Impact of liposomal bupivacaine transversus abdominis plane blocks on patient outcomes in minimally invasive colorectal surgery

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ABSTRACT

Background and Objectives: *As part of enhanced recovery after surgery protocols, there has been an increased interest in improving analgesic techniques. This study compares the efficacy of liposomal bupivacaine transverse abdominis plane blocks on outcomes in colorectal surgery patients.*

Methods: *This retrospective study compared patients who had minimally invasive colorectal surgery and perioperative liposomal bupivacaine blocks with patients who did not receive this block on post-operative outcomes, including lengths of stay, opioid consumption, and post-operative pain scores.*

Results: *The mean length of stay in the control group was 4.79 days; in the liposomal bupivacaine group, it was 4.14 days (p = 0.011). There were no differences in opioid use, acetaminophen use, or pain scores in these 2 cohorts. There was a decrease in NSAID use in the liposomal bupivacaine group.*

Conclusion: *This study shows that liposomal bupivacaine blocks can improve some post-operative outcomes in minimally invasive colorectal surgery patients, especially by decreasing length of stay and possibly by decreasing use of other analgesics.*

Keywords: Minimally invasive surgical procedures; analgesics, nerve block; post-operative pain management; bupivacaine

INTRODUCTION

Enhanced recovery after surgery (ERAS) protocols, first described in cardiac surgery, have evolved to become a mainstay in preoperative, perioperative, and post-operative care in surgical patients.[1] Selection of post-operative analgesia is a major component of ERAS. Although thoracic epidural analgesia provides good post-operative pain control for abdominal laparotomies, post-operative pain for laparoscopic procedures has traditionally been managed with multimodal oral analgesia, including opioids.[2,3,4,5] This presents a challenge in surgical patients, as opioids at prescribed doses have been associated with dependency, increased tolerance, overdose, and death.[6,7,8,9] Studies have shown low risk surgeries to be one of the most common reasons for first-time prescription of opioids with an increased risk of transitioning to chronic opioid use.[10,11,12,13,14] Thus, finding alternative pain management options to reduce the frequency of prescribed opioids remains a core goal of modern post-operative patient care. In recent years, the transversus abdominis plane (TAP) block has become part of standard ERAS pain management protocols. First described by Rafi in 2001, the TAP block technique involves injection of local anesthetic through the lumbar triangle between the transversus abdominis and internal oblique muscles.[15,16,17,18] Studies have shown that TAP blocks are an effective post-operative analgesic for a wide variety of abdominal wall surgeries. Furthermore, when compared to standard post-operative epidural anesthesia, there is evidence that TAP blocks are similarly

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effective in pain control, while epidural anesthesia is associated with increased risk of developing side effects, such as nausea and hypotension.[19,20,21,22] However, the short half-lives of conventional local anesthetics, such as ropivacaine and bupivacaine, have led to research on longer-acting TAP block formulations.[22,23,24,25] Liposomal bupivacaine, Exparel®, a longer-acting slow release anesthetic formulation, has become increasingly used in TAP blocks as part of a multimodal approach to pain management.[26,27,28,29] However, there are conflicting data on the efficacy of Exparel® TAP blocks versus traditional local anesthetics.[30,31,32,33,] Thus, we conducted a retrospective study comparing the efficacy of Exparel® TAP blocks in reducing hospital length of stay, opioid use, and post-operative pain scores in patients undergoing minimally invasive abdominal surgeries.

Methods

This multi-center, retrospective study included patients from two different health care hospital systems: Northwest Texas Healthcare Systems in Amarillo, Texas, and BSA Health System in Amarillo, Texas. Patients aged 18 to 89, admitted for colorectal surgery between January 1, 2017, and September 20, 2019, were included in the study. Patients were identified using electronic medical record platforms based on ICD-10-PCS codes or CPT codes. The inclusion criteria included patients who underwent minimally invasive colorectal surgeries, either laparoscopic or robotic. Patients who underwent open abdominal surgeries were excluded. Patients who had combination surgeries and underwent both abdominal and extra-abdominal surgeries during same hospital stay were also excluded. Chart reviews were done in two respective different electronic medical record platforms to collect data. There was a total of 241 patients included in the study. This set was divided into a control group and experimental group. The control group included patients who underwent minimally invasive colorectal surgery without liposomal bupivacaine TAP block. The three primary outcomes were length of stay, opioid use, and pain control. The three secondary outcomes were acetaminophen use, NSAID use, and post-operative complications. Opioid use during post-operative day 1 and post-operative day 2 were recorded, and all the opiates were then converted to morphine milligram equivalents. The length of stay calculations used the day of admission as day one and day of discharge as the last day of stay. Pain control was measured by using a 0 to 10 numeric pain scale, with zero being no pain and 10 being maximal pain. Acetaminophen use by measuring amount of acetaminophen used in grams on post-operative day 1 and post-operative day 2. NSAID use was measured by whether the patient also used NSAIDs for pain control in post-operative day 1 or day 2 of care. The level of post-operative complications during hospital stay was measured using the Clavien-Dindo grading scale. [34]

Statistical Analysis

Results were summarized as mean (standard deviation), median (inter-quartile range), and frequency (percentages). The differences between the 2 groups were analyzed using Wilcoxon rank sum tests and Fisher exact tests. P values < 0.05 were considered statistically significant. All the analyses will be conducted using SPSS version 25 or SAS version 9.4 (Cary, NC) or R package with the assistance of biostatisticians.

Results

The control group included 57 patients (19.2% men) with a mean age of 58 years. The experimental group included 184 patients (45% men) who underwent minimally invasive colorectal surgery with a liposomal bupivacaine TAP block. The mean age of patients in the study group was 57 years. The overall racial/ ethnic distributions included 79.4% white patients, 5.8% black patients, 0% Hispanic patients and 14.7% other races. The percentage of abdominal laparoscopic procedures was 52%, robotic abdominal surgeries was 2.3%, combination laparoscopic and robotic surgeries was 44%, and minimally invasive colorectal surgeries 0%. The mean LOS for the control group was 4.79 ± 3.29 days; for the experimental group, it was 4.14 ± 3.87 days ($p = 0.011$) (Table 1).

Assessment of the bupivacaine TAP block pain control involved recording the cumulative use of analgesics, including opioids, acetaminophen, and NSAIDs, on post-operative days 1 and 2. There was a trend toward reduced opioid use in the experimental group (43.1 ± 47.3 morphine milligram equivalents [MME] compared

Table 1. Length of Stay

LOS (days)	Control Group, N = 57	Exparel ®TAP Group, N = 184	p-value
Mean (SD)	4.79 (3.29)	4.14 (3.87)	
Median (IQR)	4.00 (3.00, 6.00)	3.00 (2.00, 4.25)	Wilcoxon rank-sum test 0.011
Range	1.00, 16.00	1.00, 25.00	

to 52.2 ± 67.9 MME in the control group), but this difference did not reach statistical significance (Table 2). The control group had higher acetaminophen use (2.96 ± 2.12 grams) on post-operative days 1 and 2 than the experimental group (2.57 ± 1.95 grams), but this difference was not statistically significant. Seventy-seven percent of control group patients required NSAIDs for pain control compared to 45% of patients in the experimental group ($p < 0.001$).

Post-operative complications were evaluated using the Clavien-Dindo classification system with no substantial differences between the control and experimental groups (Table 3). The distribution of pain scores is recorded in Table 4.

Discussion

This study compared the outcomes of patients undergoing minimally invasive colorectal surgery with and without liposomal bupivacaine TAP blocks. The goal was to evaluate the lengths of hospital stay, analgesic use, post-operative complications, and pain scores in the control group (without TAP block) and the experimental group (with TAP block). The larger size of the experimental group (184 patients) compared to the control group (57 patients) was due to the evolving standards in surgical practices, particularly the implementation of Enhanced Recovery After Surgery (ERAS) protocol that emphasizes multimodal pain management

Table 2. Analgesia Use

Drug	Control Group, N = 57	Exparel® TAP Block Group, N = 184	p-value
Opioid dose			Wilcoxon rank-sum test 0.95
N	57	184	
Mean (SD)	52.15 (67.93)	43.10 (47.37)	
Median (IQR)	33.33 (5.20, 55.00)	30.00 (10.94, 58.12)	
Range	0.00, 350.00	0.00, 275.00	
Acetaminophen			Wilcoxon rank-sum test 0.16
N	56	184	
Mean (SD)	2.96 (2.12)	2.57 (1.95)	
Median (IQR)	3.00 (1.00, 5.00)	2.00 (1.00, 4.00)	
Range	0.00, 7.65	0.00, 9.00	
(Missing)	1	0	
NSAID use			Pearson's Chi Square Test <0.001
No	13/56 (23%)	101/184 (55%)	
Yes	43/56 (77%)	83/184 (45%)	
(Missing)	1	0	

Table 3. Post-operative Complications

Clavien-Dindo Grade	Control Group, N = 57	Exparel® TAP Block Group, N = 184	p-value
1	43/57 (75%)	145/184 (79%)	
2	7/57 (12%)	21/184 (11%)	Fisher's Exact Test 0.82
3	5/57 (8.8%)	13/184 (7.1%)	
4	1/57 (1.8%)	4/184 (2.2%)	
5	1/57 (1.8%)	1/184 (0.5%)	

and reduced opioid use. This significant shift in practice likely resulted in more patients receiving the TAP block treatment during the study period.

The key finding is the statistically significant reduction in the length of hospital stay for patients who received the TAP block compared to those who did not receive the tap block. This reduction of nearly half a day should reflect improved patient comfort, reduced pain scores, and faster recovery, but also has potential financial implications associated with shorter hospital stays.

When analyzing the cumulative opioid usage on post-operative days 1 and 2, there was a trend showing lower opioid consumption in the TAP block group (43.1 ± 47.3 MME) compared to the control group (52.2 ± 67.9 MME), but this difference did not reach statistical significance. A similar trend was observed with the use of acetaminophen with non-significant reductions in the use in the TAP block group compared to the control group. The data showed that that 77% of patients in the control group required NSAIDs for pain control, but only 45% of patients in the experimental group requested NSAIDs (p-value < 0.001). The decreased use of NSAID could prevent adverse drug effects, such as renal insufficiency and post-operative anastomotic bleeding during their hospital stay.[35]

There may be two factors contributing to the lack of significance in the differences between the 2 groups the use of narcotics and acetaminophen. The first is the small number of patients in the control; the second is the way these particular data were collected. The mean LOS was 4–5 days in both the control and experiment,

Table 4. Pain Scores

Postoperative Pain Score (0–10)	Control Group, N = 26	Exparel® TAP Block Group, N = 61	p-value
0	5/26 (19%)	10/61 (16%)	
1	2/26 (7.7%)	5/61 (8.2%)	Fisher's exact test 0.73
2	4/26 (15%)	9/61 (15%)	
3	9/26 (35%)	11/61 (18%)	
4	0/26 (0%)	5/61 (8.2%)	
5	2/26 (7.7%)	4/61 (6.6%)	
6	2/26 (7.7%)	4/61 (6.6%)	
7	1/26 (3.8%)	3/61 (4.9%)	
8	1/26 (3.8%)	8/61 (13%)	
9	0/26 (0%)	2/61 (3.3%)	

while the cumulative opiate use was only calculated for post-operative days 1 and 2. The pain alleviating effects of bupivacaine can last for up to 3 days, and, theoretically, if the cumulative opiate dose calculated also included postoperative day 3, there could be a larger difference in the use of opioids by the control group.[36]

Post-operative complications scored with the Clavien-Dindo classification system were similar between the control and TAP block groups, suggesting that the TAP block did not significantly reduce the incidence of complications.[37] The study also attempted to evaluate pain scores as a marker of pain control, but these results did not reach statistical significance. The time period of the study and challenges in standardizing pain assessment methods between institutions, including differences in timing of pain score collection and subjectivity in pain perception, are potential reasons for the lack of significance in these findings.

Limitations

Pain scales were difficult to standardize as pain control is a very subjective process. Pain scores were taken immediately after surgery and the process of obtaining pain scores can be challenging to standardize between institutions. The timing of the data period for this current study was during the implementation of the ERAS protocol in a rural setting and the average length of stay was longer than current national averages. Patients in rural medical centers have to travel longer distances, may have reduced socioeconomical support to obtain care, and often have longer hospital lengths of stay. It was very difficult to standardize the timing that pain scores were taken between different institutions, and it was challenging to collect the pain scores and standardize them to a particular time period for this study.

Conclusions

This retrospective study suggests that the use of liposomal bupivacaine TAP blocks in minimally invasive colorectal surgery leads to a statistically significant decrease in length of stay and statistically significant decrease in the need for adjunct use of NSAID for post-operative analgesia. This study also indicates the need for more research with larger patient numbers to optimize TAP block protocols, as the study showed that while the liposomal bupivacaine TAP block group did have decreased opioid use and acetaminophen use, the data did not reach statistical significance. Pain scores and post-operative complication rates were similar between the two groups. More randomized multi-institutional studies are needed to characterize differences in outcomes for patients receiving TAP blocks.

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