JOURNAL of ANESTHESIA and PERIOPERATIVE MEDICINE

Original Article

Transversus Abdominis Plane Block for Postoperative Pain Relief after Abdominal Surgery

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ABSTRACT

Background: The purpose of this study is to explore whether the use of intravenous analgesics, antiemetic drugs and pain scores will decrease when transversus abdominis plane (TAP) block is used as a supplementary method for the treatment of acute postoperative pain in the post-anesthesia care unit (PACU).

Methods: This was a single-center, retrospective study. We reviewed the medical records of the patients who underwent elective abdominal surgery and subsequently sent to PACU between 1st November and 31st December 2016. Comparisons of the number of patients on whom TAP blocks were performed, were made between 2 groups: patients who underwent a laparoscopic operation (LA) and patients who underwent an open operation (OP). TAP blocks were given under ultrasound-guidance (US) with 20 ml 0.33% ropivacaine diluted in saline each side. Comparisons of the other three outcomes/endpoints (number of patients given intravenous analgesics, antiemetic drugs in the PACU, pain scores upon discharge the PACU) were made between 2 groups: patients who received TAP block (T) and those who did not (NT).

Results: A total number of 718 patients were enrolled in the study. There was no significant difference between groups T and NT when comparing the number of patients who receive TAP blocks and the use of intravenous analgesics and antiemetic drugs administered to patients. Pain scores in group T are higher than in group NT.

Conclusion: TAP block did not reduce the use of intravenous analgesics, antiemetic drugs and pain scores when used as a supplementary approach for the treatment of acute postoperative pain in the PACU in the present study. (Funded by the National Natural Science Foundation of China.)

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Citation: **Yi Zhao, Jing Yan, XiangDong Chen. Transversus Abdominis Plane Block for Postoperative Pain Relief after Abdominal Surgery. *J Anesth Perioper Med* 2018; 5 : 242-246.**

doi: 10.24015/JAPM.2018.0093

Nerve root or myofascial irritation at the abdominal wall is a common cause of pain following surgeries such as cesarean section, cholecystectomy, prostatectomy, hysterectomy and transplant surgery (1, 2). Transversus abdominis plane (TAP) block, first described by Kuppuvelumani et al. (3) and formally documented by Rafi (4), is used for the management of surgical abdominal pain by injecting local anesthesia into the plane between the internal oblique and transverse abdominis muscles (4, 5). TAP block has been shown to be a safe and effective postoperative analgesia method in a variety of general gynecological, urological, plastic and pediatric surgeries (6).

Pain occurring in the post-anesthesia care unit (PACU) is common and distressing to patients. And the pain in the PACU may be considered a failure of having adequately included a good analgesic plan as part of the general anesthetic plan. Because of intensive monitoring, giving intravenous analgesics is always preferred in treating acute postoperative pain in the PACU. However, titration of opioids as rescue often leads to common opioid side effects which include nausea, vomiting, and sedation. Although nonsteroidal anti-inflammatory drugs (NSAIDs) cause less respiratory depression, these drugs are often associated with a "ceiling" effect (7). Established acute pain guidelines clearly outline the value of multimodal analgesia and preoperative dosing of non-opioid analgesics, and advocate for local anesthetic and regional anesthetic techniques whenever possible (8).

In our center, TAP blocks are only given when patients complain of severe pain and agree to receive TAP blocks. If pain was still serious after performing TAP blocks, we would give intravenous analgesics. Different from other studies, we consider TAP block as a supplementary method for the treatment of acute postoperative pain in the PACU. Our aim is to explore whether this performance of TAP block in the PACU can decrease the use of intravenous analgesics and antiemetic drugs, and reduce the pain scores when patients discharged from the PACU.

METHODS

This was a single-center, retrospective study that analyzed patients above 18 years belonging to the American Society of Anesthesiologists (ASA) class I and II. We excluded those patients with a known allergy to the study drugs, significant cardiac, respiratory, renal or hepatic diseases and psychiatric illnesses that would interfere with perception and assessment of pain. And patients with intraoperative complications like massive bleeding, cardiovascular or cerebrovascular incidents were not enrolled. All the patients underwent elective abdominal surgery and sent to PACU between 1st November and 31st December 2016. Data were collected via a database located at the surgical center where the procedures were performed. The study was approved by the Wuhan Union Hospital Human Ethics Committee.

In our center, the induction and maintenance strategies are fixed. Anesthesia was induced for all participating patients with 2 μg/kg fentanyl, 2-3 mg/kg propofol and 0.2 mg/kg cisatracurium. Anesthesia was maintained by continuous infusion of propofol at the rate of 6-12 mg/kg/h and remifentanil at the rate of 5-18 ug/kg/h. Intravenous analgesics (tramadol, butorphanol and flurbiprofen axetil) would be given preoperatively or intraoperatively by various anesthetists. All the patients were transferred to the PACU when they still under anesthesia after surgeries. After extubation, the pain would be measured by the 11-point Numeric Rating Scale (NRS) with the following directions: "How much pain are you feeling now, on a scale from 0 (none) to 10 (very severe)?" The cut-off point for pain treatment was NRS ⩾ 4. Then the patients would be asked if they want to receive TAP blocks when pain scores went above 4. If not, we would use intravenous analgesics to elevate the pain. For those who chose to receive TAP blocks, intravenous analgesics could also be used if NRS ⩾ 4 after it.

TAP blocks were given under ultrasound-guidance (US). The ultrasound-guided bilateral TAP block was performed with a high frequency linear ultrasound probe (Philips ®, Inc. German) and an in-plane technique using a 80 mm 22 G needle (Braun® Stimuplex D, German). The ultrasound probe was placed transverse to the abdomen (horizontal plane) in the mid-axillary line between the costal margin and the iliac crest, piercing the skin 2 in. cephalad to the iliac crest. Three muscle layers are clearly seen in the im-

Table 1. Demographic Data of the Two Studied Groups.

Demographic Parameters	Group T (n = 281)	Group NT (n = 437)	P-value
Age (years)	49.76 ± 13.49	51.83 ± 11.24	0.483
Weight (Kg)	61.96 ± 10.66	61.53 ± 10.73	0.795
Sex (Male/Female)	84/197	143/294	0.426
Duration of anesthesia (min)	182 (127, 262)	189.5 (132, 277)	0.052
Extubation Time (min)	25.23 ± 16.13	27.59 ± 17.90	0.533
Time in PACU (min)	83.19 ± 28.28	76.67 ± 27.74	0.235

Values are presented as mean ± SD, number or median (P25, P75).. Group T: TAP blocks were given; Group NT: TAP blocks were not given.

age. The needle is inserted in a sagittal plane approximately 3-4 cm medial to the ultrasound probe, the needle tip was directed into the plane below the internal oblique and above the transversus abdominis muscle. After negative aspiration to exclude vascular puncture, a test dose of (1 ml of saline) was used to open the plane between the two muscles followed by instillation of the full dose of local anesthetic. If the 1 ml dose appeared to be within the muscle rather than between them, needle repositioning was required (BORE technique) and test repeated followed by injection of 20 mL of 0.33% ropivacaine (Naropin®, AstraZeneca, USA) with negative aspirations performed at every 5ml. The same procedure was repeated on the contralateral side.

The first outcome is the number of patients that received TAP blocks in the PACU. TAP blocks were given only when patients agree to accept it after extubation which means the performance of TAP blocks is driven by the patients' demands. Comparisons of this outcome were made between 2 groups: laparoscopic operation(LA) and open operation(OP).

Other outcomes included: 1. kinds of intravenous analgesics that needed after extubation, 2. numbers of antiemetic drug used and 3. patients' pain scores upon discharge from the PACU. Comparisons of these three outcomes were made between following 2 groups: patients who received TAP block (T) and those did not (NT). In PACU, the most commonly used intravenous analgesics are tramadol, butorphanol and flurbiprofen axetil. Usually, these three kinds of drugs are not used repeatedly. When a patient complains about moderate or severe pain (pain score ⩾4) after using one drug, we would choose another one. Only if the pain score was still above 4 the third one would be used. Usually, the pain could be well controlled in PACU. As an antiemetic drug, tropisetron was only used once when patients have the feeling of nausea or vomiting. At last, pain scores would be recorded before sending patients back to their wards.

Statistical Analysis

Statistical analysis was conducted using a software program, SPSS version 22 (SPSS Inc., Chicago, IL, USA). For the continuous measures, data were analyzed using analysis of variance methods. Demographic data of the two studied groups was presented as mean ± standard deviation (SD) or median and interquartile range (P25, P75) and compared with rank-sum test. The Chi-square test of four grid table was used in comparing number of patients performed TAP block in two groups in table 2 and the use of antiemetic drugs in table 3. Results of the use of intravenous analgesics and pain scores were analyzed with rank-sum test. $P < 0.05$ (2-sided) was considered to indicate statistically significant differences.

RESULTS

A total number of 718 medical records (between 1st November and 31st December 2016) were enrolled in the study. There were no significant

Table 2. Number of Patients Performed TAP Block in the PACU.

Group	T	NT	Count
LA	167	267	434
OP	114	170	284
Count	281*	437	718

Group LA: laparoscopic operation; Group OP: open operation; Group T: TAP blocks were given; Group NT: TAP blocks were not given. *P > 0.005 versus Group NT.

differences between groups in demographic data (age, weight and sex), duration of anesthesia, extubation time and time in PACU (P > 0.05) (Table 1). 434 patients underwent the laparoscopic operation (LA) and 284 patients underwent the open operation (OP) (table2). 281 patients in the PACU were given TAP blocks while the rest were not (437 patients). We compared the number of patients who receive TAP blocks, but there was no significant difference between two groups (P = 0.656). Comparisons of the rest three outcomes were made between 2 groups: patients who received TAP block (T) and those not (NT). Number of patients which were given intravenous analgesics and antiemetic drug is shown in table3. There was no significant difference between two groups when comparing given intravenous analgesics (P = 0.350) and antiemetic drug (P = 0.679). Outcomes of pain score upon discharge the PACU were also shown in table 3. Pain score is 1.14 ± 0.90 in the group where TAP blocks were performed (T) and 0.96 ± 0.84 in group NT. The difference between these two groups is statistically significant (P = 0.011).

DISCUSSION

A total number of 718 patients were enrolled in the study. There was also no significant difference between group T and group NT when comparing the number of patients who receive TAP blocks and the use of intravenous analgesics and antiemetic drugs in PACU. Outcomes of pain scores showed that pain scores in group T were higher than group NT.

The TAP block is associated with equivalent or improved nausea and vomiting compared to both no block (standard care) and active comparators. Nausea and vomiting are typical complications associated with opioid use (9-11). Any reduction in these outcomes may be a result of the corresponding reduction in morphine use associated with the TAP block. However, our study indicates that there was no significant difference between group T and group NT when comparing the records of given intravenous analgesics and antiemetic drugs. In our study, only three kinds of intravenous analgesics were used: tramadol, butorphanol and flurbiprofen axetil. Tramadol is a non-opioid analgesic. Butorphanol is an opioid analgesic, but it is less likely to produce complications like nausea and vomiting. Flurbiprofen axetil belongs to NSAIDs. All the intravenous analgesics used in the PACU are unlikely to cause nausea or vomiting.

Gerbershagen' s study demonstrated that the optimal cut-off point for pain treatment was also NRS ⩾ 4 as identifying patients with moderate and severe pain (12). All the records of pain score in our study were lower than 4. This difference is probably due to intravenous analgesics given during the operation. TAP block only acts as a supplementary method for the treatment of acute postoperative pain in the PACU. Usually, TAP block is a safe and effective procedure compared to standard care, placebo and other analgesic techniques in post-operative analgesia (13). However, in our study, we found that pain scores in group T were higher than group NT.

There were three main factors attributed to this result. Firstly, TAP blocks were performed immediately after induction of anesthesia and before skin incision in previous studies (1-3). Usually, patients would be connected to intravenous patient-controlled analgesia (IV-PCA) which contained morphine for postoperative pain management. Then the total consumption of IV PCA morphine would be calculated and compared. There were no other intravenous analgesics like NSAIDs were given. However, we used it as a supplementary modality for the treatment of acute postoperative pain in the PACU. And three kinds of intravenous analgesics were used intraoperatively or postoperatively: tramadol, butorphanol and flurbiprofen axetil. Maybe the effect of the combined use of different analgesics and the effect of TAP blocks were equal, but further studies are needed. Secondly, postoperative pain can arise from the incision site (inci-

Table 3. Number of Patients Given Antimatic and Intravenous Analgesics in the PACU. Pain Scores Upon Patients Discharge the PACU.

	Antimatic drug		Analgesic drugs				Pain score*			
	G	NG	0	1	2	3	0	1	2	3
T	45	236	193	58	28	2	77	110	73	21
NT	65	372	315	78	44	0	143	190	82	22

Group T: TAP blocks were given; Group NT: TAP blocks were not given; Group G: patients given antimatic drug in the PACU; Group NG: patients not given antimatic drug in the PACU; 0, 1, 2, 3 under analgesic drugs, kinds of analgesic drugs given in the PACU; 0, 1, 2, 3 under pain scores, pain scores upon patients discharge the PACU. *P < 0.05, between Group T and Group NT.

sional pain) or from visceral structures (visceral pain). There are still some debates on if TAP blocks have effects on visceral pain. But butorphanol can elevate it to some extent by active κ receptor. Thirdly, the performance of TAP blocks in our center is driven by patients' demands. So the patients who required TAP blocks were more likely suffering from more severe postoperative pain. Even though, all the pain scores showed the postoperative pain of patients upon discharge the PACU in our center is moderate. This difference between these two groups is significant statistically not clinically.

Limitations of this study include that the data have been retrospectively analyzed, which may have more sources of bias than if it was studied prospectively, and some information was missing. In our center, the induction and maintenance strategies are fixed. However, intravenous analgesics (tramadol, butorphanol and flurbiprofen axetil) would be given preoperatively or intraoperatively. We have recorded different intravenous analgesics used outside the PACU. But it is hard to evaluate the analgesic effects of them. This is the biggest deficiency in our study. Further well designed prospective study may rule out the influence of this factors. Additionally, TAP blocks were performed by different clinicians in the PACU. This study does not account for the differences in skill, technique, and experience between them.

CONCLUSIONS

In conclusion, TAP block did not reduce the use of intravenous analgesics, antiemetic drugs and pain scores when used as a supplementary method for the treatment of acute postoperative pain in the PACU in the present study.

This study was supported by a grant (No. 81571075) from the National Natural Science Foundation of China.
The authors have no other potential conflicts of interest for this work.

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