

## Original Article

# Comparison of Patient Controlled Analgesia to Epidural Analgesia for Postoperative Pain Management after Laparoscopic Gastric Bypass Surgery: A Retrospective Study

Rudram Muppuri, George M McKelvey, and Hong Wang

## ABSTRACT

**Background:** With the rapidly increasing incidence of obesity conditions, increases in the number of bariatric surgeries required for patients with high body mass index (BMI) provide increasing challenges for the anesthesiologists in the management of both anesthesia and postoperative pain relief. In this study, a comparison was made of the effectiveness of thoracic epidural analgesia (bupivacaine and fentanyl) versus patient controlled analgesia (PCA, morphine and ketorolac) for postoperative pain control. The study hypothesis was that obese patients undergoing gastric bypass surgery receiving local thoracic epidural analgesia will have significantly improved postoperative pain relief, decreased postoperative morbidities and decrease in hospital stay compared to those receiving conventional opioid medications via PCA.

**Methods:** In a university-affiliated hospital, a retrospective chart review of 153 patients aged 20-65 years old with American Society of Anesthesiology (ASA) physical status 2 and 3, scheduled for laparoscopic bypass surgery was conducted. For analysis, patients were divided into 2 groups, those received an epidural solution (0.075% bupivacaine and fentanyl 5 mcg/ml; N=79) or patients received postoperative PCA (morphine and ketorolac 30 mg; N=74). Study outcomes included postoperative pain scores (visual analogue score, VAS) at 6, 12, 24 and 48 hours, incidence of postoperative nausea and vomiting (PONV), pruritus, respiratory complications, time taken until ambulation and bowel function, length of hospital stay and percentage of patients in hospital greater than 3 days.

**Results:** Patients who received epidurals showed significantly lower pain scores at 6 and 12 hours compared to patients on PCA ( $P < 0.001$ ). Patients who received epidurals had significantly lower incidence of PONV ( $P = 0.002$ ) and a significantly decreased hospital stay ( $P = 0.029$ ) compared to patients on PCA.

**Conclusions:** This study indicated that obese patients who underwent gastric bypass surgery and received thoracic epidurals had significantly improved postoperative pain relief, decreased postoperative side effects and a decrease in hospital stay compared to obese patients who received conventional PCA.

From Department of Anesthesiology, Detroit Medical Center, Wayne State University, Detroit, USA.

**Correspondence** to Dr. Hong Wang at [howang@med.wayne.edu](mailto:howang@med.wayne.edu).

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The climbing obesity rate is a worldwide health issue with continual increasing rates over the last few decades (1). Based on guidelines published by the National Institutes of Health, body mass index (BMI,  $\text{kg}/\text{m}^2$ ) is used to classify obesity. Morbid obesity is defined as patients with a BMI of  $40 \text{ kg}/\text{m}^2$  or greater, or a BMI more than  $35 \text{ kg}/\text{m}^2$  with comorbid conditions (2). Approximately one-third of US adults are obese (3), with the frequency and severity of comorbid conditions directly proportional to increased obesity levels of the patient. Current evidence suggests that surgical therapies offer the best hope for substantial and sustainable weight loss in the extremely obese with resultant mortality reduction (4). Gastric bypass surgery is one of the indicated procedures for the surgical treatment of morbid obesity (5). Due to the increases in both the number of bariatric surgeries required, and increasing patient BMI, anesthesiologists face increasing challenges regarding the anesthesia management of these patients and their postoperative pain issues (6).

Optimal postoperative pain control for obese patients is paramount due to obesity being a significant risk factor for cardiovascular and respiratory complications after surgery (7, 8). Deep venous thrombosis (DVT) is one of the most common complications. Patient controlled analgesia (PCA) using intravenous morphine has been successfully used in obese subjects undergoing gastric bypass surgery (9, 10). Comparisons between the effectiveness of epidural versus PCA postoperative outcomes in obese patients undergoing bariatric surgery have been mixed, with some studies observing better outcomes with epidural analgesia (8) and other studies seeing no significant differences between the two methods (9, 10). In this retrospective study, we examined the effectiveness of thoracic epidural analgesia versus PCA morphine for postoperative pain control.

The study hypothesis was that obese patients undergoing gastric bypass surgery receiving local thoracic epidural analgesia will have significantly improved postoperative pain relief, decreased postoperative morbidities and decrease in hospital stay compared to obese patients receiving conventional opioid medica-

tions via PCA.

## METHODS

This study had Institutional Review Board approval and was a retrospective chart review, of 153 patients received laparoscopic bypass surgery at Harper Hospital, Detroit Medical Center, Detroit, Michigan, USA. Inclusion criteria was patients aged between 20- 65 years old scheduled for laparoscopic gastric bypass surgery given under general anesthesia in the study review period (Oct 2004 to Oct 2009), American Society of Anesthesiology (ASA) physical status II-III and with a body mass index (BMI)  $>40 \text{ kg}/\text{m}^2$ , or BMI  $>35 \text{ kg}/\text{m}^2$  with comorbid conditions. Exclusion criteria included patients with a known hypersensitivity to any of the medications utilized in this research study, any patient history of drug abuse within the previous year of the study period and any patients with any contraindications to regional anesthesia (bupivacaine).

Patients were divided by two treatment groups: 1) patients received thoracic epidural analgesia for postoperative pain control, or 2) patients received PCA for postoperative pain control.

All patients underwent general anesthesia for gastric bypass surgery. All general anesthetics were administered using standard medical protocol. Patients who received epidural analgesia had a thoracic epidural catheter inserted between T9-T12 in preoperative holding area as per standard protocols and evaluation of epidural functioning. Administration of 8 ml of 250 ml solution, bupivacaine 0.075% and fentanyl 5 mcg/ml was via an epidural catheter after induction of general anesthesia and before skin incision. Continuous infusion of standard epidural solution ranged between a minimum of 1 ml per hour and a maximum of 14 ml per hour. By the end of the procedure, patient received a total minimum of 25 ml of solution (from skin incision to skin closure). Postoperatively epidural analgesic solution was titrated to the patients satisfaction for pain controlled.

Postoperative PCA administration occurred via an intravenous (IV) solution of morphine and ketorolac 30 mg (IV every 6 hours) using conventional postoperative analgesia therapy for

postoperative pain requirements. All epidural disconnection/removal occurred by postoperative day 2.

### Data Collection

Preoperative: patient age, gender, ASA physical status, BMI, obstructive sleep apnea (OSA) incidence, constant positive airway pressure (CPAP) usage, pain medication use, and smoking.

Postoperative: postoperative pain scores (visual analogue score, VAS) at 6, 12, 24 and 48 hours, incidence of postoperative nausea and vomiting (PONV), pruritus, respiratory complication, time taken until ambulation, time taken until bowel function, hospital stay duration and proportion of patients with a hospital stay of greater than 3 days.

### Statistics

An unpaired students-t-test procedure (two-sample assuming equal variances, two-tail significance  $P < 0.05$ , 95% confidence interval) was performed to examine mean differences between the two study groups on all continuously scaled variables. A repeated measures analysis of variance (ANOVA) was used to measure differences between time for VAS scores at the four measured time points (6, 12, 24 and 48 hours). Assumptions of normality and/or homogeneity of variance were checked and verified. Comparisons between study groups on proportional differences were examined using a non-parametric Fisher's Exact Chi-square test, when applied to  $2 \times 2$  tables. Statistical significance was set at a  $P$  value  $\leq 0.05$ . All continuous data were expressed as the means with 95% upper confidence intervals.

A continuous outcome, superiority power analysis based on a 30% improvement in VAS scores concluded that 82 participants (41 per group) would be necessary to have a 95% chance of detecting, as significant at the 5% level, a decrease in the primary outcome measure from the control group (PCA) compared to the experimental group (epidural).

## RESULTS

Data from 153 subjects were analysed in the two patient groups, patients who used PCA (N=

	PCA (N=74 )	Epidural (N=79 )	P value
Age	44.8±11.9	39.8±10.5	<0.01
Gender (female:male)	62:12 (84:16%)	66:13 (84:16%)	0.99
BMI	49.3±7.8	49.6±7.1	0.8
OSA	48 (64.9%)	49 (62.0%)	0.74
CPAP	28 (37.8%)	30 (37.9%)	0.99
Smoking	20 (27.0%)	7 (8.9%)	<0.005
Preoperative pain medication usage	6 (8.1%)	7 (8.8%)	0.99

Continuous data (age and BMI) were expressed as means±standard deviation, and categorical data (OSA, CPAP, and smoking) were expressed as the number of patient occurrence and (percentage) in parenthesis.

BMI, body mass index; OSA, obstructive apnea; CPAP, continuous positive airway pressure.

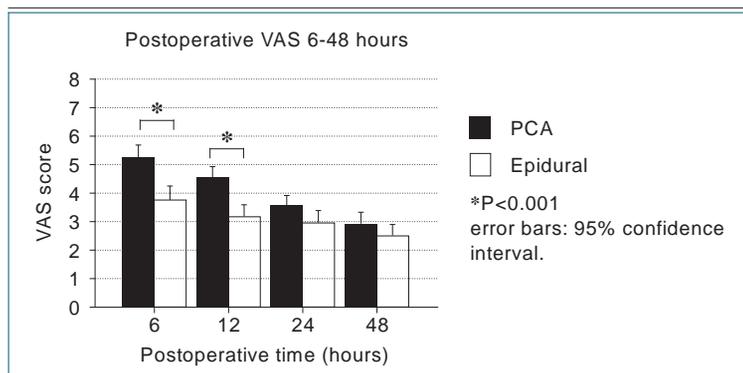
74) for postoperative pain relief and patients who received an epidural analgesia for postoperative pain relief (N=79). A comparison of patient demographics of age, gender, BMI, patient occurrence of OSA, patient CPAP usage and preoperative use of pain medication, between the two groups was outlined in table 1.

### Postoperative Data

A repeated measures ANOVA observed that there was a significant effect between treatments ( $F = P < 0.001$ ) and time ( $F = P < 0.001$ ). Post-hoc analysis revealed that postoperative VAS scores were significantly lower ( $P < 0.001$ ) in patients received epidural analgesia at 6 and 12 hours postoperatively than patients who received PCA (Figure). There was a significant difference of smoking history between the two groups but there were no significant differences in postoperative respiratory complications. Incidence of PONV ( $P = 0.002$ ), hospital stay duration ( $P = 0.029$ ) and the percentage of patients who stayed in hospital for longer than 3 days ( $P = 0.012$ ) were significantly lower in epidural treated patients than those of PCA treated patients as outlined in table 2.

## DISCUSSION

The ultimate goals for optimal postoperative pain management should be to not only reduce patient pain levels and enhance patient satisfaction but to also facilitate earlier mobilization and rehabilitation by reducing pain-related complications after surgery. Thoracic epidural anal-



**Figure. Postoperative VAS Pain Scores Measured between Patients Receiving PCA or Epidural Analgesia at 4 Time Points (6, 12, 24 and 48 hours) in the 48-Hour-Period following Gastric Bypass Surgery.**

VAS, visual analog scale; PCA, patient controlled analgesia.

Table 2. Patient Postoperative Outcome Parameters.			
	PCA ( N=74 )	Epidural (N=79 )	P value
Incidence of PONV	23 (31.1%)	8 (10.1%)	0.0022
Incidence of pruritus	12 (16.3%)	17 (21.5%)	0.42
Incidence of respiratory complication	3 (4.0%)	6 (7.5%)	0.49
Time until ambulation (days)	1.6±0.6	1.58±0.6	0.79
Time until bowel function (days)	2.4±0.9	2.4±0.6	0.59
Hospital stay duration (days)	3.6±1.4	3.2±1.0	0.029
Patient hospital stay >3 days (%)	35 (47.3%)	21 (26.6%)	0.012

Categorical data were expressed as patient number and (percentage) in parenthesis. Continuous data were expressed as means±standard deviation. PONV, postoperative nausea and vomiting; PCA, patient controlled analgesia.

gesia provides effective analgesia, and can minimize the medication induced side effects arising from PCA. In our study, thoracic epidural use for postoperative pain relief in morbidly obese patients undergoing gastric bypass surgery achieved significantly improved postoperative pain relief, decreased postoperative side effects, and a decrease in hospital stay when compared to conventional PCA.

With the rapidly increasing incidence of obesity (1) and the resultant increase of obesity-related comorbid conditions, current clinical theory suggests that gastric bypass surgery surgical therapies offer the optimal method for significant sustained weight loss and a reduction in obese related morbidity and mortality (4, 5). Increases in the number of bariatric surgeries required for patients with high BMI provide increasing challenges for the anesthesiologists in the management of both anesthesia and postoperative pain relief (6). In particular, due to the high inci-

dence of sleep apnea in bariatric patients, consideration should be given to the respiratory depressive effect of opioids used for patient controlled postoperative analgesia.

In our study PONV occurrence in thoracic epidural analgesia treated patients (10%) was significantly reduced by a factor of three compared to PCA treated patients (31%). A study of patients undergoing minimally invasive hysterectomies observed a similar trend with patients receiving postoperative pain management via thoracic epidural showing a reduced incidence of PONV compared to PCA treated patients (11).

In our study there was no significant difference between epidural and PCA patients for the time taken until ambulation or the time taken for bowel function to return. In general, epidural patients showed earlier postoperative resumption of bowel function compared to PCA treated patients (12). Stress-induced sympathetic outflow can result in ileus, decreasing bowel movement, leading to a delay in ambulation and an increased hospital stay. Our study however, did show a statistically significant difference in the length of hospital stay for the epidural treated patients.

In our study the incidence of adverse opioid-induced side effects/complications such as respiratory, pulmonary complications, pruritus or DVT, revealed no difference between epidural and PCA patients, although studies with larger patient sample sizes have observed differences. Multiple studies have observed that epidural use compared to conventional PCA reduced the incidence of venous thrombosis in orthopedic surgery patients (13), reduced the risk of cardiac events in vascular surgery patients (14), improved pulmonary outcomes (15- 17) and reduced morbidity and mortality rates (18-21).

In our study the thoracic epidurals use for postoperative pain control provided superior postoperative pain control and hastened the postoperative hospital departure of patients compared to PCA. Well-controlled postoperative pain is crucial for the bariatric patients to enable prompt postoperative mobilization. Poor postoperative pain control has been associated with negative clinical outcomes such as decreased vital capacity, decreased alveolar ventilation, pneumonia, tachycardia, hypertension, myocardial ischemia, myocardial infarction,

transition to chronic pain, poor wound healing, and insomnia (22, 23).

Although no epidural related problems arose in our study, potential adverse outcomes from epidural technical related problems can occur in up to 7% of epidural patients resulting in alternative analgesic treatment (24-27). Adverse occurrences arising from epidural placement such as hematoma, abscess, meningitis, or direct traumatic spinal cord injury are not common and permanent neurologic injury associated with epidural use is rare, ranging from 1 in 2,700 to 1 in 200,000 (24-27). Due to limitations of our retrospective study design, occurrence rates for any complications beyond the study period of 2 days were unable to be collected. Another limitation of the study may have been the small sample size, which may lack sufficient power to detect significant differences between epidural and PCA patients in time taken until ambulation, time taken for bowel function to return, and the incidence of adverse opioid-induced side effects/complications. The limited sample size of the study also limited the adjustment of the data to

take into account for potential significant confounders such as age and smoking status and to determine potential logistic confounders of binary data.

## CONCLUSION

In this study of obese patients who underwent gastric bypass surgery, thoracic epidural analgesia provided more favorable postoperative outcomes than that of PCA. The multimodal improved perioperative outcomes from epidural use included improved 12 hours postoperative pain control, decreased PONV and length of hospital stay. As observed from the epidural-related improved postoperative pain scores, we would recommend a delay in postoperative epidural disconnection to improve patient postoperative pain control in obese patients undergoing gastric bypass surgery.

All research in this study was performed at the Detroit Medical Center, Detroit, Michigan, USA.

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## References

- American Society of Anesthesiologists Task Force on Perioperative Management of patients with obstructive sleep apnea. Practice guidelines for the perioperative management of patients with obstructive sleep apnea: an updated report by the American Society of Anesthesiologists Task Force on Perioperative Management of patients with obstructive sleep apnea. *Anesthesiology* 2014; 120: 268-86.
- Gross JB, Bachenberg KL, Benumof JL, Caplan RA, Connis RT, Cote CJ, et al. Practice guidelines for the perioperative management of patients with obstructive sleep apnea: a report by the American Society of Anesthesiologists Task Force on Perioperative Management of patients with obstructive sleep apnea. *Anesthesiology* 2006; 104: 1081-93.
- SAGES Duidelines Committee. SAGES guideline for clinical application of laparoscopic bariatric surgery. *Surgical Endos* 2008; 22: 2281-300.
- Fisher BL, Schauer P. Medical and surgical options in the treatment of severe obesity. *Am J Surg* 2002; 184: 95-165.
- Tice JA, Karliner L, Walsh J, Petersen AJ, Feldman MD. Gastric banding or bypass? A systematic review comparing the two most popular bariatric procedures. *Am J Med* 2008; 121: 885-93.
- Schuster R, Alami RS, Curet MJ, Paulraj N, Morton JM, Brodsky JB, et al. Intra-operative fluid volume influences postoperative nausea and vomiting after laparoscopic gastric bypass surgery. *Obes Surg* 2006; 16: 848-51.
- Kamelgard JI, Kim KA, Atlas G. Combined preemptive and preventive analgesia in morbidly obese patients undergoing open gastric bypass: A pilot study. *Surg Obes Relat Dis* 2005; 1: 12-6.
- Schumann R, Shikora S, Weiss JM, Wurm H, Strassels S, Carr DB. A comparison of multimodal perioperative analgesia to epidural pain management after gastric bypass surgery. *Anesth Analg* 2003; 96: 469-74.
- Charghi R, Backman S, Christou N, Rouah F, Schrickler T. Patient controlled i.v. analgesia is an acceptable pain management strategy in morbidly obese patients undergoing gastric bypass surgery. A retrospective comparison with epidural analgesia. *Can J Anaesth* 2003; 50: 672-8.
- Choi YK, Brolin RE, Wagner BK, Chou S, Etesham S, Pollak P. Efficacy and safety of patient-controlled analgesia for morbidly obese patients following gastric bypass surgery. *Obes Surg* 2000; 10: 154-9.
- Hensel M, Frenzel J, Späker M, Keil E, Reinhold N. Postoperative pain management after minimally invasive hysterectomy: thoracic epidural analgesia versus intravenous patient-controlled analgesia (in German). *Anaesthesist* 2013; 62: 797-807.
- van Lier F, van der Geest PJ, Hoeks SE, van Gestel YR, Hol JW, Sin DD, et al. Epidural analgesia is associated with improved health outcomes of surgical patients with chronic obstructive pulmonary disease. *Anesthesiology* 2011; 115: 315-21.
- Urwin SC, Parker MJ, Griffiths R. General versus regional anaesthesia for hip fracture surgery: a meta-analysis of randomized trials. *Br J Anaesth* 2000; 84: 450-5.
- Beattie WS, Badner NH, Choi P. Epidural analgesia reduces postoperative myocardial infarction: a meta-analysis. *Anesth Analg* 2001; 93: 853-8.
- Ballantyne JC, Carr DB, deFerranti S, Suarez T, Lau J, Chalmers TC, et al. The comparative effects of postoperative analgesic therapies on pulmonary outcome: cumulative meta-analyses of randomized, controlled trials. *Anesth Analg* 1998; 86: 598-612.
- Guay J. The benefits of adding epidural analgesia to general anaesthesia: a meta-analysis. *J Anesth* 2006; 20: 335-40.
- Popping DM, Elia N, Marret E, Remy C, Tramer MR. Protective effects of epidural analgesia on pulmonary complications after abdominal and thoracic surgery: a meta-analysis. *Arch Surg* 2008; 143: 990-9.
- Liu SS, Block BM, Wu CL. Effects of perioperative central neuraxial analgesia on outcome after coronary artery bypass surgery: a meta-analysis. *Anesthesiology* 2004; 101: 153-61.
- Rodgers A, Walker N, Schug S, McKee A, Kehlet H, van Zundert A, et al. Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised trials. *BMJ* 2000; 321: 1493.
- Svircevic V, van Dijk D, Nierich AP, Passier MR, Kalkman CJ, van der Heijden GJ, et al. Meta-analysis of thoracic epidural anaesthesia versus general anaesthesia for cardiac surgery. *Anesthesiology* 2011; 114: 271-82.
- Wu CL, Hurley RW, Anderson GF, Herbert R, Rowlingson AJ, Fleisher LA. Effect of postoperative epidural analgesia on morbidity and mortality following surgery in medicare patients. *Reg Anesth Pain Med* 2004; 29: 525-33.
- Breivik H. Postoperative pain management: why is it difficult to show that it improves outcome? *Eur J Anaesthesiol* 1998; 15: 748-51.
- Breivik H, Stubhaug A. Management of acute postoperative pain: still a long way to go! *Pain* 2008; 137: 233-4.
- Christie IW, McCabe S. Major complications of epidural analgesia after surgery: results of a six-year survey. *Anaesthesia* 2007; 62: 335-41.
- Moen V, Dahlgren N, Irestedt L. Severe neurological complications after central neuraxial blockades in Sweden 1990-1999. *Anesthesiology* 2004; 101: 950-9.
- Paton L, Jefferson P, Ball DR. The disconnected epidural catheter: a survey of current practice in Scotland. *Eur J Anaesthesiol* 2012; 29: 453-5.
- Volk T, Wolf A, Van Aken H, Burkle H, Wiebalck A, Steinfeldt T. Incidence of spinal haematoma after epidural puncture: analysis from the German network for safety in regional anaesthesia. *Eur J Anaesthesiol* 2012; 29: 170-6.