Surgical Endoscopy (2019) 33:2657–2662
https://doi.org/10.1007/s00464-018-6543-z

2018 SAGES ORAL

Transversus abdominis block utilizing liposomal bupivacaine as a non-opioid analgesic for postoperative pain management

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Received: 25 April 2018 / Accepted: 15 October 2018 / Published online: 2 November 2018
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Abstract

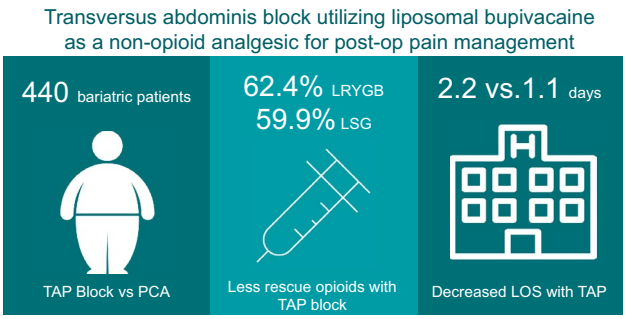
Introduction The use of non-narcotic modalities for postoperative analgesia may decrease exposure to opioids, thereby limiting their deleterious effects. The objective of this study was to determine the effectiveness of a liposomal bupivacaine transverse abdominis plane (TAP) block prior to laparoscopic sleeve gastrectomy (LSG) and laparoscopic gastric bypass (LRYGB). The primary outcome was total postoperative morphine equivalents.

Methods A single-surgeon, IRB-approved retrospective chart review was performed on consecutive patients who underwent LRYGB or LSG from 2010 to 2016. Patients were grouped according to those who received TAP blocks immediately preoperatively with rescue opioids (TAP group) and those who received PCA only (PCA group). Total parenteral morphine equivalents (PME) were calculated. Numerical pain scores were collected immediately following surgery, 12 h postoperatively, and on the day of discharge. Median length of stay (LOS) and 30-day readmissions were also calculated.

Results There were 440 patients who met inclusion criteria. The TAP group had significantly less opioid use (total PME) than the PCA, irrespective of surgical approach (70.4 ± 2.7 PCA LRYGB and 26.5 ± 1.5 TAP block LRYGB, p value ≤ 0.0001; 60.0 ± 3.5 PCA LSG vs. and 24.1 ± 2.0 TAP block LSG, p value < 0.0001). Median LOS was 2.0 days for both PCA groups, whereas LOS decreased to 1.0 day for both groups of patients receiving TAP blocks ($p < 0.0001$). Pain scores immediately following and 12 h after surgery were significantly elevated in the TAP LRYGB versus PCA LRYGB ($p < 0.05$) and immediately following surgery for PCA versus TAP block for LSG ($p = 0.0109$).

Conclusions TAP blocks with liposomal bupivacaine lead to significantly less use of parenteral morphine equivalents and decreased LOS compared to PCA alone. Pain scores were higher in the TAP LRYGB group compared to the LRYGB PCA group, with no differences in pain scores noted in the LSG groups.

Graphical abstract



Keywords TAP block · Liposomal bupivacaine · Bariatric surgery

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Opioids have been the foundation of acute postoperative pain management. Unfortunately, opioids are associated with sedation, respiratory depression, nausea, vomiting, urinary

retention, and constipation [1]. Postoperative pain management in bariatric surgery patients is especially challenging for the surgeon and anesthesiologist due to the increased risk of opioid-induced respiratory depression [2] and concomitant high prevalence of obstructive sleep apnea [3]. Non-narcotic, multimodal analgesia may help mitigate these risks by decreasing usage of perioperative narcotics [4].

A transversus abdominis plane (TAP) block is a regional anesthetic technique that targets the sensory nerves of the anterior–lateral abdominal wall. It is performed by injecting a local anesthetic into the plane between the internal oblique and the transversus abdominis muscles [5]. TAP blocks have been associated with decreased rescue opioid use after bariatric procedures [6], laparoscopic cholecystectomy [7], and cesarean section [8]. TAP blocks also decreased pain scores and length of stay in patients following robotic hysterectomy [9] and decreased pain scores following open appendectomy [10]. TAP blocks can be performed using ultrasound guidance, blindly using the "double pop" technique, or under laparoscopic guidance. Liposomal bupivacaine (Exparel™, Pacira Pharmaceuticals, Parsippany, NJ, USA) is an aqueous suspension of multivesicular liposomes containing bupivacaine. The liposomal bupivacaine allows for continuous release of bupivacaine from its liposomal carrier, theoretically extending the benefits of TAP block for up to 72 h [11].

The goals of this study were to compare the effectiveness of a liposomal bupivacaine transverse abdominis plane (TAP) block and as needed rescue opioids to opioid-only patient-controlled anesthesia (PCA) pain management in respect to total morphine equivalents received. Secondary goals of the study were hospital lengths of stay and postoperative pain scores following bariatric surgery (LRYGB and LSG).

Methods

Patient population

A single surgeon's consecutive series of laparoscopic Roux-En-Y gastric bypass (LRYGB) and laparoscopic sleeve gastrectomy (LSG) from 2010 to 2016 was identified. A priori power analysis was used to determine sufficient sample size. Patients were then randomly selected and retrospectively analyzed. Approval was received from the Institutional Research Board at Carolinas Healthcare System. All procedures were performed at an American College of Surgeons' accredited "Center of Excellence."

Postoperative pain management

From 2010 to 2015, the surgeon's standard postoperative analgesic protocol consisted of a PCA, which was changed to PRN oral Lortab on the morning of postoperative day 1 (PCA group). Starting in 2016, patients received a preoperative Exparel TAP block and postoperative PRN IV (rescue) morphine, which was changed to PRN Lortab the next morning (TAP group). Both groups received IV acetaminophen (Ofirmev®, Mallinckrodt Pharmaceuticals, St. Louis, MO, USA) 1000 mg every 6 h for the first 24 h. Neither group was treated with toradol. Patients were identified by CPT codes 43644 (LRYGB) and 43775 (LSG) and stratified into a TAP block or PCA group.

Operative technique

The TAP block was performed in the preoperative area by an anesthesiologist. Patients were in the supine position with the head of bed approximately 30°. A bilateral T10–T12 TAP block was performed with the use of ultrasound and a 21-gauge, 90-mm needle, under aseptic technique (Fig. 1). The local anesthetic was a combination of 20 mL of liposomal bupivacaine, 20 mL 0.5% bupivacaine, and 40 mL of injectable normal saline for a total volume of 80 mL. 40 mL was injected on each side of the abdominal wall. This was performed with ultrasound guidance to inject the anesthetic between internal oblique and the transverse abdominis. The components and volumes of anesthetic were standardized. However, the blocks were performed by different anesthesiologists.

Variables

Data abstracted from the electronic medical record included age, gender, and BMI. Outcomes of interest included pain scores on an 11-point (0–10) numerical rating scale, hospital length of stay, 30-day readmissions, and 90-day mortality. Total parenteral morphine equivalents (PME) were calculated for each patient for their entire admission. Hospital lengths of stay were calculated from the day of surgery to the time of discharge. All patients were followed to capture 30-day readmission and 90-day mortality rates. All postoperative narcotics used were converted using a standard opioid equivalence chart to milligrams of IV morphine [12].

Statistics

Statistical analysis was performed by using SAS 9.4 (SAS Institute, Cary, NC, USA). Student's t test (parametric), Mann–Whitney test (non-parametric), and Chi-square test were performed where appropriate. A p value < 0.05 was considered significant.

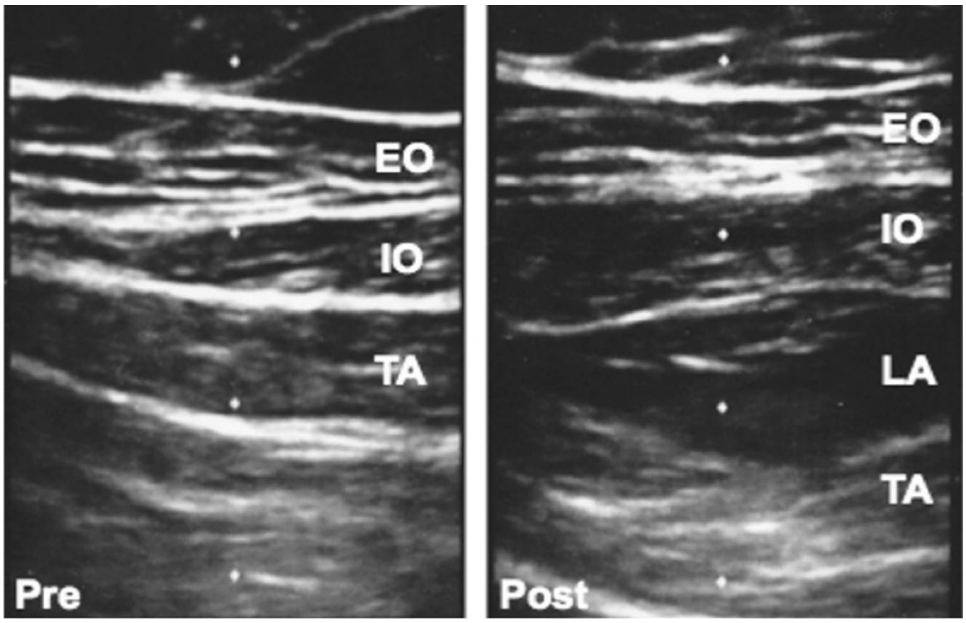

Fig. 1 Ultrasound-guided TAP block pre and post injection. *EO* external oblique, *IO* internal oblique, *TA* transversus abdominis, *LA* local anesthetic

Table 1 Patient demographics

	RYGB		*p* value	LSG		*p* value
	PCA	TAP		PCA	TAP	
n	147	106	0.7452	82	105	0.6920
Age	48.2 ± 1.0	49.0 ± 1.0	0.5484	45.31.0	47 ± 1.1	0.2263
Gender (% female)	80.4	82.2	0.7452	82.9	85.4	0.6920
Race (%)						
Caucasian	60.5	59.4	0.0688	57.3	56.2	0.5925
African American	36.7	37.7		40.2	41.0	
Hispanic	2.7	0		0	1.9	
Other	0	2.8		2.4	0.9	
BMI	45.7 ± 0.54	46.4 ± 0.40	0.2552	44.1 ± 0.33	43.9 ± 0.57	0.2639

Results

There were a total of 1328 patients who met inclusion criteria for the study period and 440 of these (LRYGB, $n = 253$; LSG, $n = 187$) were randomly selected for further analysis. Patients in both the PCA and TAP block groups had similar age, racial composition, percentage of female and male patients, and BMI, regardless of surgical approach (Table 1).

The TAP group had significantly less opioid use (total PME) than the PCA, irrespective of surgical approach (70.4 ± 2.7 PCA LRYGB and 26.5 ± 1.5 TAP block LRYGB, p value ≤ 0.0001; 60.0 ± 3.5 PCA LSG vs. and 24.1 ± 2.0 TAP block LSG, p value < 0.0001) (Fig. 2). Immediately after surgery, patients receiving a TAP block in the LRYGB group had higher mean pain scores than patients in the PCA LRYGB group (7 vs. 5, p value < 0.0001). This significant difference in mean pain scores in LRYGB patients persisted at 12 h after surgery (PCA: 4 vs. TAP: 6, p value = 0.0003) (Fig. 3A, B). There

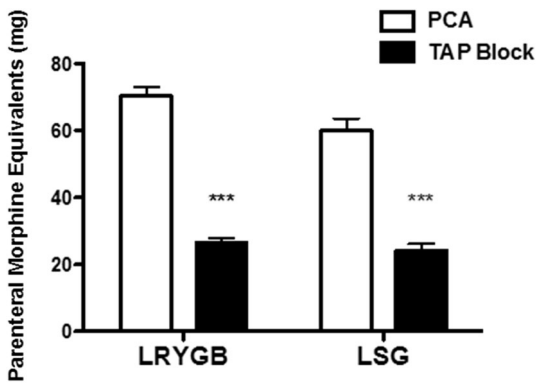

Fig. 2 Total parenteral morphine equivalent (TAP vs. PCA)

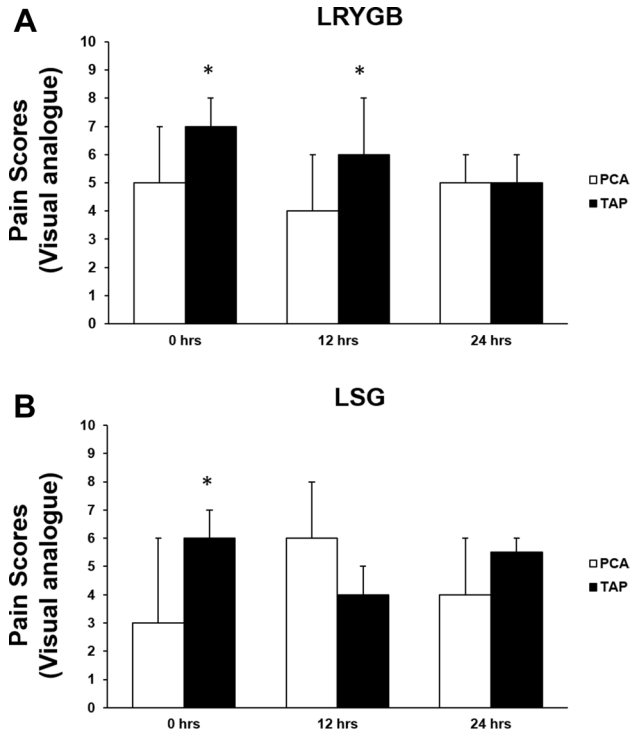

Fig. 3 Postoperative pain scores: PACU (T0), 12 h and 24 h. **A** When compared to RYGB PCA, patients with TAP block RYGB had significantly increased pain scores at T0 and 12 h postoperatively. **B** Patients with LSG PCA had significantly elevated pain scores compared to TAP block at T0 postoperatively (*$p < 0.05$)

was a significant difference in pain scores immediately after surgery between the PCA and TAP LSG groups ($p = 0.0109$); however, there was no difference in pain scores at 12 h post surgery between the two TAP and PCA LSG groups (Fig. 3A, B). There were no statistically significant differences between all groups for pain scores obtained 24 h postoperatively (Fig. 3A, B).

A significant reduction in LOS was also observed for patients receiving TAP block compared to PCA management for both LRYGB and LSG (2.2 ± 0.1 days PCA LRYGB: vs. 1.1 ± 0.1 TAP LRYGB, $p < 0.0001$) and (1.8 ± 0.1 PCA LSG vs. 1.1 ± 0.1 TAP PCA, $p < 0.0001$) (Fig. 4A). No significant difference was observed for 30-day readmissions for either pain management group regardless of surgical approach [5.6% PCA LRYGB vs. 5.71% TAP block LRYGB ($p = 0.7884$) and 4.9% PCA LSG vs. 1.0% TAP block LSG ($p = 0.1703$)] (Fig. 4B). There was no 90-day mortality reported in any group. Patients with TAP block were more likely to have missing or unreported pain scores across all time points for both LRYGB and LSG compared to patients with PCA for pain control ($p < 0.05$) (Fig. 5A, B).

Discussion

This is the first study evaluating the use of a preoperative ultrasound-guided TAP block with liposomal bupivacaine for postoperative pain control in patients undergoing bariatric surgery. The primary goal of this study was to compare the effectiveness of TAP blocks utilizing liposomal bupivacaine and narcotic use in postoperative bariatric surgery patients. There was a statistically significant decrease in total morphine equivalents in patients who received a TAP block compared to those who had a PCA in both groups.

This study is limited due to being retrospective and not randomized. It does present a seemingly inconsistent result in that patients undergoing a TAP block and a LRYGB had higher pain scores yet lower PME than the PCA group. This dichotomous result may in part be explained by the inconsistent collection and recording of patient pain scores. The difference in IV narcotic delivery is another potential confounding factor in this study. Unlike the PCA group, the TAP group received PRN IV narcotics and this

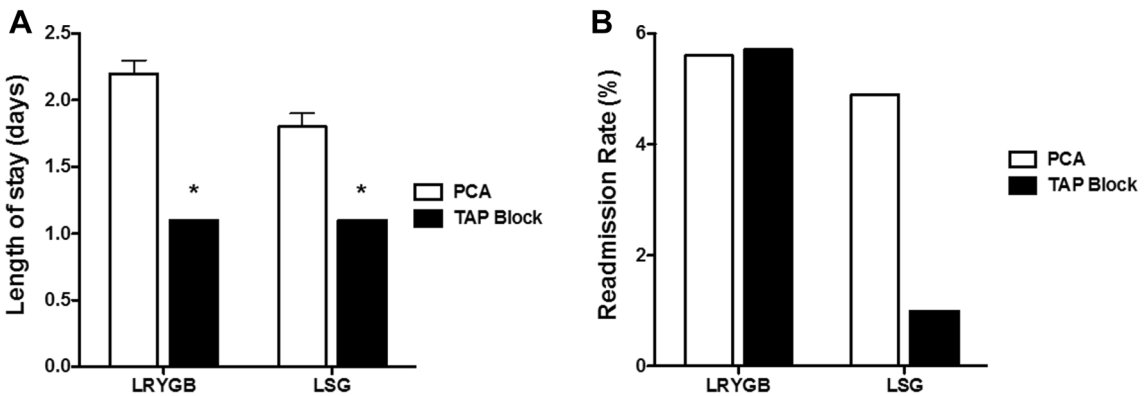

Fig. 4 Length of stay (TAP vs. PCA) and readmission rate. **A** RYGB and sleeve TAP block patients had significantly decreased lengths of stay when compared to the PCA groups. **B** There were no significant differences in readmission rate for either PCA or TAP block group irrespective of procedure type

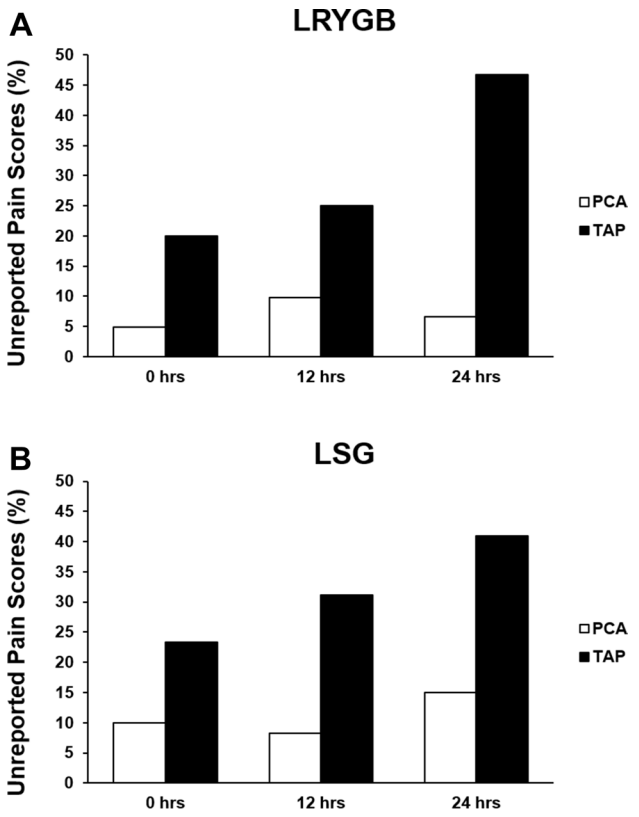

Fig. 5 Unreported pain scores (TAP vs. PCA). LRYGB (**A**) and LSG (**B**) patients with preoperative TAP block were more likely to have missing or unreported pain scores across all time points compared to the RYGB and LSG PCA patients

difference in availability of narcotics may have affected narcotic usage. This study found as a secondary endpoint that length of stay was decreased in the TAP block group. The study design was not able identify specific factors to account for this, however, decreased side effects from opioids allowing for earlier ambulation is a potential explanation.

Patients in the TAP group were more likely to have unreported or missing pain scores in the medical record at all time points compared to the PCA group of patients. There was not a significant difference in pain control between the groups at 24 h. The TAP block group had a statistically significant difference in being a younger group of patients. It is possible that younger patients have higher use of narcotics. This theory is supported by Gagliese et al., who found that morphine intake was higher in patients who were younger [13].

There is not a study published that compares the cost of TAP versus PCA. The cost of an ultrasound-guided TAP block may be more than PCA, however, this may be justified by the decreased usage of opioids and potential decreased post-discharge dependence of opioids. The cost savings of decreased length of stay and eliminating PCA were not addressed in this study and therefore no conclusions can be stated.

Bhakta et al. arrived at a similar conclusion to our study after studying bariatric surgery patients who had laparoscopic-guided liposomal bupivacaine TAP blocks with needed narcotics versus intraoperative injections of 0.25% bupivacaine and a postoperative narcotic PCA [6]. These investigators found that patients who had a TAP block performed required significantly less narcotics during the hospital stay [6]. Previous studies have also confirmed that ultrasound-guided TAP blocks reduce total morphine use in the recovery room [14] and at 24 h from surgery [14, 15]. Albrecht and colleagues found no difference in opioid consumption postoperatively when TAP blocks were performed; however, their TAP block was performed with 0.25% bupivacaine with 1:200,000 epinephrine [16]. The use of liposomal bupivacaine in our study may overcome the shorter, 3–7 h duration of action of non-liposomal bupivacaine [17].

In conclusion, this retrospective study suggests that liposomal bupivacaine used in a TAP block may be a useful method to provide an adjunct to postoperative pain control in bariatric surgery patients. It is associated with decreased total morphine equivalent use and decreased hospital lengths of stay. Although this study did not demonstrate a decrease in pain scores postoperatively, this may have been limited by the collection methods utilized. Additional prospective studies with strict adherence to pain score collection methods are recommended to further delineate the potential improvement in postoperative pain management in this patient population.

Compliance with ethical standards

Disclosures Keith Gersin: Receives personal fees outside the submitted work for being a speaker for WL Gore,GI Dynamics, and Pacira pharmaceuticals. Timothy Kuwada: Receives personal fees outside the submitted work for being a speaker for WL Gore and Bard. Susan Bear: Personal fees from Pacira Pharmaceuticals outside of submitted work. Thomas Robertson, Kyle Thompson, and Kathryn Hall have no conflicts of interest or financial ties to disclose.

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