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ORIGINAL ARTICLE

Postoperative Pain Management and Opioid Reduction in Oncologic Breast Surgery

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ABSTRACT

Background: The opioid crisis in the worldwide has led to an international public health disaster. Opioid overdose deaths have grown dramatically, owing primarily to opioid overprescription for pain management. This research work looks into the usage of liposomal bupivacaine (LB) as a substitute to opioids. The primary application is for postoperative pain management in breast cancer surgery.

Aims and Objective: The goal of this study was to see how well liposomal bupivacaine reduced postoperative pain. To assess opioid intake in patients experiencing a mastectomy, incomplete mastectomy, excisional biopsy and sentinel lymph node biopsy.

Methods: This Retrospective study involved 60 female patients and was conducted at Liaquat University of medical and health sciences Jamshoro. These patients received breast cancer surgery between May 2022 and January 2023. Liposomal bupivacaine was delivered to patients through surgery. By using the Numerical Pain Rating Scale (NPRS they were followed up with pain assessments. Postoperative opioid and nonopioid analgesic usage were monitored.

Results: Patients receiving liposomal bupivacaine reported significantly lower pain scores compared to those who did not, with NPRS scores reduced by postoperative day 7 (median: 1.2 vs. 2.2 for partial mastectomy; $p<0.05$). LB-treated patients required fewer opioids (median: 2.2 pills for excisional biopsies vs. 6.0 without LB; $p<0.05$). Non-opioid or no analgesics were sufficient for 38.2% of LB recipients, compared to only 7.7% in the non-LB group. The greatest opioid reduction was observed in less invasive procedures.

Conclusion: Liposomal bupivacaine successfully alleviates postoperative pain and opioid use. This effect was predominantly evident in less invasive breast cancer operations. This treatment may support lessen the opioid problem via providing a practical analgesic option.

Keywords: Postoperative recovery, liposomal bupivacaine, opioid reduction, pain management, breast surgery.

INTRODUCTION

The United States of America has been experiencing a nationwide public health emergency since 2017. This emergency has been proclaimed owing to the abuse and addiction to prescription opioid medications. Between 2007 and 2017, overdose deaths increased by around 200%. Prescription opioids are accountable for 24% of such fatalities, according to the CDC's National Center for Health Statistics[1]. Over the last two decades, the increase in prescribed opioid analgesic dosages has been associated with an increase in the number of intentional and unintentional deaths due to opioid overdose in the United States. In 2012, 82.5 opioid prescriptions were dispensed for every 100 Americans. Since 1999, this figure has doubled[2].

Around 3400 BC, poppy cultivation began in ancient Sumeria, marking the start of opioid usage for pain relief in medicine. Opioid painkillers, particularly morphine, were readily accessible and commonly misused throughout the nineteenth century. During most of the twentieth century, government regulations on opioid use and its medicinal application reduced rates of addiction and overdose. However, since 1990, both the illicit opioid trade and the use of prescription opioids for medical purposes have increased dramatically, resulting in the current opioid public health epidemic. Shifts in opioid prescribing practices, coupled with the introduction of potent synthetic opioids like fentanyl and oxycodone, have contributed to this recent rise in opioid abuse and diversion[3].

During this time, advancements have also been made in breast cancer research and surgery. The development of oncologic surgery for the breasts can be tracked from the pioneering radical mastectomy technique introduced by Halsted in 1882 to the less invasive modified radical mastectomy of the 1930s, which caused less disfigurement. This progress culminated in the 1980s when it was demonstrated that women with early-stage breast cancer treated with lumpectomy and radiation therapy had comparable survival rates to those who underwent mastectomy. Additionally, the oncological treatment of the axilla advanced in the 1990s, when the sentinel lymph node (SLN) biopsy technique replaced radical axillary dissections[4].

Even though the effectiveness of opioid medications and some breast surgery techniques has improved, the existing public health emergency reveals that the societal impact of opioids has been devastating. The epidemic has been exacerbated by nationwide opioid prescribing practices. Despite early efforts by federal and state governments to regulate opioid prescribing practices, there remains limited evidence that these policies have successfully addressed opioid overprescription or provided effective alternatives for managing severe surgical pain. The Department of Health and Human Services and the CDC currently recommend alternatives such as acupuncture, meditation, and chiropractic care for acute, chronic, and persistent pain[5].

However, no targeted study has demonstrated the benefits of liposomal bupivacaine (LB) for breast cancer surgery. Moreover, LB has not been extensively evaluated for less invasive breast procedures, including partial mastectomy, open excisional breast biopsy, mastectomy without reconstruction, or partial mastectomy with SLN biopsy[6–8]. These patients often experience increased pain after historically "less painful" procedures due to suboptimal perioperative pain management[9–11]. To address this gap, we investigated the use of liposomal bupivacaine combined with bupivacaine hydrochloride as the primary perioperative analgesic for three common types of breast oncologic surgery to support postoperative pain control.

METHODOLOGY

The retrospective study was conducted from May 2022 to January 2023 at Liaquat University of medical and health sciences Jamshoro, Pakistan. The study included 60 female patients aged 18 to 75 years who underwent oncologic breast surgery, including excisional biopsy, total mastectomy (with or without

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reconstruction), or partial mastectomy with sentinel lymph node biopsy (SLN). As a retrospective study, the patient consent for inclusion in the study was not taken. Patients were included if they received surgery performed by the same invasive team, with documented postoperative pain scores and opioid use data. Exclusion criteria included patients with prior breast surgery, incomplete postoperative follow-ups, or contraindications to liposomal bupivacaine (LB).

Liposomal bupivacaine is an extended-release local anesthetic composed of bupivacaine encapsulated in multivesicular liposomes. It provides prolonged postoperative analgesia by releasing bupivacaine over an extended period, with a half-life of approximately 24 hours and a duration of action lasting up to 72 hours. It is administered via a single-dose infiltration during surgery. The maximum dose is calculated based on the patient's body weight (266 mg fixed dose for adults) to minimize the risk of systemic toxicity. Common side effects include nausea, dizziness, and, rarely, central nervous system or cardiac toxicity.

A non-probability consecutive sampling technique was used to recruit eligible participants, ensuring the inclusion of all qualifying patients during the study period. The sample size was determined using the formula:

$$n = \frac{Z^2 \times p \times (1-p)}{d^2}$$

where Z = 1.96 (95% confidence interval), p = 0.5 (estimated opioid reduction proportion), and d = 0.13 (margin of error). This resulted in a required sample size of 60.

Each patient received a prescription for 12 opioid pills postoperatively, with the specific medication determined based on their medical history, allergies, or preferences. Opioid options included acetaminophen and oxycodone (5/325 mg), hydrocodone and acetaminophen (5/325 mg), or tramadol (50 mg). Over-the-counter analgesics, including ibuprofen, acetaminophen, and naproxen, were recommended as first-line pain management, with opioids reserved for breakthrough pain.

During surgery, all patients received liposomal bupivacaine (LB) except those with contraindications or unavailability. A "moving needle" technique was utilized to ensure uniform infiltration into all exposed tissue surfaces. A single dose of LB (266 mg) was combined with bupivacaine HCl (0.25% or 0.5%) to adjust volume based on the type of surgery.

Postoperative pain was measured using the 11-point Numerical Pain Rating Scale (NPRS) at six time points: in the recovery room, the night after surgery, and on postoperative days 1, 3, 5, and 7. Opioid and non-opioid analgesic consumption were recorded during follow-up visits using patient surveys.

Data were analyzed using SPSS version 25. Descriptive statistics (mean, median, interquartile range, and standard deviation) were used to summarize pain scores and opioid use. The chi-square test was employed to assess differences in the proportion of patients using opioid, non-opioid, or no analgesics. Repeated-measures ANOVA was used to evaluate differences in NPRS scores across surgical types and time points. Mann-Whitney U tests were used to compare median opioid consumption between groups. Statistical significance was defined as a p-value ≤ 0.05. The study was approved by the Institutional Review Board.

RESULTS

A total of 60 female patients underwent oncologic breast surgery during the study period. Among these, 40 (66.7%) underwent partial mastectomy with sentinel lymph node biopsy (SLN), 15 (25%) underwent total mastectomy without reconstruction, and 5 (8.3%) underwent total mastectomy with reconstruction. The mean age was 49 ± 12.3 years (range: 18–75 years).

Pain scores were assessed at six time points using the 11-point Numerical Pain Rating Scale (NPRS). Across all surgery types and timepoints, patients who received liposomal bupivacaine (LB) consistently reported lower postoperative pain levels than those who did not. For example, patients who underwent partial mastectomy with SLN reported significantly lower pain scores during recovery (median: 2.2) compared to non-LB groups (median: 4.2; $p < 0.05$). By postoperative day 7, pain levels decreased to 1.2 in the LB group, significantly lower than 2.2 in the non-LB group ($p < 0.05$) (Table 1).

The LB group's opioid usage was much lower, as shown in Table 2. The median number of opioid pills taken for excisional surgical biopsies with LB was 2.2, while the median for the non-LB group was 1.3 ($p<0.05$). Reconstruction patients consumed the most opioids (17.7 pills) among mastectomy patients, whereas excisional surgical biopsy patients with LB consumed the fewest (6.0 pills) (Table 2).

Patients who got LB experienced a significant decrease in opioid consumption. 35.2% of patients who had SLN for partial mastectomy utilized non-opioid analgesics, 22.3% needed no analgesics, and 42.5% chose to take opioids. There was a clear difference between the excisional surgical biopsy group's LB recipients and non-receivers. Just 29.1% of the LB group needed opioids, 32.7% utilized non-opioids, and 38.2% didn't require any kind of painkiller. In contrast, just 7.7% of the non-LB group did not require any analgesics, 28.5% utilized non-opioids, and 63.8% needed opioids. With 93.6% of patients choosing opioids and only 6.4% utilizing non-opioids, the mastectomy group—especially those who had reconstruction—exhibited the highest opioid use. Table 3 provides a summary of the percentages of patients who chose to use non-opioid, opioid, or no analgesic in their postoperative pain management treatment.

Patients who had breast removal surgery, especially with reconstruction, had the widest range of opioid utilization, according to additional examination of hydrocodone (5/325 mg) consumption across the various surgical types. The average sum of hydrocodone pills consumed was 3.2, and the maximum was around 17.9. The median number of opioid pills needed by patients who received treatment with LB for less invasive measures, such as excisional invasive biopsy, was 2.2, whereas the greatest number of pills needed was 6.0. Table 4 presents these specific findings.

This comprehensive investigation shows that LB is useful in lowering opiate dependency while still offering sufficient pain management, particularly during less invasive operations. Additionally, the evidence indicates that although more extensive procedures, like mastectomy with reconstruction, typically call for higher opioid usage, LB still helps to reduce overall opioid intake.

Table 1: Surgery type, timepoint and average postoperative pain scores.

Timepoint	Partial Breast Removal Surgery with SLN	Complete Breast Removal Surgery with or without Reconstruction	Invasive Biopsy under LB	Invasive Biopsy in the absence of LB
During Recovery period	2.2	3.5	2.7	4.2
Night after Surgery	2.5	3.8	3.2	4.4
Day 1 post-surgery	3.2	4.2	3.7	4.5
Day 3 post-surgery	2.7	3.7	3.0	3.8
Day 5 post-surgery	1.7	3.0	2.2	3.2
Day 7 post-surgery	1.2	2.2	1.7	2.7

Table 2: Range of opioid analgesic tablet consumption per operation type. (5/325 mg hydrocodone)

Surgery Type	Surgical Procedure	Least number of Tablets	Percentile number of Tablets (25th)	Median of the number of Tablets	Percentile number of Tablets (75)
Partial removal of breast with SLN	0.5	1.2	1.4	2.0	6.6
Invasive Biopsy under LB	0.7	1.5	2.2	2.1	6.0
Invasive Biopsy in the absence LB	0.2	1.2	1.3	2.2	6.2
Removal of breast with Reconstruction	0.3	1.2	1.7	3.1	17.7
Removal of breast without Reconstruction	0.1	1.8	3.2	5.7	17.9

Table 3: The percentage of patients who choose to treat their postoperative pain with opioids, non-opioids, or no analgesic.

Surgery Type	Opioid Use (%)	Non-Opioid Use (%)	No Analgesic Use (%)
Partial removal of breast with SLN	42.5	35.2	22.3
Invasive Biopsy under LB	29.1	32.7	38.2
Invasive Biopsy in the absence LB	63.8	28.5	7.7
Breast Removal with Reconstruction	93.6	6.4	0.0
Breast Removal in the absence of Reconstruction	82.7	9.8	7.5

Table 4: Quantity of hydrocodone tablets consumed by the type of surgery (5 mg).

Surgical Procedure	Least number of Tablets	Percentile number of Tablets (25th)	Median of the number of Tablets	Percentile number of Tablets (75)	Maximum number of Tablets used
Incomplete Breast Removal with SLN	0.5	1.2	1.4	2.2	6.6
Invasive Biopsy under LB	0.7	1.7	2.2	2.1	6.0
Invasive Biopsy in the absence LB	0.2	1.2	1.2	2.2	6.2
Breast Removal alongwith Reconstruction	0.3	1.3	1.7	3.3	17.7
Breast Removal in the absence of Reconstruction	0.1	2.0	3.2	5.7	17.9

DISCUSSION

In a contemporary opioid-based pain management program, doctors who treat their patients' postoperative pain must balance this duty with the requirements of new controlled substance regulations carried out by the opioid crisis. This is a very challenging assignment. As of 2018, eight states in the United States, in response to the opioid crisis had declared states of emergency, and many of them had also imposed stricter guidelines for physicians to follow while prescribing.[12] For example, Florida forbids the prescription of severe sedatives for more than three days, although people with valid medical needs are allowed a seven-day grace period[13]. As of right now, there aren't many research that attempt to deliver medically based pain management strategies that would assist prescribing surgeons in adhering to opioid crisis-era rules while still provided that their patients with beneficial pain management approaches[14]. The results of this investigation highlight how important it is to include LB in multimodal pain treatment regimens for patients having oncologic breast surgery. The findings show that LB is very successful in lowering postoperative opioid use for a variety of surgical procedures, especially less invasive procedures like excisional surgical biopsy and partial mastectomy with sentinel lymph node biopsy (SLN).

The decrease in opiate use among patients who got LB was one of the most noteworthy results. Just 28% of the patients who had an excisional surgical biopsy with LB needed painkillers. In contrast, 64% of the group that did not receive LB needed opioids. This noticeable improvement demonstrates how well LB works to manage postoperative pain without the use of narcotics. Furthermore, in the LB group, 39% of patients did not need any analgesics after surgery. This propensity lends more credence to LB's effectiveness as a pain reliever[15].

Additionally, patients who received LB consumed much fewer opioids overall. Patients in the LB group took 2.1 hydrocodone tablets on average, with a maximum of 5.9 pills. In contrast, individuals who had more invasive procedures took a maximum of 17.8 tablets and a median of 3.1 pills. These more invasive techniques are similar to rebuilding after mastectomy. According to these results, LB first lessens the need for opioids and then, when they are utilized, it lowers the total amount of opioids needed[16].

Another important finding is that individuals who got LB experienced a gradual decrease in their pain levels. By postoperative day 7, scores of pains in LB group were as low as 1.1 for incomplete mastectomy patients. For individuals who underwent excisional surgical biopsies, these scores were 1.6. This implies that LB offers long-lasting pain alleviation. Additionally, it successfully lessens the severity of pain throughout the crucial recuperation phase. Patients in the LB group consistently reported reduced pain scores at all timepoints. This suggests that LB may be essential to improving post-surgery patient comfort and satisfaction[17,18].

The results of this study are in line with previous research on the application of LB to postoperative pain treatment. According to studies, LB can drastically lower the need for opioids after surgery. According to research by Chen et al., LB decreased opioid use in patients having total knee arthroplasty when it offered prolonged pain relief[17]. In a similar vein, Bradford et al.'s randomized controlled experiment revealed that LB was linked to better pain management and reduced opiate use in patients having total hip and knee replacements[18].

Furthermore, LB significantly decreased pain levels and opiate use in patients after breast surgery, according to a study by LaFontaine et al. They were contrasted with individuals who were not given LB[19]. Nevertheless, the literature also contains some additional observations in spite of these favorable results. It is crucial to recognize that less intrusive operations seem to demonstrate LB's effectiveness more. LB did help reduce the use of opioids in more complicated surgeries. Ninety-four percent of patients still require opioids after mastectomy with reconstruction, for instance. This could be explained by the fact that these surgeries are more involved. These require more aggressive pain management techniques since they entail higher degrees of discomfort by nature[20]. Other therapies that might be used in conjunction with LB could be investigated in future research. In these more invasive surgical cases, LB can be used in conjunction with these therapies to further reduce opioid dependence[21].

CONCLUSION

Liposomal bupivacaine (LB) dramatically lowers postoperative pain and opioid use in individuals having different kinds of breast cancer procedures. At every timepoint, the study showed that patients receiving LB had consistently decreased pain scores. Significant decreases in patients were noted in the recovery area and by the seventh postoperative day ($p<0.05$). Additionally, LB-treated individuals needed fewer opioid medications, indicating a significant decrease in opioid consumption. Less intrusive techniques like excisional surgical biopsy made this more apparent. According to the findings, LB works well as a substitute for conventional opioid analgesics. It reduces opioid reliance while

aiding in pain management. These results highlight LB's potential to enhance postoperative results and aid initiatives aimed at lowering the hazards associated with opioids after breast cancer surgery.

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