ABSTRACT

Context: The efficacy of the transversus abdominis plane (TAP) block appears to vary considerably, depending on the surgical procedure and block technique.

Aims: This study aims to add to the existing literature and provide a more clear understanding of the TAP blocks role as a postoperative analgesic technique, specifically in renal allotransplant recipients.

Settings and Design: A retrospective chart review was conducted by querying the intraoperative electronic medical record system of a 1200-bed tertiary academic hospital over a 5 months period, and reviewing anesthetic techniques, as well as postoperative morphine equivalent consumption.

Materials and Methods: Fifty renal allotransplant recipients were identified, 13 of whom received TAP blocks while 37 received no regional analgesic technique. All blocks were performed under ultrasound guidance, with 20 mL of 0.25% bupivacaine injected in the transversus abdominis fascial plane under direct visualization. The primary outcome was postoperative morphine equivalent consumption.

Statistical Analysis Used: Morphine consumption was compared with the two-tailed Mann–Whitney U-test. Continuous variables of patient baseline characteristics were analyzed with unpaired t-test and categorical variables with Fischer Exact Test. A P < 0.05 was considered statistically significant.

Results: A statistically significant decrease in cumulative morphine consumption was found in the group that received the TAP block at 6 h (2.46 mg vs. 7.27 mg, \( P = 0.0010 \)), 12 h (3.88 mg vs. 10.20 mg, \( P = 0.0005 \)), 24 h (6.96 mg vs. 14.75 mg, \( P = 0.0013 \)), and 48 h (11 mg vs. 20.13 mg, \( P = 0.0092 \)).

Conclusions: The TAP block is a beneficial postoperative analgesic, opiate-sparing technique in renal allotransplant recipients.

Key words: Renal transplant; transversus abdominis plane block

Introduction

Modern postsurgical analgesia is aimed at developing multimodal opiate-sparing models, utilizing nonopiate pharmaceutical adjuvants and regional analgesic techniques. With this goal in mind, the efficacy of the transversus abdominis plane (TAP) block in reducing postoperative opioid consumption and improving postoperative pain scores has been an area under investigation over the past years.\(^1\)

There appears to be considerable variability in the utility of
the TAP block to provide postoperative analgesia depending on both surgical procedure and block technique. We have conducted a retrospective chart review, attempting to add to the existing literature and provide a clearer understanding of the TAP blocks efficacy.

Materials and Methods

We conducted a retrospective chart review of all renal allotransplants, occurring from May 1, 2011, through September 15, 2011, at a 1200-bed tertiary academic hospital. Local institutional review board approval for human subjects’ research was obtained. The anesthesia information management system, Compurecord (Philips Medical, Andover, MA, USA), was queried. Intraoperative records were reviewed, and data extracted included details of block placement and intraoperative narcotic administration. The inpatient electronic medical record system, Epic (Epic Systems Corporation, Verona, WI, USA), was then queried, and postoperative narcotic consumption over the subsequent 48 h was recorded.

Intravenous access was obtained in all patients prior to transportation to the operating room. On arrival to the operating room, patients were monitored using five-lead electrocardiogram, pulse oximetry, and a noninvasive blood pressure cuff. Following preoxygenation, anesthesia was induced, and neuromuscular blockade administered to facilitate endotracheal intubation via direct laryngoscopy. Arterial lines for blood pressure monitoring and assessment of serial laboratory values were placed for all patients, either preinduction or postinduction, depending on patient characteristics. All patients received fentanyl intraoperatively at the discretion of the anesthetic provider.

TAP blocks were performed under direct visualization with an M-Turbo ultrasound machine (Sonosite Inc., Bothell, WA, USA) using an L25x/13-6 MHz broadband linear array probe. Blocks were performed by an attending anesthesiologist, or by a resident anesthesiologist under direct supervision, either prior to surgical incision or after the dressing was applied. Block placement was with an insulated 22-gauge 50 mm block needle (Pajunk, Geisingen, Germany) inserted in an in-plane medial to lateral approach. After a negative aspiration, 20 mL of 0.25% bupivacaine was injected in 5 mL aliquots, with direct visualization of spread in the transversus abdominis fascial plane.

Procedures were performed by one of three surgeons, all specializing in renal allotransplant. Patients were positioned supine. The surgical technique was similar for all, including a lower quadrant curvilinear incision, connecting from cephalad of the symphysis pubis to 2 cm medial to the anterior superior iliac spine, and extending toward the lower coastal margin. Renal allografts came from a combination of living-related and cadaveric donors. At the completion of surgery, anesthetic emergence, and endotracheal extubation, patients were transported to the postanesthesia care unit. From there, they were transferred to a unit which receives all renal allotransplant recipients. They remained on this unit for the subsequent 48 h of care.

The primary outcome measured was postoperative morphine equivalent consumption. As a continuous variable with a nonnormal distribution, data analysis was with the two-tailed Mann–Whitney U-test. Continuous variables regarding patient baseline characteristics were analyzed with an unpaired t-test while categorical data were analyzed using a Fischer Exact Test. Statistically significant results were considered to have a P < 0.05.

Results

Our query resulted in 50 renal allotransplant recipients. Thirteen patients received TAP blocks; five were placed prior to skin incision, and eight placed postoperatively. Thirty-seven patients did not receive a TAP block. All blocks were ultrasound guided in the manner described, with an injection of 20 mL of 0.25% bupivacaine. However, baseline patient characteristics did not differ significantly surgical times were longer in the block group [Table 1]. Patients in the block group also tended toward lower American Society of Anesthesiologists physical status scores. There was no significant difference in intraoperative narcotic administration between the groups.

A statistically significant decrease in cumulative postoperative morphine equivalent consumption [Figure 1] was found in the block group at 6 h (2.46 ± 2.92 mg vs. 7.27 ± 4.63 mg, P = 0.0010), 12 h (3.88 ± 2.73 mg vs. 10.20 ± 5.89 mg, P = 0.0005), 24 h (6.96 ± 4.71 mg vs. 14.75 ± 7.73 mg, P = 0.0013), and 48 h (11 ± 7.52 mg vs. 20.13 ± 11.25 mg, P = 0.0005).

Table 1: Baseline patient characteristics

| Characteristic          | Block (n = 14) | No block (n = 37) | P   |
|------------------------|---------------|------------------|-----|
| Age (years)            | 48 (17)       | 54 (14)          | 0.19|
| Weight (kg)            | 75.8 (18.8)   | 78.5 (19.6)      | 0.66|
| Procedure time (min)   | 227 (60)      | 197 (58)         | 0.11|
| Intraoperative fentanyl (mcg) | 405 (151) | 447 (161)        | 0.39|
| Intraoperative fentanyl (mcg/kg) | 5.33 (1.36) | 5.79 (1.52)      | 0.41|
| ASA physical status (3/4) | 12/2        | 22/15            | 0.1 |

ASA: American Society of Anesthesiologists
$P = 0.0092$). The block group also had decreased narcotic consumption at all interval time points [Figure 2], but these differences did not reach statistical significance in the 6 to 12 h interval (1.42 ± 1.86 mg vs. 2.93 ± 2.59 mg, $P = 0.06$), the 12 to 24 h interval (3.07 ± 2.88 mg vs. 4.55 ± 3.73 mg, $P = 0.20$), or the 24 to 48 h interval (4.03 ± 3.70 vs. 5.37 ± 5.08, $P = 0.38$).

**Discussion**

The TAP block targets the ventral rami of T7-L1 as they course anteriorly carrying the somatic sensory nerves to the skin, subcutaneous tissue, abdominal muscular layers, and parietal peritoneum. Taken together, these layers comprise the abdominal wall. Deeper structures which may be disturbed during intraperitoneal surgery such as the visceral peritoneum and abdominal intraperitoneal contents have separate sensory innervation. It is thus not surprising that the TAP block has not proven its worth in a variety of gynecological and general surgical procedures.\(^2,3\) Given the heterogeneity of published results, extensive meta-analysis has highlighted the TAP block as a regional technique which warrants further investigation.\(^4\) Considering its retroperitoneal position and complete visceral denervation, renal allotransplantation provides the most unambiguous opportunity to assess the efficacy of the TAP block.

Managing postoperative pain in renal allotransplantation presents a unique set of challenges. Avoidance of NSAIDs is prudent owing to concerns of nephrotoxicity, and morphine is used with caution as active, nondialyzable metabolites may accumulate. Impaired creatinine clearance must be taken into account when dosing other opiates as well. With the increasing volume of renal allotransplantation occurring worldwide,\(^5,6\) further exploration of modern analgesic techniques for this population is timely.

This retrospective chart review shows significant reductions in morphine consumption in renal allotransplant patients receiving a TAP block over the first 48 h postoperatively. While patients receiving TAP blocks had decreased narcotic requirements at all postoperative time points, the study is underpowered to show statistically significant decreases at time intervals in the 12-48 h range. Morphine consumption at cumulative time points remains statistically significant throughout.

Interest in the use of TAP blocks and even TAP catheter placement for renal allotransplant recipients had grown since as far back as 2009, when Jankovic discussed the difficulty in placing TAP catheters in this patient population, suggesting that the surgeon place the catheter prior to closing the surgical wound.\(^7\) Since that time, four studies have investigated the use of TAP blocks in renal allotransplant recipients. The first study conducted by Frier was a randomized controlled trial which showed no difference in morphine consumption in the first 24 h with the use of TAP blocks. This was, however, the only study in which TAP blocks were not performed under ultrasound guidance.\(^8\) Our study contradicts these findings and supports the results of Soltani, whose randomized controlled trial showed a significant decrease in 24 h morphine consumption under ultrasound-guided TAP block.\(^9\) One additional group led by Mukhtar showed a significant decrease in morphine consumption under ultrasound-guided TAP block in a pilot study of 20 patients; however, they were unable to substantiate these findings in a follow-up randomized controlled trial conducted 4 years later.\(^10,11\) A recent retrospective study of ultrasound-guided continuous TAP catheters has also shown that this technique may be effective in reducing 48 h morphine consumption.\(^12\) A related, but distinct randomized controlled trial also showed decreased morphine requirements utilizing the TAP block in live-donor nephrectomy.\(^13\)
In the context of this somewhat contradictory base of literature, this retrospective review adds weight for the efficacy of TAP blocks in renal allotransplant surgery. Ultrasound guidance is likely an integral component of TAP block efficacy. A “two-pop” blind technique does not allow confirmation of local anesthetic placement in the correct abdominal layer, an integral component to block efficacy, and fear of peritoneal puncture may encourage superficial injections.

Limitations of this retrospective analysis exist. The study groups reviewed were small, particularly the block group; however, they are sufficient to show statistical significance. The study groups are underpowered to show statistically significant differences in interval morphine requirements at late time points. In addition, because patients were not blinded from the technique used, a placebo effect could influence the narcotic demands of the TAP block group, and nonblinded practitioners could introduce further bias. Nonetheless, this study does provide compelling evidence that ultrasound guided TAP blocks significantly lower postoperative narcotic requirements following renal allotransplant. A double-blinded randomized controlled trial assessing ultrasound guided TAP blocks for renal allotransplants was undertaken by this group.

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Conflicts of interest
There are no conflicts of interest.

References
1. Lissauer J, Mancuso K, Merritt C, Prabhakar A, Kaye AD, Urman RD. Evolution of the transversus abdominis plane block and its role in postoperative analgesia. Best Pract Res Clin Anaesthesiol 2014;28:117-26.
2. Griffiths JD, Middle JV, Barron FA, Grant SJ, Popham PA, Royse CF. Transversus abdominis plane block does not provide additional benefit to multimodal analgesia in gynecological cancer surgery. Anesth Analg 2010;111:797-801.
3. Skjelsager A, Ruhnaa B, Kistorp TK, Kridina I, Hvernæs H, Mathiesen O, et al. Transversus abdominis plane block or subcutaneous wound infiltration after open radical prostatectomy: A randomized study. Acta Anaesthesiol Scand 2013;57:502-8.
4. Kessler J, Marhofer P, Hopkins PM, Hollmann MW. Peripheral regional anesthesia and outcome: Lessons learned from the last 10 years. Br J Anaesth 2015;114:728-45.
5. Global Observatory on Donation & Transplantation. Spanish National Transplant Organization (ONT) in Collaboration with World Health Organization; c2015. Available from: http://www.transplant-observatory.org [Last accessed on 2015 Sep 25].
6. Matesanz R, Mahillo B, Alvarez M, Carmona M. Global observatory and database on donation and transplantation: World overview on transplantation activities. Transplant Proc 2009;41:2297-301.
7. Jankovic ZB, Pollard SG, Nachiapman MM. Continuous transversus abdominis plane block for renal transplant recipients. Anesth Analg 2009;109:1710-1.
8. Freir NM, Murphy C, Mugawar M, Linnane A, Cunningham AJ. Transversus abdominis plane block for analgesia in renal transplantation: A randomized controlled trial. Anaesth Analg 2012;115:953-7.
9. Soltani Mohammadi S, Dabir A, Shoiebi G. Efficacy of transversus abdominis plane block for acute postoperative pain relief in kidney recipients: A double-blind clinical trial. Pain Med 2014;15:460-4.
10. Mukhtar K, Khattak I. Transversus abdominis plane block for renal transplant recipients. Br J Anaesth 2010;104:663-4.
11. Gulyam Kuruba SM, Mukhtar K, Singh SK. A randomised controlled trial of ultrasound-guided transversus abdominis plane block for renal transplantation. Transplantation 2014;69:1222-6.
12. Farag E, Guirguis MN, Helou M, Dalton JE, Ngo F, Ghotbrial M, et al. Continuous transversus abdominis plane block catheter analgesia for postoperative pain control in renal transplant. J Anaesth 2015;29:4-8.
13. Hosgood SA, Thiyagarajan UM, Nicholson HF, Jeyapalan I, Nicholson ML. Randomized clinical trial of transversus abdominis plane block versus placebo control in live-donor nephrectomy. Transplantation 2012;94:520-5.