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The Effect of Gastric Banding on Kidney Stone Disease

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Abstract

Objectives—To evaluate the likelihood of being diagnosed with, or treated for, an upper urinary tract calculus after gastric banding. Bariatric surgical procedures are being increasingly utilized in the treatment of patients with morbid obesity. Certain malabsorptive bariatric procedures have been associated with an increased risk for kidney stone formation. However, the kidney stone risk of gastric banding, a restrictive bariatric procedure, is unknown.

Methods—We identified 201 patients who underwent gastric banding and a control group of 201 obese patients who did not have bariatric surgery in a national private insurance claims database within a 5-year period from 2002-2006. All patients had at least 2 years of continuous claims data follow-up. Our 2 primary outcomes were the diagnosis and the surgical treatment of a urinary calculus.

Results—After gastric banding, the diagnosis of an upper urinary tract calculus occurred in 3 subjects (1.49%), as compared with 12 subjects (5.97%) in the comparison cohort ($P = .0179$). One subject in each cohort (0.50%) underwent a surgical procedure for the treatment of an upper urinary tract ($P = 1.0000$).

Conclusions—Gastric banding is not associated with an increased risk for kidney stone disease or kidney stone surgery in the postoperative period. Additional long-term studies are required to confirm these findings.

Recent epidemiologic evidence suggests that a maximum of 30% of American adults are obese (body mass index [BMI] >30).[1,2] The prevalence of obesity has been reported to be increasing at a great rate, and at present constitutes an important public health concern. Bariatric surgery is an effective intervention for patients with morbid obesity, as it can produce significant weight loss. As a consequence of the efficacy of bariatric surgery, the past decade has witnessed a 10-fold increase in these procedures.[3]

There are 2 commonly performed bariatric surgery procedures: Roux-en-Y gastric bypass (RYGB), which is the most commonly used procedure in the United States, and gastric banding, which is the most commonly used procedure in Australia and Europe.[4] RYGB induces many physiological changes as it brings about weight loss, and laboratory findings of patients after RYGB demonstrate an increased risk for kidney stone formation, occurring

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The dataset used in this current study was originally created for a different research project on patterns of obesity care within selected Blue Cross/Blue Shield (BCBS) plans. The previous research project (but not the current study) was funded by unrestricted research grants from Ethicon Endo-Surgery, Inc. (a Johnson & Johnson company); Pfizer, Inc.; and GlaxoSmithKline. The contents of the study are solely the responsibility of the authors and do not necessarily represent the official views of the NIH-NIDDK.

as soon as 6 months after the procedure.[5,6] Clinical series, too, have reported a greater than expected incidence of kidney stone disease in patients undergoing RYGB, again occurring soon after the procedure is performed.[7-10] Gastric banding has never been similarly investigated; the prevalence of kidney stone disease after this commonly used bariatric procedure is unknown. Therefore, we performed a study to measure the prevalence of kidney stone disease after modern gastric banding procedures.

Material and Methods

The data and in-kind database development support and guidance were provided by the Blue Cross and/or Blue Shield (BCBS) Association—BCBS of Tennessee, BCBS of Hawaii, BCBS of Michigan, BCBS of North Carolina, Highmark, Inc. (Pennsylvania), Independence Blue Cross (Pennsylvania), Wellmark BCBS of Iowa, and Wellmark BCBS of South Dakota. All individuals with one of these 7 plans as their primary insurer were eligible for inclusion in the dataset. The claims data used in this study were de-identified in accordance with the Health Insurance Portability and Accountability Act of 1996 definition of a limited dataset, and were used in accordance with federal standards for protecting confidentiality of the personal health information of the enrollee. The dataset includes approximately 2.4 million insured lives over a 5-year period (2002-2006) and information on enrollee age, sex, enrollment dates, and claims for reimbursement for billable health care services. Included in these data are patient diagnoses as identified by the International Classification of Diseases, Ninth Revision (ICD-9) codes and diagnosis-related groups, and medical procedures classified by current procedural terminology codes and ICD-9 procedure codes.

Patients undergoing a gastric restrictive procedure with 2 years of follow-up were selected for the treatment group. The codes used to define gastric banding are found in Appendix 1. BMI data were not available for the treatment group. A comparison of control group of obese patients meeting criteria for bariatric surgery was drawn from a subset of the database that had BMI data from the Health Risk Assessment, a medical history document that was either completed online or based on data collected after meeting the physicians. Control subjects with a BMI >35 and 2 continuous years of follow-up data were selected and assigned an index date of 7 months after the first month of enrollment to match the median interval between first enrollment and surgery in the treatment group. We excluded female subjects who were pregnant the year before, the year of, or the year after an obese BMI value from both the treatment and control groups. We also excluded any subject with a pre-existing renal disease diagnosis or those who had undergone treatment of an upper urinary tract calculus.

The 2 groups were matched using Proc. SurveySelect software (SAS Institute, 2003) on the basis of age (18-24, 25-34, 35-44, 45-54, 55-64, 65-74, and 75-84), gender, receipt of a diagnosis of diabetes or a prescription for an antihyperglycemic agent at any time before the date of surgery or index date, and presence of a diagnosis of hypertension or a claim for an antihypertensive medication within 6 months of the surgery and/or index date. One-to-one sampling with probability proportional to size was used.

The main dependent variable in this study was a stone removal procedure (shock wave lithotripsy, ureteroscopy, nephrolithotomy); a diagnosis of urinary calculi was also examined (and was an exclusion criterion if pre-existing). The codes used to define these procedures and conditions can be found in Appendix 2.

Simple χ^2 and Fisher exact test were performed. SAS version 9.13 was used for all analyses (SAS Institute, 2003).

Results

We identified 201 patients who had undergone a gastric banding procedure and met the criteria for the treatment group. The control group was appropriately matched in number as well as gender and age distribution (Table 1). Females outnumbered males (4.7:–1); the follow-up period was equivalent between groups (2.3 vs 2.2 years). The mean BMI for the control group was 40.3 (standard deviation 5.7). The diagnosis of an upper urinary tract calculus occurred in 3 subjects (1.49%) in the gastric banding group as compared with 12 subjects (5.97%) in the comparison cohort ($P = .0179$) (Table 2).

Further analysis demonstrated that 1 patient (0.50%) in each cohort underwent a urological procedure for the treatment of an upper urinary tract calculus in the 2 years after their surgery or assigned index date ($P = 1.0000$) (Table 2). The only surgical procedure performed was ureteroscopy; no patient underwent shock wave lithotripsy or nephrolithotomy.

Comment

RYGB, the most commonly performed bariatric procedure in the United States, achieves weight loss by 2 mechanisms: the gastric reservoir is surgically reduced, which restricts food intake, and the distal stomach, duodenum, and proximal jejunum are surgically bypassed, which limits nutrient absorption. Recently, RYGB has come under increasing scrutiny, as several groups have reported that patients subjected to this procedure may be at increased risk for kidney stone disease.[7-10] Asplin and Coe,[6] as well as Sinha et al,[8] have found that after RYGB patients develop hyperoxaluria and increased calcium oxalate urinary supersaturation. Such changes were found to occur as soon as 6 months after the RYGB procedure. Several clinical series have supported that patients who undergo RYGB may be at increased risk for kidney stone disease and oxalate nephropathy.[7-10] In many cases, such stone events occurred in <1 year after the RYGB procedure.

Similar to jejunoileal bypass, it is likely that the lithogenic effects of RYGB are a consequence of the bypass-induced malabsorptive component of the surgery.[11] As fat is malabsorbed, fat-soluble vitamins and calcium are saponified, leading to subsequent nutrient loss. Concomitantly, an increased oxalate load is delivered to the colon, as the calcium that would normally bind oxalate in the intestinal lumen is lost with the malabsorbed fat. Oxalate, which cannot be metabolized by human beings, is cleared by the kidney, resulting in hyperoxaluria and calcium oxalate nephrolithiasis.

Gastric banding has been proposed as a less invasive, less morbid, and potentially reversible alternative to RYGB; it places an inflatable tube around the stomach, just below the gastroesophageal junction, rather than surgical reconstruction of the gastrointestinal tract.[12,13] Gastric banding brings about weight loss by limiting the intake of food as a result of the restricted size of the stomach reservoir. As no bowel is bypassed in a banding procedure, there is no malabsorptive component either. The weight loss associated with gastric banding is significant, and has been reported to be equivalent to that achieved by RYGB.[12]

To date, and in contradistinction to the published data on RYGB, there has been no study of kidney stone risk factors in patients undergoing gastric banding for bariatric indications. As there is no malabsorptive component to the weight loss effects, 1 would not expect an enteric hyperoxaluria condition to manifest after a gastric banding procedure. However, there are other metabolic abnormalities that could still occur after gastric banding, which might promote stone formation. The limited capacity of the gastric reservoir may result in decreased fluid intake, ultimately resulting in a low urine volume, which is a known risk factor for kidney stone formation. Consumption of citrate-containing foods and beverages, as well as other nutrients and minerals such as calcium and magnesium, may also affect stone risk. These parameters may be adversely affected by the reduced stomach capacity. At present, Nadler et al[14] have provided the only report on gastric banding that describes a kidney stone event in the postoperative period: 1 patient with a symptomatic kidney stone was encountered in a series of 73 subjects.

In one sense, the present study is a negative one, in that it failed to demonstrate an increase in the prevalence of stone disease after gastric banding. However, in this clinical situation such negative data are particularly necessary. Obesity is an independent risk factor for kidney stone disease, and there have been several recent studies of RYGB suggesting that this procedure for the treatment of obesity is associated with an increased risk of kidney stone formation. Because kidney stones are a source of significant morbidity, the question of which bariatric surgical procedure, RYGB or gastric banding, may be most appropriate for the obese, kidney stone-forming patient remains an important one.

It is unclear why the diagnosis of stones was significantly higher among the control group. As obesity is an independent risk factor for stone disease, it may be that weight reduction during the 2-year study period after gastric banding decreased the surgical group's risk for developing stones. However, because of the nature of the dataset, BMI data were not available, so this hypothesis cannot be analyzed and no definitive conclusion on a relationship between weight reduction and kidney stone risk reduction may be inferred. Nonetheless, these unique data are hypothesis-generating, and should be the subject of further investigations.

Although our study represents a limited number of patients, it remains the only investigation of the effect of gastric banding on kidney stone disease. On the basis of these data, gastric banding should be more closely investigated in the stone-forming population. It would seem logical to view our present study as hypothesis-generating, and then to study the effect of gastric banding surgery on urinary stone risk parameters, which might characterize specific, and modifiable, abnormalities. Specifically, such metabolic studies will enhance our understanding of stone risk among subjects undergoing gastric banding, and may aid in answering the question of what is the preferred bariatric intervention for a patient with a history of kidney stone formation.

Our present study has several limitations that merit mention. In general, these limitations are inherent to the use of an administrative claims database. Erroneous and incomplete coding (ie, failing to list codes for all diagnoses relevant to a given admission) may limit our ability to capture all outcomes. However, we would expect that incomplete coding and coding errors would affect both groups equally. For the cohort of patients undergoing gastric banding, BMI data were not available. The BMI threshold of 35, to define the control cohort, was selected to adequately capture the morbidly obese; it should be noted that although this value does represent a morbidly obese BMI, it is possible that certain bariatric surgical centers rely on a higher threshold for bariatric surgery. Finally, longer term follow-up of this dataset, or other similar datasets, would be welcome, as our present period of observation was limited to 2 years.

Conclusions

Gastric banding is a commonly used bariatric surgical procedure, which is associated with significant and sustained weight loss. Until our present analysis, though, the effect of gastric banding on kidney stone disease has never been described. Although further studies, representing more patients with longer follow-up will be needed, our preliminary data suggest that gastric banding does not have an adverse effect on kidney stone risk in the postoperative period.

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Appendix

Appendix Table 1

Codes used to define gastric banding procedures

Current Procedural Terminology (CPT) Code	Procedure
43770	Laparoscopy, surgical, gastric restrictive procedure; placement of adjustable gastric band (gastric band and subcutaneous port components)
43842	Gastric restrictive procedure, without gastric bypass, for morbid obesity; vertical banded gastroplasty
43843	Gastric restrictive procedure, without gastric bypass, for morbid obesity; other than vertical banded gastroplasty

Appendix

Appendix Table 2

Codes used to define urology procedures and conditions

Indicator	Type of Code	Description
		Urologic Procedures
Shock wave lithotripsy	CPT code	50590 Lithotripsy, extracorporeal shock wave
		S0400 Global fee for extracorporeal shock wave lithotripsy treatment of kidney stone(s)
	ICD-9 procedure code	98.5 Extracorporeal shockwave lithotripsy (ESWL)
		98.51 Extracorporeal shockwave lithotripsy (ESWL) of the kidney, ureter and/or bladder
Ureteroscopy	CPT code	52352 Cystourethroscopy, with ureteroscopy and/or pyeloscopy; with removal or manipulation of calculus
		52353 Cystourethroscopy, with ureteroscopy and/or pyeloscopy; with lithotripsy
Nephrolithotomy (Percutaneous and open)	CPT code	50060 Nephrolithotomy; removal of calculus
		50065 Nephrolithotomy; secondary surgical operation for calculus
		50070 Nephrolithotomy; complicated by congenital kidney abnormality
		50075 Nephrolithotomy; removal of large staghorn calculus filling renal pelvis and calyces

Indicator	Type of Code	Description
		50080 Percutaneous nephrostolithotomy or pyelostolithotomy, up to 2 cm
		50081 Percutaneous nephrostolithotomy or pyelostolithotomy, over 2 cm
	ICD-9 procedure code	55.03 Nephrostomy
		Renal disease indicators
Urinary calculi	Diagnosis-related groups (DRGs)	323 Urinary stones with complication or comorbidity and/or ESW lithotripsy
		324 Urinary stones without complication or comorbidity
	ICD-9 diagnosis code	274.11 Uric acid nephrolithiasis
		592 Calculus of kidney and ureter
		592.0 Calculus of kidney – nephrolithiasis NOS
		592.1 Calculus of ureter
		592.9 Urinary calculus, unspecified

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Table 1

Demographic information for the gastric banding cohort (treatment) and the comparison cohort (control)

	Gastric Banding Group (n = 201)	Control Group (n = 201)
Mean age in years (Standard error)	46.3 (0.66)	46.5 (0.71)
Male/Female (%)	17.4/82.6	17.4/82.6
Median observation period in years (Standard error)	2.3 (0.06)	2.2 (0.04)
Total time studied in person-years (y)	458	451

Table 2

Summary of kidney stone diagnosis and procedures performed in the gastric banding cohort (treatment) and the comparison cohort (control)

	Gastric Banding Group N = 201	Control Group N = 201	*P*
Diagnosis of a urinary calculus	3 (1.49%)	12 (5.97%)	.0179
Surgical interventions			
Shock wave lithotripsy	0 (0.00%)	0 (0.00%)	—
Ureteroscopy, with or without lithotripsy	1 (0.50%)	1 (0.50%)	1*
Nephrolithotomy	0 (0.00%)	0 (0.00%)	—
Total surgical procedures	1 (0.49%)	1 (0.00%)	1*

*Fisher exact test.