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A comparative study to access the impact of TAP block with wound infiltration in laparoscopic cholecystectomy

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ABSTRACT

Background: The transversus abdominis plane (TAP) block and local anesthetic wound infiltration have been used to relieve pain after laparoscopic cholecystectomy. This study investigated whether the subcostal transversus abdominis block was superior to traditional port-site infiltration of local anesthetic in reducing post-operative pain, opioid consumption, and time for recovery. **Aim and Objectives:** To investigated whether the subcostal transversus abdominis block is superior to traditional port-site infiltration of local anesthetic in reducing post-operative pain, opioid consumption, and time for recovery. **Materials and Methods:** All patients were randomly assigned to two equal groups (n = 30) using computer-generated randomization. Patients in Group 1 (TAP group) received a TAP block by administration of 10 mL of 0.5% bupivacaine on each side just before completion of surgery, and patients in Group 2 (local wound infiltration [LWI] group) received 10 mL of 0.5% bupivacaine as a local infiltrate at the local site just before completion of surgery. The pain was measured using a Visual Analog Scale (VAS) at intervals of 30 min to 24 h after the procedure. **Results:** The mean VAS score was significantly lower in group 1 as compared to group 2 at 2 h and 4 h. Whereas the VAS score was not significantly different post-operative 30 min, 6 h, 12 h, and 24 h. The mean first rescue analgesia was significantly more in Group 1 than in Group 2 ($P < 0.001$). **Conclusion:** The TAP block patients had significant VAS scores at 2 and 4 h postoperatively compared to the LWI patients. The TAP group had a significantly longer median time to first emergency analgesia compared to the LWI group, with a higher proportion of patients requiring only one dose of emergency analgesia.

Key words: Analgesia; Laparoscopic cholecystectomy; Peripheral nerve block; Post-operative pain; Wound infiltration

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INTRODUCTION

Laparoscopic cholecystectomy (LC) is an increasingly common minimally invasive treatment performed in the day hospital.[1,2] The incisions on the anterior abdominal wall, which have segmental innervation by nociceptors in the fascial plane of the transversus abdominis muscle between the obliquus internus and transversus abdominis muscles, are one of the main sources of pain after LC.[3,4] The procedure is usually performed under general anesthesia with infiltration of a local anesthetic through the port and additional opioid analgesia, although neuraxial blockade and intraperitoneal irrigation with local anesthetics have been successfully used to reduce opioid use and improve post-operative analgesia.[5,6]

LC, first performed by Mouret in 1987–1988, gained popularity in the 1990s after Dubois presented the first descriptive report in 1989 and Reddick popularized the procedure.[7,8] Laparoscopic surgery, particularly LC,

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has made significant advances in terms of techniques, equipment, and frequency and is now performed using 50 different techniques to improve post-operative surgical and cosmetic outcomes.[9,10]

Laparoscopy is increasingly recognized as the gold standard for benign gallbladder surgery because it allows for a smaller incision, less blood loss, post-operative pain, earlier recovery, shorter hospital stay, and better esthetic results. One of the most common factors affecting patient experience after LC is post-operative pain.[11] After LC, patients often complain of shoulder tip discomfort and abdominal pain. Irritation of the phrenic nerve in the peritoneal cavity and insufflation of the peritoneum with CO_2 are two of the many factors that contribute to post-LC pain.[12]

Various techniques have been used to relieve post-operative pain, such as the use of narcotics, gas drainage, intraperitoneal saline, intraperitoneal local anesthetics, and intraperitoneal opioids. Although these techniques have been shown to significantly reduce pain after LC, most of them have negative side effects or are not consistently effective. Therefore, it remains a challenge to find better methods to treat post-operative pain after LC.[13,14] Options such as peripheral nerve block or wound infiltration have been proposed, especially in situations where intrathecal opioids are contraindicated or general anesthesia is required. Nowadays, a multimodal analgesic approach combining parenteral analgesics with an abdominal nerve block is used for laparoscopic abdominal surgery.[15,16]

A possible regional block for the treatment of post-operative pain after abdominal surgery is the transverse abdominis plane (TAP) block, which is frequently used for post-operative analgesia. This disorder, first reported by Rafi in 2001, is characterized by blockade of the – intercostal, subcostal, ilioinguinal, and iliohypogastric neurons of T7-L1, which innervate the sensation of the anterior abdominal wall.[17] Analgesics are injected into the lateral abdominal wall and between the transverse abdominis (also called TAP) and the internal oblique muscle. The nerves supplying the abdominal wall travel through the TAP, a neurovascular plane that lies between the transverse abdominis and the internal oblique muscles, before reaching the anterior abdominal wall. Therefore, myo-cutaneous sensory blockade occurs when the local anesthetic is applied in this area.[18]

Laparoscopically guided TAP blockade is a simple procedure that carries a low risk of visceral damage, shortens the duration of the procedure, and provides a better analgesic effect after surgery. TAP blockade has been shown to have a more consistent and effective analgesic effect than local wound infiltration (LWI) in a variety of abdominal procedures, even in the early post-operative period, increasing patient satisfaction.[19] Although some studies have shown the superiority of taping over LWI, high-quality information comparing the two techniques is lacking, especially in patients scheduled for LC. The present study was conducted to evaluate the efficacy of tap block with LWI in LC for the treatment of post-operative pain.

Aims and objectives

To investigated whether the subcostal transversus abdominis block is superior to traditional port-site infiltration of local anaesthetic in reducing post-operative pain, opioid consumption, and time for recovery.

MATERIALS AND METHODS

In this prospective randomized comparative study, a total of 60 patients with ASA I and II who met the eligibility criteria were included in the study. Ethical approval was obtained from the Institutional Ethics Committee.

Patients with ASA Grade I-II aged 18–65 years were included in the study. Patients with an allergy to study drugs, infection at the needle insertion site, medications such as adrenoreceptor agonists, digoxin, anticonvulsants or psychotropic substances, body mass index (BMI) >35, requiring mechanical ventilation postoperatively, a history of respiratory, cardiac, hepatic and renal disease, and severe neurological deficits were excluded from the study. The sample size was calculated at the Department of Social and Preventive Medicine, Era's Lucknow Medical College and Hospital, Lucknow, based on the difference in morphine consumption between the study groups as depicted by Guo et al.; transversus abdominis plane block versus local anesthetic wound lnfiltration for post operative analgesia: A systematic review and metaanalysis,[20] using the formula:

$$n = 2 (z\alpha + z\beta)^2 (q^2)/d^2$$

q = 1.82, the SD of difference in morphine consumption between the groups.

D=30% of morphine consumption difference (=3.85).

The minimum difference is considered to the clinically significant.

Type I error (level of significance), a=0.05% Type II error (P)=10%.

Power of study=80%, Considering data loss= 10%.

The minimum sample required size n=30 in each group.

All patients were randomly assigned to two equal groups (n=30) using computer-generated randomization. Patients in Group 1 (TAP group) received a TAP block by administration of 10 mL of 0.5% bupivacaine on each side just before completion of surgery, and patients in Group 2 (LWI group) received 10 mL of 0.5% bupivacaine as a local infiltrate at the local site just before completion of surgery.

Patients underwent a pre-anesthetic examination and received oral anesthesia overnight before surgery. An intravenous cannula was placed and intravenous hydration was initiated. Patients were pre-oxygenated for 3 min and pre-medication was given before induction. Patients undergoing LC were randomized to receive either a TAP block with 0.5% bupivacaine or local infiltration. Post-operative hemodynamics were recorded, and patient demographics, nutritional status, and ASA grade were assessed.

The pain was measured using a visual analog scale (VAS) at intervals of 30 min, 2 h, 4 h, 6 h, 12 h, and 24 h after the procedure. The scores ranged from 0 to 10, with 0 indicating no pain and 10 indicating the most severe pain.

If the pain score was higher than six, rescue analgesia was administered. It was time for the first auxiliary analgesic. The analgesic paracetamol was used as an emergency medication. The total amount of paracetamol taken in the 24 h after surgery was recorded.

If post-operative problems such as bradycardia, tachycardia, headache, nausea, vomiting, pruritus, hypotension, and respiratory depression occurred, they were monitored and documented.

Statistical analysis

The Statistical Package for the Social Sciences (21.0 IBM Inc. in the USA) was used for statistical analysis. Data were presented in the form of numbers and percentages to represent frequency distributions and in the form of mean and standard deviation to represent central tendency and variance. The Chi-square tests and t-tests for independent samples were performed for comparison. A "P" <0.05 indicates a statistically significant relationship.

RESULTS

The present study was conducted to investigate the efficacy of TAP block and wound infiltration in LC with regard to post-operative analgesic requirements. To this end, a prospective, randomized, controlled trial was conducted in which 60 patients scheduled to undergo LC were recruited and randomly assigned to one of two groups. The first group received TAP blockade by administration of 10 mL of 0.5% bupivacaine on each side just before the completion of the operation. The second group received 10 mL of 0.5% bupivacaine as a local infiltrate on each side just before the completion of surgery. Demographic and anthropometric characteristics such as age, gender, BMI, and ASA grades were comparable between group 1 and group 2 (Table 1).

Systolic, diastolic, and arterial blood pressure, heart rate, and respiratory rate were measured and recorded as follows: 74.80±8.17 bpm, 12.73±0.98/min, 118.33±13.67 mmHg, 72.00±11.86 136 mmHg, and 87.37±11.97 mmHg in Group 1 and 76.37±7.77 bpm, 12.80±1.00/min, 121.00±12.13 mmHg, 75.67±10.06 mmHg, and 90. Although Group 2 had higher values than Group 1 for each of these measurements, the difference between the two groups was not statistically significant for any of these values (P>0.05). Therefore, the two groups were statistically matched for baseline data, demographics, and hemodynamic profile before observation began (Table 2).

After the 30-min procedure, none of the patients in either group reported feeling any discomfort. After 2 h, the mean pain scores for rGoups 1 and 2 were 0.87±0.86 (median 1) and 1.73±0.58 (median 2), respectively. This means that the VAS values of Group 2 were significantly higher than those of Group 1 (P<0.001). The mean pain scores after 4 h were 2.77±1.41 (median 2) and 4.13±0.97 (median 4) for Groups 1 and 2, respectively.

The difference between the two groups was statistically significant. The mean pain scores of Group 1 after 6, 12, and 24 h were 3.77±1.10 (median 4), 1.93±0.91 (median 2), and 1.00±0.832 (median 1), respectively. In contrast, the mean pain scores of Group 2 at the same time intervals were 3.63±1.40 (median 3), 2.33±1.16 (median 2.5), and 1.40±0.97 (median 1.5). Statistically, the difference between the two groups was not significant (Table 3). In 2 (6.7%), 16 (53.3%), and 12 (40%) patients in Group 1 and in 21 (70%), 9 (30%), and 0 (0%) patients in Group 2, the first rescue analgesia was administered after 4, 6, and 8 h. In Group 1, the mean time for the first rescue dose was 6.67±1.21 h, whereas in Group 2, it was 4.60±0.93 h. Consequently, the administration of the first rescue analgesia took significantly longer in Group 1 than in Group 2 (P<0.001) (Table 4).

DISCUSSION

Inter-fascial blocks in particular have significantly improved the treatment of post-operative pain after

Table 1: Demographic and anthropometric characteristics of the patients in two study Groups

Variable	Group 1 (n=30)	Group 2 (n=30)	Statistical significance
Mean age±SD (range) in years	38.53±9.78 (24–56)	37.90±11.07 (19–60)	t=0.235; P=0.815
Sex (%)			
Male	6 (20.0)	6 (20.0)	χ^2=0.000; P=1.000
Female	24 (80.0)	24 (80.0)	
Mean BMI±SD (range) (kg/m²)	22.37±2.46 (18.7–26.8)	22.75±2.65 (19.2–29.0)	t=−0.570; P=0.571
ASA Grade (%)			
Grade I	24 (80.0)	20 (66.7)	χ^2=1.364; P=0.243
Grade II	6 (20.0)	10 (33.0)	

BMI: Body mass index

Table 2: Between-group comparison of hemodynamic parameters

Hemodynamic parameters	Group A (n=30)		Group B (n=30)		Student "t" test	
	Mean	SD	Mean	SD	"t"	"P"
Heart rate (beats/min)	74.80	8.17	76.37	7.77	−0.761	0.450
Respiratory rate	12.73	0.98	12.80	1.00	−0.261	0.795
Systolic BP	118.33	13.67	121.00	12.13	−0.799	0.427
Diastolic BP	72.00	11.86	75.67	10.06	−1.291	0.202
Mean arterial pressure	87.37	11.97	90.67	10.07	−1.155	0.253

BP: Blood pressure

Table 3: Between-group comparison of pain (VAS) at different time intervals

Time interval	Group 1 (n=30)			Group 2 (n=30)			Mann-Whitney U test	
	Med	Mean	SD	Med	Mean	SD	Z	"P"
30 min	0	0.00	0.00	0	0.00	0.00	0.000	1.000
2 h	1	0.87	0.86	2	1.73	0.58	−3.784	<0.001
4 h	2	2.77	1.41	4	4.13	0.97	−3.554	<0.001
6 h	4	3.77	1.10	3	3.63	1.40	−0.809	0.419
12 h	2	1.93	0.91	2.5	2.33	1.16	−1.242	0.214
24 h	1	1.00	0.83	1.5	1.40	0.97	−1.837	0.066

VAS: Visual analog scale

Table 4: Between-group comparison of time of first rescue dose

Variables	Group 1 (n=30)		Group 2 (n=30)		Total (n=60)		P-value
	No.	%	No.	%	No.	%	
4 h	2	6.7	21	70.0	2	38.3	<0.001
6 h	16	53.3	9	30.0	25	41.7	
8 h	12	40.0	0	0.0	12	20.0	
Mean time for first rescue dose±SD	6.67±1.21		4.60±0.93		5.63±1.50		<0.001

laparoscopic surgery. These ultrasound (USG)-guided blocks are becoming increasingly popular as they are less invasive, cause less blood loss, and require shorter hospital stays. On the other hand, discomfort after surgery often hinders acceptance and increases hospital costs. Various techniques are used to treat pain, for example, opioids, local anesthetics, and opioids, although the question of efficacy and adverse effects remains. New, highly effective techniques may improve patient comfort and experience.

The study investigated LWI with TAP blocking for the treatment of post-operative pain in patients undergoing LC. Sixty patients were assigned to either the TAP block or LWI group in a prospective, randomized, controlled trial to evaluate the efficacy of the two procedures in the treatment of post-operative pain. In clinical research, randomized controlled trials are essential for evaluating the efficacy of drugs. However, they must be free of confounding elements. This is a challenge with living beings such as humans due to their unique characteristics. Since the researchers have no control over the allocation of participants, statistical matching is used instead of identical matching.

The study examined patients aged 19–60 years with a mean age of 38.53 and 37.90 years, respectively. The majority

were female (80%). A statistical match was found for age and gender, BMI, and ASA grade. In contrast to previous studies, which showed different patient profiles, this study showed better agreement for age and gender. Both studies showed high concordance among patients, and 75% of patients were female.

The study was limited to the first 6 h after surgery and focused on the post-operative pain evaluation of TAP and LWI. As previous studies have shown no discernible differences between the experimental groups beyond 6 h, this is the first study to evaluate the effects of the experimental medications for up to 24 h. The secondary outcome of the study was to measure the total dose of analgesic consumption over a 24-h period.

While there was no discernible difference between the two groups during the 1-h post-operative interval, the meta-analysis by Guo et al., showed that the TAP block had greater pain relief during the 8- and 24-h post-operative intervals.[20] Although in the current study, the data could only be followed for 6 h, we discovered a significant difference between the two groups 2 h after surgery, demonstrating the superiority of TAP block over LWI. However, in the study by Siriwardana et al., no significant difference in pain scores was found between the two groups at 6-h postoperatively, with the TAP participants reporting significantly higher pain scores than the LWI group. In contrast to the current study, where patients undergoing TAP blockade did not receive LWI at the connection site, in their study TAP blockade was administered in addition to LWI; however, they still found that TAP blockade increased pain scores rather than providing further pain relief.[21]

At the 24-h post-operative examination, Arik et al. found that the maximum pain score was reached 1 h after surgery, and the patients with TAP block had much lower pain scores at this time than the patients with LWI block. Furthermore, they did not find a statistically significant difference in pain levels between the two groups until 6 h after surgery. The effective dosage of anesthetic in their study was comparable to ours. In contrast to the 10 mL 0.5% bupivacaine used in this study, they used 20 mL 0.25% bupivacaine in their study.[22]

Limitations of the study

In this study, we have used the analgesic techniques postoperatively only. The pre-operative use would have benefitted the patients in terms of decreasing the intraoperative pain and opioid requirement, thereby benefitting the patient. The TAP block provides only somatic analgesia, but fails to provide analgesia for visceral pain. There is no monitoring of the plasma level of bupivacaine, which could help to reduce local anesthetic toxicity if it occurs and will also help to calculate the minimum effective volume of drugs for TAP block.

Overall patient satisfaction scale assessment was not done which is the ultimate aim of all post-operative analgesic techniques. Further studies are required to show the analgesic efficacy of USG-guided TAP block in various other abdominal surgeries using different local anesthetics at different doses and continuous catheter techniques.

CONCLUSION

In this study, we concluded that the TAP block patients had significantly higher pain and VAS scores at 2 and 4 h postoperatively compared to the LWI patients. The study found that the TAP group had a significantly longer median time to first emergency analgesia compared to the LWI group, with a higher proportion of patients requiring only one dose of emergency analgesia. However, hypertension, bradycardia, tachycardia, and respiratory depression were not noted as side effects in either group. TAP blockade and LWI are safe post-operative analgesic methods, with TAP having lower pain scores and a shorter rescue time, while LWI requires a longer rescue time and dose.

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RK- Definition of intellectual content, prepared the first draft of the manuscript, implementation of the study protocol, literature research; **RK-** Manuscript preparation, data analysis, editing, manuscript revision; **NSB-** definition of intellectual content, editing, manuscript revision; **RV-** Manuscript preparation, editing, manuscript revision; **SDG-** Manuscript preparation, data analysis, editing, manuscript revision, and submission of article

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