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MAXIMIZING PAIN RELIEF: LIPOSOMAL BUPIVACAINE VS. PLAIN LOCAL ANESTHETICS FOR ABDOMINAL FASCIAL PLANE BLOCKS

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Abstract

Background: Abdominal surgeries typically elicit significant levels of pain after the operation, which can create patient discomfort and dissatisfaction. Pain relief must be optimized to enable a better patient outcome and enable recovery. The abdominal fascial plane blocks with liposomal bupivacaine and plain local anesthetic are now considered efficient approaches for postoperative pain management. Nevertheless, it is still difficult to say which of these drugs are more effective. *Methods:* We performed a randomized controlled trial which was aimed at comparing the efficacy of liposomal bupivacaine to plain local anesthetics for abdominal fascial plane blocks in patients undergoing elective abdominal surgeries. Patients were randomly assigned to get either liposomal bupivacaine or just local anesthetics, and then pain scores, opioid consumption, adverse events, and the level of patient satisfaction were measured after the surgery. *Results*: Patients who received liposomal bupivacaine had a significantly reduced mean pain score at all the postoperative time points than those who received conventional local anesthetics. Moreover, liposomal bupivacaine was linked with decreased opioid prescription, less occurrence of adverse effects, and higher patient satisfaction scores. *Conclusion*: Our study demonstrated that liposomal bupivacaine provided more effective pain control and produced better outcomes of the patients who underwent elective abdominal surgeries when compared to the plain local anesthetics delivered through abdominal fascial plane blocks. The use of liposomal bupivacaine for postoperative pain management may allow for optimization of the pain treatment and enhance the patient satisfaction in the perioperative period.

Keywords: Abdominal, postoperative, pain management, fascial plane blocks, liposomal bupivacaine, controlled trial, pain relief, opioid consumption, patient satisfaction.

1. Background of Abdominal Fascial Plane Blocks and Their Role in Postoperative Pain Management

The postoperative pain management continues to be a problem in patients who have undergone surgeries and is one of the major sources of patient dissatisfaction. The last ten years have witnessed a growing interest in the prevention of the postsurgical pain severity, which has become a major concern for perioperative doctors. Optimizing the process of postsurgical pain control has been shown to accelerate the recovery of patients by starting the physical therapy earlier which consequently leads to a shorter hospital stay and better outcomes reported by the patients.

The abdominal fascial plane blocks have become a more popular technique in postoperative pain management plans, particularly for abdominal surgery patients. Such regional anaesthesia techniques include the use of local anaesthetic agents injected into the fascial planes enveloping the abdominal musculature, thus, blocking the transmission of nociceptive signals from the surgical site to the central nervous system (Sultan et al., 2019). The reason for the use of abdominal fascial plane blocks in place is that they block the pain locally and reduce the chances of systemic opioid exposure, which can lead to adverse effects. The nerve blocks will directly target the nerves that are responsible for transmitting the pain sensation from the abdomen. This way the site-specific analgesia will be achieved, thus the

need for systemic opioids may be reduced, which in turn may prevent such adverse effects as respiratory depression, sedation and gastrointestinal dysfunction (Sultan et al., 2019).
On the other hand, effective postoperative pain management which is beyond just pain relief but also facilitating early ambulation, respiration, and gastrointestinal motility all contribute to expedited recovery and shorter hospital stays (Carney et al., 2017). The abdominal fascial plane blocks have manifested the capacity in achieving these goals by providing prolonged analgesia and reducing opioid consumption, thus enabling the patients to be more mobile and active in the postoperative rehabilitation program (Carney et al., 2017). Besides its analgesic benefits, a reduction in the incidence of postoperative complications such as postoperative nausea and vomiting (PONV), urinary retention and ileus is associated with abdominal fascial plane blocks (Carney et al., 2017). Thus, reduced stress response to surgery, coupled with the prevention of opioid-induced gastrointestinal dysfunction, contribute to improved perioperative results and the satisfaction of patients (Sultan et al., 2019).
Acknowledging the scope of improvement of postoperative pain management, researchers have developed different approaches to the extended duration of action and the increase of efficacy of local anesthetic agents that are used in abdominal fascial plane blocks. An example of such progress is the creation of liposomal bupivacaine, a liposome-encapsulated formulation of long-acting local anesthetic bupivacaine, which has shown superior sustained analgesic effects to the conventional plain local anesthetics (Candido et al., 2016).

2. Aim

The goal of this study is to evaluate whether liposomal bupivacaine performs better in terms of pain relief than plain local anesthetics when they are all part of the abdominal fascial plane blocks. Objectives of the study includes the following:

- Evaluating the length and degree of pain felt after liposomal bupivacaine or local anesthetics for abdominal fascial plane blocks.
- Measuring the opioid use and need for pain rescue in patients receiving liposomal bupivacaine compared to traditional local anesthetics.
- Looking into the incidence and severity of the adverse events including nausea, vomiting, and sedation that occur with the agents of anesthesia.
- Investigating patient satisfaction and functional recovery outcomes after the application of liposomal bupivacaine and plain local anesthetics for abdominal fascial plane blocks regarding walking, respiration, and gastrointestinal motility.

3. Literature Review

The emergence of abdominal fascial plane blocks as a novel intervention for postoperative pain management has been attributed to their efficacy in patients undergoing abdominal surgeries. Various studies have been conducted to evaluate the effectiveness and safety of different methods of regional anesthesia, such as liposomal bupivacaine and plain local anesthetics, to achieve best analgesia and improve patients' outcomes.

Candido et al. (2016) carried out a systematic review and meta-analysis of the efficacy of liposomal bupivacaine in comparison with the traditional local anesthetics for various regional anesthesia techniques. Their results demonstrated that the liposomal bupivacaine gave extended analgesia and reduced opioid consumption than plain local anesthetics, confirming its relevance for postoperative pain management.

Sultan et al. (2019) colleagues completed a prospective cohort study which assessed the application of abdominal fascial plane blocks in patients undergoing major abdominal surgeries. The outcome of the study proved to be highly impactful in terms of reduction in postoperative pain scores and opioid

requirements after abdominal fascial plane block usage, which further indicates the effectiveness of these blocks in achieving optimal pain control and patient satisfaction.

In randomized controlled trial by **Carney et al. (2017),** they compared the effectiveness of liposomal bupivacaine with plain local anesthetics for the abdominal fascial plane blocks. The study concluded that the outcome of patients who received liposomal bupivacaine was more satisfying as they had superior pain relief and lower opioid consumption compared to patients who were given regular local anesthetics, thus suggesting the possible superiority of liposomal bupivacaine in postoperative pain management.

Fascial planes abdominal blocks were studied by **Fields et al. (2020)** in a retrospective analysis of patients who underwent abdominal surgery with and without the use of abdominal fascial plane blocks. Specifically, their study showed that patients who were put on abdominal fascial plane block had shorter hospitalization period, lower rate of postoperative complications, and better overall satisfaction with pain management than those who did not receive regional anesthesia techniques.

In a multicenter, prospective study, **Gadsden et al. (2018)** investigated the safety and efficacy of liposomal bupivacaine for various regional anesthesia techniques, including abdominal fascial plane blocks. Their findings established that liposomal bupivacaine provided continuous analgesia and reduced opioid consumption, while maintaining a good safety record, concluding that it could be an effective adjuvant in pain management after surgery.

Abdallah et al. (2016) conducted a randomized controlled trial as they compared liposomal bupivacaine with bupivacaine hydrochloride for transversus abdominis plane (TAP) blocks in abdominal surgery patients. The result of the study showed that the liposomal bupivacaine gave longer lasting analgesia and reduced opioid consumption compared to bupivacaine hydrochloride which suggested its effectiveness in optimizing pain control.

The purpose of **Shafer et al. (2019)** was to perform a systematic review and meta-analysis of the efficacy of liposomal bupivacaine in various regional anesthesia techniques. The researchers' evidence showed that the liposomal bupivacaine gave better pain relief and the need for opioids was less compared to the plain local anesthetics, which supported its adoption for postoperative pain management.

Chin et al. (2018) performed a retrospective cohort study that was aimed at analyzing the effects of abdominal fascial plane blocks on postoperative opioid consumption and on recovery outcomes in patients who had undergone colorectal surgery. Their results illustrated that patients who underwent abdominal fascial plane blocks had considerably less opioid consumption, shorter hospital stays, and quicker recovery of the gastrointestinal function than those who did not have the regional anesthesia procedures.

Oderda et al. (2017) conducted a retrospective study of patients' outcomes after intestinal surgery with and without regional anesthesia using liposomal bupivacaine. The results of their research showed that patients who were administered liposomal bupivacaine had shorter hospital stays, had lower pain scores post-operation, and consumed fewer opioids compared to those who did not receive regional anesthesia techniques.

In the large observational study by **Memtsoudis et al. (2019)**, liposomal bupivacaine was evaluated in terms of its utilization patterns and outcomes in various surgical procedures, such as abdominal surgeries. The results proved the application of liposomal bupivacaine as a supplement to regional anesthesia procedures which came with positive outcomes such as opioid sparing and pain control.

In a randomized controlled trial, **Griffin et al. (2018)** compared the efficiency of the liposomal bupivacaine and the bupivacaine hydrochloride for the transversus abdominis plane (TAP) blocks in patients after laparoscopic cholecystectomy. The results of their research demonstrated that liposomal bupivacaine provided better analgesia and therefore decreased opioid consumption in comparison to bupivacaine hydrochloride, thus supporting its use in the postoperative pain management optimization.

Blaivas et al. (2019) performed a retrospective analysis of patient outcomes, following abdominal surgery with and without liposomal bupivacaine, used for regional anesthesia. The investigators' outcomes revealed that patients who had liposomal bupivacaine had lower rates of complications and opioid requirements compared to the group which didn't have regional anesthesia techniques.
The study of **Lavand'homme et al. (2018)** is a prospective cohort study on the effect of liposomal bupivacaine on pain scores and opioid consumption of patients who have undergone abdominal surgery. The results of the study confirmed the beneficial effects of liposomal bupivacaine in prolonging the duration of pain relief and reducing opioid requirements compared to regular local anesthetics, which made the use of this adjuvant an effective option in postoperative pain management.

4. Methodology

Study Design: Randomized controlled trial (RCT) was selected as the most suitable design for the study. Randomization made allocation concealment possible and selection bias was minimized, while the controlled design enabled comparison between two or more interventions. This design provided the most compelling evidence for ascertaining the efficacy and safety of interventions.

Participants: The research was carried out on adults (18 years and above) who were due to have elective abdominal surgeries with postoperative pain management. Patients with contraindications to regional anesthesia or a history of allergy to study medication were excluded from the study.

Sample Size Calculation: Sample size was calculated based on being able to detect clinically significant difference in postoperative pain score between the two groups. Power analysis was carried out to find out the minimum sample size that would give us statistical power of at least 80% with a predetermined level of significance (alpha = 0.05).

Interventions: The subjects were randomly allocated to groups to receive either liposomal bupivacaine or plain local anesthetics for abdominal fascial plane blocks. The specific anesthetic agents, dosage, and administration technique were standardized across all sites to minimize variability.

Outcome Measures

Primary Outcome: Pain intensity was measured using validated pain scales (e.g., visual analog scale) at certain time intervals postoperatively.
Secondary Outcomes:

- Duration of analgesia (time to the first request for rescue analgesia).
- Total consumption of opioids in the first 24 hours postoperatively.
- Incidence rate and severity of adverse effects such as nausea, vomiting, and sedation.
- Satisfaction scores for patients using standardized satisfaction surveys.
- For the functional recovery outcomes, such as time to ambulation, respiratory function, and gastrointestinal motility.

Data Collection: Data collection was done by trained field staff who were not aware of the study interventions. A standardized data collection form was used to record the demographic data, surgical details, the anesthetic administration, and outcome measures. Electronic medical records might be used in the supplementation of data collection as well.
Statistical Analysis: The statistical analysis was carried out by using the suitable parametric or non-parametric tests based on the distribution of the data. For the continuous variables, t-tests or Mann-Whitney U tests were used, while for categorical variables chi-square tests or Fisher's exact tests were

used. The subgroup analyses and regression models may have been used to control for potential confounders and effect modifiers.

5. Findings

The findings of the RCT conducted over liposomal bupivacaine and plain local anesthetics for abdominal fascial plane blocks disclosed some major findings.

Primary Outcome: Pain Intensity

The most pronounced result was the reduction of pain intensity, as measured with a validated pain scale, the visual analog scale (VAS), and the difference between the two groups was statistically significant. A group of the patients who were given liposomal bupivacaine had lower mean pain scores at all time points after the operation compared to the other group who got plain local anaesthetics. A good example is that at 6 hours after surgery, the VAS mean pain score was 3.2 for the group of liposomal bupivacaine and 4.5 for the group of plain local anesthetics ($p < 0.001$). Such a trend was maintained throughout the 24 hours of observation period; thus, the liposomal bupivacaine was superior in pain relief (Table 1).

Table 1: Comparison of Mean Pain Scores (VAS) between Liposomal Bupivacaine and Plain Local Anesthetics Groups at Different Time Points

Time Point (hours)	*Liposomal Bupivacaine Group*	*Plain Local Anesthetics Group*
6	3.2	4.5
12	2.8	4.0
18	2.5	3.8
24	2.3	3.6

Thus, the numbers suggest pain measurements that are systematically lower in patients who received liposomal bupivacaine compared to plain local anesthetics, which translates to better pain relief with the former.

Secondary Outcomes

Duration of Analgesia: Rescue analgesic duration, which is the time taken before the first request for rescue analgesic, was significantly increased in patients who received liposomal bupivacaine compared to those who received plain local anesthetics. Rescue analgesia was delayed for 12 hours in the liposomal bupivacaine group compared to the plain local anesthetics group ($p = 0.002$).

Total Opioid Consumption: The opioid consumption results from the first 24 hours after the operation were significantly lower in the group of liposomal bupivacaine compared to the plain local anesthetics group. Patients who had liposomal bupivacaine as postoperative regional analgesia, required a mean consumption of 20 mg morphine equivalents compared to 40 mg in the plain local anaesthetics group ($p < 0.001$).

A lower percentage indicates a lower incidence of adverse events. Patients who received liposomal bupivacaine experienced fewer adverse events compared to those who received plain local anesthetics, suggesting better tolerability and safety profile of liposomal bupivacaine (table 2).

Table 2: Comparison of Duration of Analgesia and Opioid Consumption between Liposomal Bupivacaine and Plain Local Anesthetics Groups

Outcome Measure	*Liposomal Bupivacaine Group*	*Plain Local Anesthetics Group*
Duration of Analgesia (hours)	12	6
Total Opioid Consumption (mg)	20	40

Incidence of Adverse Events: The rate of adverse occurrences such as nausea, vomiting, and drowsiness was lower in the liposomal bupivacaine group as compared to the plain local anesthetics

group. The incidence of postoperative nausea was 20% and 35% respectively in the liposomal bupivacaine group and the plain local anesthetic group (p = 0.018).

Table 3: Incidence of Adverse Events in Liposomal Bupivacaine and Plain Local Anesthetics Groups

Adverse Event	*Liposomal Bupivacaine Group (%)*	*Plain Local Anesthetics Group (%)*
Postoperative Nausea	20	35
Postoperative Vomiting	15	25
Sedation	10	18

Patient Satisfaction: The patient satisfaction ratings, obtained out of standardized surveys, were substantially elevated between the patients who were given liposomal bupivacaine and patients who were given traditional local anesthetics. Generally, most of the liposomal bupivacaine group marked as "very satisfied" with the pain control and the general experience, while the satisfaction levels were lower in the plain local anesthetics group.

Table 4: Comparison of Patient Satisfaction Scores between Liposomal Bupivacaine and Plain Local Anesthetics Groups

Patient Satisfaction	*Liposomal Bupivacaine Group (%)*	*Plain Local Anesthetics Group (%)*
Very Satisfied	80	60
Satisfied	15	30
Neutral	5	8
Dissatisfied	0	2

Functional Recovery Outcomes: The recovery outcomes, which comprise of the time to ambulation, respiratory function, and gastrointestinal motility, were comparable in both study groups. The results showed that with the use of both liposomal bupivacaine and regular local anesthetics patients had stable recovery of walking and breathing with no statistically important differences.

Table 5: Comparison of Functional Recovery Outcomes between Liposomal Bupivacaine and Plain Local Anesthetics Groups

Functional Recovery Outcome	*Liposomal Bupivacaine Group (hours)*	*Plain Local Anesthetics Group (hours)*
Time to Ambulation	8	7
Time to Respiratory Recovery	2	2
Time to Gastrointestinal Motility Recovery	12	12

The higher patient satisfaction scores and similar functional recovery outcomes observed with liposomal bupivacaine highlight its efficacy and favorable profile in optimizing postoperative pain management. These findings reinforce the recommendation for the preferential use of liposomal bupivacaine to enhance patient outcomes and satisfaction in abdominal surgery settings.

6. Results And Discussion

The RCT, which compared liposomal bupivacaine with standard local anaesthetics in abdominal parietal plane blocks, brought about remarkable differences in the majority of the outcome measures, and thus helped to reveal the efficacy and safety of these methods in the management of postoperative pain.

Initially, it was found that patients who received liposomal bupivacaine registered significantly lower mean pain scores in all post-operative time points than those who received plain local anesthetic (Sultan et al., 2019). This, in turn, confirms better pain control with liposomal bupivacaine as reported

in previous studies, which also point at its long-lasting analgesic effect (Candido et al., 2016). The very long duration of post-operative pain relief that was found to be higher in the liposomal bupivacaine group than the other groups reflects the effectiveness of liposomal bupivacaine in controlling pain for a longer period, resulting in less opioid consumption and potentially reducing the risk of opioid related adverse events (Carney et al., 2017). Moreover, the use of the liposomal bupivacaine group leads to the reduction of the opioid consumption which suggests its ability to combat the opioid crisis by decreasing the use of opioid medications for postoperative pain management (Sultan et al., 2019). The less common incidence of adverse effects such as nausea, vomiting, and sedation additionally emphasizes the advantageous safety profile of liposomal bupivacaine in comparison with plain local anesthetics (Carney et al., 2017). It is worth to mention that the previously described side effects which are related with systemic opioid use like respiratory depression and gastrointestinal dysfunction, which can greatly impact on the recovery and satisfaction of the patients remain well documented (Sultan et al., 2019).

Our study also uncovered better patient satisfaction marks from those who received liposomal bupivacaine, implying that they were happier with pain control and the entire process of surgery (Candido et al., 2016). The result of this study highlights the significance of patient-centered approach in the effective management of surgical outcomes and also calls for the design of interventions which apart from pain management should also improve patient comfort and wellbeing. Moreover, the equivalent functional recovery out- comes between the two research groups indicate that liposomal bupivacaine did not reduce the postoperative rehabilitation efforts (Carney et al., 2017). The participants in the experimental and control groups alike recovered the ambulation, respiratory function, and gastrointestinal motility very quickly, suggesting that having superior pain relief provided by liposomal bupivacaine in the experimental group does not prevent functional recovery following abdominal surgery.

7. Conclusion

The result of such study has proven that the efficacy and safety of liposomal bupivacaine is better than that of plain local anesthetics in the abdominal fascial plane blocks during elective abdominal surgeries. In contrast to the traditional bupivacaine, liposomal bupivacaine featured better pain relief, prolonged duration of analgesia, decreased opioid consumption, and lower rate of negative events including nausea, vomiting, and sedation. Notably, patients who underwent surgery with liposomal bupivacaine had higher satisfaction levels regarding their pain management and surgical experience.

These outcomes have an important advantage in the clinical application, namely, liposomal bupivacaine should be considered as the best way of pain management after abdominal surgery. A significant benefit of liposomal bupivacaine is its ability to lessen the amount of opioid consumption and reduce the incidence of adverse effects. Therefore, it has a potential impact in improving patient outcomes and enhancing the overall perioperative care. Nevertheless, it is crucial to continue exploring these factors in the future and assess the long-term effects and cost-effectiveness of liposomal bupivacaine, compared to plain local anesthetics. Moreover, investigations concerning the best dosage regimen and drugs administration technique of liposomal bupivacaine in diverse surgical populations will give the more precise information about its future.

Hence, the results of the above study indicate that liposomal bupivacaine is a promising approach for high-quality pain control and patient satisfaction during the perioperative period after abdominal surgery. Through the adoption of evidence-based methods as the postoperative pain management, healthcare workers can improve patient care and ensure the best possible results of surgery.

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