Regional Anesthesia and Pain

Patient controlled *iv* analgesia is an acceptable pain management strategy in morbidly obese patients undergoing gastric bypass surgery. A retrospective comparison with epidural analgesia

[L'analgésie iv autocontrôlée est une stratégie de traitement de la douleur acceptable chez les patients atteints d'obésité morbide qui subissent un pontage gastrique. Une comparaison rétrospective avec l'analgésie péridurale]

Roshanak Charghi MD,* Steven Backman MD PhD,* Nicolas Christou MD PhD,† Fabrice Rouah MSc,‡ Thomas Schricker MD PhD*

Purpose: To examine the hypothesis that pain treatment with patient controlled analgesia (PCA) using *iv* morphine is a suitable and safe alternative to epidural analgesia in morbidly obese patients undergoing gastric bypass surgery. We retrospectively compared the postoperative periods in all patients undergoing this procedure in our institution between November 1999 and November 2001.

Methods: According to their perioperative pain treatment, patients were assigned to a PCA group (with *iv* morphine) or an epidural analgesia group, in which patients received either intermittent doses of morphine or continuous infusions of bupivacaine/fentanyl. Study endpoints included quality of pain control, incidence of cardiovascular and respiratory complications, analgesia related side effects, time to ambulation and first flatus, length of hospital stay, and wound infections.

Results: Data from 86 patients were analyzed with 40 patients in the PCA group and 46 patients in the epidural group. Groups were similar with respect to age, body mass index, and gender. The type of analgesia did not affect the quality of pain control at rest, the frequency of nausea and pruritus, the time to ambulation and return of gastrointestinal function, and the length of hospital stay. Patients receiving epidural analgesia had a greater risk of wound infection than subjects with PCA (epidural group: 39%, PCA group: 15%, $P = 0.01$).

Conclusion: We conclude that in grossly obese patients undergoing gastric bypass surgery PCA with *iv* morphine is an acceptable strategy for pain management and may confer some advantages when compared to epidural analgesia.

Objectif : *Vérifier l'hypothèse voulant que le traitement de la douleur par l'analgésie autocontrôlée (AAC), avec de la morphine iv soit appropriée et sans risque pour remplacer l'analgésie péridurale chez les patients atteints d'obésité morbide qui subissent un pontage gastrique.*

Méthode : *Nous avons comparé, rétrospectivement, la période postopératoire pour tous les patients qui ont subi cette intervention à notre institution entre novembre 1999 et novembre 2001. Selon l'analgésie périopératoire reçue, les patients ont été assignés à un groupe d'AAC (avec de la morphine iv) ou à un groupe d'analgésie péridurale, soit avec des doses de morphine intermittentes, soit des perfusions continues de bupivacaïne/fentanyl. Les paramètres étudiés ont été la qualité de l'analgésie, l'incidence de complications cardiovasculaires et respiratoires, les effets secondaires reliés à l'analgésie, la durée écoulée avant le premier lever et le retour du péristaltisme gastro-intestinal, la durée du séjour hospitalier et les infections de la plaie chirurgicale.*

From the Departments of Anesthesia,*and Surgery,† Royal Victoria Hospital; and the Department of Mathematics and Statistics,‡ McGill University, Montreal, Quebec, Canada.

Address correspondence to: Dr. Thomas Schricker, Department of Anesthesia, McGill University, Royal Victoria Hospital, Room S5.05, 687 Pine Ave West, Montreal, Quebec H3A 1A1, Canada. Phone: 514-842-1231, ext. 34880; Fax: 514-843-1723; E-mail: thomas.schricker@mcgill.ca

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Résultats : *Les données de 86 patients ont été analysées, 40 du groupe d'AAC et 46 du groupe d'analgésie péridurale. Les groupes étaient comparables quant à l'âge, l'index de masse corporelle et le sexe. Le type d'analgésie n'a pas affecté la qualité de l'analgésie au repos, la fréquence de nausée et de prurit, le temps écoulé avant de pouvoir se lever et avant le retour du péristaltisme gastro-intestinal, et la longueur du séjour hospitalier. Les patients sous analgésie péridurale présentaient un risque plus élevé d'infection de la plaie que les sujets sous AAC (péridurale : 39 %, AAC : 15 %, P = 0,01).*

Conclusion : *Chez les patients très obèses, devant subir un pontage gastrique, l'AAC avec de la morphine iv est une stratégie d'analgésie acceptable et peut présenter certains avantages par rapport à l'analgésie péridurale.*

THE advantages of epidural analgesia have been demonstrated in numerous studies.[1–3] Compared to patient controlled analgesia (PCA) using *iv* morphine, epidural analgesia with a local anesthetic and/or opioids provides superior dynamic pain relief[1] which in turn improves respiratory function resulting in fewer postoperative pulmonary complications.[4,5] Epidural analgesia has also been shown to be associated with a lower incidence of deep vein thrombosis,[6] decreased cardiac morbidity,[7] suppression of metabolic neuroendocrine responses[8] and acceleration of postoperative return of gastrointestinal function.[9,10] A recent meta-analysis reported a reduced overall mortality in patients receiving neuraxial blockade for major surgery further justifying the neurological risk and increased preparation time, which may be associated with a regional approach.[11]

Few clinical trials have evaluated different types of analgesia in morbidly obese patients after abdominal surgery. In this population optimal postoperative pain control is of considerable importance because obesity is an independent risk factor for cardiovascular and respiratory complications after surgery.[12] Although efficacy and safety of PCA using *iv* morphine have been suggested in obese subjects undergoing bariatric surgery,[13] comparison with neuraxial blockade has not yet been made. This lack of interest is surprising because the potential technical difficulties and neurological complications associated with epidural catheter placement render the relatively "non-invasive" *iv* analgesia an attractive option in this group of high-risk patients.

The hypothesis of the present study was that pain treatment with PCA using *iv* morphine is a suitable and safe alternative to epidural analgesia in morbidly obese patients undergoing gastric bypass surgery. We, therefore, retrospectively compared the postoperative periods in all patients who underwent this procedure in our institution between November 1999 and November 2001. Study endpoints included type and quality of pain control, incidence of major cardiovascular and respiratory complications, time to ambulation and return of gastrointestinal function, length of hospital stay, and incidence of wound infections.

Methods

With the approval of the Ethics Committee of the hospital we reviewed the charts of all patients who underwent elective gastric bypass surgery between November 1999 and November 2001 at the Royal Victoria Hospital. According to their pain treatment, patients were retrospectively divided into two groups. Patients in Group I received postoperative PCA with *iv* morphine (PCA group), while subjects in Group II received perioperative epidural analgesia (epidural group). We further subdivided the epidural group into patients who were treated with intermittent doses of epidural morphine (morphine) and those, who received continuous infusions of bupivacaine 1 $mg \cdot mL^{-1}$ combined with fentanyl 3 $\mu g \cdot mL^{-1}$(bupivacaine/fentanyl).

We did not consider the type of anesthetic a study endpoint *per se*, because it was assumed that it did not affect the outcome parameters: patients typically received a standardized anesthetic regimen, i.e., rapid sequence induction with *iv* propofol, fentanyl, and succinylcholine followed by maintenance with inhaled desflurane or isoflurane supplemented with boluses of fentanyl to keep heart rate and mean arterial pressure within 20% of the corresponding preoperative values. Surgical muscle relaxation was maintained with intermittent boluses of rocuronium and reversed with neostigmine/glycopyrrolate prior to extubation. A Roux-en-Y isolated gastric bypass surgery was carried out in a standardized fashion by the same surgeon between 8:00 am and 15:00 pm. The operation consisted of a gastric bypass with a left gastric artery based vertical pouch 5 cm long, with a diameter of 1 cm, completely separated from the native stomach. A retrocolic, retrogastric Roux-en-Y gastrojejunostomy established gastrointestinal tract continuity with 100–200 cm limbs depending on the body mass index (BMI) of the patient. The fascia was closed with two double looped number 1 PDS sutures (Ethicon, Somerville, NJ, USA) in a continuous manner. The skin was closed in all patients with metalic clips. All patients received either 1 g of cefazolin or, in case of penicillin allergy 0.5 g vancomycin, 30 min before skin incision. Discharge criteria were adequate pain control with oral analgesics, absence of fever, return of bowel function as well as ability to walk, void and hydrate themselves independently.

TABLE I Biometric data, co-morbidity, duration of surgery and hospital stay

	PCA group	*Epidural group*	*Morphine*	*Bupivacaine/ fentanyl*	*P*
Number	40	46	35	11	
Gender (male/female)	13/27	8/38	6/29	2/9	
Age (yr)	39 ± 11	38 ± 9	37 ± 10	39 ± 9	0.83
BMI ($kg \cdot m^{-2}$)	53 ± 7	52 ± 8	53 ± 8	48 ± 6	0.08
Diabetes mellitus [*n* (%)][1]	10 (25%)	6 (13%)	3 (9%)	3 (27%)	0.79
Hypertension [*n* (%)][2]	9 (23%)	11 (24%)	8 (23%)	3 (27%)	0.88
Asthma [*n* (%)]	8 (20 %)	10 (22 %)	8 (23 %)	2 (18 %)	0.84
Sleep apnea [*n* (%)]	7 (18%)	9 (20%)	8 (23%)	1 (9%)	0.81
Duration of surgery (min)	86 ± 15	88 ± 26	89 ± 28	86 ± 17	0.96
Time in OR (min)	128 ± 18	150 ± 39	154 ± 41	146 ± 24	0.01
SDU stay (hr)	26 ± 14	22 ± 10	22 ± 12	22 ± 7	0.25
Hospital stay (hr)	130 ± 46	115 ± 14	113 ± 17	118 ± 12	0.19

Non-insulin dependent.[1] Treated.[2] Values are mean ± SD. BMI = body mass index; OR = operating room; SDU = step down unit; PCA = patient controlled analgesia. *P* values refer to comparisons between the PCA and epidural group.

Postoperative pain treatment followed routine protocols established by the acute pain service of the department of anesthesia. Accordingly, adequate pain was defined as a score < 2 on a visual analogue scale (VAS) from 0 to 5 (where 0 = no; 1 = mild; 2 = moderate; 3 = severe; 4 = very severe; and 5 = unbearable pain). Shortly after arrival in the step down unit, patients in the PCA group received *iv* boluses of 2.5–5 mg of morphine every ten minutes until they were comfortable. The PCA pump was programmed to administer an *iv* bolus of 1 mg morphine with a lock-out interval of eight minutes. If analgesia was inadequate after 60 min, the dose was increased by 0.5 mg every hour to a maximum of 2 mg. If pain control was still inadequate naproxen 500 mg was administered rectally every 12 hr.

In the epidural group, the epidural catheter was inserted between T–11 and L–2 immediately before surgery. All patients received a test dose of 2% lidocaine (4 mL) to exclude accidental intrathecal catheter placement. Patients in the morphine group received 5 mg of morphine via the epidural catheter approximately one hour prior to the end of surgery and subsequent boluses of 3 to 4 mg every eight hours. If analgesia was inadequate, epidural boluses of fentanyl 100 μg were administered every three hours and naproxen 500 mg was given rectally every 12 hr. In the bupivacaine/fentanyl group patients received a mixture of bupivacaine 1 $mg \cdot mL^{-1}$ and fentanyl 3 $\mu g \cdot mL^{-1}$. Intraoperatively a 10 to 15 mL bolus of this solution was given followed by a constant infusion at a rate of 6 to 15 $mL \cdot hr^{-1}$. If postoperative analgesia was inadequate 5 mL boluses of the solution were administered and the rate of infusion increased by 2 $mL \cdot hr^{-1}$ up to a maximum rate of 20 $mL \cdot hr^{-1}$. If pain continued naproxen 500 mg was given rectally every 12 hr. The PCA and epidural protocols were maintained for at least 48-hr after surgery.

Patients' charts were analyzed for biometric data (BMI, age, gender), co-morbid diseases, the type of antibiotic given for infection prophylaxis, the duration of surgery, time in the operating theatre, the length of the patients' stay in the step down unit and the hospital. VAS scores were recorded by nurses at least twice a day, when the patients were resting. The initial VAS score was documented on the first evening after surgery. Subsequent pain scores were recorded in the morning and evening of the second and third postop-

erative day, respectively. Charts were reviewed for episodes of nausea, vomiting, pruritus or respiratory depression requiring medical treatment, time to mobilization (walking without assistance) and time to return of gastrointestinal motility (return of flatus and bowel sounds), occurrence of cardiovascular, pulmonary and infectious complications. Two weeks after surgery, the surgical wound was examined by the surgeon for wound infection, which was defined as a wound that was draining infected material requiring opening and packing.

Using pain scores as the primary outcome variable 32 patients in each group were calculated to be sufficient (one-way-ANOVA) to detect a difference of one between the highest and lowest pain scores (power: 0.90, probability of type 1 error: 0.01). Statistical comparisons of continuous variables were performed using the Kruskal-Wallis non-parametric test or the t test where appropriate. Comparisons of categorical variables were carried out using the Chi square test. Potential determinants of wound infection were analyzed using multiple logistic regression.

Results

Data from 86 patients were analyzed. There were 40 patients in the PCA group and 46 patients in the epidural group. Thirty-five patients received epidural morphine, while 11 patients received epidural bupivacaine/fentanyl. PCA and epidural analgesia were evenly distributed, i.e., the use of PCA or epidural analgesia did not vary during the study period. We observed no differences across the groups with respect to gender, age, BMI and co-morbidity (Table I). The duration of surgery was similar in the two groups (Table I). There were no differences between the groups regarding the length of stay in the step down unit or hospital. Due to epidural catheter placement patients in the epidural group spent significantly more time (20 min) in the operating room than patients in the PCA group (Table I). Pain VAS scores at rest were similar in all patients throughout the study period (Table II). Two patients in each group required supplemental naproxen treatment. Postoperative nausea and vomiting was similar in both groups (PCA group: 40%, epidural morphine: 29% or epidural bupivacaine/fentanyl: 18%, $P = 0.22$). The incidence of pruritus was similar in both groups affecting 18% of patients with PCA and 26% of patients

TABLE II Pain VAS scores at rest

Time	*PCA group*	*Epidural group*	*Morphine*	*Bupivacaine/ fentanyl*	*P*
Day of surgery					
pm	1 (1-2.5)	2 (1-2)	2 (1-2)	1 (1-2)	0.64
Postoperative day 1					
am	1 (0-2)	1 (0-2)	1 (0-2)	0 (0-2)	0.47
pm	1 (0-2)	1 (0-2)	1 (0-2)	1 (0-2)	0.51
Postoperative day 2					
am	1 (0-1)	1 (0-1)	1 (0-1)	1 (0-2)	0.45
pm	1 (0-2)	0 (0-1)	0 (0-1)	0 (0-1)	0.29

Values are median (range). VAS = visual analogue scale at rest from 0 to 5; PCA = patient controlled analgesia. *P* values refer to comparisons between the PCA and epidural group.

TABLE III PONV, pruritus, wound infection and time until ambulation and return of bowel function

	PCA group	*Epidural group*	*Morphine*	*Bupivacaine/ fentanyl*	*P*
PONV	16 (40%)	12 (26%)	10 (29%)	2 (18%)	0.22
Pruritus	8 (20%)	12 (26%)	9 (26%)	3 (27%)	0.29
Wound infection	6 (15%)	18 (39%)	14 (40%)	4 (36%)	0.01
Time until ambulation (hr)	38 ± 17	36 ± 14	36 ± 17	36 ± 12	0.48
first flatus (hr)	72 ± 17	61 ± 19	60 ± 19	62 ± 26	0.04

PONV = postoperative nausea and vomiting; PCA = patient controlled analgesia. Incidences of PONV, pruritus and wound infection are given as absolute number of patients (percentage of total patients in each group); time values are mean ± SD. *P* values refer to comparisons between the PCA and epidural group.

with epidural analgesia. Patients ambulated on average in the afternoon of the first postoperative day without showing any difference between the two treatment groups (Table III). The return of flatus in patients with epidural analgesia occurred earlier than in the PCA group (Table III). Most of the patients received cefazolin as antibiotic prophylaxis (PCA group: 77%, epidural group: 73%, a similar incidence between the two groups $P = 0.70$). Patients in the PCA group had a wound infection rate of 15%, which was lower than in patients with epidural analgesia (39%; Table III). The wound infection rate was similar in patients receiving epidural morphine (40%) and bupivacaine/fentanyl (36%; Table III).

Patients with epidural analgesia had a four times greater risk to develop a postoperative wound infection than patients with *iv* morphine [odds ratio (OR): 4.16 adjusted for gender, age, BMI, duration of surgery, incidence of diabetes, type of antibiotics, $P = 0.02$, 95% confidence interval (CI): 1.29–13.44]. The Hosmer-Lemeshow goodness-of-fit indicated that our model fit the data reasonably well ($P = 0.43$). When repeating the logistic regression analysis, with the epidural group further stratified into the two subgroups the odds of having a wound infection of patients with epidural morphine are almost 3.8 times elevated compared to patients in the PCA group (OR: 3.78, $P = 0.02$, 95% CI: 1.26–11.35). The OR of wound infection in patients receiving bupivacaine/fentanyl did not reach statistical significance (OR: 3.24; $P = 0.13$, 95% CI: 0.72–14.57).

There were no mortalities, septic or major cardiovascular complications in any of the groups. None of the patients needed naloxone for respiratory depression associated with opioid administration. One patient in the PCA group suffered from pneumonia requiring antibiotic treatment.

Discussion

The morbidity and mortality of morbidly obese patients following upper abdominal procedures is more than two and a half times higher than that of their non-obese counterparts.[14] In light of the well documented clinical advantages associated with neuraxial blockade in the non-obese patient undergoing surgery, we assumed that grossly obese patients undergoing bariatric surgery would benefit particularly from regional anesthesia techniques.[1–3] The results of our retrospective analysis do not confirm this assumption. The types of pain treatment did not affect the quality of pain control at rest, the frequency of analgesia-related side effects (pruritus, respiratory depression), and the length of hospital stay. There was a trend towards a lower incidence of nausea and vomiting in the epidural group ($P = 0.22$), possibly a consequence of the lower plasma concentration of opioids when compared with *iv* morphine analgesia.

We were surprised to find that patients receiving epidural analgesia had a four times greater risk of wound infection than subjects in the *iv* analgesia group. This difference was still valid when potentially confounding variables such as choice of antibiotics, patient demographics and co-morbidity are taken into account. This result was highly unexpected because it is commonly believed that, compared to *iv* opioid based analgesia, perioperative epidural blockade better preserves the cellular and humoral immune competence secondary to direct cytoprotective and anti-inflammatory effects and/or a more profound inhibition of neuroendocrine stress responses.[2] Furthermore, *iv* opioids *per se* have been reported to produce immunosuppressive effects in surgical patients.[15] It also contrasts with the assumption that local anesthetics, as used in the bupivacaine/fentanyl epidural group, can favourably influence wound healing through a suppression of the neutrophil release of toxic products, thereby limiting the extent of surgical tissue damage.[16,17]

We can only speculate about the factors responsible for the greater incidence of wound infections in patients receiving epidural analgesia. One explanation could be that better pain control enabled patients to move earlier and more extensively leading to less guarding and microdehiscence of the wound. It is tempting to hypothesize that a certain amount of pain during movement is "protective" after surgery, especially in the morbidly obese patient who is prone to poor wound healing. In the present study satisfactory pain control was achieved by both analgesic regimen as reflected by similar VAS pain scores at rest with only few patients requiring supplemental analgesia. However, pain levels on coughing and ambulation, which are better indicators of the quality of dynamic pain relief, could not be obtained in this retrospective analysis. Based on the results of numerous studies one would predict that dynamic pain relief was better in the epidural than in the PCA group,[2,18] although the recorded time to ambulation was identical in the two groups. Results of a previous study indicate that grossly obese patients receiving epidural morphine are more mobile at an early stage after gastroplasty than patients receiving *im* morphine.[19] It should also be noted that early mobilization after gastric bypass surgery is enthusiastically encouraged by the surgical and nursing staff in our institution. Furthermore, gastric bypass surgery is a last resort in a lifetime battle

with weight loss. Thus, the level of motivation in this patient population is very high, which may contribute to a high pain threshold and, possibly, an early recovery compared to other types of patients undergoing major abdominal surgery.

The time to first flatus was shorter in patients with epidural analgesia than in patients receiving *iv* opioids indicating a reduced duration of postoperative ileus. The earlier return of gastrointestinal motility in the epidural bupivacaine/fentanyl group is in agreement with the results of previous studies demonstrating an ileus-reducing effect with local anesthetic-opioid mixtures.[9,10] The shorter duration of ileus in the epidural morphine group, however, contrasts with the results from the majority of randomized studies showing no reduction in ileus in normal patients, who receive epidural opioids.[9,10]

We are well aware of the fact that, due to the retrospective nature of the study, the validity of our results and conclusions may be questioned. However, given the reported benefits associated with epidural analgesia in normal patients,[11] we felt compelled to perform a retrospective analysis in order to avoid the ethical dilemma of randomizing high-risk patients to PCA, a presumed suboptimal pain treatment regimen. Moreover, prospective studies involving a regional anesthetic technique in morbidly obese subjects may be compromised because of the technical difficulties associated with catheter placement, which may bias the random assignation of patients from epidural to PCA treatment.

We further have to acknowledge several limitations of this retrospective analysis such as the lack of dynamic pain scores, which were not routinely assessed by our nurses, and the relative small number of patients due to a time restricted observation period. There is also concern about the high wound infection rates of 15% in the PCA group and 39% in the epidural group, which are higher than the 1 to 10% infection rates reported in the literature. In our institution we maintain a prospective outcome database of all our bariatric surgical procedures which also records wound infections as noted by the surgeons. This rate is 17% based on 1,457 patients over the past ten years. The discrepancies between the literature wound infection rate, that recorded in our outcome database and that found in this study may reflect observer bias in documenting the infections or the definition of a wound infection. For example, a wound draining serous fluid might be recorded as a seroma by the surgeon whereas a trained infection disease practitioner may record this as infected. We have tested this hypothesis and found that an independent infection control practitioner noted a 29% wound infection rate in 123 patients operated at our institution during a one-year period (unpublished results).

We also cannot exclude the possibility of a selection bias for the type of analgesia. Some anesthesiologists may have been prompted to choose epidural analgesia rather than PCA in sicker patients, particularly in subjects with pre-existing pulmonary disease. Patients were assigned to receive epidural or *iv* analgesia according to the clinical standards established in our department during the study period: all patients scheduled for elective gastric bypass surgery were seen by an anesthesiologist in the preoperative assessment clinic at least one week before the operation. At this point the anesthesiologist explains the benefits and potential side effects of either procedure with the ultimate decision left to the patient. Even though in some patients, for example in subjects with sleep apnea or chronic obstructive pulmonary disease, some of our collegues might have actually recommended an epidural technique, the number of patients with pulmonary disease, i.e., asthma and obstructive sleep apnea, was equal in both groups. The probability of an assignment bias, therefore, seems to be unlikely.

Notwithstanding the limitations of the present analysis we would like to emphasize the economic and medical impact of our finding. Almost all patients who experience local wound infection following gastric bypass surgery develop an incisional hernia requiring readmission to the hospital and surgical intervention. Furthermore, the additional 20 min associated with epidural catheter insertion may significantly impact the number of operations that can be performed in one day.

In summary the postoperative periods of morbidly obese gastric bypass patients, treated with either neuraxial (epidural) or *iv* (PCA) administration of analgesics, were studied. The method of analgesia did not affect the quality of pain control at rest, frequency of nausea and pruritus, time to ambulation, return of gastrointestinal function, and length of hospital stay. Patients treated with PCA spent less time in the operating room and had a lower rate of wound infection. We conclude that for this unique group of patients PCA with *iv* morphine is an acceptable strategy for pain management and may confer some advantages compared to epidural analgesia.

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