Preliminary Report

Tranversus Abdominis Plane Block During Abdominoplasty to Improve Postoperative Patient Comfort

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Abstract

Background: The transversus abdominis plane (TAP) block is an effective regional nerve block for the anterior abdominal wall. An anesthesiologist typically administers the TAP block preoperatively with ultrasound guidance. It is not yet commonly used during abdominoplasty, where postprocedural pain remains a major concern for patients and surgeons.

Objectives: The author investigated the feasibility of administering the TAP block under direct vision and compared postoperative narcotic use in patients who received analgesia by TAP block vs by a standard nerve block, both performed under direct vision during abdominoplasty with or without flank liposuction.

Methods: In this pilot study, 32 consecutive patients received either a TAP block (n = 16) or a combination of pararectus injections and ilioinguinal/iliohypogastric nerve blocks (n = 16) during abdominoplasty. Patients in both groups also received an injection of bupivacaine in the rectus plication. All patients were then monitored for narcotic use patterns during the first 16 hours after surgery. Statistical significance was ascertained with the t test.

Results: Patients in the TAP block group required a significantly smaller mean dose of postoperative hydromorphone (TAP block group: 2.63 mg; standard treatment group: 4.31 mg; P = .024) and had a significantly longer mean time to first request for as-needed pain medication (TAP block group: 3 hours 11 minutes; standard treatment group: 1 hour 27 minutes; P = .022).

Conclusions: The open TAP block provided more effective analgesia than a standard nerve block in the observation period after abdominoplasty with or without flank liposuction. Larger studies are needed to confirm the results.

Level of Evidence: 3

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Abdominoplasty is a popular aesthetic operation, with more than 160,000 procedures performed in the United States each year. Given the substantial incision and soft-tissue undermining associated with this procedure, postoperative pain is a concern for patients and surgeons. Previous studies have typically incorporated multiple nerve blocks to improve analgesia after abdominoplasty. Although the regional nerve block known as the transversus abdominis plane (TAP) block was first described in the literature in 2001, it has not been widely applied in plastic surgery. This may be due to the blind nature of the technique as initially described or to the reluctance of aesthetic plastic surgeons to employ ultrasound guidance. Nevertheless, the TAP block has been successfully adopted for colorectal, hernia, and various gynecologic procedures.

This article describes the author’s experience with a TAP block administered under direct vision for accurate placement during abdominoplasty with a spreading dissection technique. The pilot study was conducted to compare narcotic use during the first 16 hours after abdominoplasty with and without flank liposuction in patients receiving either a TAP block or standard nerve blocks.

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METHODS

TAP Block Anatomy

As classically described, the TAP block involves a single bolus of local anesthetic placed into the anatomic plane between the internal oblique and transversus abdominis, in a space that extends from the costal margin superiorly to the inguinal ligament inferiorly and to the lateral border of the rectus abdominis anteriorly. Because the anterior rami of nerves T7 through L1 traverse this space anteriorly, the TAP technique potentially blocks multiple cutaneous dermatomes with 1 injection per side.

The TAP space can be accessed from several locations. The TAP block is commonly administered with a lateral approach4 through the lumbar Petit triangle or with a subcostal approach as described by Hebbard.10 It is typically administered by an anesthesiologist preoperatively with ultrasound guidance. The intraabdominal approach during laparoscopic surgery has also been described.11 Hebbard et al12 described an extended technique called the oblique subcostal TAP, or OSTAP, that involves injection of local anesthesia in the TAP space from the xiphoid process to the iliac crest. The OSTAP can effectively block the entire anterior abdominal wall; however, it is more technically challenging than other approaches to perform.

When the TAP block is administered through the lumbar Petit triangle, it reliably extends superiorly to the T10 dermatome, effectively blocking the lower quadrant of the abdomen.7,8 However, this is a reportedly difficult approach in obese patients.7,8 The standard subcostal approach provides a block that is more superiorly located and includes the T7 dermatome, but it may not block the L1 dermatome inferiorly.8,9,13 The typical zones of anesthesia and the injection positions for the subcostal and lateral TAP approaches are illustrated in Figure 1.

In 2012, a midabdominal approach to the TAP block utilizing ultrasound guidance was described.14 This single-shot technique, which involves percutaneous injection of a bolus of anesthesia 5 to 8 cm lateral to the umbilicus, commonly blocks the T9 through L1 dermatomes and is easily reproducible and effective. This midabdominal approach was adopted for this pilot study because it was thought to best combine the effects of upper and lower abdominal blockade observed with the subcostal and lateral TAP approaches and to be technically easier to perform than the OSTAP approach. Additionally, because this area of the abdominal wall is readily accessible to the surgeon during abdominoplasty, it was hypothesized that an open approach for placement of the TAP block would be feasible.

Open TAP Block Technique

The technique employed in this study was a modification of that initially described by Araco et al15,16 (Figure 2). The abdominoplasty incision and flap undermining were performed as usual. To manage diastasis, plication of the rectus sheath was performed in the midline with the suture method preferred by the author. The TAP block was performed after rectus plication because the tightening effect of this procedure helped to define the tissue planes, similar to surgical retraction by an assistant.

A muscle-splitting dissection similar to that performed during open appendectomy was employed. A small incision was made in the medial portion of the external oblique fascia, approximately 9 to 10 cm above and 2 to 3 cm medial to the anterior superior iliac spine (Figure 3). Small right-angle retractors were introduced after splitting of the muscle fibers, typically revealing a thin layer of intermuscular fat deep to the external oblique. Spreading dissection continued through this layer to the internal oblique, which was identifiable by the direction of the muscle fibers. Subsequent spreading dissection of the internal oblique allowed visualization of the space immediately deep to this muscle and above the transversus abdominis (Figure 4). The local anesthetic agent was then administered into this space, as detailed below, to accomplish the TAP block.

In this pilot study, 20 cc of bupivacaine 0.25% mixed with 4 mg of dexamethasone was used for each patient. The dose and volume of bupivacaine were selected after a prestudy literature review and discussion with anesthesia colleagues who perform ultrasound-guided TAP blocks.

An 18-gauge, 7-cm liposuction microcannula (Cosmo-France, Miami, FL) was selected for the injection because it was available for fat grafting in the author’s facility and it has a convenient blunt-tipped needle. The cannula was introduced into the TAP plane under direct vision, along the back of the internal oblique (Figure 5). The cannula was kept parallel to the abdominal wall musculature upon entry to avoid inadvertent penetration of the transversus abdominis or deeper structures and was advanced only 3 to 4 cm, so the tip was directly visible with the aid of the retractor. The cannula tip should not be angled downward or advanced more deeply between the muscle layers unless simultaneous ultrasound guidance is consulted to confirm its location.

Two injections, each containing 5 cc of bupivacaine-dexamethasone mixture, were administered in the superolateral and inferolateral directions. This approach provided 2 boluses of medication in the TAP space, 1 above and 1 below the level of the umbilicus. The cannula and retractors were removed, and the external oblique fascia was then repaired. The procedure was repeated on the contralateral side. A midline injection of bupivacaine was then delivered along the length of the rectus repair to complete the block procedure. Approximately 5 to 6 minutes was needed to perform the bilateral block. The remainder of the abdominoplasty was then performed as usual.
Proof-of-Concept Phase

To confirm the anatomic location of the injection cannula, ultrasound imaging of the injection site was performed during the TAP block procedure in 1 of our early patients. The HFL50 imaging transducer (FujiFilm SonoSite, Bothell, WA) was encased in a sterile sleeve and placed directly on the abdominal wall after elevation of the skin flap. The 3 muscular layers and their fasciae were easily identified at the proposed site of the TAP block (Figure 6). The cannula was placed according to the protocol, and the needle tip was observed at imaging to be correctly placed in the TAP space (Figure 7). A bolus of local anesthetic was then injected, with the hypoechoic fluid observed in the correct layer on the ultrasound image (Figure 8).

Pilot Study Protocol

An informed consent form describing the nerve block was given to all patients. The principles of the Declaration of Helsinki17 were followed in the study protocol.
Contraindications to participation in the pilot study included allergy to local anesthetics, coagulopathy, morbid obesity, refusal to give consent, inability to speak English, opioid tolerance or drug addiction, known psychiatric illness, known liver disease, known cardiac disease, prior abdominal wall surgery in the region of the TAP block, and intraoperative findings that precluded safe dissection and placement of the cannula.

**Pilot Study Design**

The pilot study was conducted to compare postoperative narcotic use between bilateral TAP block and standard treatment groups. Thirty-two patients undergoing abdominoplasty were included: 16 in each group. Medical records from May 2013 through January 2014 were reviewed retrospectively for patient height, preoperative body weight, age, concurrent flank liposuction procedure, postoperative intravenous narcotic dose(s), and time to first request for as-needed pain medication. Hydromorphone (Dilaudid; Hospira, Lake Forest, IL) was the standard narcotic given. For the few cases in which multiple narcotics were administered, equianalgesic doses were calculated. One patient in the control group also received a single dose of demerol postoperatively. No patients in the TAP group needed other types of analgesics.

Group means were tabulated and compared by the t test to determine statistical significance at the p < 0.05 level. All 32 patients underwent a full abdominoplasty with rectus plication; no mini-abdominoplasty or skin-only abdominoplasty procedures were included. The author performed all of the surgical procedures assisted by the same personnel: a surgical technologist, a postanesthesia care unit nurse, and an overnight nurse. All patients received general anesthesia,
and all procedures were performed in a surgical suite certified by the American Association for Accreditation of Ambulatory Surgery Facilities, Inc.

Patients who underwent flank liposuction were treated with a superwet infusion containing standard amounts of lidocaine and epinephrine. The power-assisted safe-lipo technique described by Wall was then performed in the flank before abdominoplasty. No liposuction was performed in the abdominoplasty flap area.

Patients in the standard treatment group received ilioinguinal/iliohypogastric nerve blocks, pararectus injections, and injections in the rectus plication, as described by Feng. No intercostal blocks were used. These injection (bupivacaine, 0.25%) sites are shown on the patient’s left side in Figure 1.

Patients in the TAP block group received bilateral open TAP blocks as described above, along with rectus plication injections. Otherwise, every effort was made to perform the abdominoplasty and liposuction procedures consistently between treatment groups. All patients in both groups received standard postoperative care for 3 months, with no change in care required for the TAP block group.
Results

Patient demographics for age, preoperative weight, gender, and inclusion of flank liposuction were compared between the groups (Table 1). There were no statistically significant differences in demographic data between the treatment groups.

Postoperative narcotic use data are shown in Table 2. The mean hydromorphone dose received by patients in the TAP block group in the first 16 hours after surgery was 2.63 mg, whereas the mean dose in the standard treatment group during the same time period was 4.31 mg, a reduction of approximately 39% ($P = .024$; Figure 9). After the data were normalized for patient body weight, the mean narcotic dose per kilogram of weight was also smaller in the TAP block group (TAP block group: 0.039 mg/kg; standard treatment group: 0.068 mg/kg; $P = .011$). This finding represents a 43% reduction in narcotic dose in the TAP block group (Figure 10). In addition, the time to first request for as-needed narcotic was longer in the TAP block group (TAP block group: 3 hours 11 minutes; standard treatment group: 1 hour 27 minutes; $P = .022$; Figure 11). These findings are both clinically and statistically significant, validating the feasibility of the TAP block technique in this population.

Not surprisingly, patients who underwent flank liposuction with their abdominoplasty had a greater need for postoperative analgesia than those who underwent abdominoplasty alone, regardless of the type of nerve block given (Table 3). Because the number of patients who underwent abdominoplasty alone was small in this pilot study, no statistical significance testing was performed on the subgroup data.

No complications related to either standard treatment or TAP block techniques were reported. In particular, there were no issues with perioral numbness and tingling, light-headedness, metallic taste, tinnitus, dizziness, blurred vision, tremors, seizure, or other signs of local anesthetic toxicity. No hematomas were detected at the anesthetic injection sites during physical examination. No patients in either group developed peritonitis or reported any form of intra-abdominal injury, and to date, no patients have reported

Table 1. Baseline Patient Characteristics by Treatment Group

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Standard Treatment (n = 16)</th>
<th>TAP Block (n = 16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, y (range)</td>
<td>41.4 (26–65)</td>
<td>44.8 (25–67)</td>
</tr>
<tr>
<td>Mean body weight, kg (range)</td>
<td>69.9 (45.4–130.4)</td>
<td>69.0 (52.2–90.9)</td>
</tr>
<tr>
<td>Female to male ratio</td>
<td>15:1</td>
<td>15:1</td>
</tr>
<tr>
<td>Concomitant flank liposuction, n</td>
<td>12</td>
<td>11</td>
</tr>
</tbody>
</table>

There were no statistically significant differences between treatment groups. TAP, transversus abdominis plane.

Table 2. Postoperative Hydromorphone Use by Treatment Group

<table>
<thead>
<tr>
<th>Hydromorphone Use</th>
<th>Standard Treatment (n = 16)</th>
<th>TAP Block (n = 16)</th>
<th>$P$ Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean total dose, mg (range)</td>
<td>4.31 (2–8)</td>
<td>2.63 (1–6.5)</td>
<td>.024</td>
</tr>
<tr>
<td>Mean dose/body weight, mg/kg</td>
<td>.068</td>
<td>.039</td>
<td>.011</td>
</tr>
<tr>
<td>Time to first request for as-needed medication, h:min</td>
<td>1:27</td>
<td>3:11</td>
<td>.022</td>
</tr>
</tbody>
</table>

TAP, transversus abdominis plane. *Calculated by t-test.

1 patient in std group received additional dose of demerol, 50 mg, which was accounted for in data. No patients in TAP group received other analgesics.
symptoms of abdominal nerve injuries. No hematomas; infections; incidences of partial flap necrosis, deep vein thrombosis, or pulmonary embolism; or wound breakdown have been observed in either group.

DISCUSSION

Several authors have described the advantages of nerve blocks for controlling pain and reducing narcotic use after abdominoplasty. Feng described a combination of intercostal, pararectus, iliohypogastric, and ilioinguinal nerve blocks for abdominoplasty. Her work showed substantial improvements in pain scores and reduction in narcotic use and was a key motivator behind the present study and search for improved analgesia after abdominoplasty.

Various techniques for administering the TAP block had been described in the plastic surgery literature before conduct of this pilot study. Sforza et al. described a blind injection technique during abdominoplasty in which the TAP space was accessed laterally through the lumbar Petit triangle. As mentioned, the anesthesia literature indicates this lateral block location often fails to provide sufficient blockade in the upper abdominal area. Young and associates also reported 2 cases of liver injury in patients with hepatomegaly who underwent a TAP block procedure with the lateral approach; 1 of these was an ultrasound-guided procedure.

In a brief communication in 2010, Araco et al. described an open TAP block technique during abdominoplasty, after which they followed up with a small clinical trial. West and Milner also noted in a letter to the editor that a surgeon-performed TAP block was useful for their patients after transverse rectus abdominis myocutaneous and deep inferior epigastric artery perforator flap procedures; however, they did not provide patient data.

We have modified the technique of Araco et al in several ways: (1) positioning the fascial incision superiorly by 5 cm during an established midabdominal TAP block approach to potentially improve blockade of the upper
abdomen; (2) performing a 2-bolus technique, with superiorly and inferiorly directed injections with a blunt-tip microcannula rather than 1 large bolus at the more inferior position; and (3) adding dexamethasone to bupivacaine to prolong the effect and potentially reduce postoperative nausea and vomiting, as described by Ammar and Mahmoud. The TAP block technique described herein is rapidly performed, requiring a few minutes per side.

Results from this pilot study showed the feasibility of the surgical TAP approach and substantial reductions in the amount of postoperative narcotic use. Also, the time to first request for as-needed narcotic was significantly longer in the TAP block group. These findings are consistent with results described in studies of TAP blocks administered for a variety of surgical procedures. Sufficient analgesia was seen during the 16-hour postoperative observation period. This study was not designed to test the duration of the TAP block, but others have reported effectiveness for 24 to 48 hours. It is important to note that the TAP block does not provide reliable analgesia for the rectus plication, which must be blocked separately.

Reports from the overnight nurse indicate that patients in the TAP block group also appeared less sedated and were able to ambulate earlier, more comfortably, and more confidently than those who received the standard treatment, most likely the result of reduced narcotic dosing. Some authors have reported that their TAP block-treated patients had less postoperative nausea and vomiting after procedures other than abdominoplasty. However, this study was not designed to test for this outcome.

The optimal dose of bupivacaine in a TAP block is somewhat controversial. To my knowledge, no randomized controlled studies have been conducted to compare dosing strategies. The dose administered in this pilot study, 10 cc of bupivacaine-dexamethasone mixture per side, is admittedly conservative. Other publications have reported administration of 4 times this dose without adverse effect. I am currently evaluating the effects of a higher concentration and volume of bupivacaine, and preliminary results appear promising, with greater reduction in postoperative analgesia requirements than reported here.

Another local anesthetic of interest for TAP blocks is liposomal bupivacaine (Exparel; Pacira Pharmaceuticals, San Diego, CA). One group has reported success in reducing postoperative abdominoplasty pain with this agent and a combination of multiple nerve blocks. Liposomal bupivacaine may lengthen the duration of effect, but at increased cost. This analgesic would likely be useful in conjunction with the technique described in this article, and a future study with this agent is planned. To my knowledge, no reports of administration of liposomal bupivacaine for TAP blocks have been published, and because it has not been approved by the US Food and Drug Administration for regional nerve blocks, its use in the TAP block would be off-label.

Limitations of this pilot study include its small size and limited time scale, and retrospective design. A larger blinded, randomized study would provide an improved score for level of evidence. Patient pain ratings could provide an alternative assessment of the effectiveness of nerve blocks, particularly in the postdischarge period. Other comorbidities related to narcotic use, such as postoperative nausea and vomiting, could also be tracked to determine whether their incidence in the abdominoplasty population is lower with the TAP block (ie, as a result of the reduced need for narcotics).

Although no issues with nerve injury, plastic surgeons should be familiar with the concept and diagnosis of nerve injury after abdominoplasty.

CONCLUSIONS

The open TAP block technique described in this report is simple and effective and can be rapidly performed by the surgeon without specialized equipment. However, larger studies are needed to confirm the safety and efficacy of this method as well as the optimal dosing of bupivacaine and to compare these findings with results of other TAP block methods.

All surgeons who perform abdominoplasty are encouraged to learn more about the TAP block concept and consider integrating one of the techniques in their treatment protocol. Ultrasound guidance is recommended during all percutaneous TAP block placements, whether performed by surgeons or anesthesiologists, as well as when the location of the cannula tip is in doubt during an injection.

Disclosures

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