Efficacy of transversus abdominis plane block on the chronic pain after colorectal surgery: a retrospective cohort study

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Research article

Keywords: Chronic postsurgical pain, Colorectal surgery, Transversus abdominal plane block, Analgesia

Posted Date: January 9th, 2020

DOI: <https://doi.org/10.21203/rs.2.20446/v1>

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Version of Record: A version of this preprint was published at BMC Anesthesiology on May 18th, 2020.
See the published version at <https://doi.org/10.1186/s12871-020-01032-8>.

Abstract

Background: Chronic postsurgical pain (CPSP) is common and would reduce the quality of life of patients. Transversus abdominal plane (TAP) block has been widely used in lower abdominal surgery and many researchers demonstrated that it could improve acute postsurgical pain. We aim to determine whether TAP block could improve chronic postoperative pain at 3 months and 6 months after colorectal surgery.

Methods: A total of 307 patients received selective colorectal surgery under general anesthesia between January, 2015 and January, 2019 in a single university hospital were included: 128 patients received TAP block combined with patient-controlled intravenous analgesia (PCIA) for postsurgical analgesia (group TP) and 179 only administrated with PCIA (group P). Main outcome was the incidence of pain at 3 months and 6 months after colorectal surgery, and NRS score of pain at 24 hours, 48 hours, 3 months and 6 months after colorectal surgery. The data was analyzed by two-way repeated measures anova and the chi-square test.

Results: The NRS score decreased significantly at 24 hours after surgery (rest NRS 1.07 ± 1.34 vs 1.65 ± 1.67 , $P=0.003$; and movement NRS 3.00 ± 1.45 vs 3.65 ± 1.89 ; $p=0.003$) and at 3 months after surgery (movement NRS 0.59 ± 1.23 vs 0.92 ± 1.65 , $p=0.045$) in group TP than that in group P. There were no significant difference of NRS score at 48 hours and 6 months after surgery (all $p>0.05$).

Among 307 patients, 62/307(20.2%) developed chronic post-surgical pain (CPSP) at 3 months after surgery, and 42/307(13.7%) experienced CPSP at 6 months after surgery. The prevalence of CPSP in group TP showed no significant difference compared with group P at 3 months (19.5% vs 20.7%, $p=0.806$) and 6 months (13.2% vs 13.9%, $p=0.863$) after surgery.

Conclusions: TAP block could decrease the movement pain score at 3 months after surgery, but could not reduce the incidence of CPSP at 3 months and 6 months after selective colorectal surgery. TAP block may have positive effect on chronic postsurgical pain.

Introduction

Chronic postsurgical pain (CPSP) is defined by the International Association for the Study of Pain (IASP) as pain that develops after a surgical procedure and persists for at least 3 months after surgery, where all other causes of pain (e.g. infection, recurring malignancy) or pre-existing pain problems are excluded.[1, 2] Few studies reported the prevalence of CPSP after colorectal surgery[3, 4]. A prospective study showed that 19% of patients underwent colorectal surgery reported CPSP at 6 months, 63% of which taking medication for their pain, 53% of which were using opioids to manage their pain[3]. In another retrospective study, 17% of patients reported CPSP after laparoscopic colorectal surgery, 37% of which suffering from severe pain (pain score ≥ 7)[4]. CPSP has a negative impact on the quality of life, such as mood, sleep, walking ability, and normal work, so it is important to find out methods to reduce CPSP.

It was found that acute postoperative pain was an important risk factor of CPSP[4–6] and many research demonstrated that CPSP could be partly improved by optimizing perioperative pain management, including intravenous analgesia, epidural analgesia, paravertebral blocks and regional analgesia.[7–9] Transversus abdominis plane (TAP) block is an effective regional analgesia technique to reduce perioperative pain intensity[10], especially combined with ultrasound-guided technique. TAP block is the injection of local anesthetics to neurofascial plane between internal oblique and transversus abdominis muscles aiming at blocking the neural afferents from the anterolateral abdominal wall (T7-L1).[11] TAP block has been widely used in many abdominal operation, with a satisfactory duration of analgesic action for up to 24 hours after surgery.[10, 12–14] Many studies confirmed that TAP block can improve acute postoperative pain[15, 16], but whether TAP block can reduce chronic pain after colorectal surgery has been reported scarcely.

The main aim of our study was to evaluate whether TAP block could improve CPSP after colorectal surgery. We compared the outcomes for patients who had TAP block and PCIA with those patients without TAP block.

Methods

Our research was approved by the Ethics Committee of Third Xiangya Hospital, Central South University (No:2019-S473). We reviewed the medical records of patients undertaking colorectal surgery at the third Xiangya hospital of Central South University from January, 2015 to January 2019. Eligibility criteria included patients who were over 18 years and under 85 years old, American Society of Anesthesiologists (ASA) status I–III, receiving selective colorectal surgery under general anesthesia and patient-controlled intravenous analgesia (PCIA) for postsurgical analgesia. Exclusion criteria were patients unable to communicate, wound infection after surgery, receiving a second operation.

Anesthetic and analgesia routine management

On entering the surgery room, patients' vital signs were monitored by electrocardiogram, invasive arterial blood pressure, pulse oximetry and bispectral index. General anesthesia was induced with fentanyl (4–6 µg/kg) or sufentanil 0.4 to 0.6 µg/kg, propofol (1.5–2 mg/kg), midazolam 2–3 mg, rocuronium (1 mg/kg) or cisatracurium besylate (0.15–0.2 mg/kg). Anesthesia was maintained with intravenous infusion propofol 4 to 7 mg/kg/h, remifentanyl 6 to 10mg/kg/h, and inhalation of 1% to 2% sevoflurane. Fentanyl or sufentanil and cisatracurium besylate was used while needed. All patients received 0.25 mg palonosetron hydrochloride intravenously before suture.

For those patients who received TAP block, bilateral TAP block was performed by ultrasound (SonoSite Edge®, American) before induction of general anesthesia. 40ml of 0.5% ropivacaine (AstraZeneca AB, Sweden, 20 ml each side) was injected into the transversus abdominis plane under real-time ultrasound guidance.

Postoperatively, electronic analgesic pump with wireless analgesic system was used for 48 hours of PCIA (Renxian Medtech, Jiangsu). The PCIA pump was filled with sufentanil 150 µg, azasetron 10 mg, diluted to 150 ml with 0.9% normal saline. It was programmed to give 1.5-2 ml/h background infusion with a 1.5-2 µg bolus of sufentanil solution, with a 5min lockout time. Patients were routinely informed that they could control the pain by pressing a self-controlled button to only slight pain. Pain was assessed twice a day during rest and movement with an 11-point Numeric Rating Scale (NRS) (0 = no pain; 10 = pain "as bad as you can imagine") by the same nurse of acute pain service group within 48h after operation. The NRS score recorded at the afternoon (2-4 pm) was extracted for analysis in this study.

After discharged from hospital, postoperative follow-up team contacted patients via telephone at three months and six months after operation to complete pain evaluation (NRS score and painful place).

The data extraction

Patients' data including patients' ASA status, sex, age at the time of operation, body mass index were extracted from medical records. Patients' information about surgical and anesthetic management such as anesthesia duration, surgery duration, perioperative opioid dose and pain scores was extracted from Anesthesia records. All patients were allocated to two groups: group TP were those patients who received TAP block and PCIA; and group P were those patients who only received PCIA.

Statistical analysis

In order to facilitate comparison, all perioperative analgesics were equivalent to morphine. Sufentanil 0.01mg, fentanyl 0.1mg, remifentanyl 0.1mg equal to morphine 10mg. Opioid usage were analyzed with the unpaired t-test between two groups. Two-way repeated measures anova was used for NRS scores of 24 hours, 48 hours, 3 months and 6 months after surgery. The chi-square test was used for comparisons of categorical data. Quantitative data were expressed as mean±SD and categorical variables as percentages. Data were analyzed with the SPSS software version 22.0 (SPSS Inc., Chicago, IL). Significance was determined at $P \leq 0.05$.

Results

372 patients were included in this study between January, 2015 and January, 2019 firstly, then, 38 patients were excluded: 5 patients were younger than 18 years or over 85 years old, 5 patients' ASA status was IV, 3 patients occurred wound infection in hospital, 4 patients were transferred to ICU after surgery, 4 patients underwent a second abdominal operation, 17 patients received general anesthesia combined with epidural anesthesia or analgesia; and 334 patients meeting the selection criteria were reviewed (group P =192; group TP =142). There were 13 patients lost to follow-up in group P and 14 patients in group TP, finally, 307 patients were enrolled for analysis. The flow chart of the study was presented in Figure 1.

Patients' demographics, ASA status, duration of surgery and anesthesia, and operative method were similar in the two groups (Table 1).

All opioids were converted to morphine to facilitate data statistics. Compared with group P, there was a significant reduction in intraoperative morphine use and total morphine use in group TP (180.6 ± 57.3 mg vs 205.3 ± 67.6 mg, $P=0.001$; 271.0 ± 76.1 vs 290.0 ± 84.1 , $P=0.044$, respectively). But the postoperative requirement for morphine showed no significant difference at 24h and 48h between group TP and group P ($P=0.255$, $P=0.320$, respectively) (Table 2).

The interaction effect between TAP block and time was statistically significant (movement NRS, $P=0.042$; rest NRS, $P=0.048$), which means that both TAP block and time had effects on postoperative pain. Thus we identified the effect of each factor on postoperative pain.

Compared with group P, the NRS score decreased significantly in group TP at 24 hours after surgery (rest NRS 1.07 ± 1.34 vs 1.65 ± 1.67 , $P=0.003$; and movement NRS 3.00 ± 1.45 vs 3.65 ± 1.89 ; $P=0.003$); while the same was observed in movement NRS score at 3 months after surgery (0.59 ± 1.23 vs 0.92 ± 1.65 , $P=0.045$). There were no significant difference of NRS score at rest and movement at 48 hours and 6 months after surgery (all $P>0.05$) (Fig 2).

In time comparison, both in group TP and group P, the effect of time on pain was statistically significant (all $P<0.001$) and the degree of pain decreased with time (Fig 2).

The prevalence of CPSP at 3 months and 6 months after surgery were summarized in Figure 3. CPSP occurred in 62 patients (20.2%) at 3 months after surgery and 42 patients (13.7%) at 6 months after surgery in our patients. The prevalence of CPSP in group TP showed no significant difference compared with group P (19.5% vs 20.7%, $P=0.806$) at 3 months after surgery. At 6 months after surgery, the results also showed no significant difference between the two groups (13.2% vs 13.9%, $P=0.863$).

Discussion

Our research assumptions were partially supported. TAP block not only significantly decreased the intraoperative opioids and perioperative total opioid dosage, but also lessen pain intensity at 24 hours and 3 months after colorectal surgery; however, such an effect did not occur at other time point.

In group TP, patients received bilateral TAP block before surgery, and there was a significant reduction in intraoperative morphine use compared with group P. At postoperative first 24 hour, group TP had significantly lower pain scores at rest and movement compared with group P, but the postoperative requirement for morphine showed no significant difference between the two groups. There was no difference of pain score and morphine use at 48 hours after surgery. These results were similar to some studies, which showed that TAP block with levobupivacaine could reduce postoperative visual analogue pain scores in the first 24 hours after major abdominal surgery,[17] and TAP block provided superior analgesia with lower pain scores at rest and movement in the first 24 hours after colorectal surgery, when

compared to PCIA alone.[18] All suggested that TAP block could improve acute postoperative pain and the effect lasted at least 24 hours.[10]

In our study, the overall incidence of chronic pain was 20.2% at postoperative three months and 13.7% at postoperative 6 months. A prospective research documented that the prevalence of CPSP was 19% at 6 months after colorectal surgery.[3] A retrospective analysis confirmed that the prevalence of CPSP in patients with colorectal cancer was 13% at 38 months after laparoscopic colorectal surgery [4], which was a little higher than ours. These may have something to do with the difference of race and analgesia method.

However, there was no literature on how TAP block affects the incidence of CPSP in colorectal surgery. In our study, at 3 months after surgery, the prevalence of CPSP was 19.5% in group TP and 20.7% in group P; and at 6 months after surgery, the prevalence of CPSP was 13.2% in group TP and 13.9% in group P. There was no significant difference about the prevalence of CPSP between the two groups after elective colorectal surgery. Similarly, a prospective cohort follow-up study indicated TAP block did not influence the prevalence of CPSP at 6 months and 12 months after breast reconstruction.[19] A randomized controlled trial also demonstrated that TAP block did not decrease the incidence of CPSP at 6 months after cesarean delivery.[20] They told us that TAP block could not decrease the incidence of CPSP.

Although TAP block did not improve the incidence of chronic pain after colorectal surgery, pain scores at 3 months were lower in group TP than that in group P, which means TAP block has a positive effect on CPSP. A randomized controlled trial showed that TAP block could not reduce the incidence of chronic pain after inguinal hernia repair, but reduce the pain scores in rest and movement at 6 months, which was similar to us.[14]

Our study has some limitations. Firstly, as the prevalence of CPSP after colorectal surgery is low, we need to increase the sample size to verify whether TAP block has any effect on CPSP at 6 months or more. Secondly, the design of the retrospective study made it difficult for us to strictly exclude the use of perioperative non-opioid analgesics, which may also influence postoperative pain scores.

In conclusion, TAP block could relieve pain movement score at 3 months after surgery, but could not reduce the incidence of CPSP at 3 months and 6 months after selective colorectal surgery. Further studies need to expand sample size and carry out prospective research.

Declarations

Acknowledgement

Not applicable.

Authors' Contributions

Zi-ye Pan reviewed and analyzed the data and wrote the manuscript. Zhong-Hua Hu guided the research and revised the manuscript. Fan Zhang contributed to the conception and design of the study. Wen-Xiu Xie aided the data analysis. Qin Liao and Yong-Zhong Tang conceived and designed the study, and revised the manuscript for important intellectual content. All authors read and approved the final manuscript.

Funding

This work was supported by grant from National Key R&D Program of China (2018YFC2001800) and by the New Xiangya talent projects of the third Xiangya hospital of Central South University. This study was also supported in part by the Research and Innovation Funds from Xiangya Big data Foundation of Central South University.

Consent for publication

Not applicable.

Competing interests

The authors declare they have no competing interests.

Availability of data and materials

The analyzed data sets generated during the study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by the ethics committee of the third Xiangya hospital of Central South University (approval number 2019-S473). Because of retrospective study, informed consent was waived.

Abbreviations

TAP: Transversus abdominal plane; CPSP: Chronic postsurgical pain; PCA: Patient controlled intravenous analgesia; NRS: Numerical rating scale.

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Tables

Table 1 Patients' characteristic

Measurement data were presented as Mean±SD

	Group P n=179	Group TP n=128	<i>P</i>
Gender			0.734
Male	79	74	
Female	100	54	
Age (years)	57.8±11.8	59.6±12.2	0.190
BMI (kg/m ²)	22.7±3.2	22.3±2.8	0.284
ASA status			0.405
I	1	1	
II	102	73	
III	76	54	
Surgery duration (hours)	3.8±1.4	3.9±1.0	0.671
Anesthesia duration (hours)	5.5±1.4	5.6±1.0	0.593
Operative method			0.080
Open	36	16	
Laparoscope	143	112	

Table 2 Morphine usage during perioperative period

Data were presented as Mean±SD, compared with Group P, * $P \leq 0.05$

Morphine usage (mg)	Group P(n=179)	Group TP(n=128)	<i>P</i>
Intraoperative	205.3±67.6	180.6±57.3	0.001*
24h after surgery	45.1±30.2	49.3±34.0	0.255
48h after surgery	84.7±49.1	90.4±50.7	0.320
Total	290.0±84.1	271.0±76.1	0.044*

Figures

Figure 1. Flow chart showing patient enrollment, grouping, and analysis.

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Flow chart showing patients enrollment, grouping and analysis.

NRS score at rest and movement

Figure 2. The NRS score of patients at rest and movement at different moment. Data was presented as mean $\pm$ SD. Compared with group P, the NRS score decreased significantly at 24 hours (rest and movement) and 3 months (movement) after surgery in group TP. There were no significant difference of NRS score at 48 hours and 6 months after surgery (all $P>0.05$). NRS=numerical rating scale.

Figure 2

The NRS score of patients at rest and movement at different moment. Data was presented as mean $\pm$ SD. Compared with group P, the NRS score decreased significantly at 24 hours (rest and movement) and 3 months (movement) after surgery in group TP. There were no significant difference of NRS score at 48 hours and 6 months after surgery (all $P>0.05$). NRS=numerical rating scale.

Figure 3. The prevalence of CPSP at 3 months and 6 months after surgery. Data was presented as percentage. The prevalence of CPSP in group TP showed no significant difference compared with group P at 3 months and 6 months after surgery (all $P>0.05$). CPSP=chronic postsurgical pain.

Figure 3

The prevalence of CPSP at 3 months and 6 months after surgery. Data was presented as percentage. The prevalence of CPSP in group TP showed no significant difference compared with group P at 3 months and 6 months after surgery (all $P>0.05$). CPSP=chronic postsurgical pain.