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**Reduced Postoperative Pain and Complications after a Modified Multidisciplinary Approach for Bariatric Surgery**

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## Abstract

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**Background:** There are considerable implications for pain management in morbidly obese patients undergoing weight loss operations. The purpose of this study was to determine if a modified postoperative analgesic regimen and a dedicated postoperative bariatric team reduced pain scores, length of stay and postoperative complications.

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**Materials and Methods:** We performed a retrospective analysis of morbidly obese patients admitted to our medical center for laparoscopic Roux-en-Y gastric bypass (LRYGB) and laparoscopic adjustable gastric banding (LAGB). Our previous postoperative pain regimen was ketorolac (30 mg IV plus 15 mg q6h) and patient controlled analgesia (PCA) morphine and was converted to ketorolac (30 mg IV and 30 mg i.m, plus 15 mg q6h), and IV PCA hydromorphone.

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Visual analog scale (VAS) pain scores from the post-operative care unit were collected retrospectively. The bariatric team was led by a nurse practitioner consisted of a psychologist, exercise physiologist, and nutritionist.

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**Results:** Eighty-five patients underwent bariatric operations in the year prior to implementation of the revised postoperative pain management regimen and 372 patients underwent bariatric surgery in the 2 years following implementation. Patient age, gender and BMI were evenly distributed for both groups. Mean VAS scores on postoperative days 1 through 5 were significantly lower after implanting our modified pain regimen ( $p < 0.0001$ ). Pain scores were significantly higher for patients that underwent LRYGB compared to LAGB ( $p < 0.0001$ ).

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Overall, length of hospital stay was unaffected by the new pain regimen, however a significant reduction was found in patients that underwent LAGB (0.8 days less;  $p = 0.0001$ ).

**Conclusion:** Use of our modified pain regimen resulted in a more effective analgesic protocol and a reduction of hospital stay, without added complications or side effects.

**Key Words:** analgesia; gastric banding; gastric bypass; hydromorphone; ketorolac; laparoscopic; Obesity; Roux-en-Y

70 **Introduction**

The prevalence of clinically severe obesity is increasing at a fast rate among adults in the United States. [1] As a result, the number of bariatric surgical procedures has also increased. [2-4] The implications for anesthetic and perioperative care of severely obese patients are  
75 considerable, and are believed to escalate in the presence of co-morbidities [5-6]. Postoperative pain management strategies for obesity surgery should focus on adequate pain relief while mitigating the risk of complications, such as respiratory depression, ileus, and reduced intestinal mobility.

As part of our performance measures for Joint Commission on Accreditation of  
80 Healthcare Organizations (JCAHO) disease-specific accreditation, we monitor and report pain relief during hospitalization for bariatric surgery. Upon review, our visual analog scores (VAS) were high, therefore we modified our postoperative pain management protocol in 2008 to include more acceptable analgesic orders and a dedicated interdisciplinary bariatric team.

The primary objective of our study was to assess if implementation of the modified  
85 postoperative analgesia protocol reduced pain scores, length of stay, or post-operative complications in patients undergoing laparoscopic Roux-en-Y gastric bypass (LRYGB) and laparoscopic adjustable gastric banding (LAGB).

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## Methods

This before and after concurrence study was approved by the University of South Florida institutional review board (IRB). A retrospective analysis of data from the medical records of 85  
100 patients admitted to our medical center for bariatric surgery between January 2006 and January 2007 and 372 patients admitted between January 2008 and January 2010 was completed. Patients admitted between 2008 and 2010 were given a modified postoperative pain regimen. We also implemented an interdisciplinary bariatric team in 2008, directed by an Advanced Registered Nurse Practitioner, comprising of a dedicated bariatric psychologist, exercise physiologist and a  
105 bariatric nutritionist [7]. The main outcome of the study was post-operative pain up to five days postoperatively.

Our clinical database was used to select patients with procedure codes for laparoscopic Roux-en Y gastric bypass (44.38) and laparoscopic adjustable gastric banding (44.95) with a body mass index (BMI) of 40 kg/m<sup>2</sup> or greater. All procedures were primary laparoscopic cases  
110 and all were performed the same surgeon (MM). Revisions and open cases were excluded. Surgical techniques were unchanged after the modified pain regimen including: type of stapler used for bypass, number of trocars, size of trocars, and types of trocars.

Anesthesia: Anesthetic management was provided by members of our anesthesiology staff for all preoperative, intraoperative, and postoperative care. Standard general anesthesia with  
115 desflurane, 2 mg Versed and a dexmedetomidine drip started at 0.5 to 1.0 microgram per kilogram and maintained at 0.25 to 0.5 microgram per kilogram per hour was utilized in all cases. After administration of propofol, ventilation was assured, cricoid pressure applied and succinylcholine administered. If the airway was not visualized, intubation was performed with fiberoptic endoscopy. All patients received an oral gastric tube after induction, radial artery

120 catheterization for continuous blood pressure monitoring, and a central venous catheter line for  
postoperative blood draws and intravenous access. Narcotics were avoided until the patient was  
extubated. Patients were extubated after they demonstrated adequate respiratory drive,  
respiratory muscle strength, cough reflex to clear secretions, laryngeal function and clearance of  
sedative, neuromuscular blocking medications. In addition patients were kept intubated until  
125 adequate tidal volume, respiratory rate, and a negative inspiratory force  $>-25$  cmH<sub>2</sub>O were  
observed.

Pain Control: As a pain management strategy, all patients received preoperative  
education, counseling and routine postoperative monitoring. The postoperative pain order-set  
from January 2006 to January 2007 was a single dose of ketorolac 30 mg intravenous (IV) in the  
130 post-anesthesia care unit (PACU) followed by 15 mg IV every 6 hours for 24 hours (four-15mg  
doses total). In addition, patient controlled analgesia (PCA) with intravenous morphine at a  
demand dose of 1-2 mg per 10 minutes with a maximum of 6 mg per hour and no basal rate was  
utilized. In January 2008, our postoperative pain management orders were modified to include a  
standing dose of ketorolac 60 mg in the post anesthesia care unit (30 mg IV. plus 30 mg *i.m.*),  
135 then 15 mg IV every 6 hours for 24 hours (four-15mg doses total) and IV PCA with  
hydromorphone at a demand dose of 0.2 mg per 10 minutes with a maximum of 1.2 mg per hour,  
but no basal rate.

Role of interdisciplinary bariatric team: The interdisciplinary bariatric team was  
developed, parallel to the modified analgesic regimen, to work alongside the surgical team and  
140 the nursing staff in the care of the bariatric patient. The psychologist preoperatively assessed the  
patient with motivational interviewing to determine the patient's well-being and willingness to  
participate in postoperative treatment and documented incidences of depression, anxiety, or body  
image disorders. Postoperatively the psychologist followed up with the patients to counsel to

support a sustainable weight loss program. The bariatric nutritionist assessed the patient's  
145 nutritional status and aided in preoperative and postoperative patient education, counseling, and  
meal planning. The exercise physiologist assessed the patient's physical ability preoperatively  
and helped design a sustaining exercise program postoperatively.

The parameters that were evaluated before and after the implementation of the modified  
analgesic protocol included: procedure type, length of stay, co-morbid diseases, postoperative  
150 complications, and assessment of pain. The quality of postoperative analgesia was based on a  
visual analog scale (VAS) 10 centimeter line (where 0 = no pain, and 10= unbearable pain), and  
was averaged each day to generate a daily VAS score. The VAS scores were recorded as  
standard of care by the nurses every 4 hours starting in the PACU and continuing until the  
patient was discharged from the hospital. Pain was assessed while the patients were resting.

155 Postoperative complications were recorded based upon occurrence, not severity (Table  
1). The postoperative complications evaluated were surgical wound infection and postoperative  
ileus defined by the surgical team as: prolonged return of gastrointestinal movements, longer  
than 24 hours, accompanied by nausea and vomiting.

All data were analyzed to represent outcomes before and after the implementation of the  
160 modified pain protocol. Data were analyzed using Software or Predictive Analytics 17.0 (SPSS  
Inc, IL). Categorical variables were analyzed using either Chi-square or Fisher Exact tests.  
Patient demographics were summarized using conventional descriptive statistics. To evaluate if  
age or BMI correlated to increased length of stay, a multivariable linear regression model was  
used. Results are expressed as mean (SD) (medians for nonparametric) for continuous variables  
165 and as frequencies and percentages for categorical variables. A *p* value of <0.05 was considered  
statistically significant.

## Results

Eighty-five patients underwent bariatric operations in the year prior to the  
170 implementation of the new postoperative pain management regimen. Three hundred seventy-two  
patients underwent bariatric surgery in the 2 years after and received the modified pain  
management regimen. Patient age, gender and BMI were evenly distributed for both groups  
(Table 1). The patient population before our modified pain management strategy had a higher  
incidence of obstructive sleep apnea, diabetes, and hypertension (Table 1). Of the two surgical  
175 procedures included in the analysis, LRYGB was the most common comprising 72.9 % and  
77.7% of all cases before and after the modified regimen respectively. There was no significant  
difference in the percentage of LRYGB and LAGB procedures between the before and after  
group (Table 1) ( $p = 0.3495$ ). The group of patients evaluated following the modified pain  
regimen postoperatively showed significant reductions in wound infection and postoperative  
180 ileus (Table 1).

Tables

Table 1 Patient Characteristics Before and After

	Before	After	P Value
Number of Subjects	85	372	
Gender (male/female)	15/70	70/302	0.8025
Age (yr) mean (SD)	46.5 (11.2)	46.6 (12)	0.9584
BMI (kg/m <sup>2</sup> ) mean (SD)	47.9 (7.2)	49.2 (8.8)	0.1976
Length of Hospital Stay mean (SD)	3.6 (3.3)	3.3 (4.2)	0.5166
Surgery Type			
Laparoscopic Roux-en-Y [n (%)]	62 (72.9)	289 (77.7)	0.3495
Laparoscopic Gastric Banding [n (%)]	23 (27.1)	83 (22.3)	
Pre-operative Co Morbidities			
Diabetes Mellitus [n (%)]	33 (38.8)	80 (21.5)	0.001
Hypertension [n (%)]	48 (56.5)	121 (32.5)	<0.0001
Sleep Apnea [n (%)]	37 (43.5)	106 (28.5)	0.007
Post-Operative Complications			
Wound Infection [n (%)]	6 (7.1)	5 (1.3)	0.0019
Ileus [n (%)]	4 (4.7)	2 (0.5)	0.0124

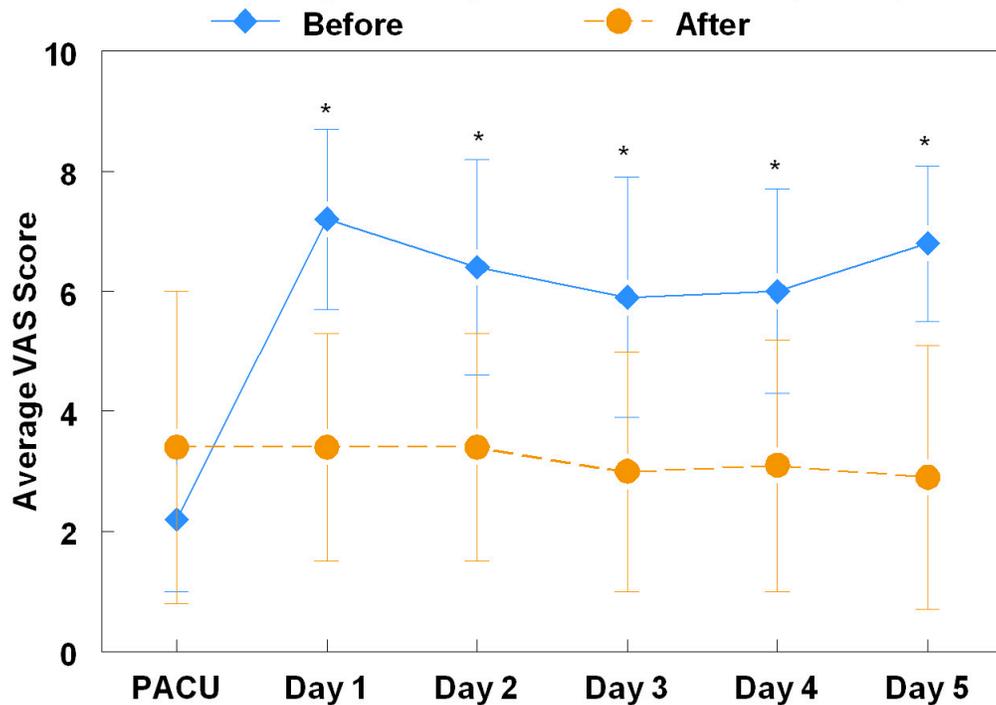
P values of <0.05 are considered statistically significant based upon the Chi-square test or Fisher's exact test. BMI=Body Mass Index

*Postoperative Pain*

Mean VAS scores significantly decreased on postoperative days 1 through 5 after implementing our modified pain regimen (Figure 1). Compared with the old group, the average VAS score during the 5 days post operation was 3.27 lower with the modified regimen (p<0.001). When stratified by procedure type, VAS scores were significantly lower following the modified pain regimen for both LRYGB and LAGB (p <0.0001 and p <0.0001 respectively). When comparing females to males within the groups, it was found that on average the VAS score on five day follow up was higher in females compared to males, but not statistically significant (p=0.059). In addition, older patients had lower VAS scores when compared to

younger patients ( $p=0.003$ ). As expected, patients who underwent LRYGB group had significantly higher VAS scores when compared with patients that underwent LAGB ( $p<0.0001$ ). Those with and without the comorbidities listed in Table 1, both before and after the pain management modification, did not differ in their VAS score response to pain.

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**Figure 1. Average Daily VAS Score Before and After Implementation of the Revised Pain Management Strategy.** Data are presented as mean (SD). \*P values of  $<0.05$  are considered statistically significant based upon the Wilcoxon sign rank test.

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### *Length of stay*

Overall, there were no differences in length of hospital stay (LOS) before and after our modified pain regimen ( $p=0.634$ ). When stratified by procedure type however, a significant

205 reduction in LOS for patients that underwent LAGB (0.8 days less;  $p=0.0001$ ) after

implementing our pain regimen. For both types of surgery, older patients tend to stay longer than

younger patients (0.08 days and 0.03 days longer,  $p < 0.0001$  and  $p = 0.0011$  for LRYGB and LAGB respectively). Patients with higher BMIs stayed 0.05 days longer when undergoing LRYGB ( $p = 0.002$ ), but no relationship between BMI and LOS was found with LAGB procedures. Females that underwent LAGB had a LOS of 1.11 days less than males ( $p < 0.0001$ ), but no differences in LOS for LRYGB procedures were found.

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## **Discussion**

Bariatric surgery is widely performed to achieve sustained weight loss in severely obese patients. One of the most common complications after laparoscopic bariatric surgery is severe pain. Our data revealed that our earlier analgesic regimen in this patient population was not sufficient to properly control postoperative pain. However, after implementing our modified pain regimen, VAS scores significantly reduced from 6 to 3 on post-operative day 3 (Figure 1).

With the advent of Hospital Consumer Assessment of Health Provider and Systems  
230 (HCAHPS®) surveys, an increased effort to improve the quality of patient care is pertinent. The  
results of this study support the benefits of the modified bariatric protocol implemented at our  
facility parallel to a modified pain regimen. This multidisciplinary approach focused on a  
sustainable protocol that addressed comprehensive medical criteria such as psychological well-  
being, specific comorbidities, diet and exercise for weight loss surgery. After adopting these  
235 techniques our patients not only experience a significant reduction in postoperative pain but also  
postoperative complications and length of stay.

The complications that were reduced in this study were postoperative ileus and wound  
infection. Length of stay in LAGB patients was also reduced after our bariatric protocol.  
Although this is likely unrelated to the type of analgesics given, we hypothesize the  
240 implementations of the dedicated bariatric team contributed to the reduction of these  
complications and length of hospital stay due to increased mobility and daily activities promoted  
by the bariatric team.

There is a need for more research that examines the effect of markedly increased  
adiposity on analgesic drug requirements. Fear of overdosing pain medications may lead to  
245 insufficient pain management in the obese population. The physiological changes produced by  
obesity can markedly affect the pharmacokinetics of anesthetic drugs, and severe adverse events  
can occur if drug dosing is based only on the actual body weight [8-9]. Drug distribution is  
dependent on permeability between tissues (between blood and tissues in particular), blood flow  
and perfusion rate of the tissue and the ability of the drug to bind plasma proteins and tissue [9].  
250 Furthermore, bypass of the acidic environment of the stomach added to a dramatic loss of body  
mass may affect drug absorption in LRYGB patients [10].

Madan and colleagues [11] used a postoperative pain management strategy following LRYGB procedures that involved a dosing regimen of ketorolac that was similar to our modified regimen and double the amount of our previous regimen, as well as morphine sulphate 2 mg every 2 hours as needed. Using postoperative opiate consumption as the primary measurement, they concluded that patients experience better pain relief with ketorolac than with morphine. In addition, the authors emphasized the importance of treating the psychological component of pain by providing preoperative education and counseling and postoperative reassurance [11]. Their study did not use any direct methods to measure the amount of pain; such as a visual analog scale. They state it is possible their patients may have had a higher amount of pain due to their minimal narcotic use.

Weingarten and colleagues performed a retrospective study to identify preoperative patient factors associated with greater postoperative opioid use in patients undergoing laparoscopic bariatric surgery [12]. This study reviewed 384 consecutive patients who underwent laparoscopic bariatric surgery from January 2000 to December 2006. Patient characteristics included demographic and socioeconomic variables, tobacco or psychotropic medications use at the time of surgery and previous psychiatric hospitalization. The study concluded that patients undergoing laparoscopic bariatric surgery, who are younger, male, and who had been previously hospitalized for psychiatric disorders use more opioids in the first 48 postoperative hours. Our study showed similar VAS scores for younger patients, however differs in VAS scores of female patients which were similar to male counterparts in our study.

This study has several limitations. First, the data were collected retrospectively and depend on the accuracy of the medical record. Because this study had a before-and-after design, it is limited by confounding factors related to changes in environmental variables, such as increased experience and fine-tuning of the surgeon's skills, increased patient size, variability in

preoperative co-morbidities, changes in clinical management, and quality improvement measures of a dedicated postoperative team which was following daily the progress for our obese patients. There is also the possibility that increased awareness about patient satisfaction and postoperative pain could have lead to improved medical practice.

## 280 **Conclusion**

The rapid advancement of bariatric surgery has led to successful outcomes in weight loss but increasing patients' postoperative pain is an ongoing process. In conclusion, the implementation of our multidisciplinary approach for quality improvement resulted in a significant decrease in VAS scores through five postoperative days, complications and mean  
285 hospital stay for patients undergoing laparoscopic bariatric surgery.

**Conflict of Interest:**

None

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## References

- 310 [1] Sturm R. Increases in morbid obesity in the USA: 2000-2005. *Public Health* 2007; 121: 492-6.
- [2] Santry HP, Gillen DL, Lauderdale DS. Trends in bariatric surgical procedures. *JAMA* 2005; 294: 1909-17.
- 315 [3] Matarasso A, Roslin MS, Kurian M. Bariatric surgery: an overview of obesity surgery. *Plast Reconstr Surg* 2007; 119: 1357-62.
- [4] Murr MM, Martin T, Haines K, et al. A state-wide review of contemporary outcomes of gastric bypass in Florida: does provider volume impact outcomes? *Ann Surg* 2007; 245: 699-706.
- 320 [5] Adams JP, Murphy PG. Obesity in anaesthesia and intensive care. *Br J Anaesth* 2000; 85: 91-108.
- [6] Ogunnaike BO, Jones SB, Jones DB, Provost D, Whitten CW. Anesthetic considerations for bariatric surgery. *Anesth Analg* 2002; 95: 1793-805.
- [7] Kuruba R, Koche LS, Murr MM. Preoperative assessment and perioperative care of patients undergoing bariatric surgery. *Med Clin North Am* 2007; 91: 339-51.
- 325 [8] Casati A, Putzu M. Anesthesia in the obese patient: pharmacokinetic considerations. *J Clin Anesth* 2005; 17: 134-45.
- [9] Cheymol G. Effects of obesity on pharmacokinetics implications for drug therapy. *Clin Pharmacokinet* 2000; 39: 215-31.
- 330 [10] Brocks DR, Ben-Eltriki M, Gabr RQ, Padwal RS. The effects of gastric bypass surgery on drug absorption and pharmacokinetics. *Expert Opin Drug Metab Toxicol*. 2012; 8: 1505-19.
- [11] Madan AK, Ternovits CA, Speck KE, Tichansky DS. Inpatient pain medication requirements after laparoscopic gastric bypass. *Obes Surg* 2005; 15: 778-81.
- 335 [12] Weingarten TN, Sprung J, Flores A, Baena OA, Schroeder D, Warner D. Opioid Requirements after Laparoscopic Bariatric Surgery. *Obes Surg* 2011; 21: 1407-12.

340