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ORIGINAL ARTICLE

Comparison of the postoperative pain outcomes with bilateral ultrasound-guided transversus abdominis plane block versus local anesthetic wound infiltration in patients undergoing laparoscopic cholecystectomy At A Tertiary Care Hospital, Karachi.

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ABSTRACT… Objective: To compare the postoperative pain outcomes of bilateral ultrasound (US)-guided TAP block versus ocal anesthetic (LA) wound infiltration in patients undergoing laparoscopic cholecystectomy for symptomatic cholelithiasis at a tertiary care hospital in Karachi. **Study Design:** Randomized Controlled Trial. **Setting:** Department of Anaesthesiology, Surgical ICU and Pain Management, Dr. Ruth K. M. Pfau Civil Hospital, Karachi. **Period:** Six months: April 21, 2022, to October 21, 2022. **Methods:** Two groups of sixty patients were randomly assigned based on their fulfillment of inclusion and exclusion criteria. Quantitative and qualitative data were collected, presented, and analyzed using SPSS. Statistical significance was determined using post-stratification chi-square and independent t-tests, with a p-value of less than or equal to 0.05. Results: In Group T (TAP block), the average pain score was 4.38 ± 2.35, while in Group L (LA infiltration), it was 6.4 ± 2.58 (p = 0.001). Mean analgesic consumption was 6.89 ± 3.87 mg in Group T versus 9.78 ± 4.78 mg in Group L (p = 0.001). The mean duration of analgesia in Group T (515.9 ± 150.41 min) was noticeably greater than in Group L (290.7 ± 67.03 min) (p = 0.001). **Conclusion:** After surgery, bilateral US-guided TAP blocks offer better pain management and a longer analgesic duration than LA wound infiltration. On the other hand, LA is still more accessible and cheaper.

Key words: Cholecystectomy, Postoperative Pain, Transversus Abdominis Plane Block.

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INTRODUCTION

Over the last 20 years, laparoscopic intervention has become increasingly popular in gastrointestinal and gynaecologic surgery because of its many advantages, including a low risk of complications, short recovery time, excellent aesthetic results, and less postoperative pain.[1] Surgeons and patients alike place a premium on a speedy recovery from surgery that allows for an early return to full physical activity.[2] To alleviate discomfort after surgery, abdominal wall blocks and local anaesthetic (LA) injections are common techniques.[3]

One relatively new regional anaesthetic technique is the percutaneous transversus abdominis plane (TAP) block, which is designed to obstruct the afferent neural pathways of the anterior abdominal wall. The space between the transversus abdominis and the internal oblique muscles is injected with a local anaesthetic to achieve this. According to studies, the TAP block is an effective method for pain management after both open and laparoscopic surgeries.[44]Local anesthetics such as bupivacaine and lignocaine block the conduction of pain impulses, providing effective analgesia with minimal side effects. LA infiltration at the surgical wound site has also been validated for pain relief after surgery. While opioids, paracetamol, and NSAIDs all alleviate pain, they are not without their share of potential adverse effects.[5] The use of additional analgesics and their negative effects have been decreased since TAP blocks are part of multimodal postoperative analgesia treatments.[6]

A bolus anaesthetic injection blocks the dermatomal afferents of the T7–T11 intercostal nerves, the T12 subcostal nerve, the ilioinguinal and iliohypogastric nerves, as well as the cutaneous branches of the

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L1–L3 nerves in the anatomical compartment known as the TAP, which is located between the transversus abdominis and the internal oblique muscles.[7] Anatomical variations in nerve entry and exit are common. An essential landmark for guiding the placement of TAP blocks is the inferior lumbar triangle, also known as the Petit triangle, which is surrounded by the latissimus dorsi, external oblique, and iliac crest.[8]

Postoperative analgesia following open appendectomy, laparoscopic cholecystectomy, or abdominal hysterectomy has been effectively achieved by an ultrasound-guided TAP block, according to many randomized controlled trials.[9] Suseela et al. evaluated the analgesic duration of bilateral US-guided TAP block in laparoscopic cholecystectomy; the duration of analgesia was 510.35 ± 154.55 minutes, while it was 290.7 ± 67.03 minutes for the LA wound infiltration group. Similarly, Ali et al. reported mean pain scores and analgesic consumption over 12 hours as 3.01 ± 2.55 versus 6.04 ± 2.74 and 6.39 ± 3.86 mg versus 9.95 ± 4.62 mg, respectively.[10]

This study aims to compare the postoperative pain outcomes of a bilateral US-guided TAP block versus LA wound infiltration in symptomatic cholelithiasis patients undergoing laparoscopic cholecystectomy. There is a paucity of local data, and clinical equipoise exists regarding the superiority of either method. Findings from this study could provide clinicians with evidence to improve pain management, enhance patient outcomes, and reduce psychological and financial burdens.

METHODS

This randomized controlled trial was conducted at the Dr. Ruth K. M. Pfau Civil Hospital in Karachi, Pakistan, specifically in the Department of Anaesthesiology, Surgical Intensive Care Unit, and Pain Management. The study duration was six months, from April 21, 2022, to October 21, 2022, after taking approval from the institutional review board/ethical committee (Ref No. IRB-3212/DUHS/Approval /2022/167) dated: November 2, 2022. There were a total of sixty participants in the research, thirty in each group. The sample size was calculated using the WHO program, based on previous findings by Ali et al. (6.39 ± 3.86 mg versus 9.95 ± 4.62 mg). The test had an alpha level of 5% and a power of 80% (1-beta).[14] Enrolment was accomplished through non-probability consecutive sampling.

The study comprised male and female patients (40–80 years old) with a history of symptomatic cholelithiasis who underwent laparoscopic cholecystectomy and were categorised as having an ASA score of 2 or below. Exclusion criteria included a family history of bupivacaine allergy, hepatitis B, C, or HIV infection, bipolar illness, cancer, hypo- and hyperthyroidism, pregnancy, and chronic diseases such as heart failure, liver disease, chronic obstructive pulmonary disease (COPD), or stroke. The College of Physicians and Surgeons Pakistan gave their consent before data gathering could begin. Eligible patients were enrolled, and we made sure to get written informed consent. Age, gender, and place of residence were among the demographic details noted. We used a wall-mounted scale to measure height, recorded weight to the nearest kg, and computed BMI. Patients were randomly allocated using sealed opaque envelopes into Group T (bilateral ultrasound-guided TAP block) or Group L (local anaesthetic wound infiltration). Both the patients and the researcher who measured their pain after surgery were unaware of the group assignments; only the anaesthesiologist performing the procedure knew the patients' groups.

Standard monitoring in the operating room was established with an electrocardiogram (ECG), non-invasive blood pressure (NIBP), pulse oximetry (SpO_4), and capnography ($EtCO_4$). Baseline data were collected. Through the use of a snug-fitting face mask, patients were pre-oxygenated with 100% oxygen. Following tracheal intubation with a cuffed endotracheal tube of the appropriate size, anaesthesia was induced using intravenous doses of 2 mg/kg propofol, 0.1 mg/kg nalbuphine, and 0.5 mg/kg atracurium. The patient was then maintained under anaesthesia with oxygen and isoflurane. Patients were then mechanically ventilated on the CMV mode. One seasoned investigator delivered the TAP block or local infiltration just before extubation after the procedure. Under ultrasound supervision, Group T underwent bilateral transversus abdominis

plane (TAP) blocks with 25G pencil-point needles inserted at the mid-axillary line and two inches cephalad to the iliac crest. Following a negative aspiration, a 1 ml test dose was administered, and ultrasonography confirmed the division of the fascial planes. The needle was repositioned if resistance occurred. This procedure was performed with 0.6 ml/kg of 0.25% bupivacaine. Injecting 0.6 ml/kg of 0.25% bupivacaine into their surgical wounds was the procedure for patients in Group L. Patients were reversed postoperatively with neostigmine (0.04–0.08 mg/kg) mixed with glycopyrrolate (0.2 mg per 2.5 mg of neostigmine).

Patients had normal postoperative monitoring in the postanesthesia recovery unit. Pain was assessed using the Numerical Rating Scale (NRS, 0–10 cm) as soon as patients regained consciousness, followed every two hours for twelve hours while on the ward. Outcomes, including mean pain score, mean analgesic use, and duration of analgesia, were recorded. Quantitative variables (age, height, weight, mean VAS score, length of hospital stay, and surgical time) and qualitative variables (gender, residency status, type II diabetes mellitus, hypertension, smoking status, body mass index, and postoperative discomfort) were input into the research form.

Patients presenting with fever (temperature ≥ 37.5°C for ≥ 24 hours), pain under the right costal margin (VAS ≥ 4 for ≥ 24 hours), or ultrasound showing gallstones with a dilated common bile duct (>8 mm) were labeled as having symptomatic cholelithiasis. Patients who had laparoscopic cholecystectomy performed with either a bilateral US-guided TAP block or local anaesthetic wound infiltration had their postoperative discomfort evaluated. Following a 12-hour period of general anaesthesia recovery, patients were assessed in the recovery area every two hours and subsequently on the ward. The Numerical Rating Scale (0-10 cm) was used to record pain scores, which were averaged over a 12-hour period. Rescue analgesia with nalbuphine was given based on pain scores, and mean analgesic consumption over 12 hours was calculated. The time from block distribution to the first pain report with a numerical rating scale (NRS) of 4 or above was used to quantify the duration of analgesia. Diabetic patients were those on antidiabetic medication for at least six months, compliant with therapy, and with HbA1c ≤ 7%. Hypertensive patients were on antihypertensive medication for at least six months, compliant with therapy, and with SBP ≤ 130 mmHg and DBP ≤ 90 mmHg. Smokers were defined as those consuming ≥ 10 cigarettes per day for the last two years. Height and weight were measured at inclusion, and a BMI ≥ 30 kg/m^2 was labeled as obesity. We tracked the time it took from inserting the first port until the gallbladder was removed, marking the surgical duration.

We used SPSS version 20.0 to analyse the data. We calculated the standard deviation, mean, and median (IQR) for the variables. Qualitative factors were quantified using percentages and frequencies. To compare the groups' postoperative pain results, an unpaired t-test was utilised. To account for potential confounding factors, we stratified patients according to age, gender, place of residence, comorbidities, obesity status, length of hospital stay, and operation duration. An independent t-test was used after stratification, and statistical significance was determined by a p-value that was below or equivalent to 0.05.

RESULTS

Thirty patients from each group made up the total number of trial participants. The average age of Group L was 61.5 years, whereas that of Group T was 59.8 years. There were 10 patients in Group T whose ages ranged from 40 to 60 and 20 patients in Group T whose ages ranged from 61 to 80; in Group L, the corresponding numbers were 11 and 19, respectively. There were fourteen male patients and sixteen female patients in Group T, and eleven male patients and nineteen female patients in Group L. Groups T and L had different mean body mass indexes (BMIs): 28.4 and 29.7 kg/ m^2, respectively. Groups T and L had different mean heights (158.2 and 152.9 cm, respectively), and weights (69.1 and 72.0 kg, respectively). Urban residents numbered 22 in both groups, and rural residents numbered 8 in each group. Surgery took no more than two hours for fourteen patients in Group L and fifteen in Group T. Operations lasted longer than two hours for sixteen patients in Group L and fifteen in Group T. Only 10 of the patients in Group T and 15 individuals

in Group L had hospital stays of 7 days or less; however, 20 patients in Group T and 15 individuals in Group L had stays of more than 7 days. Twelve individuals in Group T and eleven within Group L had diabetes mellitus as a comorbidity. There were seven cases of hypertension assigned to Group T and nine to Group L. Smoking was detected in six people in Group T and five in Group L, while ten people in Group T and 20 in Group L were overweight (Table-I).

TABLE-I

Demographic and baseline characteristics of study participants (n=60)

Parameters	Category	Group T (n=30)	Group L (n=30)
Age	Mean ± SD	59.8 ± 7.9	61.5 ± 8.0
	40–60 years	10 (33.3%)	11 (36.7%)
	61–80 years	20 (66.7%)	19 (63.3%)
Gender	Male	14 (46.7%)	11 (36.7%)
	Female	16 (53.3%)	19 (63.3%)
BMI	BMI (kg/m²)	28.4 ± 3.7	29.7 ± 2.4
	Height (cm)	158.2 ± 15.7	152.9 ± 14.2
	Weight (kg)	69.1 ± 10.2	72.0 ± 11.1
Residence	Urban	22 (73.3%)	22 (73.3%)
	Rural residence	8 (26.7%)	8 (26.7%)
Surgery duration	≤2 hours	15 (50%)	14 (46.7%)
	>2 hours	15 (50%)	16 (53.3%)
Hospital stay	≤7 days	10 (33.3%)	15 (50%)
	>7 day	20 (66.7%)	15 (50%)
Comorbidities	Diabetes mellitus	12 (40%)	11 (36.7%)
	Hypertension	7 (23.3%)	9 (30%)
	Obesity	10 (33.3%)	20 (66.7%)
	Smoker	6 (20%)	5 (16.7%)

With mean scores of 4.38 and 6.40, respectively, Group T reported less postoperative pain than Group L, and this difference is statistically significant (p=0.001) (Table-II).

Stratified analysis of postoperative pain scores showed that patients with diabetes mellitus, hypertension, or obesity in Group T had mean pain scores of 4.2 compared to 6.3 in Group L. Smokers in Group T had a mean pain score of 4.9 versus 6.5 in Group L. The statistical significance of all differences was high (p=0.001). (Table-III)

Stratified analysis of analgesic dosage indicated that patients with diabetes mellitus, hypertension, obesity, or smokers in Group T received lower mean doses of analgesics (6.81–6.91 mg) compared to Group L (9.81–9.82 mg), with all comparisons showing a highly significant finding (p=0.001). (Table-IV)

TABLE-II

Postoperative pain score in Group T versus Group L (n=60)

Parameter	Group T (n=30)	Group L (n=30)	P-Value
Pain score	4.38 ± 2.35	6.4 ± 2.58	0.001

FIGURE-1

Postoperative pain score in Group T versus Group L (n=60)

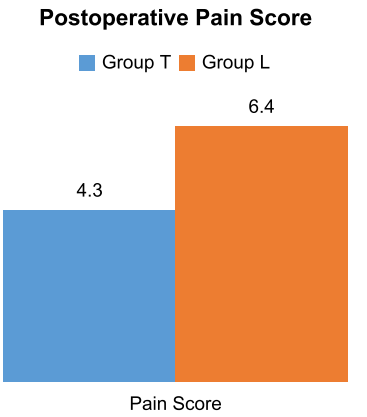


TABLE-III

Stratified postoperative pain scores (n=60)

Parameter	Group T (n=30)	Group L (n=30)	P-Value
Diabetes mellitus	4.2 ± 2.28	6.3 ± 2.51	0.001
Hypertension	4.2 ± 2.28	6.3 ± 2.51	0.001
Obesity	4.2 ± 2.28	6.3 ± 2.51	0.001
Smoker	4.9 ± 2.56	6.5 ± 2.78	0.001

TABLE-IV

Stratified analgesic dosage in Group T versus Group L (n=60)

Parameter	Group T (n=30)	Group L (n=30)	P-Value
Diabetes mellitus	6.81 ± 3.82	9.82 ± 4.84	0.001
Hypertension	6.91 ± 3.76	9.81 ± 4.84	0.001
Obesity	6.91 ± 3.83	9.81 ± 4.83	0.001
Smoker	6.91 ± 3.84	9.81 ± 4.76	0.001

Stratified analysis of the duration of analgesia

showed that patients with diabetes mellitus, hypertension, obesity, or smoking status showed significant differences (p=0.001), with Group T smokers experiencing analgesia for a longer duration (511.6–516.6 minutes) than Group L smokers (289.5–291.7 minutes) (Table-V).

TABLE-V

Stratified duration of analgesia in Group T versus Group L (Yes Responses Only, n=60)

Parameter	Group T (n=30)	Group L (n=30)	P- Value
Diabetes mellitus	511.6±149.41	289.7±68.03	0.001
Hypertension	512.5±149.41	289.7±62.03	0.001
Obesity	516.6±142.41	289.5±65.03	0.001
Smoker	513.9±158.41	291.7±69.03	0.001

DISCUSSION

The gold standard for symptomatic cholelithiasis treatment is laparoscopic cholecystectomy since it is less intrusive and takes less time to recover from. A major issue that impacts patient comfort and recovery following this treatment is postoperative discomfort. To lessen reliance on opioids, speed up recovery time, and lessen the length of hospital stay, effective analgesia is essential.[11,12] An efficient regional anaesthetic method for abdominal procedures is the transversus abdominis plane (TAP) block. Local anesthetic wound infiltration is a conventional method but may provide a shorter duration of analgesia. Comparing the TAP block with local infiltration can help identify the optimal pain management strategy for individuals undergoing a laparoscopic cholecystectomy.[13,14]

Compared to patients in Group L who received local wound infiltration, patients in Group T who had bilateral ultrasound-guided TAP blocks experienced much less postoperative pain, required less analgesic consumption, and had longer durations of analgesia. The average score for postoperative pain in Group T was 4.38 ± 2.35, whereas in Group L it was 6.4 ± 2.58 (p = 0.001). Also, in Group T, the time frame of analgesia was much longer (515.9 ± 150.41 minutes vs 290.7 ± 67.03 mins, p = 0.001), and the mean analgesic demand was 6.89 ± 3.87 mg, in contrast to 9.78 ± 4.78 mg in Group L (p = 0.001). Stratified analysis based on comorbidities such as diabetes mellitus, hypertension, obesity, and smoking status consistently demonstrated that the TAP block provided superior analgesia and reduced rescue analgesic needs across all subgroups. Patients undergoing a laparoscopic cholecystectomy report significantly less postoperative discomfort after using the TAP block, according to these findings.

Our results are similar to those of Hassan et al., who found that periportal local anaesthesia (4.26 ± 1.29, p = 0.033) produced higher mean VAS scores than the TAP block (3.69 ± 1.21), indicating that the TAP block is more effective in relieving pain.[14] In a similar vein, Palijo et al. discovered that an ultrasound-guided TAP block considerably decreased postoperative pain scores, rescue analgesia needs, and increased patient satisfaction; these findings are in line with our own findings of reduced analgesic consumption and longer duration of analgesia in Group T.[14] Grape et al. reviewed ten trials and found that the TAP block was associated with lowered opioid needs, considerably lower resting and moving pain scores relative to wound infiltration, further supporting our study's findings.[17]

Our findings are in agreement with Guo et al. (2015); in comparison to wound infiltration, patients who underwent the TAP block reported much less discomfort 8 and 24 hours after surgery, but no change at 1 hour. Additionally, those who had the TAP block significantly reduced their 24-hour morphine intake. Additionally, subgroup analysis showed greater analgesic benefit in adults than in children. These results support our study, emphasising the importance of the TAP block in multimodal analgesia for better pain relief.[18] Ahmad et al. observed that TAP block patients required fewer rescue analgesic doses at multiple postoperative time points, particularly at 12, 18, and 24 hours, which corresponds with our results showing a prolonged duration of analgesia in Group T.[19] Additional evidence that the TAP block is beneficial in multimodal analgesia comes from Ali et al., who found that patients who had the procedure had lower VAS scores and used less opioids.[20] Finally, Irfan et al. compared subcostal and posterior TAP blocks and concluded that the TAP block provided superior pain relief after the initial hours, mirroring our findings of sustained analgesic effect

with the TAP block versus local wound infiltration.[21]

In terms of mechanics, the TAP block applies a somatic blockade to the nerves of the anterolateral abdominal wall, reducing painful afferent input from the area of surgery. This localized analgesic effect reduces systemic opioid requirements and associated side effects, while providing consistent pain control across diverse patient populations, including those with diabetes, hypertension, obesity, and a history of smoking. Despite these positive outcomes, there are several drawbacks to this research. The study may not have generalisable results due to its limited population and single-center approach. Further, neither the cost-effectiveness nor patient-reported outcomes, such as functional recovery or satisfaction, were assessed. To validate these findings, future multicenter trials should use larger cohorts and longer followup periods.

LIMITATIONS

The research was limited by a small sample size of 60 patients and a single-center design. Only short-term postoperative outcomes up to 12 hours were evaluated. Long-term analgesic efficacy and patient satisfaction were not assessed.

CONCLUSION

When it came to decreasing postoperative pain levels, analgesic requirements, and prolonging the duration of analgesia, the TAP block was determined to be more efficient than local wound infiltration. This approach can improve postoperative recovery and patient comfort. As an additional pain-relieving measure during laparoscopic cholecystectomy, a TAP block may be suggested.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Sana Badar:** Study design, drafting.
2	**Muneeba Arshad:** Data interpretation.
3	**Anum Mughal:** Data analysis.
4	**Sidra Javed:** Review of paper.
5	**Kenza Ahsan:** Critical revisions.
6	**Farjad Sultan:** Proof reading.