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Quantitative Effects of Tumescence Infiltration and Bupivacaine Injection in Decreasing Postoperative Pain in Submuscular Breast Augmentation

Dean Jabs, MD, PhD; Bryson G. Richards, MD; and Franklin D. Richards, MD

BACKGROUND: In submuscular breast augmentation, the muscle is transected along its inferior and medial border to allow the implant to rest beneath the breast mound and supply adequate cleavage. This leads to significant pain in the postoperative period.

OBJECTIVE: This study was undertaken to quantitatively document the effectiveness of tumescence infiltration and bupivacaine with epinephrine injection in controlling postoperative pain in primary submuscular breast augmentation and its effect on operating time, narcotic use, and complications.

METHODS: A retrospective chart review of 150 primary submuscular augmentation mammoplasties performed by 2 surgeons was conducted. Seventy-five consecutive augmentations performed by each physician during the same time period were studied. One surgeon used tumescence infiltration, using a syringe and a blunt infiltration cannula, placing 50 mL of standard tumescence solution in the planned pocket area of each breast before dissection. In addition, all cut muscle ends were injected with 0.25% bupivacaine with epinephrine (1:100,000, 40 mL per patient) under direct vision. The other surgeon omitted these steps. Patients evaluated pain subjectively using a 0 to 10 numeric pain intensity scale reported to the recovery room staff at specific times in the postanesthesia care unit.

RESULTS: Postoperatively, the initial and discharge average pain rating was significantly different between the groups. The group that received tumescence and bupivacaine with epinephrine entered the recovery room with a significantly lower average pain score: 0.5 as compared with the pain score of the control group, which was on average 3.3. In addition, the highest average pain rating was 2.6 in the infiltrated group compared with 5.4 in the noninfiltrated group. Pain at discharge between the groups was also seen to be markedly lower with a subjective average rating of 2.0 in the infiltrated group compared with 4.0 in the control group. No difference was seen in operative time or complications.

CONCLUSIONS: This is the first report to quantitatively show a pain reduction regimen that is effective in significantly decreasing postoperative pain and decreasing the use of narcotics in the recovery room. The authors conclude that its advantages are significant, and they advocate its use in all breast augmentations. (*Aesthetic Surg J* 2008;28:528–533.)

The American Society for Aesthetic Plastic Surgery reported that augmentation mammoplasty was the most common cosmetic surgical procedure performed in women in the United States in 2007. More than 399,000 augmentations were performed in 2007 alone, up 4.1% from the previous year.¹ With the recent approval of silicone gel-filled breast implants by the US

Food and Drug Administration (FDA), there has been a substantial increase in the use of gel implants.

In an effort to decrease the rate of capsular contraction, noticeable upper pole rippling, and an abrupt transition overlying the implant, the prosthesis is often placed beneath the pectoralis major muscle. One of the drawbacks of submuscular placement, however, is that the muscle must be transected along its inferior and medial borders to allow the implant to rest beneath the breast mound and to provide adequate cleavage. This leads to significant pain in the postoperative period.²

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Pain associated with any type of surgery is of great concern to patients and their physicians. The Anesthesia Departments at the University of Chicago and Duke University sampled 250 adults who had undergone surgical procedures and found that 80% had experienced acute pain after surgery. Of all concerns, pain was the concern at the top of the list for 59% of the respondents.³

Submuscular implant placement can also lead to more bleeding compared with subglandular placement. Noting that most of our patients undergoing lipoplasty experience only mild pain postoperatively and a small amount of bruising, we began to use tumescent solution infiltrated beneath the pectoralis major muscle and in the subglandular area of pocket dissection to decrease intraoperative bleeding and postoperative pain in our breast augmentation patients. In the interest of decreasing postoperative pain as much as possible, we also began to inject the pectoralis muscle that was cut with bupivacaine with epinephrine.

The effects of local anesthetic intervention in either topical or injection form on perceived pain in breast augmentation has been reported but not quantitatively studied with regard to narcotic use. Our clinical impression from patients and recovery room nurse reports was that the use of tumescent fluid and bupivacaine intraoperatively increased postoperative comfort and decreased the use of narcotics, leading to less nausea and vomiting, a more comfortable patient, and speedier discharge. It also appeared that the use of tumescent fluid decreased intraoperative bleeding. This study was undertaken to quantitatively document the effectiveness of intraoperative tumescent infiltration along with bupivacaine with epinephrine injection in controlling postoperative pain, its effects on the use of narcotics in recovery, and the possible complications in primary breast augmentation.

METHODS

A retrospective chart review of 150 primary submuscular augmentation mammoplasties performed by 2 surgeons was conducted to determine if the use of tumescent infiltration and bupivacaine with epinephrine injection could provide a quantitative benefit in controlling post-

operative pain and to determine if its use increased operative time and complications. Seventy-five consecutive augmentations performed by each physician, occurring during the same time period, were studied. All patients were ASA category I and underwent primary augmentations performed under general anesthesia with no other surgeries performed at the same time.

A similar amount of narcotic anesthetic was used in each group of patients during surgery. Patients ranged in age from 18 to 52 years (Table 1). The surgical technique used by both surgeons was similar in that blunt dissection was kept to a minimum, all muscle attachments were transected under direct vision using electrocautery, and all pockets were irrigated with antibiotic solution. The surgical technique differed in that 1 surgeon used tumescent infiltration, using a syringe and a blunt infiltration cannula, placing 50 mL of standard tumescent solution (1 L Ringer's lactate, 50 mL 1 % lidocaine, and 1 mL epinephrine 1:1000) in the planned pocket area of each breast before dissection. In addition, all cut muscle ends were injected with 0.25% bupivacaine with epinephrine (1:100,000, 40 mL per patient) under direct vision. The other surgeon omitted these steps. All surgeries were performed in the same outpatient surgery facility with the same anesthesiologists. All implants were from the same manufacturer (Mentor, Santa Barbara, CA) and were placed in a partial submuscular (retropectoral) pocket. The implants rested beneath the pectoralis major muscle superiorly and the breast parenchyma inferiorly. Incisions were either periareolar or in the inframammary crease. The surgeons audited each other's techniques and found them to be essentially the same. Operative times were similar.

Data were obtained from office charts and postoperative hospital records. The reported pain rating was a subjective response by the patient using a 0 to 10 numeric pain intensity scale reported to the recovery room staff at specific times in the postanesthesia care unit (PACU). This rating of pain has been found to be valid and reliable.⁴ Patients in both groups were treated for postoperative pain by staff anesthesiologists at the outpatient surgery center. Different anesthesiologists used different

Table 1. Comparison of study groups

	Control group	Tumescent infiltration and bupivacaine injection	P
No. of patients	75	75	N/A
Tumescent infiltrate volume	None	50 mL	N/A
Average implant size (mL ± SD [range])	357 ± 5.6 (225–600)	352 ± 5.0 (250–630)	.53
Intraoperative equianalgesic dose (mg ± SD) morphine IV	17.8 ± 0.8	16.0 ± 0.9	.11
PACU time (min ± SD)	113 ± 3.7	103 ± 4.9	.11
Complications	1 hematoma, 1 infected implant	2 hematomas	No difference in complications

PACU, Postanesthesia care unit; IV, intravenous; SD, standard deviation.

Table 2. Equianalgesic conversion table for acute pain

Opioid analgesic (trade name)	Equianalgesic dose (10 mg)
Morphine (MS Contin, Roxanol)	10 mg IM/IV
Fentanyl (Sublimaze)	0.1 mg (100 µ) IM/IV
Hydrocodone (Lortab, Vicodin)	20 mg PO
Hydromorphone (Dilaudid)	1.5 mg IM/IV
Meperidine (Demerol)	75 mg IM/IV
Oxycodone (Percocet)	20 mg PO

IM, Intramuscular; IV, intravenous; PO, per oral.
MS Contin is manufactured by Purdue Pharma (Cranbury, NJ).
Roxanol is manufactured by Xanodyne Pharmaceuticals (Newport, KY).
Sublimaze is manufactured by Akorn Inc (Buffalo Grove, IL).
Lortab is manufactured by UCB Pharma (Brussels, Belgium).
Vicodin is manufactured by Abbott Laboratories (Abbott Park, IL).
Dilaudid is manufactured by Abbott Laboratories.
Demerol is manufactured by Sanofi-Aventis (Bridgewater, NJ).
Percocet is manufactured by Endo Pharmaceuticals (Chadds Ford, PA).
Adapted from: American Pain Society. *Principles of Analgesic Use in the Treatment of Acute Pain and Cancer Pain*. 4th ed. Glenview, IL: American Pain Society, 1999.

pain medications, depending upon their experience. Patients were assigned to anesthesiologists randomly. Postoperative pain medications included morphine, fentanyl, hydrocodone, hydromorphone, meperidine, and oxycodone. Because different patients received different medications, the medication dosage was adjusted to morphine equivalents for comparison (Table 2).⁵

RESULTS

The additional step of infiltrating 50 mL of tumescent solution into each pocket and injecting bupivacaine into

the cut muscle did not significantly increase operative time. The amount of intraoperative pain medication given did not significantly differ between the 2 groups (17.8 equivalent units for the control group and 16 units for the treated group). The average PACU time to discharge was less with tumescent/bupivacaine infiltration by 10 minutes, but this was not statistically significant. The average implant volume placed was approximately 350 mL (225 to 630 mL). No difference in complication rates was seen between the groups (Table 1).

The initial and discharge average pain rating was significantly different between the groups. The group that received tumescence and bupivacaine with epinephrine entered the recovery room with a significantly lower average pain score: 0.5 as compared with the pain score of the control group, which was on average 3.3. In addition, the highest average pain rating was 2.6 in the infiltrated group compared with 5.4 in the noninfiltrated group. Pain at discharge between the groups was also seen to be markedly lower with a subjective average rating of 2.0 in the infiltrated group compared with 4.0 in the control group. All values are highly significant ($P < .001$; Table 1; Figure 1). The percentage of the patient population that reported each pain level can be seen in Figure 2. This graph demonstrates that the data were not skewed by a small subset of patients. The subjective patient ratings demonstrate that intraoperative intervention with tumescent infiltration and bupivacaine injection leads to markedly lower initial postoperative pain, less intense pain, and lower overall pain at discharge when compared with patients receiving no bupivacaine injection and tumescent infiltration.

The amount of postoperative pain medication used in the recovery room was adjusted to morphine equivalents

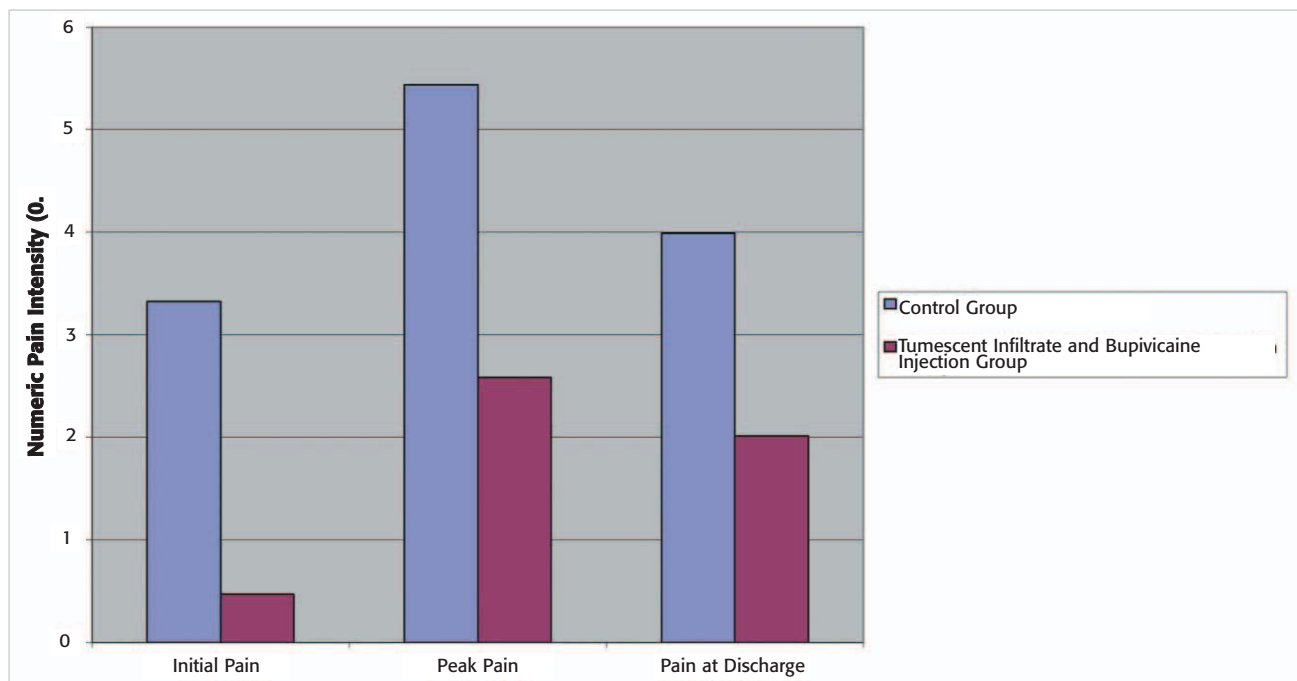


Figure 1. Postoperative pain levels. Average postoperative pain levels recorded using a 0 to 10 numeric pain intensity scale. Three sets of pain data were analyzed: (1) initial pain upon entering the postanesthesia care unit, (2) peak pain in the postanesthesia care unit, and (3) pain reported at discharge.

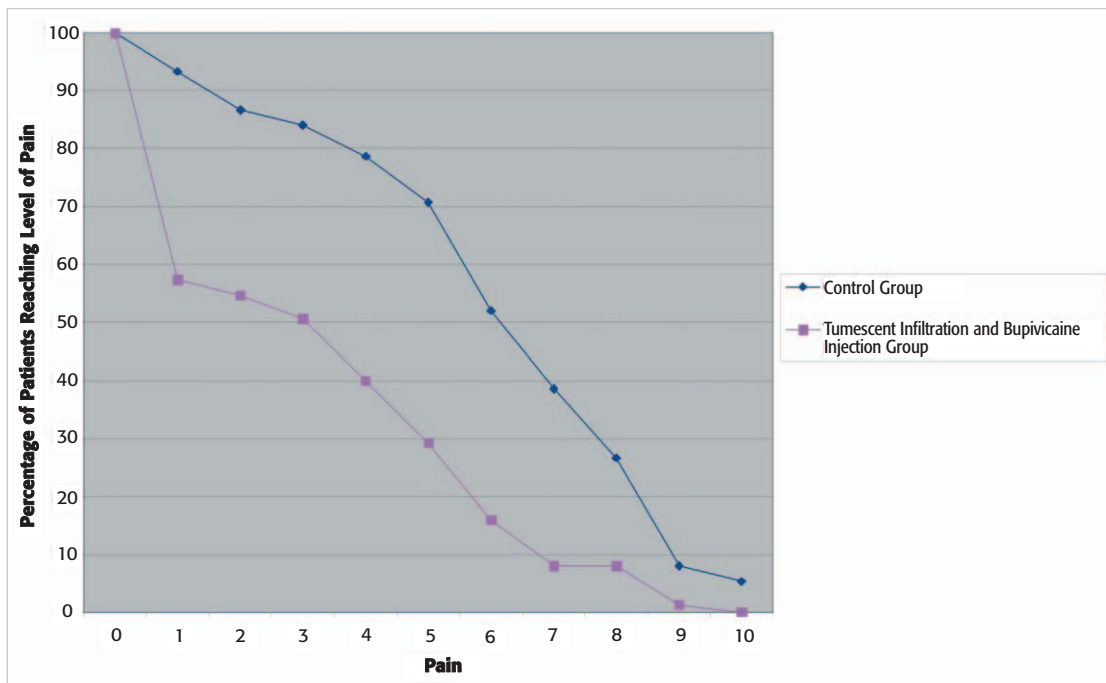


Figure 2. Each curve shows the percentage of patients that report meeting or exceeding a given level of pain (0 to 10 on a numeric pain intensity scale).

to allow for comparison between patients. The group receiving tumescent solution and bupivacaine injection was seen to require much less pain medication (4.1 morphine equivalent units as compared with 8.3 morphine equivalent units in the control group), demonstrating a greater than 50% reduction in postoperative narcotic requirement. This difference is highly significant ($P < .001$; Table 3). Again, when each group was evaluated to determine the percentage that required a specific morphine equivalent dose of narcotic, it is apparent that the groups did not overlap at any point nor are the means skewed by a particular subset of patients (Figure 3).

DISCUSSION

As submuscular breast augmentation gains popularity, the need for a reliable method of decreasing postoperative pain becomes more important. This procedure is typically performed on an outpatient basis in which pain control requirements are different from an inpatient setting. Ideally, patients in an outpatient setting should enter the recovery room in no pain and require little if any subsequent narcot-

ic analgesia while they awake from their general anesthetic. This allows for speedier discharge and decreases the likelihood of nausea and vomiting associated with narcotics.

Additionally, the pain control method employed should have a low complication risk and not take substantial time to administer in the operating room. Some possible methods that could meet these criteria are epidural anesthesia, synergistic oral medication, and perioperative local anesthetics administered in a variety of ways.

Lai et al⁶ reported using continuous epidural anesthesia to perform submuscular breast augmentation in 30 patients. The catheter was left in place until discharge, allowing more anesthetic to be administered as needed. One patient was noted to require general anesthesia. An increase in blood pressure was noted up to 30 minutes after epidural injection. Postoperative pain was well controlled, although 13% of patients experienced shortness of breath. Nesmith⁷ reported a similar experience in 20 patients. A 10% hypotension rate was noted. Both groups stated satisfaction with the technique, although neither presented a quantitative analysis of postoperative pain.

Table 3. Postoperative pain and equianalgesic morphine dose

	Control group	Tumescent and bupivacaine group	Reduction	P
Initial PACU pain	3.3 ± 0.4	0.5 ± 0.2	86%	<.001
Peak PACU pain	5.4 ± 0.3	2.6 ± 0.3	52%	<.001
Discharge PACU pain	4.0 ± 0.3	2.0 ± 0.2	50%	<.001
Equianalgesic dose (mg) morphine IV in the PACU	8.3 ± 0.6	4.1 ± 0.5	51%	<.001

IV, Intravenous; PACU, postanesthesia care unit.

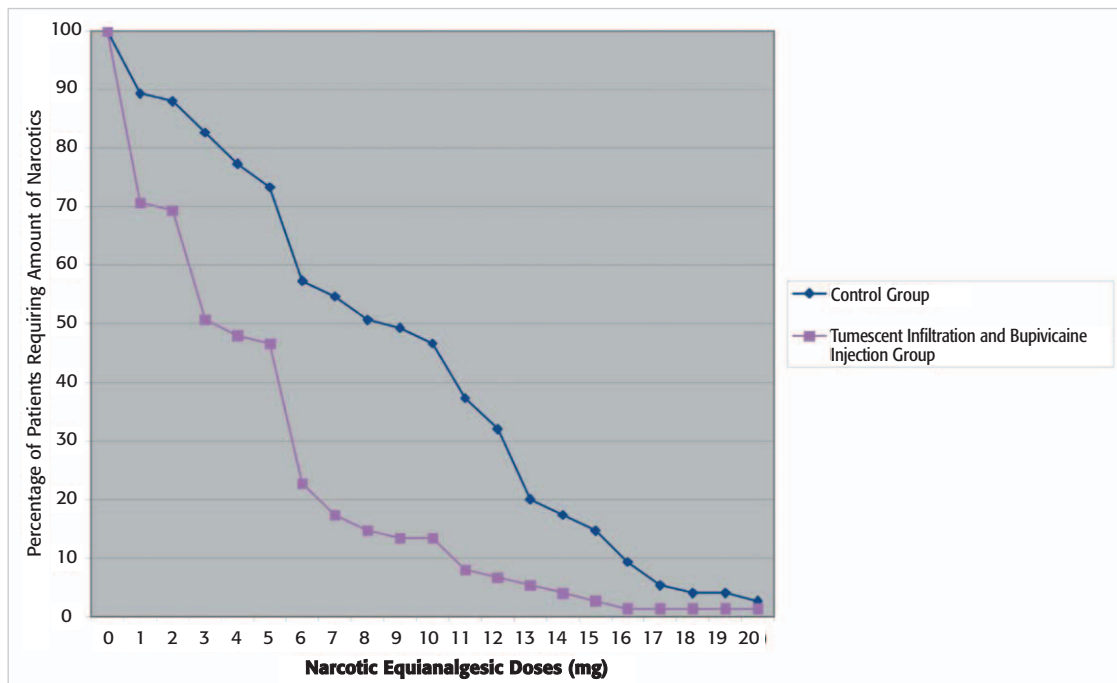


Figure 3. Percentage of patients that required a specific morphine equivalent narcotic dose in each group.

Methocarbamol and celecoxib have been studied for their value as oral medications to decrease perioperative pain. Schneider⁸ reported a nonrandomized study of 62 patients who received perioperative methocarbamol. Only 11% of the patients felt that the drug was of no benefit. Schneider observed an improvement in postoperative pain, but a quantitative method was not used. Freedman et al,⁹ in a well designed study, examined the effect of celecoxib on postoperative pain and the use of hydrocodone in 100 patients. Half used celecoxib and hydrocodone while the other half used hydrocodone alone for postoperative pain control. Celecoxib, a selective nonsteroidal anti-inflammatory drug (NSAID), was found to significantly decrease postoperative pain and the use of hydrocodone in the first week after surgery. As expected, with less narcotic use there was less reported nausea and vomiting. Its effect in the immediate postoperative period was not discussed. The FDA has found serious adverse cardiac effects when NSAIDs of all classes (except for aspirin) are used over the long term. No such effects have been shown for celecoxib in short-term use. Patients may show reluctance to use this form of the drug because of this recent publicity.

Several authors have looked at methods of controlling postoperative pain using intra- and postoperative local medications administered directly into the surgical pocket. Hunstad¹⁰ anecdotally reported on his use of bupivacaine and its safety in breast augmentation and abdominoplasty. He applied bupivacaine topically through a red rubber catheter and noted a subjective decrease in postoperative pain and also a marked increase in postoperative pain when this step was omitted. No measurement of pain or bupivacaine was included in the report. In a letter to the editor, Papanastasiou and Evans¹¹ reported their experience with topical bupivacaine placed in the surgical pocket via closed suction drains after completion of the procedure.

The drains were clamped for approximately 10 minutes after infiltration before being unclamped. He noted “adequate” pain relief in more than 80 cases. No other analysis was provided. Peled¹² anecdotally reported using tumescence infiltration in subglandular breast augmentation, describing his technique and the advantages of less bleeding and decreased pain. No data were offered to support his endorsement of tumescence infiltration. Similarly, in brief communication, Weiss¹³ reported using bupivacaine tumescence soaked lap sponges to pack subpectoral pockets after dissection to minimize bleeding and decrease postoperative pain. No data were provided.

Large area local anesthesia involves irrigation of the surgical pocket with dilute anesthetic, typically bupivacaine, to decrease perioperative pain. Several authors have studied this technique in a variety of surgical applications. Fredman et al¹⁴ compared 50 patients undergoing major intraabdominal surgery in a prospective, placebo-controlled, double-blind study. Half received bupivacaine through a patient-controlled catheter, while the other half received placebo. The amount of rescue narcotic required in the first 6 hours after surgery was noted. No difference was found between the groups. Similarly, Johannson et al,¹⁵ in a randomized, prospective, double-blind trial, failed to observe a benefit using large area local anesthesia in partial mastectomy and axillary node dissection when using ropivacaine as the anesthetic. Nausea, vomiting, pain, and narcotic requirements were found to be similar. Parker and Charbonneau¹⁶ conducted a retrospective chart review comparing 116 patients that underwent retropectoral augmentation, approximately half of whom received pocket irrigation with 10 mL of 0.125% bupivacaine. No significant difference was found comparing

nausea and vomiting, or narcotic requirement. Time to discharge was found to be less in the bupivacaine group. Pain was not measured in this study. Mahabir et al¹⁷ performed a prospective, randomized, double-blind trial in 100 patients comparing the effects of 4 solutions (normal saline, ketorolac, bupivacaine, and ketorolac with bupivacaine), placed topically into the pockets developed for implant placement. Pain was decreased in the groups containing bupivacaine for up to 90 minutes. No significant difference was noted in the use of postoperative narcotics. This was the first study to document a significant effect of bupivacaine irrigation on postoperative pain. There was no statistically significant difference when ketorolac was added. No adverse reactions were seen.

Only 1 study has shown that bupivacaine irrigation is helpful in decreasing postoperative pain, while the preponderance of data indicate it is not a useful technique. Its use does not significantly decrease the use of postoperative narcotics. Topical bupivacaine application may be useful if it is left in contact with the open wound long enough to allow sufficient absorption, but this delivery method is not uniform.

We found that the intraoperative use of tumescent infiltration and bupivacaine injection with epinephrine quantitatively decreased perceived postoperative pain uniformly, at all times in the recovery room, and significantly decreased the use of postoperative pain medication in the immediate perioperative period. Patients uniformly awoke from anesthesia in less pain and were more comfortable when this regimen was used. Decreasing the amount of postoperative narcotics decreases the likelihood of nausea and vomiting. We found a trend to earlier discharge (113 vs 103 minutes) and noted that patients were more comfortable during the postoperative period.

Bupivacaine, in toxic doses, has central nervous system and cardiovascular effects. Central nervous system effects usually occur at lower doses and may include excitation (nervousness, tingling around the mouth, tremor, and blurred vision) followed by depression (drowsiness followed by loss of consciousness). Cardiovascular effects (hypotension, bradycardia, and arrhythmias) typically occur at higher doses. Both are difficult to reverse. We did not see signs of toxicity in any of our patients despite having bupivacaine injected into highly vascular muscle.

The possibility of tumescent infiltration alone being as effective as tumescent infiltration with bupivacaine injection remains to be elucidated.

CONCLUSIONS

Using a chart review analysis of 2 sets of patients, 1 with and 1 without tumescent infiltration and bupivacaine injection, we found a statistically significant difference in patient-reported postoperative pain during all phases of PACU recovery, with the control group exhibiting higher pain ratings. In addition, there was a statistically significant reduction in postoperative narcotic use and a trend to shorter recovery room stays. No significant differ-

ence in operative time or postoperative complications was noted between our 2 study groups. This is the first report to quantitatively show a pain reduction regimen that is both effective in significantly decreasing postoperative pain and the use of narcotics in the recovery room. We advocate its use in all breast augmentations. ■

DISCLOSURES

The authors have no financial interest in and receive no compensation from manufacturers of products mentioned in this article.

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