Transversus Abdominis Plane Block Anesthesia in Abdominoplasties

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Background: The transversus abdominis plane block is a promising approach to the provision of postoperative analgesia following abdominal incision. This effective method blocks the sensory nerve supply to the anterior abdominal wall. The authors evaluated its analgesic efficacy over the first 12 postoperative hours after abdominoplasty with liposculpture in a randomized, controlled, double-blind clinical trial.

Methods: Twenty-eight women undergoing abdominoplasty by means of a lower abdominal incision were randomized to undergo transversus abdominis plane block (n = 14) in addition to standard care therapy (n = 14). The investigators, who were blinded to the conditions of the study, assessed the patients in the postanesthesia care unit at 4, 6, and 12 hours postoperatively.

Results: The transversus abdominis plane block group reported reduced pain scores (F = 12.73, p < 0.001). Morphine requirement was also reduced in the first 12 postoperative hours (χ² = 19.27; p < 0.005). Transversus abdominis plane block group patients also exhibited early ambulation compared with the control group (F = 65.15, p < 0.001). All of the patients in the transversus abdominis plane block group reported lower levels of pain with their postoperative analgesic regimen, which was demonstrated by their rates of recovery. The Mann-Whitney test was performed on the data, which illustrated that mean ranks consistently corresponded to the trend the authors predicted.

Conclusions: The transversus abdominis plane block seems to hold considerable promise for patients undergoing abdominoplasty by providing effective postoperative analgesia in the first 12 postoperative hours after major abdominoplasty. (Plast. Reconstr. Surg. 128: 529, 2011.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, II.

A substantial component of the pain experienced by patients after abdominoplasty surgery is derived from the abdominal incision and the plication of the rectus abdominis muscles. The abdominal wall consists of three muscle layers—the external oblique, the internal oblique, and the transversus abdominis—and their associated fascial sheaths. The central abdominal wall also includes the rectus abdominis muscles and the associated fascial sheath. This muscular wall is innervated by nerve afferents that course through the transversus abdominis neurofascial plane. A promising approach to the provision of postoperative analgesia after abdominal incision is to block the sensory nerve supply to the anterior abdominal wall.¹ A block of the transversus abdominis plane was first described by Rafi² and

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produces a dermatomal sensory block of the lower six thoracic and upper lumbar abdominal afferents.³

Postoperative pain in cosmetic surgery patients delays mobilization and ambulation and can lead to deep venous thrombosis, pulmonary embolism, and ultimately death in a “nonsick” patient. The estimated risk of deep venous thrombosis is more than 1 percent in abdominoplasty patients having prophylaxis (e.g., heparin).⁴

The aim of this study was to compare postoperative pain in patients having an abdominoplasty associated with a transversus abdominis plane block and those without. Transversus abdominis plane blocks have already been proved very effective in abdominal, urologic, and gynecologic procedures. We postulated that transversus abdominis plane block will reduce the amount of postoperative analgesic medication (especially morphine), which allows the patients to ambulate earlier and exhibit fewer side effects and complications of other analgesic drugs, especially morphine.

THE TRANSVERSUS ABDOMINIS PLANE

The innervation of the abdominal wall is derived from anterior divisions of spinal segmental nerves that run laterally between the transversus abdominis and the internal oblique muscle. This has been described as the transversus abdominal plane (Fig. 1). Performing an anesthetic infiltration in this plane will block the neurovascular bundles and the subsequent pain associated with the anterior abdominal wall from the symphysis pubis to around the T8 level.

PATIENTS AND METHODS

Primarily, an appropriate hospital approval and written informed patient consent were obtained. Twenty-eight American Society of Anesthesiologists physical status I to III patients undergoing abdominoplasty by means of a lower abdominal incision associated with liposculpture on the flanks, in a prospective, randomized, double-blind, controlled clinical trial were studied. Before the study, it was confirmed that none of the patients had a history of relevant drug allergy and none of them was receiving medical therapies considered to cause tolerance to opiates.

Patients were allocated randomly to undergo transversus abdominis plane block (\(n = 14\)) or to receive standard care (\(n = 14\)). The randomization was concealed in sealed envelopes, and the patients, their anesthesiologists, and the staff in charge of postoperative care were blinded to group designation. All patients received a standardized general anesthetic, which was induced with intravenous fentanyl (1 to 1.5 \(\mu g/kg\) to a maximum of 100 \(\mu g\)) and propofol (2 to 3 mg/kg). Standard monitoring, including electrocardiography, noninvasive blood pressure, arterial oxygen saturation, and end-tidal carbon dioxide monitoring were used throughout, and patients were placed in the supine position.

Technique

The abdominal flap is raised and, after careful hemostasis, marks are drawn for the plication of the rectus abdominis muscles and for the identification of the external oblique muscle (Fig. 2). When plication is finished, the external oblique muscle is pulled medially, which in turn helps in the identification of the landmarks for the transversus abdominis plane block (Fig. 3).

The iliac crest is palpated from anterior to posterior until the latissimus dorsi muscle can be felt. The triangle of Petit is then located just anterior to the latissimus dorsi muscle. Using a regional anesthesia needle (22-gauge, Plexufix; B. Braun, Melsungen AG, Germany), the fascia is pierced just cephalad to the iliac crest just before the triangle of Petit (Figs. 4 and 5) perpendicular to
to the external oblique muscle. Subsequently, it is gently advanced in the plane between the external and internal oblique fascial layers, slightly more laterally to minimize the risk of penetrating the peritoneal cavity. The needle is advanced at right angles to the fascia, in a coronal plane, until resistance is encountered. Further gentle advancement of the needle results in a “pop,” which indicates entry into the transversus abdominis fascial plane. After careful aspiration to exclude vascular puncture, 20 ml of solution consisting of 10 ml of bupivacaine 0.5% plus 10 ml of lidocaine 1% plus 0.2 ml of adrenaline 1:1000 is then injected through the needle. (See Video, Supplemental Digital Content 1, which demonstrates transversus abdominis plane block anesthesia in abdominoplasties, http://links.lww.com/PRS/A357.) The transversus abdominis plane block is subsequently performed on the opposite side, using an identical technique. The control group of our patients received 20 ml of normal saline solution.

After completion of the surgical procedure and emergence from anesthesia, patients were transferred to the recovery care unit. A standard intraoperative analgesic regimen consisting of 10 mg of morphine plus 1 g of intravenous paracetamol was given to both groups.

The presence and severity of pain were assessed systemically by an investigator blinded to group allocation. These assessments were performed in the recovery care unit 20 minutes after they woke up and in the ward 4, 6, and 12 hours postoperatively.

All patients were asked to give scores for their pain at rest. Pain severity was measured using a
categorical pain scoring system (0 = none, 1 = mild, 2 = moderate, and 3 = severe).

The sample size was estimated based on 12-hour morphine requirement of patients undergoing abdominoplasty. Thus, the sample size was calculated on the basis that a clinically important reduction in 12-hour morphine consumption would be a 25 percent absolute reduction. We therefore estimated that 14 patients per group would be required, incorporating two equal-sized groups, with $\alpha = 0.05$ and $\beta = 0.2$.

Statistical analysis was applied to the data using the statistical program SPSS (SPSS, Inc., Chicago, Ill.). Demographic data were analyzed using the $t$ test or Fisher’s exact test. Repeated measures (pain scores) were analyzed by repeated measures analysis of variance if normally distributed, with further paired comparisons at each time interval performed applying the $t$ test or the Mann-Whitney $U$ test. Categorical data were also analyzed using chi-square analysis.

RESULTS

Twenty-eight patients were included in the study: 14 of the patients were randomized to be allocated to standard therapy and the remaining patients were randomized to undergo transversus abdominis plane blockade. All patients underwent abdominoplasty, requiring a lower abdominal incision associated with liposculpture on the flanks. Both groups were comparable in the operative procedures performed. In all patients randomized to receive transversus abdominis plane block, the triangle of Petit was located easily on palpation under direct vision, the transversus abdominis neurofascial plane was localized after one or two attempts, and the block was performed without complication.

The general pattern of the data shows that patients in the transversus abdominis plane block group consistently reported lower levels of pain. The statistical analysis of repeated measures analysis of variance was performed on the data, and $F_{3,78} = 12.73, p < 0.001$ was obtained, suggesting the effectiveness of transversus abdominis plane block in pain reduction over the first 12 postoperative hours. Chi-square analysis was also applied to the data for further comparisons and revealed significant differences between the groups over the specified postoperative hours. In the recovery care unit, 42.9 percent of the patients in the control group reported severe pain compared with 0 percent in the transversus abdominis plane block group. The chi-square value was highly significant in the recovery care unit, $\chi^2 = 19.27, p < 0.001$ (Figs. 6 and 7). To consolidate the results further, Mann-Whitney comparisons were also performed, showing $U = 12,000, z = 4.137, and p < 0.001$ for the recovery care unit; and $U = 39,000, z = 2.883, and p < 0.005$ after 4 hours and $U = 47,000, z = 2.660, and p < 0.05$ after 6 hours.

Patients were given morphine for the first 4 postoperative hours. For the remaining part of the study, tramadol was administered if the patients reported experiencing any pain. The summary statistics suggest that more patients required morphine after 4 postoperative hours. In fact, in the control group, all patients were given 15 mg of morphine compared with none in the study group. The overall chi-square value is significant at 11.80 ($p < 0.005$) (Fig. 8). In addition, the Mann-Whitney test was performed on the data compar-
ing the mean ranks in the control and study groups, 19.11 versus 9.89, respectively, which revealed a significant value of $U = 35,000, z = 3.51$, and $p < 0.001$ (Mann-Whitney test for further comparisons indicated a consistent trend for postoperative hours). Moreover, interval tramadol consumption was also significantly lower at 6 hours in the patients who underwent transversus abdominis plane blockade ($\chi^2 = 3.74, p = 0.05$).

Effective pain control also resulted in early ambulation in patients in the transversus abdominis plane block group ($F_{1,78} = 65.15, p < 0.001$). Further comparison also revealed that this postoperative analgesic effect significantly facilitated ambulation after 4 and 6 postoperative hours ($\chi^2 = 7.34, p < 0.05$; and $\chi^2 = 11.2, p < 0.005$, respectively) (Fig. 9). At 4 hours, in the transversus abdominis plane block group, 81.8 percent of patients exhibited ambulation compared with 18.2 percent in the control group. These figures reduced to 70 and 30 percent after 6 hours, respectively. Patients’ ambulation rates were not signif-

Fig. 6. Mean postoperative pain scores at rest in each group over the first 12 postoperative hours. This graph indicates significantly higher pain scores for the control group when compared with the transversus abdominis plane (TAP) block group.

Fig. 7. Pain scores were reported consistently as more severe in the control group compared with the study group, in which most patients did not report any pain. Rcu, recovery care unit; TAP, transversus abdominis plane.

Fig. 8. Morphine requirements were significantly higher in the control group when compared with the transversus abdominis plane (TAP) block group.

Fig. 9. Mean postoperative ambulation scores in each group over the first 12 postoperative hours. This graph indicates significantly higher ambulation scores in the transversus abdominis plane (TAP) block group when compared with the control group.
ically different after 12 postoperative hours. The Mann-Whitney test was also only significant for the ambulation scores after 4 and 6 hours with, $U = 49,000, z = 2.660, and p < 0.005$; and $U = 42,000, z = 3.286, and p < 0.05$, respectively.

**DISCUSSION**

This randomized, double-blind, controlled study clearly demonstrates that when a standard multimodal analgesic regimen is supplemented with a transversus abdominis plane block, patients had reduced pain scores, which facilitated rehabilitation and led to accelerated recovery from surgery. It has long been widely accepted that direct blockade of the neural afferent supply of the abdominal wall, such as abdominal field blocks and ilioinguinal and hypogastric nerve blocks, provides effective postoperative analgesia in patients undergoing abdominal surgical procedures such as cesarean delivery and inguinal herniorrhaphy. However, anatomical landmarks of the abdominal wall remain to be unravelled further. Thus, an alternative, simple, and effective regional analgesic method is required. The proposed lumbar triangle of Petit, which was recognized to be an identifiable, fixed, and palpable landmark located dorsal to the midaxillary line, was easily visualized under direct vision because of the nature of the abdominoplasty procedure itself, without the need for ultrasound.

There is a risk of inadvertent peritoneal puncture with this block. Although the incidence is not known, if the block is performed as described, the risk of peritoneal puncture is likely to be low. We have not encountered complications relating to peritoneal puncture in the literature so far, as the needle is blunt. Also, if the anesthetic is injected inside the peritoneal cavity, its absorption should not be a problem.

The study confined assessment of postoperative analgesia to the first 12 postoperative hours. However, the inspection of summary statistics of our data indicates that the severity of pain in the control patients has subsided substantially by this time, and most patients no longer appear to require systematic opioid therapy. In fact, after 12 postoperative hours, the morphine requirement and the patients’ pain scores in the control group somewhat resembled those of the experimental group. It is very important because those in the transversus abdominis plane block group were more comfortable after surgery and had lesser additional analgesia, giving them the confidence to ambulate at an earlier stage. It should also be noted that all blocks were performed by the same surgeon, which reduced the variability in the conduct and performance of the block.

The type of anesthesia used for abdominoplasty is very personal and is a consensus between the surgeon and his team. Some surgeons may prefer to conduct their abdominoplasties under a spinal block (with or without a catheter). The use of the transversus abdominis plane block is significant only to the group of surgeons that perform their procedures under general anesthesia. We encourage future studies comparing abdominoplasties under spinal anesthetic and those under general anesthetic with transversus abdominis plane block.

A block of the transversus abdominis plane was studied for the first time in cosmetic surgery patients. We conclude that a transversus abdominis plane block offers substantial advantages as part of a multimodal analgesic regimen for patients undergoing abdominoplasty involving abdominal wall incision. This seems to hold considerable promise, as it reduced postoperative pain scores, both at rest and on movement, and significantly diminished postoperative opioid requirements. In the future, this can help in earlier hospital discharge and can lead to reductions in potential severe complications such as deep venous thrombosis.

**REFERENCES**


