The Efficacy of Inside-Out Transversus Abdominis Plane Block vs Local Infiltration before Wound Closure in Pain Management after Kidney Transplantation: A Double-blind, Randomized Trial

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ABSTRACT

Objective: Transversus abdominis plane (TAP) block is a form of multimodal pain management in open abdominal surgery. Among patients who undergo kidney transplantation, their choice of painkillers is limited. This study aims to determine the efficacy of TAP block vs local infiltration in pain management after kidney transplantation.

Materials and Methods: In this prospective, randomized, double-blinded clinical trial, 46 patients with end-stage kidney disease who had undergone kidney transplantation were randomly divided into two groups: a local anesthetic infiltration (LA) group receiving 0.25% Bupivacaine 20 ml around the surgical wound before wound closure and a TAP block group receiving 0.25% Bupivacaine 20 ml by the inside-out technique. Their postoperative pain scores and morphine consumption were recorded at 2, 6, 12, 18, 24, and 48 hours.

Results: There was no statistically significant difference in the baseline characteristics between the groups. The postoperative pain score at two hours in the TAP block group was significantly lower than in the LA group (P value = 0.037), but without other differences in their pain scores after two hours. There was no statistical difference in the morphine consumption between the two groups. The total morphine consumption in the TAP block group was less than in the LA group, but this was not statistically significant. No patients suffered from complications of the TAP block.

Conclusion: Transversus abdominis plane block can reduce postoperative pain at two hours after kidney transplantation, without significant complications.

Keywords: Transversus abdominis plane block; kidney transplantation; pain management; postoperative pain (Siriraj Med J 2022; 74: 233-238)

Abbreviations

TAP	Transversus abdominis plane
NRS	Numerical rating scale
BMI	Body mass index
LA	Local anesthesia
QL	Quadratus lumborum

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INTRODUCTION

Kidney transplantation is the treatment of choice in patients with end-stage kidney disease. A kidney transplant is a major operation requiring a classical incision at the lower abdomen, extending from laterally to the pubic symphysis to the anterior superior iliac crest called Gibson incision. Many patients require a painkiller after the operation, and postoperative pain control is crucial to improving one's surgical outcome. Multimodal analgesia aims to decrease opioid consumption and its side effects. Especially among patients who undergo kidney transplantation, their choice of painkiller is limited, due to any such drugs' interaction with immunosuppressive drugs and nephrotoxicity.[1] Local anesthesia infiltration around the incision is one of the traditional methods of local pain control. Two decades ago, transversus abdominis plane (TAP) block was introduced as a new technique to reduce postoperative pain. This was originally reported by Rafi in 2001.[2] TAP block is a regional anesthesia, targeting sensory nerves running between the internal oblique muscle and the transversus abdominis muscle layer, these nerves receiving signal from anterior abdominal wall between level of T9 and T12 via a blinded technique or ultrasound guidance.[3,4] A TAP block can be performed by a surgeon or anesthesiologist using the outside-in technique after the induction of anesthesia or through the inside-out technique before the wound is closed. A TAP block has been used to control postoperative pain involving many kinds of abdominal surgery. The results from many trials have produced variable outcomes, some showing no significant difference in post-operative pain management, while others have resulted in significant pain scores and/or opioid consumption.[5-11] According to meta-analyses, the TAP block seems to benefit postoperative pain control in kidney transplantation patients.[12] Until now, there has been no report comparing traditional, local anesthetic infiltration with the TAP block by the inside-out technique in kidney transplantation patients. This study aims to determine the efficacy of the TAP block vs local infiltration in pain management after kidney transplantation.

MATERIALS AND METHODS

This prospective, randomized, double-blinded clinical trial was approved by the Ethics Committee of the Faculty of Medicine Siriraj Hospital, Mahidol University, Thailand, protocol number 826/2019(IRB4). After informed consent, 46 patients with end-stage kidney disease who had undergone kidney transplantation from both living-donor and cadaveric kidney transplant at Siriraj Hospital were recruited. Patients were excluded if they had a history of painkiller allergy, if they could not define a pain score in the numerical rating scale (NRS), were suspected of having a painkiller addiction or an abnormal coagulopathy, or had incomplete data.

Patients' demographic data (sex, age, BMI, and previous abdominal surgery); intraoperative data (operative time and length of wound); and postoperative data covering 48 hours (pain score and opioid usage) were collected. Patients were randomly divided into two groups: a local anesthetic infiltration (LA) group and a TAP block group. The group allocations were concealed in opaque envelops which were randomly picked up and opened just before each wound was closed. After standard monitoring, all patients received general anesthesia. The kidney transplantation was then done routinely. In the LA group, patients received 0.25% Bupivacaine 20 ml around the surgical wound before the wound was closed. In the TAP block group, the TAP block was performed by a surgeon with the ultrasound- guided inside-out technique. A curvilinear ultrasound probe was placed just lateral to the quadratus lumborum muscle above the iliac crest as high as possible via a standard Gibson incision. After the layer between the internal oblique muscle and the transversus abdominis muscle was found, 0.25% Bupivacaine 20 ml was injected into the space via needle 25-gauge 1.5 inch with the appearance of a Goose egg sign before the wound was closed (Fig 1). All patients were received postoperative care and pain control at postanesthesia care unit following Siriraj protocol[13] including Acetaminophen 500 mg 1 tab per oral every 6 hours for 3 days. After the operation, patients were assessed on a pain score with a numerical rating scale

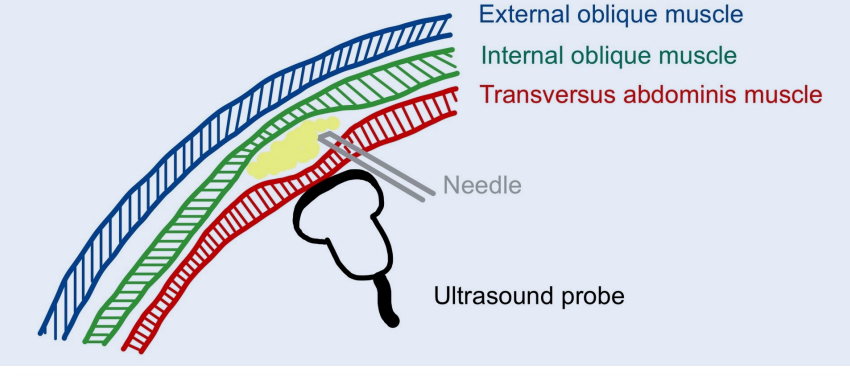

Fig 1. TAP block procedure
0.25% Bupivacaine 20 ml was injected into the space between the internal oblique muscle and the transversus abdominis muscle via needle 25-gauge 1.5 inch with ultrasound guided.

(NRS) (0=no pain, 10=worst possible pain) at 2, 6, 12, 18, 24, and 48 hours. If the pain score was more than 3 or analgesics were required, 1 mg of morphine was intravenously administered, and then the pain score was rechecked after five minutes. The amount of morphine consumption was recorded. All pain scores and morphine consumption were recorded by investigators who were blinded to the group allocations.

The goal was to compare the pain score and morphine consumption after the TAP block and LA technique. The sample size was calculated from previous study on TAP-block efficacy.[9-11] Statistical analysis was conducted using SPSS version 21 software. Demographic data and intraoperative data were present as mean ± SD. In a normal distribution of data, the Student's t-test and Pearson's chi-square were used to compare the results between the two groups. The postoperative pain scores and morphine consumption were present as a median with IQR, and compared between the groups by using the Mann-Whitney U test. A P value less than 0.05 was determined as having statistical significance.

RESULTS

From January, 2020 to November, 2020, 46 patients were enrolled in this study and were randomized into two groups, with 23 people in each group. One patient in the TAP block group was excluded due to the need for reoperation within 24 hours because of bleeding from tissue around the kidney graft (Fig 2). 62.2% of the study population was male, and the mean age was 46.7 years old (range: 26 – 62). The mean body mass index was 21.39 kg/m^2 (range: 15.6 – 27.9). 28.9% of the patients had previous abdominal surgery. The mean operative time was 177 minutes (range: 110 – 360) and the mean length of the wound was 16.6 centimeters (range: 12 – 23). There was no statistically significant difference in the baseline characteristics between the groups, as is indicated in Table 1.

The pain scores (NRS) were compared in two groups, (as seen in Fig 3), at 2, 6, 12, 18, 24, and 48 hours postoperatively. The median and IQR of pain scores at 2, 6, 12, 18, 24, and 48 hours in LA group are 3 (3-4), 2 (1-3), 2 (0-3), 1 (0-2), 0 (0-1) and 0 (0) respectively.

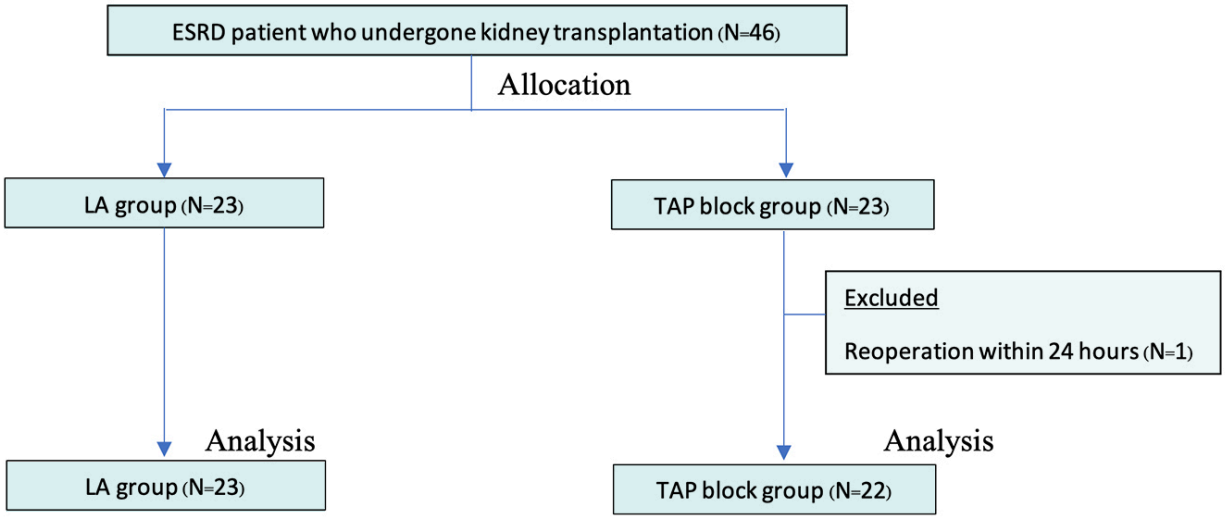

Fig 2. Patients flow chart.

TABLE 1. Comparison of two outflow reconstruction techniques among the study patients.

	LA group	TAP block group	P value
Sex			0.848
Male	60.9%	63.6%	
Female	39.1%	36.4%	
Age (years)	48.4 ± 9.7	44.9 ± 10.2	0.247
Body mass index	21.8 ± 3.1	20.9 ± 2.8	0.339
Previous abdominal surgery	30.4%	27.3%	0.815
Operative time (minute)	181.8 ± 50.1	172.5 ± 36.9	0.484
Length of wound (cm)	16.5 ± 2.2	16.7 ± 2.3	0.771

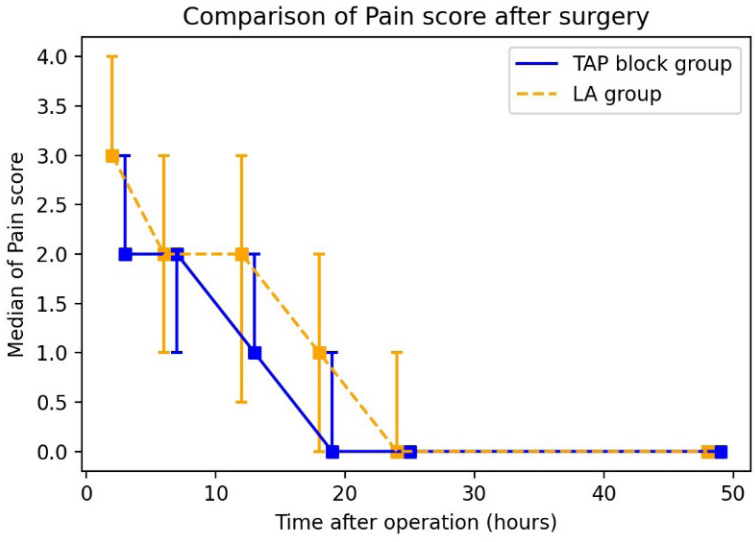

Fig 3. Postoperative pain score (NRS) at 2, 6, 12, 18, 24, and 48 hours postoperatively (median with IQR).

The median and IQR of pain scores at 2, 6, 12, 18, 24, and 48 hours in TAP block group are 2 (2-3), 2 (1-2), 2 (1-2), 0 (0-1), 0 (0-0.25) and 0 (0). The postoperative pain score at two hours in the LA group was higher than in the TAP block group (P value = 0.037), though there were no other differences in the pain scores after two hours and throughout a 48-hour period.

There was no statistical difference in morphine consumption between the groups, in terms of total usage, and any recorded time point, as shown in Fig 4. The median total morphine consumption in the LA group was 2 mg (IQR 1-4); in the TAP block group, it was 1 mg (IQR 1-3), with a p value of 0.105. No patients suffered from complications of the TAP block.

DISCUSSION

The most effective options for postoperative pain control after kidney transplantation are not always easily determined, due to the many limitations arising from patients' status. In post-kidney transplant patients, many kinds of painkillers have a risk of causing nephrotoxicity and can alter renal clearance. An epidural block is an option for postoperative pain control in abdominal surgery, but there is risk of epidural hematoma formation in kidney transplantation patients because of platelet dysfunction.[14] Regional nerve block has become a promising choice for postoperative pain control in kidney transplant patients. Regional nerve block or TAP block is target on specific sensory nerve but local anesthesia can be variable due to

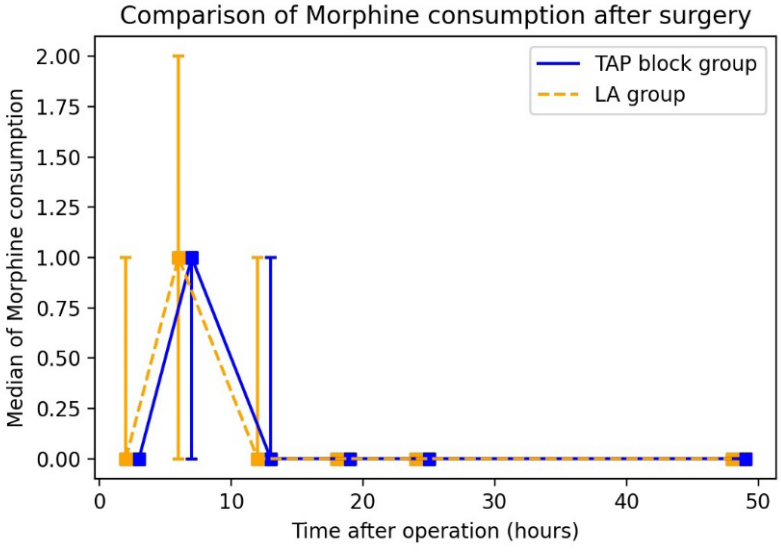

Fig 4. Morphine consumption at 2, 6, 12, 18, 24, and 48 hours postoperatively (median with IQR).

operator dependent and variations of anatomy.[3] From a meta-analysis[15], we see that a TAP block can reduce total opioid consumption (morphine consumption to 6 mg per day) as well as a patient's pain score within 24 hours after the operation. Our study shows that the pain scores two hours after the operation in the TAP block group were lower than in the LA group, but, again, there was no significant difference between the groups after that. Our LA group were given 0.25% Bupivacaine 20 ml around the surgical wound, which can also reduce the postoperative pain scores and morphine consumption. Even though our study had local pain control in the LA group, the results still reveal that the TAP block was better than the LA, as regards post-operative pain control after kidney transplantation. TAP block is recommended if ultrasound is available and patients do not have an abnormal coagulopathy.

Concerning the duration of pain control after the TAP block, our meta-analysis[15] showed that 0.375%, 0.5% and 0.75% Ropivacaine TAP block reduced the pain score at two hours after surgery, but only 0.75% Ropivacaine was effective 12 to 24 hours after surgery. We used 0.25% Bupivacaine 20 ml for the TAP block. Onset of action of 0.25% Bupivacaine is about 19 ± 41 seconds and duration of action is about 7.02 ± 1.46 hours after injection.[16] This may be one of the reasons why there were significantly reduced pain scores only at two hours after the operation. In some studies, specialists added drug regimens to the TAP block in order to prolong the pain-control effect. Yang et al.[17] have shown that the addition of dexmedetomidine can provide a more effective analgesic effect for the TAP block. Systematic review and meta-analysis from Choi et al.[18] have indicated that adding dexamethasone to the local nerve block can prolong the effect of nerve block more than by just doing a local nerve block alone.

In a meta-analysis[14], some of researchers used the blinded technique of the TAP block, but many used the ultrasound-guided approach. The efficacy of the latter has been shown to be superior. Today, the ultrasound-guided technique is considered the gold standard for the TAP block.[4] Regarding the other technique of TAP block in our study, we used the ultrasound-guided method with the inside-out technique. The typical outside-in TAP block technique may cause visceral organ damage, even if the procedure is ultrasound-guided.[19,20] The inside-out technique can reduce the possibility of visceral organ damage due to performers' visualization while performing the TAP block. Additionally, the TAP block, which is performed by a surgeon intra-operatively, requires less time than the conventional TAP block by an anesthesiologist, and there is with no difference in the postoperative pain-control outcomes.[21]

There is an important question involving the timing of the administration of the TAP block. In our study, the TAP block was applied before the wound was closed, though some performers do this before starting to operate. Dahl et al.[22] have demonstrated that postoperative pain scores were not significantly different between the pre- and post-incisional nerve block. Another technique that may help in pain management for kidney transplant patients is the quadratus lumborum (QL) block 2. According to Kolacz et al.[23], this kind of block can reduce fentanyl consumption within 24 hours after kidney transplantation, without a difference in the pain score, compared to the TAP block. Given the inside-out technique used in our study, we may also perform a QL block via a kidney-transplantation incision.

There were a number of limitations in this study. First, we could not assess the patients' sensory-distribution level because the TAP block was performed before the wound was closed and while patients were still under general anesthesia. Secondly, our inside-out technique is different from original TAP technique. The double pop sensation described in original technique cannot be felt during needle passage, so ultrasound guided is necessary to determine the depth of the needle. The third limitation is no use of intravenous patient control analgesia to access accurate dose of morphine requirement. Lastly, our sample size was too small to broadly assess the safety of the TAP block technique. Further studies are required to compare the safety of the inside-out method with the outside-in technique of the TAP block, and to determine the optimum dose or volume to use for the TAP block.

CONCLUSION

The transversus abdominis plane block can reduce postoperative pain after kidney transplantation, without significant complications. We conclude that the TAP block can be used as a part of multimodal pain management for post-kidney transplantation patients.

Conflicts of interest statement: The authors declare that there are no financial or other conflicts of interest involved in this project.

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