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SURGERY FOR OBESITY AND RELATED DISEASES

Original article

Acute changes in renal function after laparoscopic gastric surgery for morbid obesity

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Abstract

Background: Acute renal failure (ARF) is a serious complication that contributes to patient morbidity and may result in death. To date, no data are available regarding the predictive risk of ARF or its effect on the outcome of patients who undergo laparoscopic gastric bypass.

Methods: The medical records of 1800 patients who underwent gastric bypass from July 1997 to July 2003 at a single institution were analyzed. The data collected included demographics, comorbid factors, operative details, and postoperative outcomes. Multivariant analysis was performed and the results were compared with those of 500 age-, gender-, and comorbidity-matched control patients who underwent similar operations.

Results: The mean age was 50 ± 8 years; 23 were men and 19 were women. Of the 1800 patients, 42 (2.3%) developed ARF after surgery. Dialysis was required in 6 patients, 2 of whom became dialysis dependent. ARF completely resolved in the remaining patients.

Conclusion: Primary ARF after laparoscopic gastric bypass is an uncommon complication, with an incidence of 2.3% in our institution. Patients with a body mass index >50, previous chronic renal failure, and long operating times and intraoperative hypotension are at the greatest risk of postoperative renal failure. All patients who had normal renal function preoperatively returned to normal renal function within 6 months.

Keywords: Laparoscopy; Morbid obesity; Bariatric surgery; Gastric bypass; Acute renal failure; Acute tubular necrosis

Surgery is currently the only proven effective treatment for obesity [1]. This approach to the treatment of obesity has grown exponentially with the advent of laparoscopic techniques [2]. However, the laparoscopic approach has potential complications that are unique to this approach. The use of gas insufflation is associated with decreased perfusion to the kidneys and can cause acute oliguria (acute renal failure [ARF]) [3–6]. Usually, this impairment is transient and without sequelae. However, this subtle renal injury may become clinically significant, particularly in patients with reduced renal function or other predisposing risk factors such as diabetes, elevated intraabdominal pressure, and hypertension [7].

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Currently, very limited knowledge is available about the physiologic effect of laparoscopy in patients with morbid obesity. The aim of this single-institutional experience was to study and identify our incidence of renal failure after laparoscopic bariatric surgery; identify the associated risk factors contributing to this complication; and suggest any preventive measures to avoid this complication.

Methods

This study was performed at the University of Pittsburgh Medical Center and was approved by the University of Pittsburgh Institutional Review Board. The study was also recognized as being compliant with Health Insurance Portability and Accountability Act (HIPAA) regulations. A retrospective analysis of 1800 consecutive laparoscopic operation performed for morbid obesity from July 1997 to August 2003 was done.

All information was collected from an electronic database and by medical chart review. Preoperative renal function was assessed by measuring the baseline serum creatinine level and a thorough history and physical examination. Postoperative renal function was assessed by measuring serum creatinine on the first postoperative day, and the daily urinary output was recorded throughout the patient's hospital stay. ARF was defined as a rise in serum creatinine >1.4 mg/dL at any time during the stay with an increase of serum creatinine of >0.3 mg/dL from the baseline value during the first postoperative week. Patients were excluded from the study if they had undergone an open bariatric procedure or developed renal failure as a component of multiorgan failure or secondary to injection of intravenous contrast.

The data collected included age, gender, height, weight, body mass index (BMI), comorbidities, history of renal dysfunction, and a list of all current medications. The operative data included procedure type, operation time, amount of intravenous fluids administered during surgery, perioperative blood transfusion, incidence and duration of intraoperative hypotension, and total intraoperative urine output. Intraoperative hypotension was defined as systolic blood pressure <100 mm Hg for >5 minutes.

The postoperative data collected included urine output, use of nephrotoxic medications, blood transfusions, use of intravenous contrast, and measurement of serum creatinine levels. Therapy for renal failure included fluid resuscitation and dialysis. Follow-up was available for all study patients to 6 months.

We performed a nested case-control study. The control group consisted of 500 randomly selected patients from our database of 1800. The data sets collected were similar to the study group. Data are expressed as mean ± standard deviation. Comparisons of the variable data were considered using Student's t test and analysis of variables, as needed. We performed a logistic regression analysis. Variables were included if $P < 0.01$.

Table 1
Patient demographics

Factor	ARF Group (n = 42)	Control Group (n = 1800)	P Value	Power
Age (y)	50.9 ± 8.7	42.3 + 9.2	<0.0001	1
Gender (%)				
Female	45	81	<0.001	1
Male	55	19	<0.001	
Weight (kg)	362 ± 80	295 ± 56	<0.001	*
BMI (kg/m^2)	56 ± 9.3	48 ± 8.9	<0.001	1
Hypertension (%)	96	56	<0.001	1
Sleep apnea (%)	70	42	<0.001	.9
Diabetes mellitus (%)	52	21	<0.001	1
Peripheral edema (%)	50	27	<0.002	.85
History of renal insufficiency (%)	31	1.8	<0.001	1
OR time (min)	271 ± 93	222 + 62	<0.001	1

ARF = acute renal failure; BMI = body mass index; OR = operating room.

Table 2
Comparison of operating room factors

Factor	ARF Group (n = 42)	Control Group (n = 1800)	P Value	Power
Intraverous fluids (mL)	2552 ± 848	2689 ± 812	0.419	0.05
Urine output (mL)	344 ± 459	285 ± 221	0.386	0.05
OR time (min)	271 ± 93	222 ± 62	<0.01	1

Abbreviations as in Table 1

Results

During the study period, 1800 patients underwent laparoscopic bariatric surgery. The age, weight, BMI, and comorbidities are listed in Table 1 for both groups.

Of the 1800 patients, 52 (2.8%) developed postoperative ARF. Ten patients with renal failure were excluded from the study. Of these, 8 patients (0.4%) developed renal failure as a component of multiorgan failure, and 2 patients (0.1%) developed renal failure after receiving intravenous contrast for a radiologic procedure. The remaining 42 patients (2.3%) of the total 1800 were included in the analysis. Of these 42 patients, 37 underwent laparoscopic Roux-en-Y gastric bypass, 4 underwent sleeve gastrectomy, and 1 underwent a laparoscopic banding procedure.

For the patients with primary renal failure, their age, BMI, operating room time, episodes of intraoperative hypotension, and comorbidity profile were significantly different from those of our control group (Table 1). Of the 42 patients with ARF, 13 (31%) had preoperative renal insufficiency with a basal serum creatinine >1.4 mg/dL. The average intraoperative fluid administration and urinary out-

The foremost criticism of this study would be its retrospective nature and that was from a single institution. However, this is the first report to detail the changes in renal function in the bariatric population undergoing laparoscopic surgery. The second limitation was the use of creatinine levels rather than an estimation of GFR. Although the GFR is the most accurate method, it is also impractical in retrospective reviews. What is most important to know in the patient with renal disease is whether the GFR (and therefore the disease severity) is changing or is stable. This can usually be determined by monitoring the plasma creatinine concentration alone. A rise in plasma creatinine almost always represents a reduction in GFR, with the exception of certain drugs that interfere with the creatinine assay or secretion or conditions such as rhabdomyolysis [12].

We selected ≥1.5 mg/dL as the cutoff for renal failure (normal range in men 0.8–1.3). To exclude those patient with preexisting renal insufficiency (basel serum creatinine >1.5 mg/dL) but did not develop ATN, we added the additional criterion of a rise in creatinine by >0.3 mg/dL from the basal level to define ARF. This definition has been used before; however, no clear consensus has been reached as to what laboratory values constitute renal failure [12]. The criticism that our definition of renal failure was not stringent enough is valid, but we elected to use this one because of its recent use in broad-based population studies [13,14]. The remaining intraoperative factors we studied, including fluid resuscitation and urine output, had no effect on postoperative ATN (Table 1).

Although we had an incidence of primary renal failure of 2.3% in our series, most of these patients had a favorable outcome. Fifty percent of the patients who developed ATN had normal urine output. Thirty-six patients with ATN (86%) did not required hemodialysis and responded well to fluids and/or diuretics. Only 6 patients (14%) had elevated creatinine at discharge. Of the 6 patients (14%) who required hemodialysis, only 2 (5%) progressed to end-stage renal failure requiring long-term dialysis. Both of these patients had preoperative renal insufficiency. Thus, all patients with normal kidney function preoperatively returned to normal kidney function within 6 months postoperatively.

Conclusion

The incidence of primary renal failure at our institution after laparoscopic bariatric surgery was 2.3%. This could possibly be much lower for bariatric surgeons in general because the University of Pittsburgh is a tertiary referral center, and our patients could be much sicker on average than those at other institutions. The risk factors associated with the occurrence of renal failure included gender, age, BMI >50 kg/m^2, diabetes, hypertension, peripheral edema, intraoperative hypotension, operating time >210 minutes, and the existence of preoperative renal insufficiency. Of the nine risk factors (Table 3), preoperative renal insufficiency placed patients at the greatest risk. Surgeons could potentially reduce the incidence of renal failure by decreasing the operating time and working with the anesthesiologist to reduce the incidence of intraoperative hypotension. All patients with normal kidney function preoperatively, who develop ATN, can be expected to recover completely.

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