Original Article

Analgesic Efficacy Of Preoperative Versus Postoperative Ultrasound-Guided Transverse Abdominis Plane Block For Laparoscopic Cholecystectomy

Muhammad Khalid Palijo[1], Faheem Feroze[2], Muhammad Shaheer Bin Faheem[3], Saadia Faheem[4], Maliha Khalid[5], Saeed Farooq[6]

Abstract

Objective: In enhanced recovery procedures, the transversus abdominis plane (TAP) block is applied as one of the multimodal pain control techniques. The study evaluated whether administering an ultrasound-guided TAP block before or after laparoscopic cholecystectomy is more effective for managing postoperative pain within enhanced recovery protocols.

Methods: A prospective study was conducted at PAF Hospital Mushaf Sargodha between July 2024 and December 2024. Patients who met the criteria for laparoscopic cholecystectomy were split randomly into two groups (n=50 for each group). Patients in the preoperative group (PG) had a bilateral ultrasound-guided transversus abdominis plane block performed with 20 cc of bupivacaine 0.25% performed on them after the induction of general anaesthesia. A visual analogue scale was used to evaluate the patients' levels of pain when they were first brought into the recovery room, as well as after four, eight, twelve, and twenty-four hours had passed. The pain score recorded in the recovery room as well as at the 4th, 8th, 12th, and 24th hours is the primary outcome.

Result: The ultrasound-guided TAP block resulted in a significantly reduced pain score in the POG group in comparison to the PG group with stable hemodynamic parameters (heart rate and mean arterial pressure). Following the operation, the POG patients reported significantly less pain when coughing at 4,8,12 and 24 hours. The POG consistently had considerably higher levels of patient satisfaction across the board. Patients in the POG had much lower rates of post-operative nausea and vomiting and required a longer time duration before rescuing analgesic demand than patients in the PG group.

Conclusion: When it comes to giving postoperative analgesia, our study suggested that postoperative TAP block is more effective than preoperative TAP block.

Keywords: analgesic, ultrasound, Laparoscopic cholecystectomy

Introduction

The management of postoperative pain is a significant subject that is presently receiving a great deal of interest in the academic and clinical realms of medicine.[1] Systemic analgesia, which can be either opioid or non-opioid, as well as neuraxial anaesthesia, are two of the many pain treatment options available following surgical procedures.[2] Along with the uncomfortable side effects of opioid analgesics, such as ileus, nausea, vomiting, and itching, as well as the challenges of identifying the appropriate dosage and achieving a steady-state concentration, recent studies have focused a lot of attention on localised analgesic approaches. Peripheral nerve block is one of these treatments that has earned a lot of attention recently due to its better tolerance and capacity to minimise postoperative pain. The reason for this is that it is one of the techniques that can help lower the risk of complications after surgery. The utilisation of ultrasound-guided regional nerve blocks in conjunction with non-steroidal anti-inflammatory medications as a form of multimodal analgesia, to improve the patient's experience of perioperative pain, has recently garnered a lot of attention.[3]

The prevalence of somatic pain following laparoscopic cholecystectomy (LC) and open cholecystectomy varies across studies. However, research suggests that approximately 20-40% of patients experience somatic pain after LC, with visceral pain being more prominent. In contrast, somatic pain is more common and severe after open cholecystectomy, affecting around 50-60% of patients.[4] Because of the complexity of the pain experienced following laparoscopic cholecystectomy (LC), the multimodal analgesia approach is the treatment modality of choice. The discomfort felt in the abdomen following LC surgery has always been the primary source of postoperative pain. Due to the small (1-4 cm) abdominal incisions at the trocar site and the minimal damage to the abdominal wall, the somatic or parietal pain experienced in LC is less severe than the visceral pain experienced. The transversus abdominis plane (TAP) block, on the other hand, is an effective method for controlling pain when combined with other types of analgesia.[5] One of the treatments advised for postoperative pain, more specifically for the control of somatic discomfort in the abdomen, is an ultrasound-guided TAP block, also known as USG-TAP.[6]

Numerous research studies have shown that the TAP block is effective at lowering postoperative pain and increasing patient satisfaction; however, it carries with it the risk of causing major complications or severe damage to the abdominal viscera, including liver injury and intestinal puncture.[7] While the TAP block has been used to ease pain before surgery, limited studies have been done to determine when it should be administered to lessen pain following surgery. Even though basic bupivacaine has a long duration of action, it is possible to

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produce the optimum possible analgesia by carefully timing the TAP blocks. The purpose of this research was to analyse and contrast the efficacy of administering a USG-TAP block before laparoscopic cholecystectomy versus after the procedure.

Materials And Methods

This prospective study, based on non- non-probability consecutive sampling technique, was carried out in PAF Hospital Mushaf Sargodha from July 2024 to December 2024 and included candidates for elective laparoscopic cholecystectomy. Institutional Ethics Committee approval was obtained before the commencement of the research. Informed consent was acquired from all participants involved in the study. The research was conducted with respect for participant privacy, confidentiality and autonomy.

The three parameters that made up the inclusion criteria were patients between 20 to 60 years old, having an ASA physical state of I–II based on the American Society of Anesthesiologists classification and patients' willingness to take part in the study

Patients having an emergency cholecystectomy, having an opioid dependence or tolerance history and Switching from a laparoscopic to an open cholecystectomy, those who didn't give permission, having a history of amide local anaesthetic (e.g., bupivacaine) allergy, coagulopathy, having a Body mass index (BMI) >35 kg/m2 and uncontrollable bleeding during surgery were excluded from the study.

Based on the study by Suseela et al.,[8] with an 80% confidence interval, a margin of error 5% (p-value <0.05) and a 20% incidence of somatic pain following Laparoscopic cholecystectomy, a sample size of 100 (n = 50 for each group) was determined. Two groups of eligible patients were randomly assigned, one group being the preoperative group (PG) and the other group being the postoperative group (POG). A table containing random numbers is utilised to carry out the basic randomisation process. The reading path of the table numbers (for example, top, bottom, left, or right) must be identified before we can use the random numbers. For each group, we assume ten different numbers (for instance, even numbers for intervention A and odd numbers for intervention B). Ten, we pick up a number, walk in a predefined path, write down the number, and divide it into various categories. We allocated first, and then blinding was carried out. The allocation group was not concealed from the participants. Allocation concealment was used, meaning that the group's specific sequence was unknown before intervention, to prevent selection bias. Patients were assigned to PG or POG using this sequence.

Group A: Patients receiving TAP block containing 0.25% bupivacaine before surgery (PG group)

Group B: Patients receiving a TAP block containing 0.25% bupivacaine after surgery before extubation of the ETT tube (POG)

Following the hospital's protocol, patients received intravenous antibiotic prophylaxis, nalbuphine 0.1 mg/kg, and midazolam 0.12 mg/kg as premedication before being put to sleep by the research procedure. Anaesthesia was induced using a combination of propofol (2 mg/kg) and atracurium (0.5 mg/kg). Injection Metoclopramide 10 mg was used as an antiemetic. Isoflurane 1 MAC (1.2%) and 0.1 mg/kg of atracurium were given every 30 minutes during the maintenance phase. Non-invasive blood pressure (NIBP), pulse oximetry, electrocardiography (ECG) and capnography (ETCO2) were used to monitor each patient. ETCO2 levels were maintained between 30 and 35 mmHg during general anaesthesia. Four trocar entrance sites, each measuring 1-4 cm, were used: three in the right upper and lower abdomen quadrant and one near the umbilicus. Carbon dioxide gas was infused intraperitoneally and then intrabdominally at a pressure of less than 15 mm Hg. Over the last 20 minutes, intravenous ondansetron 4 mg and paracetamol 1 gram were administered. Patients were reversed with neostigmine and glycopyrrolate once the pneumoperitoneum was evacuated, and they were then extubated. According to the standard of care, fluid and electrolyte management was done.

When both groups arrived at the post-anaesthesia care unit (PACU), standardised monitoring (ECG, pulse oximetry, and NIBP) was implemented. Upon arrival at the PACU, each patient was started on patient-controlled intravenous analgesia (PCIA) with a bolus bottom (2 ml per 15 min) comprising 20 mg/ml of acetaminophen and 0.6 mg/ml of ketorolac.

Patients were resting in a supine posture when the USG TAP block (Fuji Film Sonosite S-Nerve, Bothel, WA, USA) was done using a linear probe (5–13 MHZ) in the PG group following the induction of anaesthesia and in the POG group following the conclusion of surgery and before the extubation. The transversus abdominis and internal oblique muscles were scanned and examined while the ultrasonography probe was positioned longitudinally on the midaxillary line close to the umbilicus in order to execute the TAP block. After inserting the needle (a disposable 90-mm 22-gauge spinal needle) in plane and inserting the needle tip into the fascia between the internal oblique and transversus abdominis muscles, 20 millilitres of bupivacaine 0.25% were administered into each side. One anaesthetist, who was an expert in the field and was not in charge of data collection, handled everything.

Pain intensity was measured using a visual analogue scale (VAS), which provided a range of scores from 0 (no pain) to 10 (severe pain). The pain scores were measured at five different times: T0: upon entrance to the PACU, T4:4th h, T8:8th h, T12:12th h, and T24:24th h. Nalbuphine 5 mg was also provided as a rescue analgesic at every time during the postoperative period for 24 hours if the patient had a VAS score >4 after taking PCIA. At the end of the 24 hours, the patients' satisfaction was assessed by the same blind assessor, who also recorded the scores. It is true that neither the outcome assessor nor the information analyst knew about the research groups.

Data was obtained using a proforma that included demographic information as well as other post-operative pain variables. SPSS 23 software was used for statistical analysis. The following statistical study was carried out to compare the effectiveness of two methods: The chi-square tests were used to compare gender, ASA classification grade and postoperative nausea and vomiting between the two groups (pre-op and post-op). Using the Independent samples T-test, comparisons of age, BMI, intra-operative hemodynamic parameters and post-operative pain killer demands were made between the two groups, taking a p-value less than 0.05 as statistically significant. The Two-way ANOVA test for Repeated Measures was performed to compare the two groups' VAS scores at 0, 4, 8, 12, and 24 hours during rest.

Results

This study included a total of 100 participants (n = 50 for each group) undergoing elective LC. There was not a statistically significant difference identified between the two groups about any of the following demographic characteristics: age, gender, BMI and ASA classification grade. See Table 1.

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Table 1: Demographic characteristics of patients (n= 100)

Demographics	Mean±SD PG Group n=50	Mean±SD POG Group n=50	P value
Age of patients (years)	47.680±8.01	46.560±9.16	0.517
BMI of patients (kg/m2)	26.620±1.85	26.640±1.93	0.958
ASA classification grade (I: II)	27:23	29:21	0.840
Gender (male: female)	24:26	15:35	0.100

Regarding hemodynamic parameters and pain control observed in both of the groups that are being compared, Group B demonstrated superior hemodynamic stability and analgesia in this region when successive requests for analgesic agents were made, and there was a significant difference between the patients' responses of Group A and Group B (p-value <0.05). See Table 2 and 3. Even though neither group experienced any difficulties, the number of postoperative nausea and vomiting episodes experienced by patients in Group B was much lower than the number reported by patients in Group A.

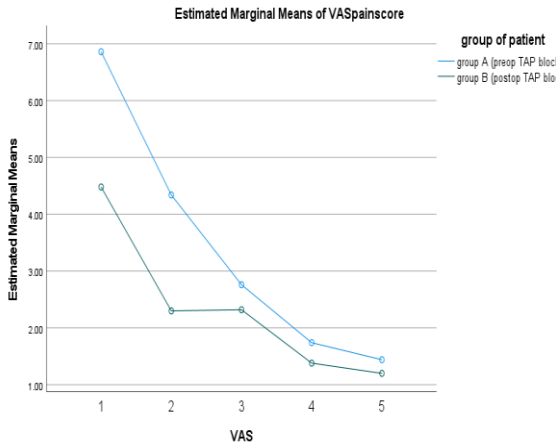

Figure 1: Plotting of VAS pain scores at different time intervals (1: VAS score in recovery room, 2:VAS score at 4 hours, 3: VAS score at 8 hours, 4: VAS score at 12 hours, 5: VAS score at 24 hours) in both groups

Following surgical intervention, the VAS scores at rest eventually increased over time across the board for both groups, and the trend was statistically significant at 4,8,12 and 24 hours following the surgery in Group B (p-value<0.05). See Table 3 and Figure 1. Patients in Group B were more satisfied with their pain control than patients in Group A. See Table 3. After the block, there were no complications that were reported.

Table 2: Intraoperative characteristics (n=100)

Intraoperative characteristics	Mean±SD PG Group (n=50)	Mean±SD POG Group (n=50)	P value
Baseline MAP before induction (mmHg)	77.700±7.70	78.960±7.49	0.409
MAP after extubation (mmHg)	109.640±1.208	89.540±3.51	**<0.001**
Baseline heart rate before induction (beats/min)	82.980±1.28	82.400±1.78	0.065
Heart rate after extubation (beats/min)	92.460±1.40	85.080±0.82	**<0.001**
First rescue analgesic demand (minutes)	408.360±52.025	678.100±34.170	**<0.001**
Postoperative nausea and vomiting (yes: no)	17:33	8:42	0.062

Table 3: Pain scores measured in both groups (n= 100)

VAS pain scores after surgery	Mean±SD PG Group n=50	Mean±SD POG Group n=50	P value
Pain score at 0 hours (T0)	6.860±0.808	4.480±0.504	**<0.001**
Pain score at 4 hours (T4)	4.340±0.478	2.300±0.462	**<0.001**
Pain score at 8 hours (T8)	2.760±0.431	2.320±0.471	**<0.001**
Pain score at 12 hours (T12)	1.740±0.486	1.380±0.490	**<0.001**
Pain score at 24 hours (T24)	1.440±0.501	1.200±0.404	**0.010**
Frequency of painkillers demanded in 24 hours	1.940±0.818	1.340±0.519	**<0.001**
Patient satisfaction regarding pain control (yes: no)	34:16	45:5	**0.013**

Discussion

Postoperative pain management is a key component in achieving the goals of enhanced recovery protocols following laparoscopic cholecystectomy surgery. TAP blocks are an effective method for lowering opioid usage, which is especially encouraging when one considers the low risk of adverse effects that they present.[9] When used with other multimodal analgesics for the treatment of postoperative pain, the ultrasound-guided TAP block has been demonstrated in several studies to improve analgesia, increase patient satisfaction, and amplify the effects of opioid sparing.[10,11] Finding the optimal moment to perform a TAP block before or after surgery to optimise block efficiency is critical from a clinical standpoint. This is because patients undergoing LC surgery often experience the most pain in the trocar sites within the first twenty-four hours following surgery. Finding the perfect time to perform a TAP block is, thus, very crucial. On the other hand, limited research has been done to compare the analgesic benefits of preoperative and postoperative USG TAP blocks on pain control after LC. Within the scope of the present investigation, a USG TAP block was executed in the POG after the procedure, just before extubation, and in the PG after induction of anaesthesia had taken place. According to the findings of our research, a postoperative TAP block with isobaric bupivacaine was much more successful than a preoperative TAP block at reducing the amount of intravenous opioids that were used following surgery, including PICA and intravenous injections. In addition, patients who received postoperative TAP block required a decreased overall quantity of opioid prescription medication up until the time they were discharged from the hospital. The postoperative TAP group experienced significantly lower postoperative rates of nausea and vomiting than the preoperative TAP group. There was no discernible change in other characteristics such as the length of stay, predicted

blood loss during surgery, the length of the procedure, reoperation rates, or readmission rates, regardless of whether the TAP was delivered preoperatively or postoperatively.

Given that basic bupivacaine has a long duration of action, it is possible to produce the optimum possible analgesia by carefully timing the TAP blocks. According to a research conducted by Kalu and his colleagues in which he evaluated the impact of applying TAP either before or after surgery on the amount of postoperative opioid usage, he discovered that post-operative TAP block of the abdominal wall, in concert with other multimodal analgesic treatments, has the potential to significantly reduce the amount of postoperative pain experienced by the patient along with minimal opioid requirements.[12] According to the findings of our study, the USG-TAP block decreased the amount of nalbuphine consumed by the POG; however, it did not affect the PG, thus decreasing opioid consumption as well as the adverse effects associated with it, including PONV. However, this decrease was only statistically significant in the POG. Similarly, Rahimzadeh conducted a single-blinded randomised clinical trial to compare the effects of preemptive versus postoperative ultrasound-guided transversus abdominis plane (USG-TAP) block on pain relief after laparoscopic cholecystectomy using 20cc of 0.25% ropivacaine.[13] The block was administered after surgery and before extubation, with the post-operative group experiencing less pain in the following 24 hours. Ambooken et al. and Priyanka et al. also concluded that a post-incision TAP block significantly reduced pain and vomiting when compared to a pre-incision TAP block and enhances patient satisfaction.[14,15] John and his colleagues gained similar results when they administered a TAP block after cesarean section in female patients. [16]

The blind TAP block approach, which is dependent on anatomical landmarks, carries with it the risk of causing damage to the abdominal viscera. Because we used real-time ultrasonography guidance throughout the process, we did not encounter any TAP block concerns among the patients who participated in this experiment. In addition, there was no anatomical variation seen in this region. In the current study, there were no complications associated to the block, which suggests that a TAP block could be utilised to safely minimise post-operative pain by determining the optimum dosage of local anaesthetic to provide. Accordingly, employing the USG-TAP block has significantly reduced systemic toxicity from local anaesthetics.[17]

At every point in our study for the first 24 hours following surgery, patient satisfaction scores were significantly higher in both groups. This outcome was in line with a study by El Sharkwy et al. that compared the analgesic effectiveness of trocar sites local anaesthetic injection with and without transversus abdominis plane block following gynecologic laparoscopy.[18] Similar results were found in a meta-analysis done by Cai and his colleagues [19]

This study does have certain drawbacks, though. A study disadvantage involved the absence of an assessment of the effects of varying local anaesthetic dosages and concentrations. Previous research has indicated that administering greater doses of local anaesthetics can alleviate pain and decrease parental opioid use. The absence of sensory assessment of the TAP block was another study drawback, as the effectiveness of the USG-TAP block and the assessment of the patient's pain depend on the correct sensory level being produced. The study's single-centre design and small sample size present additional limitations.

Conclusions

When used in conjunction with various other multimodal analgesic approaches for postoperative pain management, the USG-TAP block produced extended analgesia and greater patient satisfaction with reduced pain levels in the post-operative group compared to the preoperative group. Because it spared opioids, the TAP block was able to lessen the unpleasant side effects of opioid use, such as nausea and vomiting. TAP block is, thus, an effective treatment that is low-cost, straightforward, and uncomplicated; also being one of the most vital components of a multimodal analgesic strategy.

Author Information

1. Consultant Anesthetist, PAF Hospital, Sargodha 2. Consultant Anesthetist, CMH, Rawalpindi 3. House Officer, Karachi Institute of Medical Sciences 4. House Officer, CMH, Rawalpindi 5. FCPS II Trainee, PAF Hospital Sargodha 6. Radiologist, DHQ Hospital, Sargodha.
Corresponding author: Dr. Maliha Khalid dowite18malyha@yahoo.com

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