


The use of bilateral transversus abdominis plane blocks with liposomal bupivacaine on postoperative cesarean delivery patients during COVID-19 pandemic is associated with reduced narcotics use and reduced length of stay

Women's Health
Volume 17: 1–6
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DOI: 10.1177/17455065211058046
journals.sagepub.com/home/whe


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Abstract

Background: The use of transversus abdominis plane blocks has been previously shown in both large-scale studies and our own institution to significantly reduce postoperative pain and opioid use. In addition, the use of bilateral transversus abdominis plane blocks using liposomal bupivacaine in combination with neuraxial morphine significantly reduced post-cesarean-delivery pain and opioid use. During the COVID-19 crisis, our anesthesia department in a collaborative effort with our obstetric colleagues thought that the use of bilateral transversus abdominis plane blocks with liposomal bupivacaine could reduce the use of opioids to treat postoperative pain and might result in decreased length of stay.

Methods: After institutional review board approval, a retrospective study of 288 patients who underwent cesarean delivery under spinal or epidural (neuraxial) anesthesia at Maimonides Medical Center in Brooklyn, NY was conducted. Historical controls were from 142 consecutive patients from 1 January 2012 through 12 May 2012. An additional set of controls consisted of 30 consecutive patients from 10 March 2020 through 13 April 2020. The primary outcome data analyzed were the use of opioids and length of stay.

Results: Post cesarean delivery, patients who received both bilateral transversus abdominis plane blocks with liposomal bupivacaine and neuraxial morphine was associated with a significant decrease in the number of patients using post operative opioids, 54%–60% decreased to 18% ($p < 0.001$), and a decreased length of stay; 3.1 days was reduced to 2.39 ($p < 0.001$).

Conclusion: Neuraxial opioids combined with liposomal bupivacaine transversus abdominis plane blocks provided significant pain relief for patients post cesarean delivery, required less post operative opioids, and facilitated earlier discharge that may aid in reducing patient exposure and hospital burden secondary to COVID-19.

Keywords

analgesia, bupivacaine, length of stay, liposomal bupivacaine, post-cesarean delivery pain

Date received: 26 May 2021; revised: 6 October 2021; accepted: 12 October 2021

Introduction

During the COVID-19 pandemic and hospital surge, the priorities of the hospital and patient care shift, particularly with pregnant patients. During the intense COVID-19 surge at our hospital, in an attempt to safely discharge post-cesarean delivery patients as early as possible to minimize exposure to the virus, we instituted the routine use of

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liposomal bupivacaine containing transversus abdominis plane (TAP) blocks, a technique that some of our practitioners had used previously with good success in reducing opioid use. In medically uncomplicated cesarean deliveries, it was reasoned that patients who did not need opioids for pain control could be safely discharged home earlier.

For pregnant patients who underwent cesarean delivery, bilateral TAP blocks with liposomal bupivacaine were administered in addition to the preservative-free morphine administered via neuraxial anesthesia for postoperative pain. In multiple studies, TAP blocks have been shown to provide successful, extended postoperative pain relief for incisions on the mid and lower abdominal wall, particularly for gynecologic and abdominal procedures.¹⁻⁴ Previous studies have also shown that TAP blocks with bupivacaine plus liposomal bupivacaine (a long-lasting bupivacaine), provide 2–4 days of postoperative pain relief and decreased postoperative opioid use.^{5,6} However, there has been limited data on the comparison between neuraxial administration of preservative-free morphine plus the addition of bupivacaine-only bilateral TAP blocks or neuraxial morphine combined with liposomal bupivacaine bilateral TAP blocks. Although there was an impetus to expedite patient discharges during the COVID crisis, we hypothesize that the combination of neuraxial preservative-free morphine with bupivacaine plus liposomal bupivacaine TAP blocks will result in extended postoperative pain control with decreased opioid use, which can facilitate safe early discharge from the hospital. The objective of our study was to compare neuraxial morphine (with and without bupivacaine TAP blocks) to neuraxial morphine with TAP blocks containing both bupivacaine and liposomal bupivacaine for providing post operative analgesia and early discharge in patients undergoing cesarean delivery.

Methods

This study was a retrospective case review of patients who underwent cesarean delivery under spinal or epidural anesthesia at Maimonides Medical Center in Brooklyn, NY. Approval from the institutional review board (IRB) committee was obtained to review charts.

Data collection

Data were collected from three different sets (Figure 1):

Set 1: patients who received only neuraxial preservative-free morphine (60 patients) or neuraxial preservative-free morphine and bupivacaine (regular 0.25%) TAP blocks (82 patients). In 2013, the anesthesiology department started performing multiple TAP block studies on this patient population using different concentration of bupivacaine. Therefore, we chose our historical consecutive data to begin on 1 January 2012.

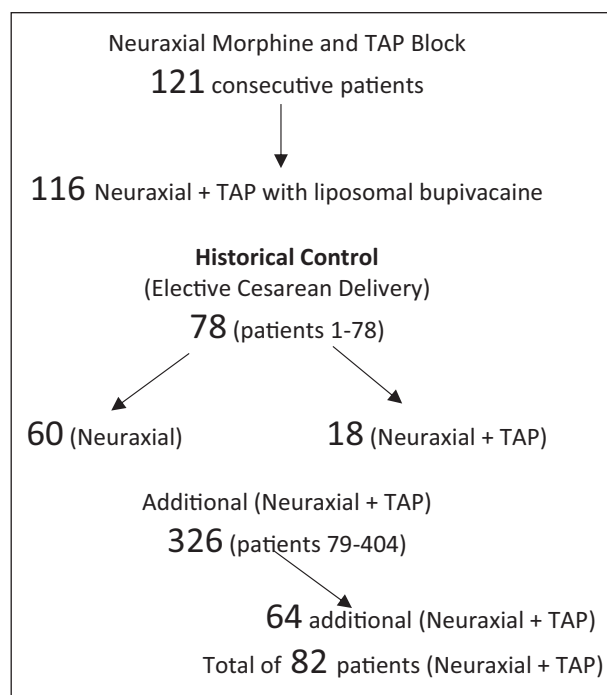


Figure 1. Selection of charts for study. Starting on 14 April 2020 through 1 June 2020, 121 consecutive patient charts were identified where the patients had a cesarean delivery using neuraxial anesthesia with neuraxial morphine and bilateral TAP blocks. If the patient's TAP block note did not specifically state the use of liposomal bupivacaine, the patient was excluded. Historical controls were obtained using consecutive patient charts starting 1 January 2012. Sixty charts were identified that had neuraxial anesthesia with neuraxial morphine and no TAP block. An additional 326 charts were reviewed to obtain a total of 82 charts of patients who had neuraxial anesthesia with neuraxial morphine plus bilateral TAP blocks.

Patients who received TAP blocks with other than 0.25% bupivacaine were excluded.

Set 2: Since it could be argued that they were discharged early because of the COVID pandemic, another set of patients included 30 consecutive patients for cesarean delivery from 10 March 2020–13 April 2020, who delivered during the start of the severe COVID pandemic surge at our hospital, who received bupivacaine 0.25% only TAP blocks.

Set 3: included 116 consecutive patients during the period from 14 April 2020–1 June 2020 who consented and received neuraxial morphine plus bupivacaine combined with liposomal bupivacaine TAP blocks. Patients who did not consent to a TAP block were excluded as were patients who had tested positive for COVID-19.

Treatment groups definitions

It should be noted that every patient received neuraxial morphine. Throughout the article, we will refer to the

group of patients as NM if they only received neuraxial morphine. TAP-Bupi=Patients who received neuraxial morphine and a TAP block with 0.25% bupivacaine. TAP-Lipo=Patients who received neuraxial morphine and a TAP block with both 0.25% bupivacaine and liposomal bupivacaine.

The description of the procedure for group 3 patients undergoing elective cesarean delivery: After obtaining informed consent and a negative COVID-19 PCR test, patients received either spinal or epidural anesthesia for their cesarean delivery anesthesia. The spinal included hyperbaric bupivacaine 0.75%, fentanyl 15 mcg, and preservative-free morphine 0.1 mg; Epidural anesthesia included 25 mg lidocaine with epinephrine and preservative-free morphine 1 mg. Immediately after surgical closure, each participant received ultrasound-guided bilateral TAP blocks as previously described⁷ with 15 mL of 0.25% bupivacaine and 10 mL of liposomal bupivacaine (266 mg/20 mL; 13.3 mg/mL) on each side. Confirmation of proper TAP block placement was determined by separation of the transversus abdominis muscle from the internal oblique muscles with 2–3 mL of 0.25% bupivacaine via real-time ultrasound visualization. The remainder of the 0.25% bupivacaine and liposomal bupivacaine was then injected into the ultrasound-confirmed plane. There were no recorded complications in all patients who received a TAP block.

All subjects had medication orders to receive intravenous (IV) Acetaminophen as needed (p.r.n.; in the post-anesthesia care unit (PACU)), 30 mg of ketorolac as needed for mild to moderate pain as well as—one to two tablets of oxycodone (5 mg)/acetaminophen (325 mg) per os (p.o.) p.r.n. for severe pain. Subjects were evaluated for postsurgical pain after Cesarean delivery using an NRS 11-point scale (0–10) throughout their hospital stay. The amount of opioid administered within 24 h; 24–48 h; 48–72 h; and > 72 h post-surgery was recorded. Date and time of hospital discharge was also collected. The hospital length of stay was calculated as the time of arrival in the PACU until the hospital discharge time. Primary outcome data were the use of opioids and length of stay.

Sample size and statistical analysis

Using the statistical analysis from previous studies, if 60% of patients used opioids postoperatively, we should have a power > 80% with and α 0.05 if we examined approximately 60–80 charts to explore the data for differences in opioid use of 50%.

The liposomal bupivacaine patient subset during the COVID crisis, included 116 consecutive patients during the period from 14 April 2020–1 June 2020 that received neuraxial morphine plus bupivacaine combined with liposomal bupivacaine TAPs. Patients who did not consent to TAP blocks were excluded as were patients who had tested

positive for COVID-19. The control group, during this period (patients who only received neuraxial morphine.) consisted of 60 patients.

Since a possible explanation for the shorter lengths of stay is that the patients wanted to leave the hospital as early as possible to decrease their exposure to COVID-19 infection. A second group of patients included 30 consecutive patients for cesarean delivery from 10 March 2020–13 April 2020, who delivered during the start of the severe COVID pandemic surge at our hospital, who received bupivacaine 0.25% only TAP blocks. Examining 30 charts we should have a power of > 80% with and α 0.05 to see a decrease in length of stay from 3 days to 2 days.

For continuous linear data, we used the Student's *t*-test, where $p < 0.05$ was considered significant. A Chi-square test was used to compare two categorical variables, that is, use of narcotic versus non-use of opioid, or overnights = 2 days versus overnights > 2 days.

Results

Table 1 shows the demographic characteristics of our study population. All groups were similar in their characteristics with one difference; the patients in the 2020 COVID time had slightly higher body weights and BMIs than the set of patients from 2012.

Opioid use

The percentage of subjects who used opioids throughout their hospital stay was significantly lower among the patients who received liposomal bupivacaine TAP blocks compared to those who received bupivacaine-only TAP or neuraxial anesthesia. Of the patients who received neuraxial preservative-free morphine without TAP blocks, 60% used opioids; and of patients who received bupivacaine-only TAP blocks, 54% used opioids. The use of opioids significantly decreased (only 18% vs 54%–60%) in patients who received liposomal bupivacaine TAP blocks ($p < 0.00001$; Table 2). There was no significant difference between the non-TAP neuraxial-only and bupivacaine-only TAP group ($p < 0.536$). The use of liposomal bupivacaine in the TAP blocks decreased opioid usage within the first 24 h by 65% when compared to the other groups: (opioid use: TAP-Lipo: 7%; TAP-Bupi: 13%, NM: 20%, see Table 3. This was even more pronounced at 24–48 h (9%, 32%, and 33% for the TAP-Lipo, vs NM, vs TAP-Bupi, respectively). Decreased opioid usage was also found at 48–72 h (2%, 7%, and 8%, TAP-Lipo, vs NM, vs TAP-Bupi, respectively).

Length of stay

In addition, mean length of stay was significantly decreased in the TAP-Lipo group (2.29 days, $p < .001$), Table 4,

Table 1. Patient demographics.

Group (Data year)	Age, years X ± SD	Weight, kg X ± SD	Height, inches X ± SD	BMI, kg/m ² X ± SD
TAP-Lipo (2020, COVID)	(N=116) 33 ± 10	84 ± 22 ^{a,c}	63 ± 3	32 ± 9 ^{b,d}
TAP-Bupi (2020, COVID)	(N=30) 30 ± 5	79 ± 17	64 ± 6	30 ± 6
NM (2012)	(N=60) 30 ± 5	75 ± 16	63 ± 3	29 ± 7
TAP-Bupi (2012)	(N=82) 30 ± 5	76 ± 18	64 ± 5	28 ± 9

NM: patients who only received neuraxial morphine; TAP-Bupi: patients who received neuraxial morphine and a TAP block with 0.25% bupivacaine; TAP-Lipo: patients who received neuraxial morphine and a TAP block with both 0.25% bupivacaine and liposomal bupivacaine.

^a $p < 0.01$ TAP-Lipo compared to NM.

^b $p < 0.01$ TAP-Lipo compared to NM.

^c $p < 0.01$ TAP-Lipo compared to TAP-Bupi.

^d $p < 0.03$ TAP-Lipo compared to TAP-Bupi.

The average age was 30–33 years. Data are the mean ± standard deviation (X ± SD).

Table 2. Use of opioids.

	NM	TAP-bupi	TAP-Lipo
Narcotics (%)	60	54	18
No narcotic (%)	40	46	82
p (vs TAP-Lipo)	<0.00001	<0.00001	
p (TAP-Bupi vs NM)		<0.536	Chi-square

NM: patients who only received neuraxial morphine; TAP-Bupi: patients who received neuraxial morphine and a TAP block with 0.25% bupivacaine; TAP-Lipo: patients who received neuraxial morphine and a TAP block with both 0.25% bupivacaine and liposomal bupivacaine.

Postoperative orders were written on all post-cesarean delivery that included the use of ketorolac, acetaminophen, and oxycodone. Only if the patient used oxycodone, they were considered positive for postoperative narcotic use. A Chi-square test was used to compare two categorical variables, that is, use of narcotic vs non-use of narcotic.

compared to the NM group (3.16 days) and TAP-Bupi group (3.14 days). Median length of stay of 2.04 days for the TAP-Lipo group was also significantly decreased when compared to the NM and TAP-Bupi groups 3.17 and 3.05 days, respectively.

Seventy-six percent of the patients in the TAP-Lipo blocks group were discharged before their third night in the hospital. This was significantly lower than the other two groups: 10% for the NM group and 13% for the TAP-Bupi group ($p < 0.001$). A possible explanation for the shorter lengths of stay is that the patients wanted to leave the hospital as early as possible to decrease their exposure to COVID-19 infection. However, we looked at a group of patients who had their cesarean delivery during high volume of COVID-19 infections at the hospital; but before (approximately a month) we started performing liposomal bupivacaine TAP blocks on the patients. Table 5 shows that without the liposomal bupivacaine TAP block, mean patient length of stay was 3.22 days, which was comparable to our cohort from 2012 (3.14–3.16/days, Table 4) and were significantly longer than the patients who received liposomal bupivacaine containing TAP blocks of 2.19/days. More than 76% of the patients

with a liposomal bilateral TAP block stayed one less night in the hospital.

Discussion

Multimodal pain management of post-cesarean-delivery patients has recently increased in an attempt to improve pain relief and decrease opioid consumption, especially important in this era of an opioid pandemic. Although opiates are the most commonly used analgesics for post-cesarean-delivery pain management, this comes with many potential deleterious opioid-induced side effects for postpartum patients as well as opioid exposure to the newborn through breastfeeding. Studies have shown that a large proportion of patients depend on opiates for postoperative pain relief for many days after cesarean delivery.^{8–10} There is also a risk of patients becoming repeat opioid users⁹ and several authors have shown that opioid-naïve patients continue to use opioids well beyond the recovery period.^{11,12}

In our study, post-cesarean-delivery pain management with neuraxial preservative-free morphine and liposomal bupivacaine TAP blocks significantly reduced the percentage of patients who required opioids throughout their hospital stay. A previous case series done at our institution showed patients receiving the TAP blocks with liposomal bupivacaine and neuraxial anesthesia had significant postoperative pain relief and decreased postoperative opioid use.⁶

Opioid sparing techniques are desirable as they allow patients to avoid opioid-related adverse side effects such as pruritus, nausea, vomiting, constipation, hypoventilation, and somnolence. These opioid sparing techniques also alleviate mothers' fears of opioid delivery to their newborn via breast milk. The liposomal bupivacaine TAP block group also showed a significant decrease in the mean length of stay of ≥ 0.85 /days compared to the other relevant groups. Median data showed a decreased length of stay of over a full day.

Previous studies have compared intrathecal or epidural opiates with non-liposomal local anesthetic (bupivacaine

Table 3. Use of opioids.

Group	<24 h (%)	24–48 h (%)	48–72 h (%)	>72 h (%)
NM	20	32	7	1
TAP-Bupi	13	33	8	
TAP-Lipo	7	9	2	

The data for the NM and TAP-bupi were obtained from reviewing charts from 2012.

NM: patients who only received neuraxial morphine; TAP-Bupi: patients who received neuraxial morphine and a TAP block with 0.25% bupivacaine; TAP-Lipo: patients who received neuraxial morphine and a TAP block with both 0.25% bupivacaine and liposomal bupivacaine.

Postoperative orders were written on all post-cesarean delivery that included the use of ketorolac, acetaminophen, and oxycodone. Only if the patient used oxycodone in the respective time period they were considered positive for post operative narcotic use.

Table 4. Length of stay I.

	NM	TAP-Bupi	TAP-Lipo
Average # of days	3.16	3.14	2.29 ^a
Median # of days	3.17	3.05	2.04
<i>p</i> (vs TAP-Lipo)	$< 2.14 \times 10^{-13}$	$< 8.41 \times 10^{-14}$	
<i>p</i> (TAP-bupi vs NM)		< 0.84	Student's <i>t</i> -test (average days)
Overnights = 2	6	11	89 ^b
Overnights > 2	54	71	27
<i>p</i> (vs TAP-Lipo)	< 0.0001	< 0.0001	
<i>p</i> (TAP-bupi vs NM)		< 0.54	Chi-square test

The data for the NM and TAP-Bupi were obtained from reviewing charts from 2012.

NM: patients who only received neuraxial morphine; TAP-Bupi: patients who received neuraxial morphine and a TAP block with 0.25% bupivacaine; TAP-Lipo: patients who received neuraxial morphine and a TAP block with both 0.25% bupivacaine and liposomal bupivacaine.

^aA Student's *t*-test was used to compare the average number of days.

^bA Chi-square test was used to compare two categorical variables, that is, overnight equal to 2 days vs overnight > 2 days.

Length of stay was calculated as the time from arrival in the post-anesthesia care unit (PACU) until discharge.

Table 5. Length of stay II.

	March 2020 TAP-Bupi	TAP-liposomal
# of days AVG	3.22	2.29 ^a
# of days Median	3.13	2.04
Student's <i>t</i> -test	0.0000006	
Overnight = 2	4	89 ^b
Overnight > 2	26	27
Chi-square	$p < 0.00001$	

The data for the TAP-Bupi were obtained reviewing charts from 30 additional patients from March 2020.

TAP-Bupi: patients who received neuraxial morphine and a TAP block with 0.25% bupivacaine; TAP-Lipo: patients who received neuraxial morphine and a TAP block with both 0.25% bupivacaine and liposomal bupivacaine.

^aA Student's *t*-test was used to compare the average number of days.

^bA Chi-square test was used to compare two categorical variables, that is, overnight equal to 2 days vs overnight > 2 days.

Mean length of stay (AVG) was calculated as the time from arrival in the post-anesthesia care unit (PACU) until the hospital discharge.

only) TAP blocks without consistent definitive improvements. These studies are mixed with some studies showing bupivacaine-only TAP blocks to have better analgesic control than intrathecal and epidural opiates,¹³ while others show little to no analgesic advantages over intrathecal and epidural opiates.^{14,15} It should be noted that patients with

intrathecal or epidural opioids have been shown more likely to suffer from opiate side effects including pruritus, nausea, vomiting, and sedation.¹⁵

Our data show that bilateral bupivacaine-only TAP blocks did not result in a significant decrease in the use of opioids. (Table 3: NM vs TAP-Bupi). However, in this study, the use of liposomal bupivacaine in our bilateral TAP blocks showed a significant decrease in the use of opioids and the ability to comfortably discharge patients home earlier.

A confounding factor for the length of stay is that one of the priorities of the hospital was to safely discharge patients as soon as possible to limit exposure to COVID-19. However, post-cesarean-delivery patients would not be discharged if they did not have adequate pain control and/or another co-morbidity that required longer observation or hospitalization. In brief review of patient charts in September 2020, of the patients who received both liposomal bupivacaine bilateral TAP blocks and neuraxial morphine, greater than 40% of those patients who needed a stay of > 2 overnights also had a complicating medical factor that was responsible for their longer hospitalization; the patients had preeclampsia (unpublished data).

This study has limitations, particularly lack of blinding and randomization. Another limitation is that some data for the comparison group were from 2012, while the TAP-Lipo

group data were from 2020. However, we did select a control group from March 2020 through early April 2020, which was during the COVID-19 surge but before we made changes to our patient care to include liposomal bupivacaine in our TAP blocks. We found that in the TAP-Bupi group from 2020, the time to discharge and overnight stays were the same as in the 2012 group (Tables 4 and 5).

Early in the COVID-19 crisis, despite the desire for earlier discharge and before instituting TAP blocks with liposomal bupivacaine, patients were not discharged earlier despite the intention and goal to do so. Patients who received liposomal bupivacaine in their TAP blocks, instituted during the ongoing COVID crisis, used significantly less opioids, indicating that pain control was adequate for discharge. This additional control comparison group from March 2020 through early April 2020 (during the COVID surge) and prior to the use of liposomal bupivacaine in the TAP blocks, both the mean and median LOS were significantly longer when compared to the patients who received liposomal bupivacaine in their TAP blocks. This strongly indicates that the decrease in LOS was due to the use of liposomal bupivacaine.

Conclusion

We conclude that neuraxial opioids combined with liposomal bupivacaine TAP blocks will provide significant pain relief for post-cesarean-delivery; less patients require opioids and have earlier discharge from the hospital, possibly leading to decreased negative outcomes from hospital stays.

Author contributions

D.E.F., J.K., A.B., A.M., C.D., A.A., and K.T. were involved in the design of study; obtaining data; data interpretation; writing of the article; and review of the article.

V.L. was involved in the design of study; data interpretation; writing of the article; and review of the article.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval


The requirement to obtain informed consent from subjects was waived by the IRB in accordance with 45 C.F.R. § 46.116(d) (IRB approval study number 2016-11-13).

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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