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CASE REPORT

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Pre-bariatric surgery acute kidney injury: Can this be prevented?

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Key Clinical Message

Pre-bariatric surgery dietary recommendations should take into account daily protein intake and other risk factors for kidney injury. This is important because a high protein intake can potentially lead to kidney injury.

Abstract

Bariatric surgery has been shown to be a highly effective intervention for achieving weight loss and reducing obesity related-comorbidities. Acute kidney injury (AKI) is considered one of the common complications in perioperative and post-bariatric surgery. However, pre-bariatric surgery AKI has never been reported. Several studies demonstrated that pre-bariatric surgery weight loss improved surgical outcomes and decrease postoperative complications. Some diet regimens have been introduced including low-caloric diet (LCD), very-low caloric diet (VLCD), and very-low caloric ketogenic diet (VLCKD). We present a patient who develops AKI after 10 days of having a high-protein diet from a pre-bariatric weight loss strategy.

KEYWORDS

acute kidney injury, bariatric surgery, pre-bariatric surgery weight loss

1 | INTRODUCTION

Obesity is one of the strongest risk factors for early chronic kidney disease and premature death[1] with reported chronic inflammation and abnormal lipid metabolism causing kidney cell injury, glomerular hyperfiltration causing glomerulosclerosis, and renal lipotoxicity as a result of the intracellular accumulation of free fatty acids and triglycerides in glomerular and tubulointerstitial cells as a pathophysiology.[2] Over the past few decades, the increasing prevalence of morbid obesity and Type 2 diabetes has increased the number of bariatric surgery[3] which has been shown to be a more rapid, highly effective, and more durable intervention for achieving weight loss with a significant reduction of comorbidities such as diabetes mellitus Type 2, metabolic syndrome, hypertension, metabolic syndrome, non-alcoholic fatty liver disease, left ventricular hypertrophy, kidney disease including obesity-related nephropathy and diabetic kidney disease, and obstructive sleep apnea.[1] As of 2020, there were approximately 198,000 bariatric procedures (per 2020 numbers) performed each year in the US.[4]

Acute kidney injury (AKI) which is defined as a sudden drop in kidney function characterized by increased serum creatinine and/or reduced urine output can complicate the early postoperative course after bariatric surgery. The incidence is estimated to be 1%–5.8% which is mostly caused by dehydration and infections. The independent risk factors associated with post-bariatric surgery AKI are increased body mass index (BMI) and diabetes mellitus.[5,6] However, pre-bariatric surgery AKI has never been reported. Several studies demonstrated that pre-bariatric surgery weight loss improved surgical outcomes and decrease postoperative complications. It should be advised to all patients due to its benefits, especially in patients with a higher risk of operation. Therefore, calorie-restricted diets are usually recommended to those patients including a low-caloric diet (LCD), a very-low caloric diet (VLCD), and a very low-caloric ketogenic diet (VLCKD).[7] We present a patient who develops pre-bariatric surgery AKI after 10 days of having a high-protein diet for a pre-bariatric weight loss which has never reported.

2 | CASE DESCRIPTION

A 56-year-old male with a history of coronary artery disease, hypertension, poorly controlled diabetes mellitus Type 2, morbid obesity, and Stage 2 chronic kidney disease presented to the emergency room for an evaluation of AKI that was discovered from pre-bariatric surgery laboratory evaluation. The patient was instructed to drink only 16 ounces bottle of Premier Protein Shake four times a day (176 g of protein/day) as per VLCD protocol for 2 weeks before surgery along with adequate fluid intake. Preoperative laboratory tests after 10 days of taking VLCD showed an elevated serum blood urea nitrogen of 121 mg/dL and a rising in serum creatinine from 1.0 mg/dL (1.5 months prior) to 3.3 mg/dL. The patient was asymptomatic. He denied having fatigue, nausea, vomiting, dizziness, confusion, shortness of breath, facial or extremities edema, chest pain, and a recent infection. His urine output was normal and denied having hematuria or foamy urine. He denied taking nephrotoxic medications. Physical examination was remarkable for high BMI (39.5 kg/m^2). Other laboratory test results (Table 1) were remarkable for anion gap metabolic acidosis (anion gap 18 mEq/L, serum bicarbonate 11 mmol/L), and hemoglobin A1c of 8.6%. Urinalysis showed no evidence of infection, no proteinuria, and no cast. Chest X-ray and EKG were unremarkable. Non-contrast CT abdomen and pelvis revealed mild left-sided hydronephrosis without renal calculi. The fraction excretion of sodium (FENa) was 0.4% consistent with pre-renal AKI. The patient was started on intravenous fluid since admission. VLCD was discontinued given as a suspected etiology of AKI. Serum creatinine slowing came back to his baseline creatinine in 6 days (Figure 1). Kidney function remained stable 10 days later. He was recommended against having VLCD in the future prior to surgery. The operation was postponed for. He eventually underwent successful bariatric surgery 3 months later.

3 | DISCUSSION

Various pre-operative multidisciplinary assessment has been recommended to optimize patients before undergoing bariatric surgery with the goal to reduce surgical complications and improve surgical outcomes. Pre-bariatric weight loss via VLCD or VLCKD for 2–4 weeks is implemented as one of those methods. It is reported to have multiple benefits which include reducing liver size resulting in less operation hour and complexity during the operation, fewer surgical complication, and fewer conversion rate from laparoscopic to open surgery. Thus, it is required in some bariatric surgical program and even as a requirement for insurance coverage for some insurance companies.[8] However, the long-term benefit regarding resolution of comorbidities and long-term weight loss has not proved yet and the consensus of diet regimen has not been solidified.

VLCD is the diet regimen with limit the calories ranging between 400 and 800 kcal/day whereas VLCKD limit the maximum calories intake of 700 kcal/day. Currently there are two forms of diet available including normal foods with vitamin and mineral supplements and another form using balanced formulas in the liquid form of meal replacement. VLCKD characterized by the restriction of carbohydrates and fat intake with a slight increase in protein intake to induce a change in metabolism and plasma ketone generation. It contains proteins 1.4 g/kg, <20–30 g carbohydrates, and 15–20 g lipid whereas VLCD contains proteins 0.8–1.5 g/kg, carbohydrates 80 g, and lipids 15 g.[9] However, this might vary from study to study. It requires medical supervision because of the increased risk for medical complications including electrolyte imbalance and dehydration.[10]

In general population, the recommended daily allowance for protein intake is 0.83 g/kg/day. Even though, there is no consensus regarding the definition of a high-protein dietary intake, most thresholds ranging between 1.2 and 2.0 g/kg/day is consider high. Thus, daily protein intake recommended for VLCD and VLCKD is in high range. Even though, these two diet regimens seem promising for losing weight and management of obesity-related comorbidities, their potential risks and the long-term use have not well studied. There has been a concern regarding tolerance, side effects (nausea, vomiting, constipation, diarrhea, headache), serum sodium level, risk of acidosis

TABLE 1 Laboratory test results on admission day.

Investigation	Laboratory test results	Reference range
White blood cell (K/μL)	9.93	3.98–10.04
Hemoglobin (g/dL)	14.6	11.2–15.7
Hematocrit (%)	43.9	44.1–44.9
Platelet (K/μL)	286	182–369
Blood urea nitrogen (mg/dL)	121	6–20
Serum creatinine (mg/dL)	3.3	0.5–1.2
eGRF	57.31	–
Sodium (mmol/L)	128	136–145
Potassium (mmol/L)	4.9	3.5–5.1
Chloride (mmol/L)	98	97–107
Carbon dioxide (mmol/L)	11	20–30
Calcium (g/dL)	9.9	8.8–10.5
Magnesium (mg/dL)	2.1	1.6–2.4
Phosphorus (g/dL)	7.4	6.4–8.3
Anion gap (mmol/L)	18	4–12
Lactic acid (mmol/L)	1.0	0.5–2.2
Hemoglobin A1c (%)	8.6	4–6
Aspartate transaminase (intl units/L)	24	5–37
Alanine transaminase (intl units/L)	30	5–41
Total protein (g/dL)	6.6	6.4–8.3
Albumin (g/dL)	4.1	3.5–5.2
Serum osmolarity (mOsm/kg)	350	280–3
Urinalysis	Specific gravity 1.015. no WBC, RBC < 1, negative protein, negative nitrite and leukocyte esterase	–
Urine osmolarity (mOsm/kg)	520	300–1090
Urine creatinine (mg/dL)	159	40–278
Urine sodium (mmol/L)	25	28–272
Urine potassium (mmol/L)	5.8	12–129
Urine chloride (mmol/L)	<20	Negative

connected to ketones, micronutrient deficiency, and possible damaging kidney function.[11]

High protein dietary intake can worsen renal function in individuals with or without impaired kidney function due to several mechanisms.[12] It may lead to dilation of afferent arterioles, which results in intraglomerular pressure and glomerular hyperfiltration. It could damage glomerular structure causing compensatory increase of glomerular pressure in remaining glomerulus over time. Prolonged amino acids exposure might induce increment of afferent and decrement of efferent arteriolar resistances. The cumulative dose of amino acids overall stimulates renal arteriole vasodilation which consequently poses kidneys in an ischemic injury-prone condition.[13] Our patient developed AKI after 10 days of consuming protein 1.7 g/kg/day which can be predisposed by the underlying of chronic kidney disease.

However, the evidence regarding kidney effect of VLCD and VLCKD on normal kidney function is still lacking and conflicting. An observational study evaluating patients with obesity and mild kidney failure (eGFR between 60 and 89 mL/min) following 3 months of VLCKD showed no significant change of kidney function (creatinine and eGFR) and there was no difference compared to the normal kidney function patients. This study also reported the average weight loss was nearly 20% of initial weight with a significant reduction in fat mass.[14] Another systemic review of 548 patients taking VLCD ranging from 25 days to

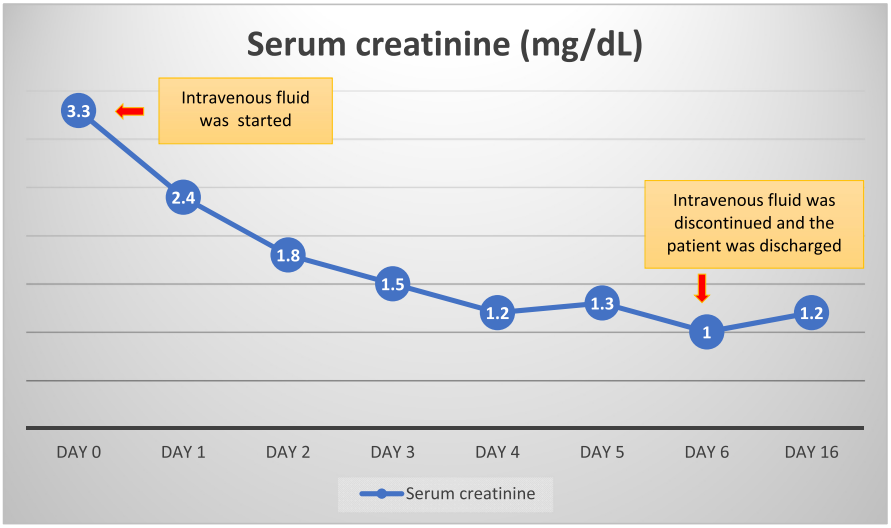

FIGURE 1 The changes of the serum creatinine level during the hospitalization.

9 months showed an improved creatinine, urea, and eGFR. However, this study was done in patients with normal kidney function. Furthermore, as a result of VLCD, the intake of creatine drops dramatically resulting in the drop of serum creatinine which may give a false interpretation of improve kidney function.[15] Recent study suggests that the impact of dietary protein on kidney function may depend on the protein source. Red meat can be harmful in a dose dependent manner whereas other protein sources such as poultry, fish, egg and dairies are safe and plant-based protein sources might even have a renoprotective effect.[16]

4 | CONCLUSION

To date, there is no consensus guideline for pre-operative diet protocols for pre-bariatric surgery weight loss. Thus, daily protein intake and other risk factors for kidney injury should be considered as part of pre-bariatric surgery dietary recommendations since high protein intake may induce kidney injury. Patients should also be advised to consume adequate amounts of water and increase their daily fiber intake along with recommended daily intake of essential vitamins, minerals, and trace elements. Further standardized research is required to fully assess the impact of pre-operative diet regimen.

AUTHOR CONTRIBUTIONS

Natnicha Leelaviwat: Conceptualization; project administration; writing – original draft; writing – review and editing. **Pitchaporn Yingchoncharoen:** Conceptualization; data curation; writing – original draft. **Jerapas Thongpiya:** Data curation; formal analysis; writing – original draft. **Mahmoud Abdelnabi:** Conceptualization; writing – review and editing. **Poemlarp Mekraksakit:** Conceptualization; writing – review and editing.

CONFLICT OF INTEREST STATEMENT

All the authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

CONSENT

Verbal and written consent was obtained from the patient to publish his case.

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REFERENCES

1. Bjornstad P, Nehus E, van Raalte D. Bariatric surgery and kidney disease outcomes in severely obese youth. *Semin Pediatr Surg*. 2020;29(1):150883.
2. Nehus E. Obesity and chronic kidney disease. *Curr Opin Pediatr*. 2018;30(2):241-246.
3. Bal BS, Finelli FC, Shope TR, Koch TR. Nutritional deficiencies after bariatric surgery. *Nat Rev Endocrinol*. 2012;8(9):544-556.
4. American Society for Metablolic and Bariatric Surgery. Estimate of bariatric surgery numbers, 2011–2020. 2022.
5. Abdullah HR, Tan TP, Vaez M, et al. Predictors of perioperative acute kidney injury in obese patients undergoing laparoscopic bariatric surgery: a single-centre retrospective cohort study. *Obes Surg*. 2016;26(7):1493-1499.
6. Weingarten TN, Gurrieri C, McCaffrey JM, et al. Acute kidney injury following bariatric surgery. *Obes Surg*. 2013;23(1):64-70.
7. Tabesh MR, Maleklou F, Ejtehadi F, Alizadeh Z. Nutrition, physical activity, and prescription of supplements in pre- and post-bariatric surgery patients: a practical guideline. *Obes Surg*. 2019;29(10):3385-3400.

8. Tan SYT, Loi PL, Lim CH, et al. Preoperative weight loss via very low caloric diet (VLCD) and its effect on outcomes after bariatric surgery. *Obes Surg*. 2020;30(6):2099-2107.
9. Albanese A, Prevedello L, Markovich M, Busetto L, Vettor R, Foletto M. Pre-operative very low calorie ketogenic diet (VLCKD) vs. very low calorie diet (VLCD): surgical impact. *Obes Surg*. 2019;29(1):292-296.
10. Blankenship JD, Wolfe BM. Dietary Management of Obesity. In: Buchwald H, Cowan GSM, Pories WJ, eds. *Surgical management of obesity*. W.B. Saunders; 2007:67-72.
11. Castellana M, Conte E, Cignarelli A, et al. Efficacy and safety of very low calorie ketogenic diet (VLCKD) in patients with overweight and obesity: a systematic review and meta-analysis. *Rev Endocr Metab Disord*. 2020;21(1):5-16.
12. Ko GJ, Rhee CM, Kalantar-Zadeh K, Joshi S. The effects of high-protein diets on kidney health and longevity. *J Am Soc Nephrol*. 2020;31(8):1667-1679.
13. Jhee JH, Kee YK, Park S, et al. High-protein diet with renal hyperfiltration is associated with rapid decline rate of renal function: a community-based prospective cohort study. *Nephrol Dial Transplant*. 2020;35(1):98-106.
14. Bruci A, Tuccinardi D, Tozzi R, et al. Very low-calorie ketogenic diet: a safe and effective tool for weight loss in patients with obesity and mild kidney failure. *Nutrients*. 2020;12(2).
15. Rolland C, Mavroeidi A, Johnston KL, Broom J. The effect of very low-calorie diets on renal and hepatic outcomes: a systematic review. *Diabetes Metab Syndr Obes*. 2013;6:393-401.
16. Lew QJ et al. Red meat intake and risk of ESRD. *J Am Soc Nephrol*. 2017;28(1):304-312.

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