ABSTRACT • Background: The purpose of our study is to evaluate the role of intercostal nerve block and pectoralis major muscle infiltration in postoperative pain management following subpectoral breast augmentation. Methods: This is a prospective randomized controlled study using patients as their own controls. Women undergoing primary bilateral subpectoral breast augmentation from July 2012 until July 2013 were enrolled and randomly allocated to two cohorts. Both cohorts received pectoralis major muscle infiltration using 20 mL of 0.25% bupivacaine with epinephrine on one breast. The contralateral breast was treated with intercostal nerve block in cohort 1, and with a placebo infiltration of the pectoralis major muscle in cohort 2. The 10-point Visual Analog Scale was used postoperatively on each breast at 0, 1, 3, 8 and 24 hours at rest and after movement. The change in pain score difference over time was analyzed with a mixed effect linear regression model. Results: Cohort 1 and 2 consisted of 13 and 15 patients respectively. Pectoralis major muscle infiltration and intercostal nerve block were easily performed and no complications were reported. When comparing pectoralis major muscle infiltration to intercostal nerve block, there was no difference in pain on admission to the recovery room at rest (p = 0.98), or after movement (p = 0.79). Postoperative pain gradually decreased with time and no difference in pain was found across time at rest (p = 0.91), or on movement (p = 0.92). The comparison of pectoralis major muscle infiltration to placebo yielded similar results with no difference in pain on admission or across time. Conclusion: Intercostal nerve block and pectoralis major muscle infiltration do not offer any significant analgesic benefit following breast augmentation.

Keywords: breast augmentation; postoperative pain; intercostal nerve block; pectoralis major muscle infiltration

INTRODUCTION

Cosmetic breast augmentation can have a significant impact on a woman’s body image and her psychosocial and sexual well-being [1]. Unfortunately, this is a painful procedure and the introduction of the prosthesis in a subpectoral plane further increases postoperative pain, due to surgical dissection and induced muscle trauma [2,3]. Postoperative pain can lead to an increased consumption of opioids with subsequent nausea, prolonged recovery time and decreased patient satisfaction.

In an effort to improve patient experience, numerous alternatives to narcotics have been studied to reduce postoperative pain [4]. Faced with a lack in consensus, postoperative pain management to date relies on surgeon and anesthesiologists preferences. Nerve blocks and pectoralis major muscle infiltration with local anesthetics seem to offer an attractive alternative to opioids.
Intercostal nerve block (ICNB) was successfully used to decrease postoperative pain in lumpectomies and mastectomies [5-7]. In addition, it is used as an alternative to general anesthesia in breast augmentation [8,9]. However, its use as an analgesic method to reduce postoperative pain in subpectoral breast augmentation has shown mixed results [10].

On the other hand, pectoralis major muscle (PMM) infiltration with bupivacaine, and tumescent infiltration of the planned pocket area with lidocaine decrease pain and postoperative analgesic use, as found by Jabs et al. [11].

Our aim in this study is to assess the role of ICNB and PMM infiltration in postoperative pain control following subpectoral breast augmentation patients.

METHODS

In this study, we collected data prospectively and used patients as their own controls. Women aged 18 years or older, of ASA (American Society of Anesthesiologists) physical status category 1, undergoing primary bilateral subpectoral breast augmentation from July 2012 until July 2013, were enrolled in the study. A preoperative consent was obtained. Exclusion criteria consisted of a known allergy to local anesthetic, subglandular breast augmentation, concomitant surgeries on the breast or other organs, pregnancy, history of chronic pain or narcotic and substance abuse.

Patients received general anesthesia with endotracheal intubation and were operated on by the same surgeon. The surgical technique consisted of a periareolar incision and a transglandular approach with partial subpectoral augmentation (“dual plane”) using round textured implants. No concomitant procedures were performed.

Patients were randomly allocated to two cohorts. Patients in both cohorts received a pectoralis major muscle infiltration (PMM) using 20 mL of 0.25% bupivacaine with epinephrine (5 μg/mL) on one breast. In cohort 1, the contralateral breast was treated with an intercostal nerve block (ICNB). In cohort 2, the contralateral breast was treated with a placebo infiltration of the pectoralis major muscle using 20 mL of normal saline. Treatment laterality was randomly determined using sealed envelopes. In cohort 2, both the primary surgeon and the patient were blinded towards the randomization process: unlabeled syringes with either anesthetic or placebo solutions were handed by the nurse according to the randomization envelop. In cohort 1, only patients were blinded.

The primary surgeon performed the PMM infiltration intraoperatively by injecting the infiltration solution at the inferior cut end of the muscle prior to implant placement. Careful aspiration was performed prior to the injection to avoid intravascular entry and subsequent local anesthetic toxicity.

The ICNB was done after general anesthesia induction and prior to skin incision. An anesthesiologist significantly experienced in regional blocks performed all procedures. Using sterile technique, a 10 cm 22-gauge needle is advanced into the intercostal space at the midaxillary line. Caution is made to maintain precise control of the needle at all times while the palpating hand rests firmly on the skin and straddles the insertion site at the inferior border of the rib to prevent any inadvertent movements. Six segments extending from T2 to T7 were blocked after negative aspiration for blood or air prior to each injection. Each segment received 3 mL of 0.25% bupivacaine with epinephrine (5 μg/mL), and the pectoralis minor muscle was infiltrated with 2 mL. A total of 20 mL of local anesthetic was administered during the intercostal nerve block. In all patients, the total amount of bupivacaine with epinephrine injected did not exceed the recommended safe dose of 2.5 mg/Kg.

Postoperatively, a standardized multimodal intravenous analgesic protocol was used. All patients received 1 g of acetaminophen every 6 hours, 50 mg of ketoprofen every 6 hours and tramadol at the dose of 1 mg/Kg every 8 hours. Patients reported the postoperative pain felt on each breast using the 10-point Visual Analog Scale (VAS), a validated measure of pain ranging from 0 to 10, 0 representing the absence of pain and 10 representing the worst pain imaginable. Postoperative pain was assessed at rest and after movement at 0, 1, 3, 8 and 24 hours. A plastic surgery resident blinded to the randomization process collected the timed assessments in the hospital. In case of same-day discharge, the patient was instructed to take note of the pain level at the remaining points in time and the scores were obtained via telephone call.

Demographic and surgical data were retrieved from the hospital charts. Demographic data consisted of the age, height, weight, body mass index (BMI) and parity. Surgical data included implant volume, and intraoperative or postoperative complications. Patient satisfaction was noted at the 2-week postoperative visit.

Statistical analysis

The primary outcome of the study was the difference in patient-reported pain scores between the breast treated with PMM infiltration and the contralateral breast at different points in time. To study the change in pain score difference over time, a mixed effect linear regression model was performed.

Two models were generated: Model 1 studies change of pain score difference with time for the patients who received ICNB on the contralateral breast. It thus compares response to ICNB and response to PMM infiltration. Model 2 studies change of pain score difference with time for patients who received placebo on the contralateral breast. It thus compares response to placebo and response to PMM infiltration. The same analysis was repeated for pain scores at movement.

Results were reported using regression coefficients and 95% confidence intervals. Continuous data were described as medians with ranges or as means with standard deviations. A p value < 0.05 was considered statistically significant. All statistical analysis was conducted using Stata 12 (Stata Corporation, College Station, TX, USA).
RESULTS

Over a one-year period ending in July 2013, twenty-eight women were consecutively enrolled in the study. Cohort 1 and 2 consisted of 13 and 15 patients respectively. Patients in each cohort were randomly assigned to right or left PMM infiltration. There were no patients lost to follow-up and a total of 28 patients are included in the statistical analysis. Figure 1 describes the flow of subjects throughout the study.

Mean patient age and BMI were 30.21 years and 20.44 Kg/m² respectively. Each patient received the same prosthesis volume on both breasts. The mean implant volume used was 293.93 mL. Table I depicts the demographic and surgical results in both cohorts.

In all patients, PMM infiltration and ICNB were easily performed on the intended side, and there were no described complications related to the surgery or to either approach. There were no detected postoperative pneumothoraces and no reported anaphylactic reactions or episodes of local anesthetic toxicity. All patients were satisfied with the final esthetic results.

When comparing PMM infiltration to ICNB (Cohort 1), there was no difference in pain on admission to the recovery room (time 0) at rest ($p = 0.98$), or after movement ($p = 0.79$). Postoperative pain gradually decreased with time in all patients. When using the mixed regression model, no difference in pain scores was found over time at rest ($p = 0.91$), or on movement ($p = 0.92$) (Figures 2-3, Table II).

When comparing PMM infiltration to placebo (Cohort 2), there was no difference in pain on admission to the recovery room (time 0) at rest ($p = 0.23$) or after movement ($p = 0.15$). Postoperative pain gradually decreased

<table>
<thead>
<tr>
<th>TABLE I DEMOGRAPHIC and SURGICAL CHARACTERISTICS</th>
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<tbody>
<tr>
<td>Variable</td>
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<tr>
<td>----------</td>
</tr>
<tr>
<td>AGE years, mean (SD)</td>
</tr>
<tr>
<td>BMI Kg/m², mean (SD)</td>
</tr>
<tr>
<td>PARITY median [range]</td>
</tr>
<tr>
<td>IMPLANT VOLUME mL, mean (SD)</td>
</tr>
</tbody>
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SD: standard deviation  
BMI: body mass index
with time in all patients. When using the mixed regression model, no difference in pain scores was found over time at rest \((p = 0.77)\), or on movement \((p = 0.90)\) (Figures 4-5, Table II).

**DISCUSSION**

The results from this study suggest that neither PMM infiltration nor ICNB have an analgesic effect after breast augmentation surgery. Indeed, there was no statistically significant difference in pain scores when comparing PMM infiltration to placebo or PMM infiltration to ICNB.

Pain control after breast augmentation has been considerably studied to improve women’s overall perception of this experience. A recent systematic review by Stanley *et al.* exposes different methods of controlling postoperative pain [4]. PMM infiltration and ICNB seem to offer an attractive alternative to traditional methods of analgesia. However, there are conflicting data in the literature regarding the efficacy of these techniques. Whereas ICNB failed to add any analgesic benefit in some comparative trials [10], Sangdal *et al.* demonstrated efficient analgesia lasting for 48 hours [12]. On the other hand, even though Jabs *et al.* showed that PMM infiltration decreases pain perception and postoperative use of analgesics, the study is limited by its retrospective nature [11].

Decreasing postoperative pain is one of the cornerstones of overall patient satisfaction [2]. Aside from being efficient, the ideal analgesic method should be simple, easily reproducible and safe. In this regard, both PMM infiltration and ICNB were successfully performed in all patients with no reported complications. In fact, toxic doses of bupivacaine could result in central nervous system and cardiovascular effects. Furthermore, plasma levels obtained after an ICNB were shown to be lower than the toxic threshold [7]. When compared to patient controlled analgesia PCA, PMM infiltration and

**TABLE II.** MEAN CHANGE in PAIN SCORES OVER TIME USING the MIXED REGRESSION MODEL

<table>
<thead>
<tr>
<th></th>
<th>p value</th>
<th>95% CI</th>
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<tr>
<td><strong>PMM versus ICNB</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At rest</td>
<td>0.91</td>
<td>[-0.05, 0.04]</td>
</tr>
<tr>
<td>On movement</td>
<td>0.92</td>
<td>[-0.06, 0.07]</td>
</tr>
<tr>
<td><strong>PMM versus placebo</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At rest</td>
<td>0.78</td>
<td>[-0.04, 0.03]</td>
</tr>
<tr>
<td>On movement</td>
<td>0.90</td>
<td>[-0.04, 0.03]</td>
</tr>
</tbody>
</table>

CI: confidence interval PMM: pectoralis major muscle infiltration ICNB: intercostal nerve block
ICNB have the advantage of eliminating the role played by the patients in their own pain management, consequently improving patient comfort and satisfaction [13]. Pneumothorax, a complication associated with ICNB [14] has been successfully avoided in our study by using a fine-gauge needle and ensuring accurate and reliable placement of the needle in angle and depth by an experienced anaesthesiologist.

Although thoracic intercostal nerves provide sensory innervation to the breast, the contribution of the pectoral nerves to post-breast augmentation pain has yet to be determined [15]. The failed effect of ICNB to significantly decrease postoperative pain may be explained by the fact that pain felt after subpectoral implants is predominantly channeled via the thoracacromial trunk compared to the intercostal nerves. In fact, a study by Blanco et al. demonstrated that by combining a pectoralis major muscle nerve block to an ICNB, provides complete analgesia in breast surgeries [16,17].

In addition, using a refined surgical technique with minimal dissection as advocated by Tebbets could help decrease muscle spasms, consequently reducing postoperative pain. In his series, post-breast augmentation pain was managed by ibuprofen alone, with return to full normal activities within 24 hours [18,19].

Our study differs from the literature in its design. It is a prospective, randomized controlled study. By treating the right and left breast differently and comparing the analgesic outcomes, we were able to study each patient as her own control. This enables us to control for confounding factors related to the patient, in particular the recall bias as well as bias brought by the subjectivity of pain perception.

Nonetheless, it is unclear if this novel design is appropriate when assessing analgesia since pain could be perceived as a whole and it might be challenging for a patient to accurately differentiate between pain stemming from the right side or left side of the chest. The small number of patients enrolled constitutes the main weakness. On the other hand, even though our study was double-blinded when comparing PMM infiltration to placebo (Cohort 2), it lacked the double-blind design when comparing PMM infiltration to ICNB (Cohort 1).

In conclusion, Our pilot study shows that ICNB and PMM infiltration are safe and feasible but do not offer any analgesic benefit in pain reduction following breast augmentation. The debate continues regarding the best analgesic method that would provide clinically relevant alleviation of pain post-breast augmentation surgeries. Further large randomized controlled trials are needed to confirm our results.

REFERENCES


