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ORIGINAL CONTRIBUTIONS

Preoperative Transversus Abdominis Plane (TAP) Block with Liposomal Bupivacaine for Bariatric Patients to Reduce the Use of Opioid Analgesics

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Abstract

Introduction Postoperative pain remains the most common challenge following inpatient and outpatient surgeries, and, therefore, opioid analgesics are widely used during the perioperative period. The aim of this study is to examine the efficiency of transversus abdominis plane (TAP) block using liposomal bupivacaine in reducing the use of opioid analgesics during the perioperative period of bariatric procedures.

Material and Methods A retrospective chart review was performed on 191 patients who underwent a laparoscopic bariatric procedure between September 13, 2017, and February 26, 2018. A total of 97 patients received TAP block with liposomal bupivacaine, and 94 patients did not receive TAP block.

Results Baseline patient characteristics were comparable between the two groups. The mean age was 43.7 and 41.1 years, and the mean preoperative body mass index (BMI) was 45.6 and 46.1 kg/m^2 in TAP and non-TAP groups, respectively. In the TAP group, 65 patients (69.2%) received intravenous (IV) hydromorphone or morphine while 93 (95.9%) did in the non-TAP group ($p < 0.0001$). In the TAP group, 44 (46.8%) received oral opioid analgesic while 73 (75.3%) did in the non-TAP group ($p < 0.0001$). The odds of receiving IV hydromorphone or morphine for TAP group was about 0.10 times the corresponding odds for non-TAP group, and the odds of receiving oral opioid analgesic for the TAP group was about 0.29 times the corresponding odds for the non-TAP group.

Conclusion The use of preoperative TAP block with liposomal bupivacaine significantly decreased the use of IV and oral opioid analgesics. A larger prospective study may be needed to further validate the results.

Keywords Preoperative · Transversus abdominis plane block · Liposomal bupivacaine · Postoperative pain · Bariatric · Opioid · Narcotic

Introduction

In 1999, pain was labeled "the fifth vital sign" and subsequently, the prescribing of opioids for pain relief became a routine part of postoperative care [1]. Currently, 99% of patients who undergo a surgical procedure in the USA will receive opioids perioperatively in their treatment plan [2]. Studies show that when perioperative opioid prescribing became standard operating procedure, prescription related morbidity and mortality increased [2]. "Opioid use, however, begets opioid use," meaning patients who receive opioids in any step of their perioperative treatment are more likely to require a stronger dose of opioids to treat their pain, because of the "acute tolerance" effect of opioids [2]. "Acute tolerance" can lead to chronic dependence [1]. Due to the side effects, addiction, and mortality potential of opioid analgesics, opioid-free analgesics should be recommended for postoperative use.

Studies are now showing that many postoperative symptoms that have long been observed in the medical field are actually the adverse effects of synthetic opioids [3]. Postoperative nausea and vomiting, respiratory depression, and confusion/delirium are some of the most frequent adverse effects [3]. Fortunately, there are emerging methods to relieve pain but also minimize the amount of adverse effects seen

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postoperatively. A popular method, often used in cesarean section and abdominal surgeries, is the transversus abdominis plane (TAP) block [4]. The ultrasound-guided TAP block is a type of regional anesthetic technique involving an intervention along the anterolateral abdominal wall between the T6-L1 spinal nerves [4]. Multimodal pain regimens are used conjunctively with TAP blocks to decrease the amount of opioids consumed postoperatively [4]. Alpha-2-adrenergic-agonists are frequently used in conjunction with a TAP block to relieve pain postoperatively [2]. While the effectiveness of TAP block in reducing perioperative opioids has been reported for bariatric surgeries, the results have been controversial and the use of local anesthetics have varied across studies. The aim of this study is to examine the efficiency of preoperative ultrasound-guided TAP block with a long half-life local anesthetic in reducing the use of opioid analgesics during the perioperative period of bariatric procedures.

Methods and Materials

After institutional review board approval and following the Health Insurance Portability and Accountability Act guidelines, the authors performed a review of Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) database of 191 patients who underwent a laparoscopic or robot-assisted laparoscopic bariatric procedure. Patients who underwent non-bariatric procedures such as hiatal hernia repair were excluded. Of these, 94 consecutive patients between September 13, 2017, and November 20, 2017, did not receive TAP block, and the following 97 consecutive patients between November 21, 2017, and February 26, 2018, received ultrasound-guided TAP block. Bilateral TAP block was administered by anesthesiologists right before the procedure, along with 20 ml liposomal bupivacaine (Exparel®), an extended release formulation. Postoperatively, patients receiving TAP block also received intravenous (IV) ketorolac 15 mg every 6 h except when they had a history of ulcer or bleeding. Of the patients receiving TAP block, 48 received IV muscle relaxant motocarbamol 1000 mg every 8 h and 46 did not receive motocarbamol. A retrospective chart review was performed for these patients, noting the amount of medication each patient received during their length of hospital stay (LOS).

Laparoscopic and robot-assisted laparoscopic bariatric procedures were performed by two surgeons according to the National Institutes of Health criteria for the surgical management of morbid obesity. Both surgeons performed sleeve gastrectomy, Roux-en-Y gastric bypass, duodenal switch, and revisional procedures. After the procedure, patients were given IV hydromorphone 0.5 mg, IV morphine 2 mg, per os (PO) hydromorphone 2 mg, PO hydrocodone/paracetamol 7.5 mg/500 mg, or PO acetaminophen/codeine 120 mg/12 mg as needed.

Statistical Analysis

Demographics and perioperative variables were summarized and stratified by TAP status. Categorical variables were reported as count and frequency; continuous variables were reported as either mean and standard deviation or median and interquartile range, as appropriate. Differences between groups were assessed for statistical significance with the chi-square test for categorical variables and the two-sample t test or Mann-Whitney test for continuous variables, as appropriate. Normality assumption was checked for continuous variables. Univariable and multivariable logistic regression models were built to identify the association between TAP block and opioid analgesic use. All tests of hypotheses were two-sided and conducted at a 0.05 level of significance. All statistical analyses were performed using SAS software version 9.4 (SAS Institute, Cary, North Carolina).

Results

The baseline characteristics were comparable between the TAP group ($n = 94$) and non-TAP group ($n = 97$) (Table 1). The mean age was 43.7 years in the TAP group and 41.1 years in the non-TAP group. The mean preoperative body mass index (BMI) was 45.6 kg/m^2 in the TAP group and 46.1 kg/m^2 in the non-TAP group. Most patients underwent sleeve gastrectomy, followed by gastric bypass and duodenal switch. Median LOS was similar between the two groups ($p = 0.18$).

Amount and Frequency of Opioid Analgesics

Most patients in the non-TAP group received either IV hydromorphone or morphine during their hospital stay, while only 69.2% of patients in the TAP group did (Table 2). While the number of patients who received PO hydromorphone or hydrocodone/paracetamol was similar between the two groups, significantly greater percentage of patients in the non-TAP group received PO acetaminophen/codeine than patients in the TAP group. Looking at the frequency of medications requested during hospital stay, patients in the non-TAP group requested IV hydromorphone almost three times as many as patients in the TAP group. Likewise, patients in the non-TAP group requested PO acetaminophen/codeine almost twice as many as patients in the TAP group. Six (6.4%) patients in the TAP group did not receive ketorolac due to history of ulcer or bleeding. All six patients received IV hydromorphone or morphine during the hospital stay. Likely due to the small number of patients not receiving ketorolac, the probability of receiving IV hydromorphone or morphine was similar between patients who received ketorolac and who did not ($p = 0.09$). No differences were observed for receiving PO hydromorphone or hydrocodone/paracetamol

Table 1 Demographic characteristics of patients in TAP and non-TAP group

	TAP ($n = 94$)	Non-TAP ($n = 97$)	P value
Age (years), mean (std)	43.7 (11.4)	41.1 (10.1)	0.09
Female, n (%)	77 (81.9)	70 (72.2)	0.11
BMI (kg/m^2), mean (std)	45.6 (8.5)	46.1 (7.2)	0.69
Co-morbidities, n (%)			
Diabetes mellitus	67 (71.3)	71 (73.2)	0.88
Hypertension	44 (46.8)	43 (44.3)	0.73
GERD	20 (21.3)	15 (15.5)	0.30
Sleep apnea	33 (35.1)	34 (35.1)	0.99
Hyperlipidemia	20 (24.1)	29 (29.9)	0.17
Procedure, n (%)			
Sleeve gastrectomy	64 (68.1)	66 (68.0)	0.21
Roux-en-Y gastric bypass	11 (11.7)	19 (19.6)	
Duodenal switch	17 (18.1)	9 (9.3)	
Length of hospital stay, median (q1, q3)	2 (1,2)	2 (1,2)	0.18[a]

TAP transversus abdominis plane block, *BMI* body mass index, *GERD* gastroesophageal reflux disease

[a] Mann-Whitney test

and PO acetaminophen/codeine between patients who received ketorolac and who did not ($p = 0.41$ and $p = 0.14$, respectively).

Odds of Receiving Opioid Analgesics

In the unadjusted analysis, the odds of receiving IV hydromorphone or morphine for TAP group were about 0.10 times the corresponding odds for non-TAP group (Table 3). The odds ratio was similar when the result was adjusted for other medications (PO hydromorphone or hydrocodone/paracetamol and PO acetaminophen/codeine). The odds of receiving PO acetaminophen/codeine for TAP group were about 0.29 times the corresponding odds for non-TAP group in the unadjusted analysis. Likely, the odds ratio was similar when the result was adjusted for other medications (IV hydromorphone or morphine and PO hydromorphone or hydrocodone/paracetamol). The odds of receiving PO hydromorphone or hydrocodone/paracetamol were similar between the two groups, in both unadjusted and adjusted models.

Subgroup Analysis—Motocarbamol

As a subgroup analysis, motocarbamol was used as an exposure for possible reductions in opioid analgesic use among patients who received TAP block. However, in both unadjusted and adjusted analyses, the odds of receiving any kind of opioid analgesic were similar in patients who received motocarbamol and those who did not receive motocarbamol (Table 4).

Table 2 Number of times and number of patients receiving pain medications in TAP and non-TAP group

	TAP ($n = 94$)	Non-TAP ($n = 97$)	P value
Mean number of times receiving the medication, mean (std)[a]			
IV hydromorphone 0.5 mg	2.3 (2.7)	6.1 (9.6)	< 0.0001
IV morphine 2 mg	0.1 (0.7)	0.1(0.5)	0.24
PO hydromorphone 2 mg	0.2 (0.7)	0.4 (1.7)	0.56
PO hydrocodone/paracetamol 7.5 mg/500 mg	0.0 (0.3)	0.3 (1.6)	0.11
PO acetaminophen/codeine 120 mg/12 mg	1.2 (1.8)	2.1 (2.1)	0.0001
Number of patients receiving the medication, n(%)			
IV hydromorphone or morphine	65 (69.2)	93 (95.9)	< 0.0001
PO hydromorphone or hydrocodone/paracetamol	9 (9.6)	15 (15.5)	0.22
PO acetaminophen/codeine	44 (46.8)	73 (75.3)	< 0.0001

TAP transversus abdominis plane block, *IV* intravenous, *PO* per os

[a] Mann-Whitney test

Table 3 The odds of receiving each medication in the TAP group vs. non-TAP group

	Odds ratio	95% CI	*P* value
Unadjusted models			
IV hydromorphone or morphine	0.10	0.03–0.29	< 0.0001
PO hydromorphone or hydrocodone/paracetamol	0.58	0.24–1.40	0.22
PO acetaminophen/codeine	0.29	0.16–0.54	< 0.0001
Adjusted models			
IV hydromorphone or morphine	0.16	0.05–0.51	< 0.01
PO hydromorphone or hydrocodone/paracetamol	0.38	0.13–1.06	0.06
PO acetaminophen/codeine	0.34	0.16–0.70	< 0.01

TAP transversus abdominis plane block, *IV* intravenous, *PO* per os, CI confidence interval

Discussion

Our findings show that preoperative ultrasound-guided TAP block using liposomal bupivacaine as part of multimodal analgesia significantly decreased the use of postoperative opioid analgesics among bariatric patients. Adding motocarbamol to the formula did not have a significant impact.

Multiple studies have demonstrated that TAP block is a safe and effective component of post-operative pain control, increasing the time to first request for narcotics and reducing overall narcotic consumption [5]. The results for bariatric surgery procedures, however, are mixed. Albrecht et al. [6] performed a double-blind prospective randomized control trial comparing preoperative USG-TAP block plus trocar site injection to trocar site injection only in patients undergoing laparoscopic gastric bypass. They found no significant difference in pain severity scores or opioid consumption during the first 24 h or the 24- to 48-h interval [6]. Saber et al. [7] performed a double-blind prospective randomized control trial comparing ultrasound-guided TAP block to placebo in patients undergoing laparoscopic sleeve gastrectomy. Although, there was a decrease in pain at 3 h, there was no significant difference in pain scores at any other measured time though 30 h or postoperative opioid requirements [7]. Wassef et al. [8] performed a double-blind prospective randomized control trial comparing ultrasound-guided TAP block to no block. Although patients had significantly decreased pain scores during the first 12 h, there was no difference in opioid use [8].

Conversely, several studies have shown TAP block to be effective. Sinha et al. [9] performed a double-blind prospective randomized control trial comparing postoperative ultrasound-guided TAP block to placebo in patients undergoing laparoscopic gastric bypass [9]. Patients in the TAP block group had lower pain scores throughout the first 24 h and reduced opioid requirements at 1 h, 3 h, and overall in the first 24 h [9]. Mittal et al. [10] performed a single-blind prospective randomized control trial comparing postoperative ultrasound-guided TAP block to no TAP block in patients undergoing laparoscopic sleeve gastrectomy. Patients in the TAP block group had lower pain scores through the first 48 h and required less total doses of rescue medication [10]. Ruiz-Tovar et al. [11] performed a prospective randomized control trial comparing laparoscopic TAP block to trocar site infiltration in patients undergoing laparoscopic gastric bypass. Patients in the TAP group had significantly lower pain scores and morphine needs during the first 24 h [11].

However, all of the previously studies used local anesthetics with a half-life significantly shorter than the time frame examined. This could explain why Saber et al. [7] found a decrease in pain only at 3 h and Sinha et al. [9] had the greatest reduction in opioid requirements at 1 and 3 h. We used liposomal bupivacaine (Exparel®), an extended release formulation

Table 4 The odds of receiving each medication in the motocarbamol group ($n = 48$) vs. non-motocarbamol group ($n = 46$)

	Odds Ratio	95% CI	P value
Unadjusted models			
IV hydromorphone or morphine	0.52	0.21–1.28	0.16
PO hydromorphone or hydrocodone/paracetamol	2.05	0.48–8.73	0.33
PO acetaminophen/codeine	0.77	0.35–1.75	0.54
Adjusted models			
IV hydromorphone or morphine	0.48	0.18–1.26	0.14
PO hydromorphone or hydrocodone/paracetamol	2.65	0.56–12.62	0.22
PO acetaminophen/codeine	1.07	0.43–2.65	0.88

TAP transversus abdominis plane block, *IV* intravenous, *PO* per os, CI confidence interval

designed to be release slowly for 96 h after injection and demonstrated to be effective for up to 72 h [12]. As our median length of stay was 2 days, the effects of the TAP block should have persisted throughout the examined time period. Our finding of decreased opioid requirements is consistent with the one other study that also used liposomal bupivacaine [13], as well as a study using catheter-based 24-h infusion [14]. Said et al. [14] performed a double-blind prospective randomized control trial comparing laparoscopically placed catheter with 24 h local anesthetic infusion to control in patients undergoing laparoscopic sleeve gastrectomy. They found a significant decrease is opioid requirements and pain score in the TAP group [14]. Bhakta et al. [13] performed a retrospective chart review comparing laparoscopic TAP block with liposomal bupivacaine to laparoscopic TAP block with 0.25% bupivacaine plus post-operative PCA in laparoscopic gastric bypass and sleeve gastrectomy patients. They found a significant decrease in opioid use in the liposomal bupivacaine group over the entire hospital stay; although, there was not a significant difference in pain score [13]. These findings overall suggest that TAP block with liposomal bupivacaine may be more effective at reducing opioid requirements due to the longer duration of action resulting in more prolonged pain control. Since we started using TAP block with liposomal bupivacaine, we have not prescribed opioid analgesics when patients are discharged home. When occasionally patients complain of pain after discharge, they were able to manage the pain with gabapentin.

Potential limitations of this study are that it is retrospective and not blinded. Aside from the addition of motocarbamol to half the TAP block group, there was no change in surgical technique or the multimodal analgesic regimen at the initiation of the TAP block. All patients received scheduled IV acetaminophen and ketorolac unless contraindicated; opioids were ordered as needed. Therefore, the retrospective nature of the study should not have introduced significant bias into the results. The lack of blinding, however, could have resulted in bias. Because patients were informed that the TAP block was being performed for pain control, they may have been less likely to request opioid pain medication. Similarly, nursing staff may have been less likely to offer or encourage opioids, knowing that the patient had undergone TAP block.

Another limitation of this study is that it did not look at secondary outcomes such as pain score, nausea and vomiting, patient satisfaction, or opioid use after discharge. Nausea is one of the most frequent side effects of liposomal bupivacaine, occurring in up to 40% of patients [12]. Bhakta et al. [13] found that patients undergoing TAP block with liposomal bupivacaine required more antiemetics over the first 24 h after surgery, though this finding was not significant over the entire admission. Length of stay was found to be equal between the two groups, as it was in the other study using liposomal bupivacaine [13]. If decreasing opioid use in the inpatient setting does not translate into improved patient outcomes, then there may not truly be a benefit to liposomal bupivacaine TAP block over administration of additional opioid analgesia.

Conclusion

Our findings support the use of preoperative ultrasound-guided TAP block using liposomal bupivacaine as part of multimodal analgesia for bariatric surgery based on decreased postoperative opioid requirements. Further studies are needed to determine if this decreased opioid use translates into improved patient outcomes including decreased nausea and vomiting, shorter length of stay, improved patient satisfaction, and decreased opioid use after discharge.

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Compliance with Ethical Standards

Conflict of Interest Authors Moon, Lastrapes, Wier, Nakajima, Gaskins, Teixeira, and Jawad have no commercial associations that might be a conflict of interest in relation to this article.

Ethical Approval For this type of study, formal consent is not required.

Informed Consent Does not apply.

References

1. Bartels K, Mayes LM, Dingmann C, et al. Opioid use and storage patterns by patients after hospital discharge following surgery. PLoS One. 2016;11(1):e0147972.
2. Koepke EJ, Manning EL, Miller TE, et al. The rising tide of opioid use and abuse: the role of the anesthesiologist. Perioper Med (Lond). 2018;7:16.
3. Beloeil H, Laviolle B, Menard C, et al. POFA trial study protocol: a multicentre, double-blind, randomised, controlled clinical trial comparing opioid-free versus opioid anaesthesia on postoperative opioid-related adverse events after major or intermediate non-cardiac surgery. BMJ Open. 2018;8(6):e020873.
4. Singh R, Kumar N, Jain A, et al. Addition of clonidine to bupivacaine in transversus abdominis plane block prolongs postoperative analgesia after cesarean section. J Anaesthesiol Clin Pharmacol. 2016;32(4):501–4.
5. Ma N, Duncan JK, Scarfe AJ, et al. Clinical safety and effectiveness of transversus abdominis plane (TAP) block in post-operative analgesia: a systematic review and meta-analysis. J Anesth. 2017;31(3):432–52.
6. Albrecht E, Kirkham KR, Endersby RV, et al. Ultrasound-guided transversus abdominis plane (TAP) block for laparoscopic gastric-bypass surgery: a prospective randomized controlled double-blinded trial. Obes Surg. 2013;23(8):1309–14.

7. Saber AA, Lee YC, Chandrasekaran A, et al. Efficacy of transversus abdominis plane (TAP) block in pain management after laparoscopic sleeve gastrectomy (LSG): a double-blind randomized controlled trial. Am J Surg. 2019;217:126–32.
8. Wassef M, Lee DY, Levine JL, et al. Feasibility and analgesic efficacy of the transversus abdominis plane block after single-port laparoscopy in patients having bariatric surgery. J Pain Res. 2013;6:837–41.
9. Sinha A, Jayaraman L, Punhani D. Efficacy of ultrasound-guided transversus abdominis plane block after laparoscopic bariatric surgery: a double blind, randomized, controlled study. Obes Surg. 2013;23(4):548–53.
10. Mittal T, Dey A, Siddhartha R, et al. Efficacy of ultrasound-guided transversus abdominis plane (TAP) block for postoperative analgesia in laparoscopic gastric sleeve resection: a randomized single blinded case control study. Surg Endosc. 2018;32:4985–9.
11. Ruiz-Tovar J, Garcia A, Ferrigni C, et al. Laparoscopic-guided transversus abdominis plane (TAP) block as part of multimodal analgesia in laparoscopic Roux-en-Y gastric bypass within an enhanced recovery after surgery (ERAS) program: a prospective randomized clinical trial. Obes Surg. 2018;28(11):3374–9.
12. Candiotti K. Liposomal bupivacaine: an innovative nonopioid local analgesic for the management of postsurgical pain. Pharmacotherapy. 2012;32(9 Suppl):19S–26S.
13. Bhakta A, Glotzer O, Ata A, et al. Analgesic efficacy of laparoscopic-guided transverse abdominis plane block using liposomal bupivacaine in bariatric surgery. Am J Surg. 2018;215(4):643–6.
14. Said AM, Balamoun HA. Continuous transversus abdominis plane blocks via laparoscopically placed catheters for bariatric surgery. Obes Surg. 2017;27(10):2575–82.