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Liposomal Bupivacaine as an Adjunct to Postoperative Pain Control in Total Hip Arthroplasty

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ABSTRACT

Background: Although pain management affects rehabilitation, length of stay, and functional outcome, an optimized pain management protocol has yet to be standardized. Opioids are the primary agent used to control acute postoperative pain; however, they are associated with a wide range of side effects. Liposomal bupivacaine (LB), a long-acting analgesic agent administered intraoperatively, has been introduced as a new modality to control pain for up to 72 hours after operation without affecting motor function.

Methods: Six hundred eighty-six primary total hip arthroplasty (THA) patients, who received the standard THA pain management protocol, were compared to a cohort of 586 primary THA patients, who were treated with an additional intraoperative injection of LB. All other pain management parameters and standard of care were identical. Statistical significance was set at $P \leq .05$.

Results: Although patient-reported pain scores were statistically similar, the LB cohort demonstrated a significant decrease in total narcotic use ($P < .001$), specifically up to postoperative day 2 ($P = .016$). Physical therapy milestones were significantly achieved to a greater degree ($P < .001$) in the LB cohort. Operation time and hospital cost were unaffected ($P = .072$ and .811, respectively); however, the LB cohort exhibited a decrease in length of stay by 0.31 days ($P < .001$) and improvement in discharge disposition to home ($P = .017$).

Conclusion: LB is a valuable adjunct to our THA pain management protocol, as we strive to achieve improved patient outcomes, reductions in length of stay, and enhanced quality of THA care.

Total hip arthroplasty (THA) is a highly effective procedure for patients who have end-stage degenerative joint disease of the hip [1]. THA is one of the most commonly performed procedures in the United States, and the popularity of the surgery is a testament to its efficacy, with well over 300,000 THAs being performed each year [1,2]. The costs associated with THA and osteoarthritis are considerable, with osteoarthritis being the most expensive condition to treat among Medicare patients [3]. In the past, advances in technology, material innovations, refined surgical techniques, and improved implant survivorship had been prioritized [4]; however, in today's changing political and economic climate, the current focus is shifting toward improving patient satisfaction, increasing the rate of return to function, and enhancing quality of care.

Perioperative pain management is a component of surgery that affects all 3 of these metrics [5-7]. Nevertheless, a standardized and optimized pain management protocol has yet to be adopted. Although the traditional approach that couples opioid patient-controlled analgesia (PCA) with oral narcotics has been shown to be effective in controlling pain [8], these agents are regularly associated with side effects, such as respiratory depression, hypotension, urinary retention, and postoperative ileus [9,10]. These adverse reactions frequently lead to increased hospital stays and delayed return to function, negating some of the intended benefits of pain management, affecting length of stay (LOS), rehabilitation participation, and functional outcomes [11]. As a result, pain management protocols vary widely between institutions and

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incorporate different developments in analgesia, all while striving to minimize the side effects and complications associated with these agents.

As part of the ongoing endeavor to improve our departmental pain management protocols and the quality of care delivered to THA patients, our institution adopted the routine use of liposomal bupivacaine (LB) in May 2014. LB distinguishes itself from other local anesthetic agents by its long-acting effect, using bupivacaine and a cytarabine liposomal delivery mechanism [12,13]. LB has shown benefit in providing postoperative analgesic relief for up to 72 hours, specifically after bunionectomy [14] and total joint arthroplasty (TJA) [15,16]. The purpose of this study is to evaluate periarticular LB as an adjunctive mode of analgesia for postoperative THA pain management.

Materials and Methods

Patients

Our study consisted of 1272 consecutive primary THA patients from September 2013 to October 2014. Two patient cohorts were compiled by date, from September 2013 to April 2014 (cohort 1) and from May to October 2014 (cohort 2). Department-wide adoption of LB began in May 2014 and became routinely used in all patients undergoing TJA at our institution.

Pain Management Protocols

The standard multimodal analgesia protocol was provided to all patients in both cohorts as illustrated in Figure 1. Before entering the operating room, patients received preemptive oral analgesics, consisting of 200-mg celecoxib, 1000-mg acetaminophen, and 50-mg pregabalin. Intraoperative analgesia was chosen at the discretion of the anesthesiologist and preferentially consisted of spinal anesthesia with general anesthesia as an alternate. For both cohorts, a peri-incisional analgesic cocktail was injected before closure consisting of 40-cc 0.25% Marcaine, 5-cc (1 mg/cc) morphine, and 1-cc (30 mg/cc) ketorolac. Postoperative analgesic protocols included PCA administration for the first 24 hours postoperatively, with PRN oral narcotic administration for the remainder of the hospital stay.

In contrast to cohort 1, LB was intraoperatively administered to patients in cohort 2. This addition of LB administration is the only difference in standard of care between the 2 time periods and cohorts, as no other changes were made to the department's THA standard clinical pathway during the study period.

LB Administration

As LB diffuses to a much lesser extent (30% less) than traditional bupivacaine preparations, proper technique and standardized infiltration is essential when using LB [17]. As a result, all surgeons at our institution underwent standardized teaching protocols and were instructed on proper LB technique. The LB injection is prepared intraoperatively by the surgical technician before placing the final THA components. A homogeneous solution is created with 20 cc of LB in 40 cc of 0.9% normal saline solution. The total volume of 60 cc once mixed is placed into 3-20-cc syringes to be administered to the soft tissue surrounding the hip joint. The joint is adequately exposed and the analgesic is injected in a 3-layer fashion using a 21-gauge needle or smaller, with equal amounts injected into each of the (1) periarticular capsule, (2) overlying periosteum, muscle, and fascia, and (3) the subcutaneous fat and subcuticular layer [17].

Inpatient Hospitalization Period

All patients received the standardized THA postoperative clinical pathways and rehabilitation programs. Metrics recorded included (1) patient-reported pain scores, which were collected within regular 2- to 8-hour intervals by nursing staff; (2) narcotic administration, dosing, and PCA use; (3) physical therapy (PT) milestones, specifically when a patient was able to functionally achieve stair climbing and ambulate >100 feet; (4) LOS; and (5) discharge destination. Patients were discharged home when they were medically stable, their pain was adequately controlled, and PT milestones were achieved. Patients were discharged to inpatient rehabilitation facilities if they could not achieve independence sufficient for home discharge.

Data Abstraction

Patient information was abstracted from the electronic medical record (Epic Systems Corporation, Verona, WI) including procedure type, date of surgery, age, gender, body mass index, and American Society of Anesthesiologists score. Pain scores were collected and recorded in 8-hour intervals, starting from the time of postoperative floor admission to the time discharge. The pain score closest to the 8-hour mark was recorded as the pain score for that time interval. Narcotic usage was aggregated per postoperative day (POD) and converted to morphine equivalent dosages [18]. PT milestones (gait distance and stair climbing) were recorded as the best effort for each POD.

Quality metrics such as discharge location, LOS, 30-day readmission rates, and operating room time were collected. OR time refers to the time from incision to close, including the exposure and placement of the components, as well as the injection and preparation of LB in cohort 2.

Financial metrics, including direct hospital costs, were collected through the administrative database for each patient. The cost figures are calculated for the entire LOS and are reported as relative percentages between the 2 cohorts.

Statistical Analysis

Descriptive statistics were used to compare the 2 cohorts of patients, based on age, gender, body mass index, and American Society of Anesthesiologists score to compare the 2 populations. Standard independent-samples t tests were used to detect statistical differences between the means of each outcome variable of the 2 groups, and chi-squared analyses were used for categorical data. A Mann-Whitney U statistical test was used to detect differences in median for narcotic use. Statistical significance was set at $P \leq .05$.

Results

Of the 1272 patients included in our study, 686 received the standard pain protocol only, whereas 586 received the standard pain protocol with the addition of LB intraoperatively. Descriptive statistics of the 2 populations revealed no statistically significant differences (Table 1).

Pain Scores, Narcotic Use, and PT Milestones

In the immediate 8 hours after the operation, the LB cohort reported significantly less pain ($P = .031$), but at all other time points, pain scores followed parallel trends and were statistically similar (Fig. 2).