Does Euglycemic Diabetic Ketoacidosis Contribute to the Risk of Postoperative Hemorrhage?

Rachael P Seddighzadeh, M.S., D.O.[1]; Gabrielle O'Dougherty, B.A. [2]; Jingjing Sherman, M.D.[3]; [1]
[1] Hackensack Meridian Health Palisades North Bergen, NJ 07047; [2]Hackensack Meridian School of Medicine Hackensack, NJ 07601; [3]Englewood Health Englewood, NJ 07631

INTRODUCTION:

Many patients undergoing bariatric surgery have diabetes mellitus (DM). Bariatric surgery, has been shown to induce disease remission, reducing mortality and macrovascular complications in DM more than medical management alone.[1,2,3] However, several precautions must be taken before operating on a diabetic patient, as there are increased surgical complication rates among diabetics. [4]

ADA recommendations for diabetics undergoing any operation: [5]

- Target glucose 100-180 mg/dL within 4 hours of surgery
- HbA1c <8%
- Discontinue SGLT-2 inhibitors 3-4 days before surgery
- Withhold metformin on the day of surgery
- Give 50% of NPH or 80% of long acting insulins like Lantus the day of surgery
- Monitor blood glucose every 2-4 hours while withholding food and/or fluids

Diabetic ketoacidosis (DKA) is typically characterized by hyperglycemia, metabolic acidosis, and ketonemia. However, DKA may occur in the absence of hyperglycemia in type 2 diabetics taking sodium-glucose cotransporter-2 (SGLT-2) inhibitors, due to increased urinary glucose excretion of glucose. Figure 1.

Additional factors associated with euglycemic DKA (eDKA) include dehydration and decreased caloric intake. Precipitants of SGLT-2 inhibitor-associated eDKA include surgery, a low carbohydrate diet, and insulin dose reduction.[6] Sometimes, the preparation for bariatric surgery includes a two week low carbohydrate, low calorie diet to reduce the size of the liver, and often requires insulin dose reduction. As such, the risk of eDKA in patients undergoing bariatric surgery is likely multifactorial.

Commonly recognized complications of DKA include hyperkalemia, shock, stroke, myocardial infarction, and thrombosis. [6,7] Several studies have documented the association between DKA and gastrointestinal bleeding, but none have looked at postoperative bleeding. [8]

CASE SUMMARY:

A 44-year-old male with a past medical history of long standing insulin-dependent DM, hypertension, hyperlipidemia, coronary artery disease status post cardiac stents, and obstructive sleep apnea, underwent laparoscopic sleeve gastrectomy. The initial surgery date was delayed until the preoperative HgA1C was below 8%, per the endocrinologist recommendation. The patient stopped taking insulin two days prior to surgery and took an SGLT-2 inhibitor the day before his operation, as he was instructed. Decision was made for sleeve over bypass considering the patient's long standing insulin dependent DM was less likely to resolve with gastric bypass.

VERTICAL SLEEVE GASTRECTOMY

*Uncomplicated case

*SBP raised to 140 mmHg to check for hemostasis

*Abdomen irrigated & staple line and ligated omenutm reassessed, noted without bleeding

*Uneventful extubation and PACU recovery

8 HRS POSTOP

*Tachycardic and hypotensive (HR 120 and SBP 90/60)

*Stat labs:
-Stable hemoglobin (12 from preoperative of 14)
-Anion gap 24
-B hydroxybuterate >5
-Bicarbonate 17
-Blood glucose 159
-pH 7.37

Suggestive of eDKA

ICU CARE

*Received intravenous Dextrose 5% in water and insulin drip

*Acidosis resolved

*However, tachycardia and hypotension persisted despite normal exam

*To rule out postoperative hemorrhage and PE, a CT was obtained demonstrating hemoperitoneum.

Figure 2.

RETURN TO THE OR

*Hematoma evacuation. Approx. 1L aspirated. 340cc given back via cellsaver. Figure 3.

*No active bleeding.

*Remainder of the postoperative course was uneventful, tachycardia resolved Anion gap resolved

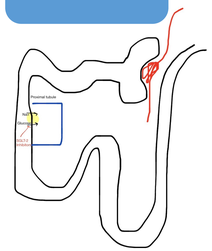


Figure 1: SGLT-2 inhibitor mechanism of action

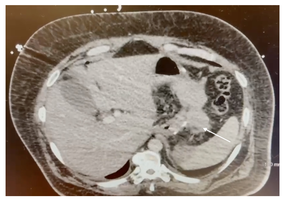


Figure 2: CT demonstrating hemoperitoneum along the sleeve gastrectomy staple line

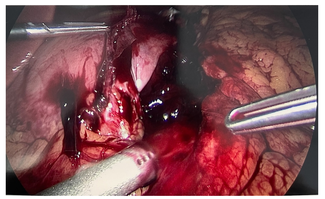


Figure 3: Intraoperative image of clotted blood & intact staple line from POD#1 diagnostic laparoscopy

DISCUSSION:

The development of eDKA in this patient was likely multifactorial: 1.His insulin regimen was discontinued entirely two days prior to surgery. 2. He underwent two weeks of a low carbohydrate, low calorie diet to reduce the size of his liver for increased visualization and safety during the surgery. 3. He took an SGLT-2 inhibitor the day before surgery. 4. He underwent the physical stressor of an operation. All of these factors are known precipitants of eDKA.

Postoperative bleeding in this patient was likely due to his acidotic state. DKA has a known association with increased risk of gastrointestinal bleeding. The pathophysiology of acidosis has been shown to impair platelet aggregation, increasing fibrinogen breakdown and impairing the coagulation cascade. We hypothesize that DKA may also contribute to postoperative hemorrhage, though other similar scenarios have yet to be documented.

While most oral DM medication should be held on the day of surgery, SGLT2 inhibitors should be held 4 days prior to surgery, per FDA 2022 recommendations. We hypothesize that it may even be helpful to hold the SGLT2 inhibitors four to seven days prior to initiating the pre-operative liquid diet in patients undergoing bariatric surgery. Moreover, it is important to weigh the risks and benefits of a liver shrinking diet in a population at high risk for DKA.

This case highlights the importance of recognizing DKA in a timely manner following bariatric surgery. Its presentation is similar to that of postoperative complications with symptoms of abdominal pain, tachycardia, nausea, making accurate and timely diagnosis difficult. Bariatric surgeons need to be aware of eDKA and how to manage SGLT2 inhibitors preoperatively.

REFERENCES:

1. Syn NL, Cummings DE, Wang LZ, Lin DJ, Zhao JJ, Loh M, Koh ZJ, Chew CA, Loo YE, Tai BC, Kim G, So JB, Kaplan LM, Dixon JB, Shabbir A. Association of metabolic-bariatric surgery with long-term survival in adults with and without diabetes: a one-stage meta-analysis of matched cohort and prospective controlled studies with 174 772 participants. *Lancet*. 2021 May 15;397(10287):1830-1841. doi: 10.1016/S0140-6736(21)00591-2. Epub 2021 May 6. PMID: 33965067.
2. Billeter AT, Eichel S, Scheurlen KM, Probst P, Kopf S, Müller-Stich BP. Meta-analysis of metabolic surgery versus medical treatment for macrovascular complications and mortality in patients with type 2 diabetes. *Surg Obes Relat Dis*. 2019 Jul;15(7):1197-1210. doi: 10.1016/j.soard.2019.04.029. Epub 2019 May 2. PMID: 31201113.
3. Sjöström L, Peltonen M, Jacobson P, Ahlin S, Andersson-Assarsson J, Anveden Å, Bouchard C, Carlsson B, Karason K, Lönroth H, Näslund I, Sjöström E, Taube M, Wedel H, Svensson PA, Sjöholm K, Carlsson LM. Association of bariatric surgery with long-term remission of type 2 diabetes and with microvascular and macrovascular complications. *JAMA*. 2014 Jun 11;311(22):2297-304. doi: 10.1001/jama.2014.5988. PMID: 24915261.
4. Robinson, P., et al. "Complications in Diabetic Patients after Isolated CABG Surgery—Analysis of Data from the ASCTS Database Program." *Heart, Lung and Circulation*, vol. 16, 2007, https://doi.org/10.1016/j.hlc.2007.02.073.
5. American Diabetes Association. Standards of Care in Diabetes - 2023. Diabetes Care. 2023 Jan 1;46(Supplement_1):S1-S291 PDF
6. Westerberg DP. Diabetic ketoacidosis: evaluation and treatment. Am Fam Physician. 2013 Mar 1;87(5):337-46
7. Badipatla, Kanthi Rekha, et al. "Predictors of Acute Gastrointestinal Bleeding in Diabetic Ketoacidosis: A Retrospective Observational Study in Minority Population." *Gastroenterology Report*, vol. 5, no. 4, 2017, pp. 293–297., https://doi.org/10.1093/gastro/gox006.

ENGLEWOOD HEALTH

Hackensack Meridian *Health*