Painless Abdominoplasty: The Efficacy of Combined Intercostal and Pararectus Blocks in Reducing Postoperative Pain and Recovery Time

Lu-Jean Feng, M.D.

Pepper Pike and Cleveland, Ohio

Background: Reducing postoperative pain following abdominoplasty is essential for shortening the length of recovery time, reducing the use of narcotics, promoting quicker return to normal activities, and maximizing overall patient satisfaction. The extended use of narcotics and pain pumps is often unacceptable because of nausea, restriction of normal activities, and inconvenience. When the recovery process is not too lengthy and debilitating for the patients, they are more likely to refer the procedure to others and to return for additional elective procedures.

Methods: The charts of 209 patients undergoing abdominoplasty over a 10-year period were reviewed. The control group ($n = 20$) received no blocks, whereas the treatment group ($n = 77$) received a combination of nerve blocks, using bupivacaine, tetracaine, and Depo-Medrol. Recovery room data and patient questionnaires were used to evaluate clinical efficacy. Patient procedures were classified into four severity classes for analysis.

Results: The treatment group had significantly less pain across all severity classes and required significantly less narcotics and less time in the recovery room. Pain scores continued to be significantly lower at home. Patients had significantly less nausea, took less pain medication, and resumed normal activities significantly sooner than the control group.

Conclusions: This is the first study showing successful long-term relief of pain associated with abdominoplasty using a combination of intercostal, ilioinguinal, iliohypogastric, and pararectus blocks. This pain-block procedure significantly reduces the recovery time and allows the patient to return to normal activities and work much sooner. (*Plast. Reconstr. Surg.* 126: 1723, 2010.)

Management of postoperative pain following abdominoplasty is a significant challenge and is essential for minimizing the time needed for recovery. The extended use of narcotic medication is often unacceptable because of the frequency of nausea, malaise, constipation, and restriction of normal activities. Pain infusion pumps have shown promise in reducing pain and narcotic use, but results are variable depending on placement of the catheters.[1,2] These pumps also add inconvenience and unnecessary cost to the patient. To truly decrease pain and recovery

from abdominoplasty, the method must be highly efficacious for a prolonged period, convenient and without the encumbrance of drains and catheters, and cost-effective.

The author has been searching for a reliable method of pain control after abdominoplasty since 2000. Initially, local anesthetic was injected into the skin incisions. Pain was diminished in the recovery room but recurred later at home. In 2001, ilioinguinal and iliohypogastric nerve blocks were added to diminish pain in the lower abdomen but were not effective in the upper abdomen

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and periumbilical region. When the pararectus block[3] was added in 2002, pain resolved in the lower abdomen but not in the upper abdomen. In 2005, the intercostal block was added and significant improvement in upper abdominal pain was achieved. However, it was not until the addition of Depo-Medrol (Pfizer, New York, N.Y.)[4] into the local anesthetic that the block lasted well beyond the time of discharge.

To fully evaluate this type of block, the recovery room records of patients who had no blocks versus combination blocks were reviewed. Visual analogue pain scores, pain medications used, and length of recovery room time were analyzed. Patients were also sent questionnaires after 6 weeks to rate their pain scores at home, use of narcotic medications, level of nausea, when they resumed driving and normal activities, when they were pain free, and level of satisfaction with their cosmetic result. The data collected were compared between the no-block control group and the combination-block treatment group.

PATIENTS AND METHODS

The charts of 209 patients who underwent abdominoplasty alone or in combination with other procedures were reviewed. All operations took place at the same outpatient surgery facility from April of 2000 through June of 2009. Age, gender, body mass index, date and type of procedure, types and composition of blocks, pain score and narcotics given in recovery, pain location, and length of time in the recovery room were collected from the facility charts. Procedures were classified by levels of severity. Abdominoplasty alone was classified as class I. Abdominoplasty with other procedures was classified from class II to class IV as indicated in Table 1. Figure 1 shows the percentage of patients in each category.

All patients underwent general anesthesia. Progressive tension sutures were used after 2004, elim-
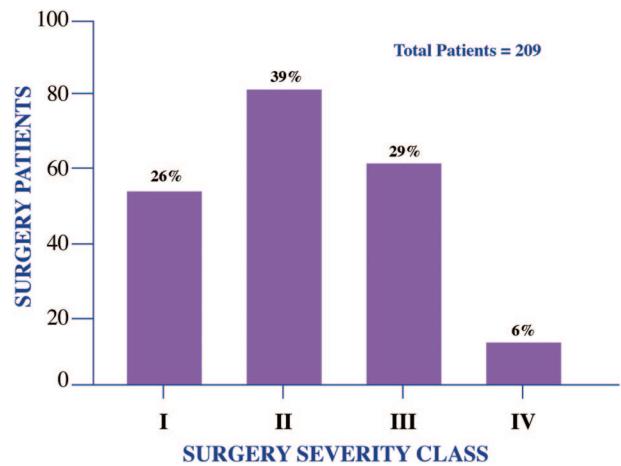
Table 1. Classification of Patient Procedures by Surgery Severity Classes

Class	Procedures
I	Abdominoplasty
II	Abdominoplasty plus liposuction (one area)
	Abdominoplasty plus breast (reduction, augmentation or mastopexy)
III	Abdominoplasty plus liposuction (two areas)
	Abdominoplasty plus breast plus liposuction (one area)
	Circumferential abdominoplasty
IV	Abdominoplasty plus liposuction (three areas)
	Circumferential abdominoplasty plus liposuction (one area)

Fig. 1. Patient distribution by surgery severity classes.

inating drains in the abdomen. Patients were divided into two groups. Twenty patients met the criteria of the control group (i.e., no local anesthesia or nerve blocks). Seventy-seven patients met the criteria of the treatment group [i.e., local anesthesia in the skin, intercostal blocks before incision, and pararectus blocks before plication, and whose blocks contained 0.25% Marcaine (sanofi-aventis, Bridgewater, N.J.) with 1:200,000 epinephrine (Astrazeneca LP, Wilmington, Del.), Pontocaine (Hospira, Inc., Lake Forest, Ill.), and Depo-Medrol (Pfizer, New York, N.Y.)]. The control group patients underwent surgery before 2004, and the treatment group underwent surgery in the later part of the series. The technique of abdominoplasty remained consistent, with flap undermining and fascial plication from the xiphoid and pubic symphysis.

Technique of Blocks

All intercostal blocks were performed from T7 to T12 at the posterior axillary line before incision because the lateral cutaneous branches are more superficial and lie in the internal intercostal muscle near the midaxillary line. This technique allows more superficial placement than any other previously reported blocks.[5] This block was performed following general anesthesia to allow sufficient time for diffusion. To prevent pneumothorax, a 23-gauge needle was placed at the most superficial aspect of the rib, then walked off inferiorly, and inserted 1 to 2 mm into the intercostal muscles while the patient was off positive ventilation. For patients who were having concurrent breast procedures, the blocks were extended superiorly from T6 to T2 in the midaxillary line.

Before plication, the iliohypogastric and ilioinguinal nerves were blocked at 2 cm above and 2

cm medial to the anterior superior iliac spine with a 27-gauge needle. The pararectus block was injected above and below this point, from the costal margin to the groin, in the plane of the internal oblique muscle. The composition of the block was 2.5 mg/kg of 0.25% bupivacaine with 1:200,000 epinephrine, 20 mg of Pontocaine, and 40 mg of Depo-Medrol, using a volume of 4 to 5 cc at each intercostal space. Skin incisions were anesthetized by tumescent infiltration.

Outcome Variables Collected

Pain scores were obtained from the recovery room records on arrival using the visual analogue scale (ranging from 0 to 10) before any analgesia was administered. Narcotics given in the recovery room were calculated using an opioid equivalence chart,[6] converted to morphine milligram units. The length of time in recovery room was calculated from arrival to discharge in minutes.

Patient questionnaires were sent 6 weeks later to obtain pain level in the recovery room and at various time intervals at home. They were also queried regarding when they were pain-free; what type of pain medications they had taken; their level of nausea; when they resumed driving, normal activities, or work; and whether they were satisfied cosmetically with their result.

Statistical Analysis

The principal analysis was conducted using SAS 9.1 (SAS Institute, Inc., Cary, N.C.). Differences between the two groups in continuous variables such as body mass index, length of stay, and narcotics given in recovery were compared using the t test. Nominal categorical variables such as type of pain medicine taken at home were compared using Fisher's exact test or chi-square test. The nonparametric Mann-Whitney U test was used for comparison of pain scores and other ordinal categorical variables. The difference of variables among several groups was analyzed by analysis of variance or nonparametric analysis of variance (Kruskal-Wallis test followed by the Mann-Whitney U test) where appropriate. A difference was considered significant for values of $p < 0.05$. Normally distributed data were presented as means ± SD, ordinal categorical data were presented as median ± interquartile range, and categorical data were presented as raw data and as frequencies.

RESULTS

To determine whether the control and treatment groups were comparable, the age, body mass

Table 2. Comparison of Age, Body Mass Index, and Severity Class of Surgery between Control and Treatment Groups

	No.	Age*	Body Mass Index†	Severity Class‡
Control	20	46.9 ± 9	27.5 ± 7	II (III, I)
Treatment	77	45.7 ± 9	24.6 ± 3	II (III, II)

*Mean ± SD; $p = 0.59$.
†Mean ± SD; $p = 0.0825$.
‡Median (upper, lower quartile); $p = 0.59$.

index, and type of procedure(s) performed, as classified into severity classes I to IV, were compared. Table 2 shows no significant difference in age, body mass index, or type of procedures performed between the two groups. Recovery room data were collected for all patients. They were also given questionnaires to complete to assess pain, medication usage, and activity at home. Of 20 patients in the control group, nine (45 percent) responded; and of 77 patients in the treatment group, 61 (79 percent) responded.

Recovery Room Data

Figure 2 shows the comparison of pain scores in the recovery room at admission for patients in each severity class. For severity class I, there were six patients in the control group and 13 patients in the treatment group. The median pain score
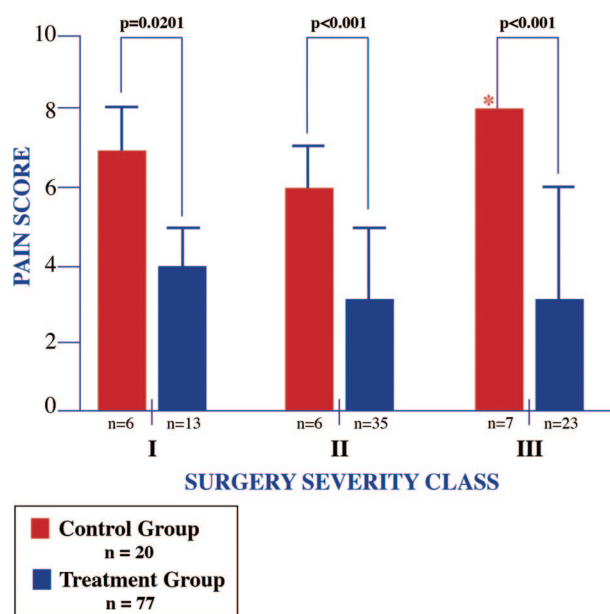
Fig. 2. Comparison of pain scores in the recovery room for the control group versus the treatment group, with differentiation by surgery severity classes. *Seventy-five percent quartile and 25 percent quartile = 8.

was 7 for the control group and only 4 for the treatment group. This difference was significant ($p = 0.0201$). For severity class II, there were six patients in the control group and 35 patients in the treatment group. The median pain score was 6 for the control group and 3 for the treatment group. This difference was significant ($p < 0.0001$). For severity class III, there were seven patients in the control group and 23 patients in the treatment group. The median pain score was 8 for the control group and 3 for the treatment group. This difference was also highly significant ($p < 0.0001$). Despite having more operations in severity class III, patients with combination blocks still had significantly less pain on awakening in the recovery room. We were not able to compare patients in severity class IV because there was only one patient in the control group.

According to the Kruskal-Wallis test, there was no difference in the median pain scores among the different severity classes in the control and treatment groups. The two groups were also compared without surgery severity class stratification. The median pain score was 7.50 for the control group ($n = 20$) and 3.00 for the treatment group ($n = 77$). This difference was highly significant ($p < 0.0001$) (Fig. 3).

Figure 4 shows the comparison of narcotics given in recovery between the control and treatment groups, according to different severity classes of procedures. In severity class I, the mean
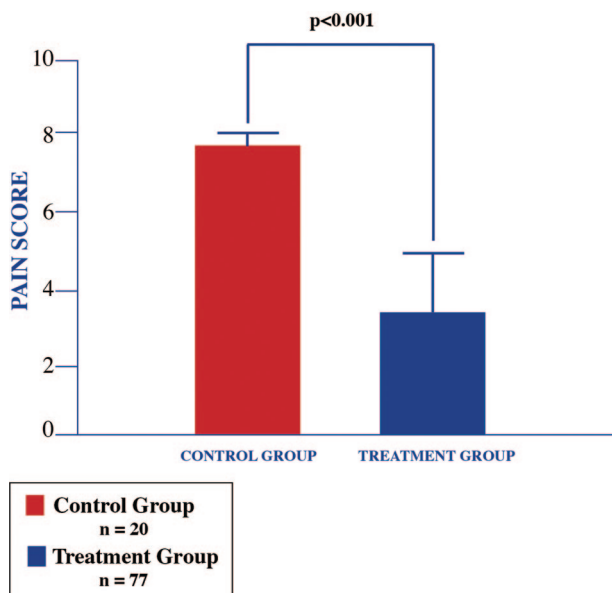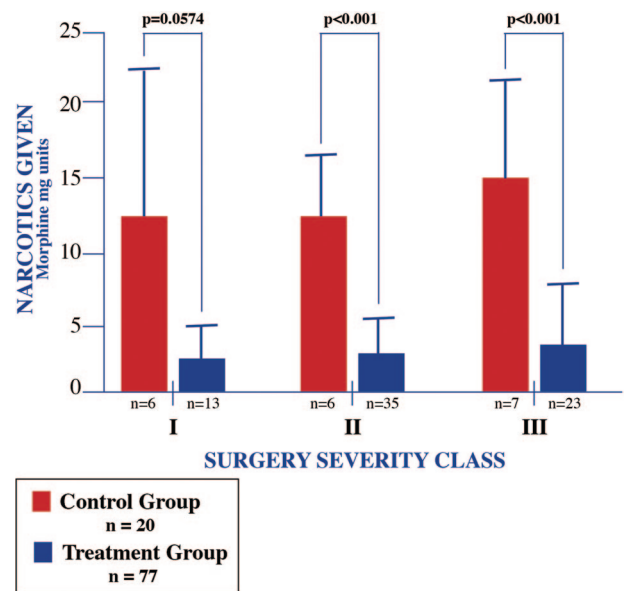

Fig. 4. Comparison of narcotics given in the recovery room in the control group versus the treatment group, with differentiation by surgery severity classes.

narcotic given was 12.465 ± 10.138 morphine milligram units in the control group and 2.3077 ± 2.7879 morphine milligram units in the treatment group. This difference was borderline significant at $p = 0.0574$ by the approximate t test (for unequal variances with the Satterthwaite method). This difference, however, was significant ($p = 0.0018$) according to the Wilcoxon rank sum test. The discrepancy in significance may be attributable to small sample size and greater variance in the control group.

For severity class II, the mean narcotic given was 12.388 ± 4.2485 morphine milligram units in the control group and 2.8046 ± 2.7983 morphine milligram units in the treatment group. This difference was highly significant at $p < 0.0001$ by the approximate t test (for equal variances with pooled variance method). For severity class III, the mean narcotic given was 14.778 ± 7.3451 morphine milligram units in the control group and 3.4048 ± 4.5218 morphine milligram units in the treatment group. This difference is highly significant ($p < 0.0001$) by the approximate t test (for equal variances with pooled variance method.

Because there was no significant difference (by one-way analysis of variance) in group means among the severity classes in the control and treatment groups, the narcotics given were compared without severity class stratification (Fig. 5). The mean narcotic given was 12.836 ± 7.368 morphine milligram units in the control group

Fig. 3. Comparison of pain scores in the recovery room for the control group versus the treatment group, without differentiation by surgery severity classes.
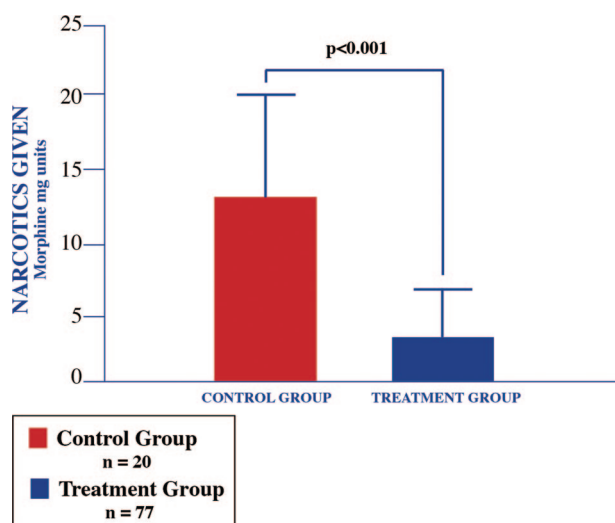
Fig. 5. Comparison of narcotics given in the recovery room for the control group versus the treatment group, without differentiation by surgery severity classes.

and 3.099 ± 3.677 morphine milligram units in the treatment group. This difference was highly significant at $p < 0.0001$.

Figure 6 shows the comparison of length of time in the recovery room between control and treatment groups as separated into severity classes. For severity class I, the mean length of time in recovery was 135.83 ± 32.468 minutes for the control group and 76.615 ± 17.737 minutes for the treatment group. This difference was highly significant ($p < 0.0001$) by the approximate t test (for
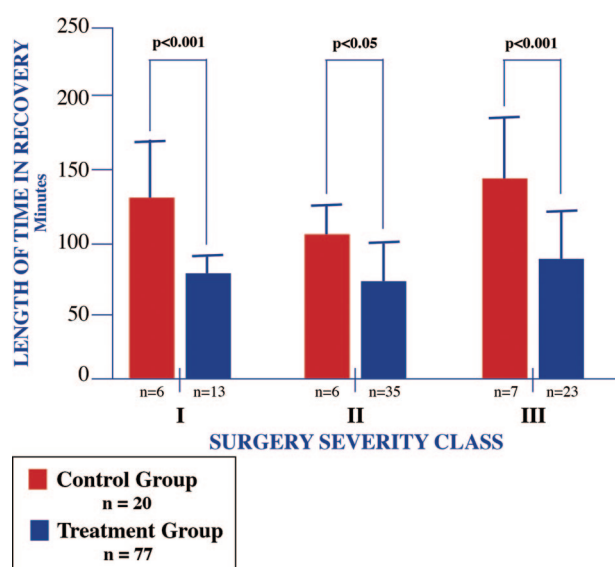
equal variances with pooled variance method). For severity class II, the mean length of time in recovery was 104.17 ± 21.977 minutes for the control group and 70.800 ± 30.443 minutes for the treatment group. This difference was significant ($p = 0.0144$). For severity class III, the mean length of time in recovery was 147.86 ± 34.271 minutes for the control group and 86.478 ± 34.821 minutes for the treatment group. This difference was highly significant ($p = 0.0003$).

Because there were no differences in mean length of time among the different severity classes in the control group or the treatment group by one-way analysis of variance, the length of time in recovery was compared without stratification into different severity classes. Figure 7 shows the comparison of length in recovery in minutes between control and treatment groups without stratification into severity classes. The mean length of time in recovery was 133.25 ± 35.954 minutes for the control group and 76.247 ± 29.81 minutes for the treatment group. This difference was highly significant ($p < 0.0001$).

Questionnaire Results

Patients were asked what their level of pain was in the recovery room. The median pain score was 3.00 for the control group and 1.00 for the treatment group. This difference was close to being significant ($p = 0.0523$), as indicated in Figure 8. For the first 2 days at home, the median pain score was 7.00 for the control group and 2.00 for the treatment group. This difference was highly significant ($p < 0.0001$). From days 3 to 7, the median
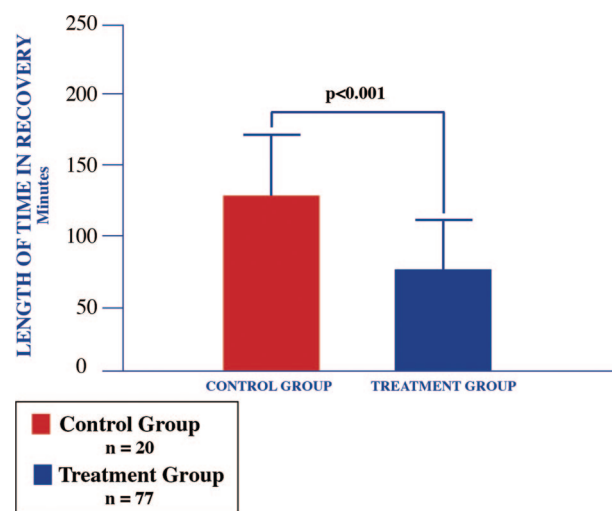

Fig. 6. Comparison of length of time in the recovery room control group versus the treatment group, with differentiation by surgery severity classes.

Fig. 7. Comparison of length of time in the recovery room for the control group versus the treatment group, without differentiation by surgery severity classes.
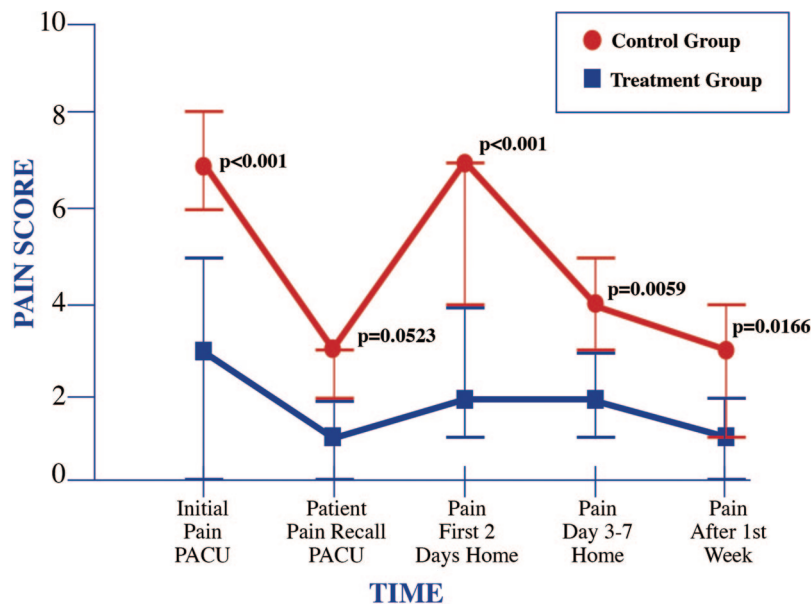
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Fig. 8. Longitudinal pain score comparison between the treatment and control groups. *PACU*, postanesthesia care unit.
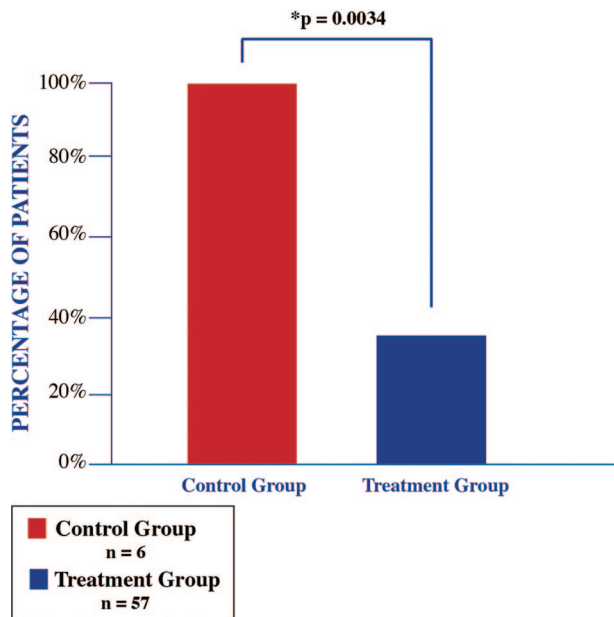

Fig. 9. Comparison of patients taking narcotic medications at home following abdominoplasty surgery for the control group versus the treatment group. All patients in the control group took narcotics following surgery compared with only 35 percent of patients in the treatment group.

pain score was 4.00 for the control group and 2.00 for the treatment group. The difference between the control and treatment groups was also highly significant ($p = 0.0059$). After the first week at home, the median pain score was 3.00 for the control group and 1.00 for the treatment group.

The difference between the control and treatment groups was also highly significant ($p = 0.0166$). Figure 8 shows the longitudinal pain score comparison between the control and treatment groups from admission to the recovery room to the first week at home.

The patients were asked what type of pain-relieving medications were taken at home. Three patients in the control group and four patients in the treatment group could not recall what medications they took. All six patients (100 percent) in the control group took narcotics, whereas only 20 patients (35.09 percent) in the treatment group took narcotics. This difference was highly significant by the Fisher's exact test ($p = 0.0034$) (Fig. 9).

The patients were asked to rate their level of nausea at home. Figure 10 shows the results in the control and treatment groups. One patient in the treatment group had no recall. Using chi-square analysis, the difference in level of nausea between control and treatment groups was highly significant ($p = 0.0005$).

The patients were asked when they were pain-free and not requiring any prescription pain medications. Figure 11 shows the responses in the control and treatment groups. Using chi-square analysis, there was a significant difference between the control and treatment groups ($p = 0.0344$).

The patients were asked when they resumed driving as indicated in Figure 12. Using chi-square analysis, there was a significant difference between the control and treatment groups ($p = 0.0012$).
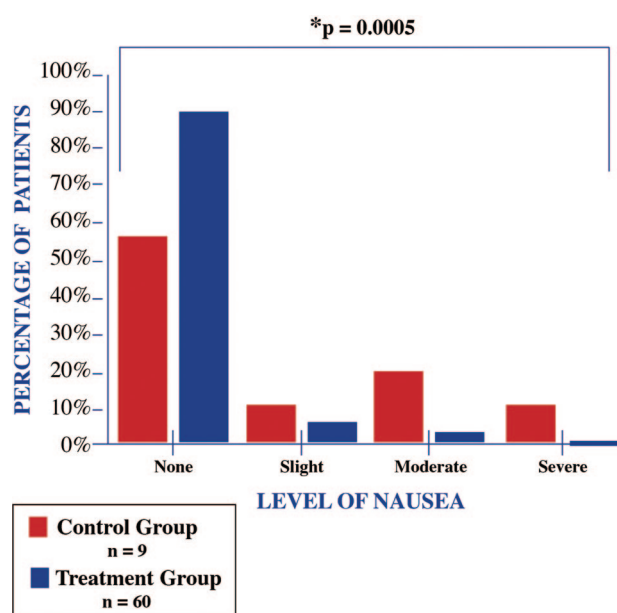
Fig. 10. Level of nausea experienced at home. The treatment group had significantly less nausea than the control group.
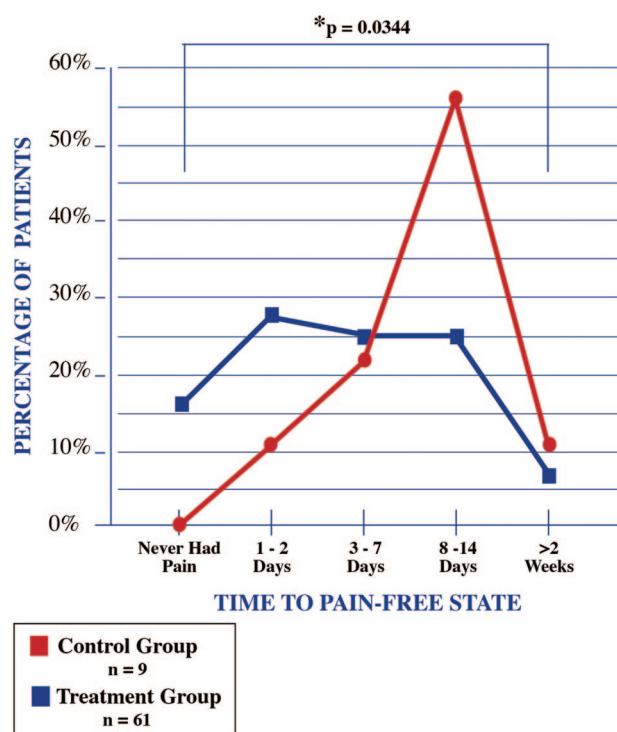

Fig. 11. Time to pain-free state following abdominoplasty. The treatment group reached a pain-free state significantly sooner than the control group did.

Fig. 12. Time to resume driving in the control and treatment groups.

The patients were asked when they resumed normal activities (excluding exercise) and/or returned to work. Figure 13 shows the comparison b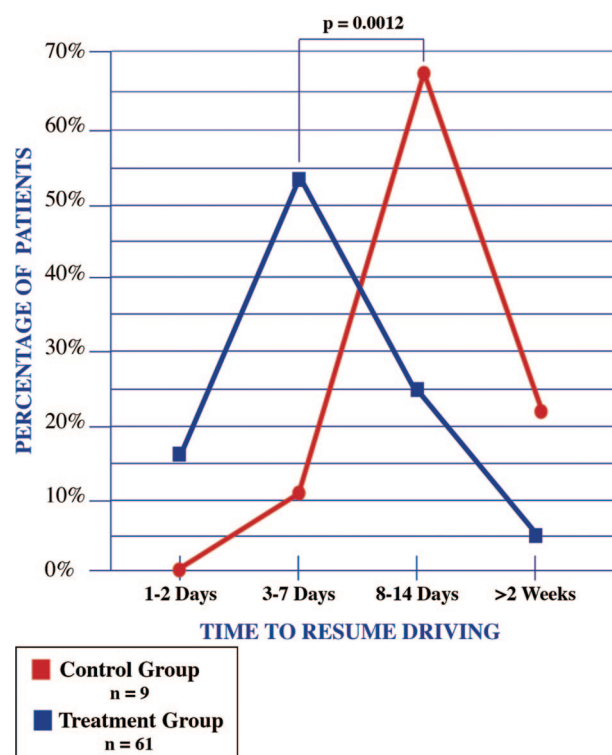etween the control and treatment groups. Using chi-square analysis, there was a significant difference between the control and treatment groups ($p = 0.0087$).

Patients were asked to rate their cosmetic result. Figure 14 shows the degree of satisfaction in the control and treatment groups. Using chi-square analysis, there was no significant difference between the control and treatment groups ($p = 0.0834$).

Figure 15 shows before-and-after results of a patient who had abdominoplasty and breast reduction. She had an intercostal block from T2 to T12 to block the sensory nerves to the breast and abdomen and a pararectus block to anesthetize sensory nerves in the lower abdomen. She took no narcotics postoperatively, resumed driving between days 3 and 7, was pain-free, and returned to work between 8 and 14 days after surgery.

Figure 16 shows before-and-after results of a patient who had circumferential abdominoplasty. She had an intercostal block from T6 to T12 at the angle of the rib, a pararectus block, and tumescent infiltration of the area of incision. She was discharged comfortably from the recovery room. She took Celebrex (Pfizer) postoperatively, resumed driving at 1 week, and was pain-free and returned to work between 8 and 14 days.
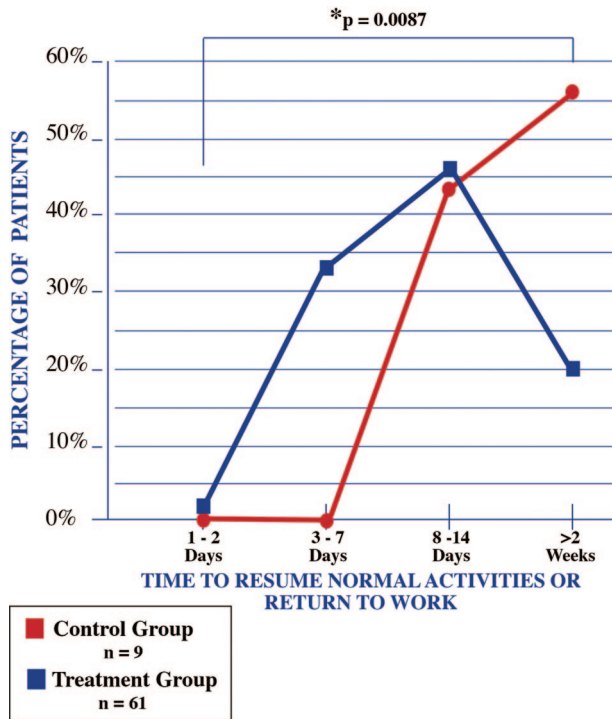
Fig. 13. Time to resume normal activities or return to work in the control and treatment groups. The treatment group resumed normal activities or returned to work significantly sooner than the control group did. Eighty percent of the treatment group resumed normal activities within 2 weeks versus 44 percent of the control group.
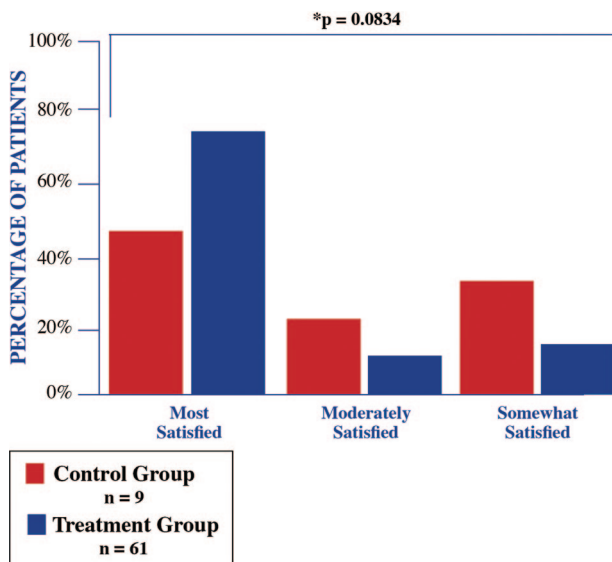

Fig. 14. Comparison of degree of patient satisfaction with cosmetic result in the control and treatment groups. Although the treatment group had a higher percentage of most satisfied patients, this difference was not significant compared with the control group.

Complications

There was no pneumothorax in the treatment group or in the control group. No patients in the control group had a hematoma, whereas two patients (2.86 percent) in the treatment group did.

One patient in the control group had a drain-site infection, whereas no patients in the treatment group had an infection. Fourteen of 20 patients (70 percent) in the control group had seromas, whereas only five of 70 patients (7 percent) in the treatment group had seromas. The difference in seroma rate between the two groups can be explained by the use of progressive tension sutures in the treatment group.

DISCUSSION

Previous studies on pain control after abdominoplasty have failed to demonstrate efficacy beyond the recovery room.[1,5,8] Bray et al.[1] used pain pumps with catheters placed under the subcutaneous flaps, but they achieved little pain relief. This finding is consistent with this study because all of the sensory branches of the abdominal wall are located deep to the internal oblique muscle, above the anterior superior iliac spine or deep to the external oblique muscle below the anterior superior iliac spine.[7] Although Mentz et al.[2] showed that pain pumps were helpful, there was no statistical analysis in their study. Abramson[8] used tumescent infiltration supplemented by intrafascial Marcaine to decrease pain after abdominoplasty in the recovery room to allow the procedure to be performed on an outpatient basis. The intrafascial Marcaine is similar to our pararectus block; however, his study did not have a control group and did not use any standardized pain scores or narcotic medication units in recovery to document the efficacy of the patients' pain management. Michaels and Eko[5] used intercostal rib blocks supplemented by local subcutaneous infiltration in the lower abdomen to avoid general anesthesia during abdominoplasty. Although the study showed efficacy of pain control during surgery and in recovery, the study did not extend beyond the recovery room.

In this study, patients who received the combination blocks experienced significantly less pain, used less narcotics, and needed less recovery time in the recovery room and at home. Although the blocks primarily block pain in the abdomen, they are highly effective in reducing pain across all

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Fig. 15. Before-and-after photographs of abdominoplasty and breast reduction. The patient received an intercostal block from T2 to T12 and a pararectus block for the lower abdomen. No narcotics were taken postoperatively, driving was resumed between days 3 and 7, and the patient returned to work between 8 and 14 days after surgery.

Fig. 16. Before-and-after photographs of circumferential abdominoplasty. The patient received an intercostal block from T6 to T12, a pararectus block for the lower abdomen, and tumescent infiltration of the area of the incision. No narcotics were taken postoperatively, driving was resumed between days 3 and 7, and the patient was pain-free and returned to work between 8 and 14 days after surgery.

severity classes of combined procedures with abdominoplasty. When pain is reduced, patients can tolerate combined procedures more easily and recover more quickly.

Less pain in the combination block/treatment group resulted in significantly less use of narcotics in both the recovery room and at home, which resulted in less nausea. Less postoperative pain also resulted in less time in the recovery room and quicker recovery at home, leading to faster resumption of normal activity and return to work. Significant pain after surgery has tremendous consequences on a patient's overall recovery, in terms of bodily discomfort, psychological stress, delay in return to normal activities, economic loss, and the costs associated with longer recoveries.

Pain after abdominoplasty can be a strong deterrent to having surgery, no matter how beneficial the surgery can be. Postoperative pain is therefore a very important subject for cosmetic plastic surgeons to study. Today, prospective patients are concerned about not only the aesthetic quality of results but also the overall ease of recovery and downtime associated with elective surgery.

Lu-Jean Feng, M.D.
The Lu-Jean Feng Clinic
31200 Pinetree Road
Pepper Pike, Ohio 44124
drfeng@fengclinic.com

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