyponatremia and pseudonormoglycemia in DKA patients are two examples of this.^[14] Since hypertriglyceridemia associated with DKA is caused by insulin deficiency, it is managed effectively with conventional DKA treatment (that includes continuous insulin administration and IV fluid) as demonstrated in our case and many others, and the time it takes for TG levels to return to normal ranges from 3 to 17 days in most cases^[13], but it can take up to 6 months in others.^[8] However, some patients, particularly those with end-organ damage like renal failure, can require heparinization or plasmapheresis.^[15,16] Lipid-lowering medications, such as fibrates, are another recommended therapy, they are generally beneficial, except for people with LPL deficiency, since they function by activating LPL^[17], as well as omega oils that are recommended by both the National Lipid Association^[18] and the American Heart Association^[19] to be used as a TG-lowering drug in the management of severe HTG.

CONCLUSION

In summary, the underlying pathophysiology of diabetic ketoacidosis (DKA), insulin deficiency, and unique

patient features all play a role in the complicated phenomena of hypertriglyceridemia in DKA patients. To prevent complications linked to increased triglyceride levels, healthcare providers managing DKA cases must be aware of how these factors interact. This understanding will enable prompt interventions and enhance the overall care and outcomes.

REFERENCES

1. Kitabchi AE, Nyeu EA. Hyperglycemic crises in diabetes mellitus: diabetic ketoacidosis and hyperglycemic hyperosmolar state. *Endocrinol Metab Clin North Am.*, 2006; 35: 725–751. [PubMed] [Google Scholar]
2. Klingensmith GJ, Tamborlane WV, Wood J, Haller MJ, Silverstein J, Cengiz E, et al. Diabetic ketoacidosis at diabetes onset: still an all too common threat in youth. *J Pediatr*, 2013; 162(2): 330–4.e1. Epub 2012 Aug 15. [PubMed] [Google Scholar]
3. P. R. Blackett, J. H. Holcombe, P. Alaupovic, and J. D. Fesmire, "Plasma lipids and apolipoproteins in a 13-year-old boy with diabetic ketoacidosis and extreme hyperlipidemia," *The American Journal of the Medical Sciences*, 1986; 291(5): 342–346. Publisher Site | Google Scholar
4. Fick T, Jack J, Pyle-Eilola AL, Henry RK. Severe hypertriglyceridemia at new-onset type 1 diabetes mellitus. *J Pediatr Endocrinol Metab*, 2017; 30(8): 893–897. doi: 10.1515/jpem-20170008. [PubMed] [CrossRef] [Google Scholar]
5. Athyros V. G., Gioulema O. I., Nikolaidis N. L., et al. Long-term follow-up of patients with acute hypertriglyceridemia-induced pancreatitis. *Journal of Clinical Gastroenterology*, 2002; 34(4): 472–475. doi: 10.1097/00004836-200204000-00020. [PubMed] [CrossRef] [Google Scholar]
6. Sandhu S., Al-Sarraf A., Taraboanta C., Frohlich J., Francis G. A. Incidence of pancreatitis, secondary causes, and treatment of patients referred to a specialty lipid clinic with severe hypertriglyceridemia: a retrospective cohort study. *Lipids in Health and Disease*, 2011; 10: 157. doi: 10.1186/1476-511x-10-157. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
7. Sharma P. K., Kumar M., Yadav D. K. Severe hypertriglyceridemia causing pancreatitis in a child

- with new-onset type-i diabetes mellitus presenting with diabetic ketoacidosis. *Indian Journal of Critical Care Medicine*, 2017; 21(3): 176–178. doi: 10.4103/ijccm.IJCCM_281_16. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
8. Fulop M, Eder H. Severe hypertriglyceridemia in diabetic ketosis. *Am J Med Sci.*, 1990; 300: 361– 365. [PubMed] [Google Scholar]
 9. Zaher FZ, Boubagura I, Rafi S, Elmghari G, Elansari N. Diabetic Ketoacidosis Revealing a Severe Hypertriglyceridemia and Acute Pancreatitis in Type 1 Diabetes Mellitus. *Case Rep Endocrinol*, 2019; 2019: 8974619. [PubMed ID: 30723557]. [PubMed Central ID: PMC6339756]. <https://doi.org/10.1155/2019/8974619>.
 10. Vitale RJ, Laffel LMB. New-Onset Type 1 Diabetes in a Child With Diabetic Ketoacidosis and Severe Hypertriglyceridemia Without Pancreatitis. *JCEM Case Rep.*, 2023; 1(3): luad046. [PubMed ID: 37223066]. [PubMed Central ID: PMC10201541]. <https://doi.org/10.1210/jcemcr/luad046>.
 11. Skala-Zamorowska E, Kaminska H, Gawel W, Szarpak L, Mlynarski W, Jarosz-Chobot P. Severe hypertriglyceridemia in the course of ketoacidosis in a patient with newly diagnosed type 1 diabetes mellitus. *Disaster Emerg Med J.*, 2022; 7(1): 5862. <https://doi.org/10.5603/DEMJ.a2022.0008>.
 12. Fulop M., Eder H. A. Plasma triglycerides and cholesterol in diabetic ketosis. *JAMA Internal Medicine*, 1989; 149(9): 1997–2002. doi: 10.1001/archinte.1989.00390090063013. [PubMed] [CrossRef] [Google Scholar]
 13. Saengkaew T, Sahakitrungruang T, Wacharasindhu S, Supornsilchai V. DKA with severe hypertriglyceridemia and cerebral edema in an adolescent boy: a case study and review of the literature. *Case Rep Endocrinol*, 2016; 2016: 7515721. doi: 10.1155/2016/7515721. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
 14. Frier BM, Steer CR, Baird JD, Bloomfield S. Misleading plasma electrolytes in diabetic children with severe hyperlipidemia. *Arch Dis Child.*, 1980; 55: 771–775. [PMC free article] [PubMed] [Google Scholar]
 15. Lutfi R., Huang J., Wong H. R. Plasmapheresis to treat hypertriglyceridemia in a child with diabetic ketoacidosis and pancreatitis. *Pediatrics*, 2012; 129(1): e195–e198. doi: 10.1542/peds.20110217. [PubMed] [CrossRef] [Google Scholar]
 16. Cole R. P. Heparin treatment for severe hypertriglyceridemia in diabetic ketoacidosis. *JAMA Internal Medicine*, 2009; 169(15): 1439–1441. doi: 10.1001/archinternmed.2009.221. [PubMed] [CrossRef] [Google Scholar]
 17. Rahalkar A. R., Giffen F., Har B., et al. Novel LPL mutations associated with lipoprotein lipase deficiency: Two case reports and a literature review. *Canadian Journal of Physiology and Pharmacology*, 2009; 87(3): 151–160. doi: 10.1139/Y09005. [PubMed] [CrossRef] [Google Scholar]
 18. Jacobson T. A., Ito M. K., Maki K. C., et al. National Lipid Association recommendations for patient- centered management of dyslipidemia: Part 1 - Executive summary. *Journal of Clinical Lipidology*, 2014; 8(5): 473–488. doi: 10.1016/j.jacl.2014.07.007. [PubMed] [CrossRef] [Google Scholar]
 - 19- Miller M., Stone N. J., Ballantyne C., et al. Triglycerides and cardiovascular disease: a scientific statement from the American Heart Association. *Circulation*, 2011; 123(20): 2292–2333. doi: 10.1161/CIR.0b013e3182160726. [PubMed] [CrossRef] [Google Scholar]