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Comparison Of Ultrasound Guided Bilateral Subcostal Transversusabdominis Plane Block And Port-Site Infiltration With Ropivacaine In Laproscopic Cholecystectomy

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Abstract

Introduction: *Laparoscopic cholecystectomy is the preferred technique for gallbladder removal, but postoperative pain remains a concern and impacts recovery. Conventional analgesics alone are often insufficient, highlighting the need for multimodal strategies. Ultrasound-guided subcostal TAP block extends analgesia up to T6 and provides effective coverage of the anterior abdominal wall and peritoneum. It has shown superiority in reducing opioid use compared to standard port-site infiltration, making it a valuable option for postoperative pain control in abdominal surgeries.*

Materials and methods: *After ethical committee approval and informed consent, 60 ASA I–II female patients (18–65 years, 40–100 kg) scheduled for elective laparoscopic cholecystectomy were randomized (computer-generated) into two groups (n=30 each): Group S received bilateral subcostal TAP block with 20 mL 0.25% ropivacaine per side, and Group P received port-site infiltration with 20 mL (5 mL at four sites). Standard ASA monitoring and general anesthesia induced with propofol, fentanyl, succinylcholine, for maintenance isoflurane and intermittent muscle atracurium was used. All patients received IV paracetamol (1 g) intraoperatively and postoperatively every 8 h; IV tramadol (1 mg/kg) served as rescue analgesia (VAS>3). Postoperative pain was assessed using VAS at 1, 2, 3, 6, 12, and 24 h. Outcomes measured were time to first analgesic request, VAS at first request, duration of analgesia, and total 24-h analgesic requirement. Hemodynamic parameters and adverse events (nausea, vomiting, hematoma, bleeding, allergic reactions) were also recorded.*

Results: *Group PI showed significantly higher systolic BP at 1 h ($p=0.004$), 2 h ($p=0.002$), and 6 h ($p=0.002$) postoperatively, with no differences at other times. Diastolic BP was higher in Group PI at 1 h ($p=0.007$) and 2 h ($p=0.002$). Heart rate was higher at 1 h ($p=0.001$) and 6 h ($p=0.019$), while mean arterial pressure was elevated at 1 h ($p=0.003$) and 6 h ($p=0.017$). VAS pain scores were lower in the subcostal TAP group at 1, 2, and 12 h ($p<0.05$), with no differences at other intervals. The mean time to first rescue analgesia was significantly longer in the TAP group (5 h 15 min) compared to port-site infiltration (1 h 10 min). Total rescue analgesic requirement was significantly lower in the TAP group at 6 and 24 h.*

Conclusion: *Ultrasound-guided subcostal TAP block provides longer postoperative analgesia, lower opioid requirement, and better pain control than port-site infiltration in laparoscopic cholecystectomy. It is safe, effective, and enhances recovery without added complications.*

Key words: *Laparoscopic cholecystectomy, postoperative analgesia, subcostal TAP block, port-site infiltration, ultrasound-guided regional anesthesia, ropivacaine, opioid-sparing analgesia*

INTRODUCTION:

Laparoscopic cholecystectomy, a minimally invasive procedure for removal of diseased gallbladder is one of the most common procedures and is also considered as the gold standard for removal of the gallbladder comparing to open, which carries many complications such as bleeding, post-operative pain, bad cosmeses and other problems leading to increased hospital stay and increased expenses [1,2,3].

Although Laparoscopic cholecystectomy is viewed as a minimally invasive procedure, but the need for management of pain postoperatively especially in the early post operative period is really essential as the pain ranges from Mild to Moderate to Severe following surgery[4].Management of this pain not only provides relief to the patient but also enables early mobilization, decreases the post-operative complications, also prevents the

stress response, reduced hospital expenses and improved cosmesis which overall leads to early discharge and patient satisfaction.

As the pain and discomfort after laparoscopic cholecystectomy can be multifactorial ,which were not as effectively managed with the use of NSAIDS and Opioids ,hence we require a multimodal approach. Most commonly as per the literature ,the approach for performing Transverse Abdominal Plane block(TAP) using an ultrasound machine for laparoscopic cholecystectomy is the classical or posterior approach, which provide analgesia between T10 to L1 dermatome[5] as compared to subcostal transverse abdominis plane block which was chosen to accomplish the extent of this block till T6 dermatome [6].Using Ultrasound for Subcostal Transverse abdominal plane block(TAP) to deposit the Local Anaesthetic in the plane between the transversus abdominis and posterior sheath of the rectus muscle around the subcostal region which anesthetizes the anterior cutaneous branches of the lower intercostal nerves (T7-T11) which provide unilateral analgesia to the skin, anterior abdominal wall muscles, and parietal peritoneum . Subcostal TAP block has shown effectiveness in reducing perioperative opioid use in elective abdominal surgeries[7], including open appendectomies[8], caesarean sections[10], and laparotomies[9]. Utilizing point-of-care ultrasonography during abdominal blocks can enhance the safety and success of these procedures.

MATERIALS AND METHODS:

After approval by institutional ethical committee and written informed consent, 60 Female patients classified as American Society of Anaesthesiologists (ASA) physical status I and II, aged between 18 - 65 years and with a weight of 40-100kg, scheduled for elective laparoscopic cholecystectomy, were recruited and randomized into two groups of 30 each using computer generated random number chart in our randomised controlled trial. Each patient was provided with information about the study, and written informed consent was taken.

A) **Group S** – Bilateral Subcostal TAP block with 20ml of 0.25% Ropivacaine
B) **Group P** - Port-site infiltration with 5ml of 0.25% Ropivacaine on four sites, to a total of 20ml.

ASA monitors were attached and baseline vital parameters like electrocardiogram, non-invasive blood pressure (NIBP), temperature, pulse oximetry and capnography was noted. All patients received Tablet Alprazolam 0.5mg +Tablet Ranitidine 150mg orally a night before proposed surgery. An intravenous dose of 1 mg midazolam is administered just prior to induction of anaesthesia . Intravenous induction is achieved using propofol (2 mg/kg) and fentanyl (2 μg/kg). Succinylcholine 1.5 mg/kg after which, patient is intubated with a cuffed Endotracheal tube of appropriate size. Anaesthesia maintained with oxygen, nitrous oxide and isoflurane and muscle relaxation facilitated with an intravenous bolus of atracurium at 0.5 mg/kg. Vitals signs maintained stable throughout intraoperative period. 1gm Paracetamol intravenously given at the beginning of the surgery to all patients. At the end of surgery before extubation , Either port-site local infiltration or an ultrasound-guided bilateral subcostal TAP block administered to the patients. The operating surgeon administered 20 mL of 0.25% Ropivacaine for port-site infiltration, distributing 5 mL at each of the four sites: umbilical, epigastric, midclavicular, and anterior axillary ports on the right side. Ultrasound-guided TAP block helps in clearly demarcating the anatomy it also increases the margin of safety and so helps in deposition of the anaesthetic under vision increasing the success rate and reducing the volume of drug required for effective blockade[33].Bilateral subcostal TAP block under ultrasound-guidance was performed by the attending experienced anaesthesiologists with 20 mL of 0.25% ropivacaine on each side using LOGIQ E GE Ultrasound. Postoperative follow-up were conducted independently, without involvement from the anesthesiologists or surgeons who performed the block. Intravenous paracetamol (1 g) given to all patients at 8-hour intervals in the postoperative period. Injection tramadol 1 mg/kg intravenous bolus was used as rescue analgesia[11-12]. VAS(Visual analogue scale) for pain was assessed serially at 1, 2, 3, 6, 12 and 24 hr after surgery. Rescue analgesics administered when VAS >3. Time for first analgesic request and VAS at first analgesic request recorded. Analgesia duration measured from the moment the block is given until the patient either reports pain or presents a VAS >3 at regular evaluation intervals. Rescue analgesic requirements during the first 24 hours tracked. Simultaneously, the incidence of complications—including but not limited to hematoma, active bleeding, nausea, vomiting, and allergic manifestations—were evaluated. Our objectives is to find mean total analgesic requirement in 24 hr and the duration of analgesia. HR, SBP, DBP, SPO2 ,RR is also monitored at 1, 2, 3, 6, 12 and 24 hours postoperatively.

Statistics

$$n = \frac{(Z\alpha + Z\beta)^2 * \sigma^2}{}$$

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d^2

The size of the the effect that is clinically worthwhile to detect *(d)=2.9*

The probability of of falsely rejecting a true null hypothesis(*a*)=0.05,Z*a*=1.96

- The probability of failing to reject a false null hypothesis(β)=0.80,Zβ=0.84
- The standard deviation of the the population being studied(SD or σ)=0.98*

* SD from previous article

$$N= (1.96 + 0.84)^2 \times (0.98)^2 / (0.5)^2$$

N= 30 per group or 30x 2 groups = total 60

Sampling- purposive sampling

Type of study: Randomised controlled trial

DATA ANALYSIS

Descriptive statistics: mean, standard deviation, frequency, and percent

Non-parametric statistics: chi-square test

Parametric statistics: t test-Independent and paired samples, Repeated measure ANOVA

Software: SPSS for Windows version 28

STATISTICAL ANALYSIS:

SPSS version 28 was used for data analysis. Using a student t-test, VAS scores of the two subgroups was compared. Unpaired t-test was used for the statistical analysis of age, weight, surgery duration, and tramadol use. The chi square test was used to examine the relationship between various factors. Chi-square was used to compare patient percentages and frequencies. Statistical significance is defined as a p value < 0.05.

RESULTS

A total of 60 patients completed the study, with 30 patients in each group. Both groups were comparable with respect to demographic variables, ASA physical status, duration of surgery, and intraoperative hemodynamic stability, with no statistically significant differences.

Hemodynamic parameters:

Patients in the port-site infiltration (Group P) demonstrated significantly higher systolic blood pressure (SBP) compared to the subcostal TAP group (Group S) at the 1st (p=0.004), 2nd (p=0.002), and 6th (p=0.002) postoperative hours. No differences were observed at 3, 12, or 24 hours. Similarly, diastolic blood pressure (DBP) was significantly higher in Group P at the 1st (p=0.007) and 2nd (p=0.002) hours, while subsequent measurements showed no significant differences. Heart rate (HR) was also higher in Group P at the 1st (p=0.001) and 6th (p=0.019) hours, with comparable values at other times. Mean arterial pressure (MAP) was significantly higher in Group P at the 1st (p=0.003) and 6th (p=0.017) hours, with no further differences. Overall, hemodynamic stability was better maintained in patients receiving subcostal TAP block.

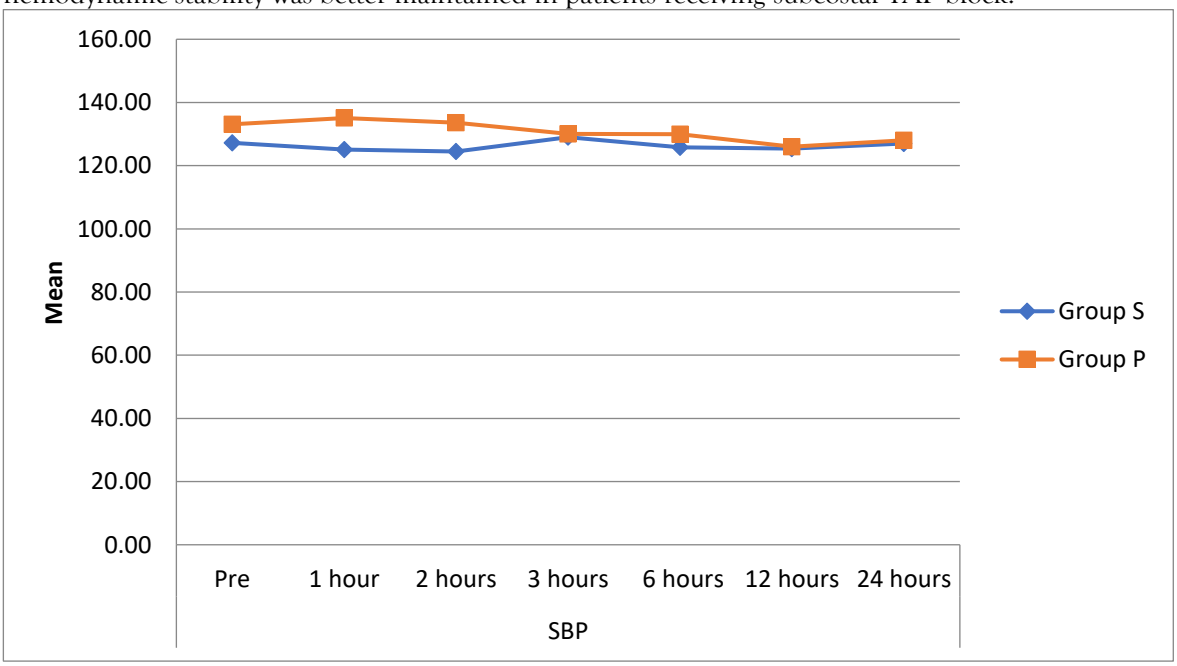

Figure 1: Systolic blood pressure distribution

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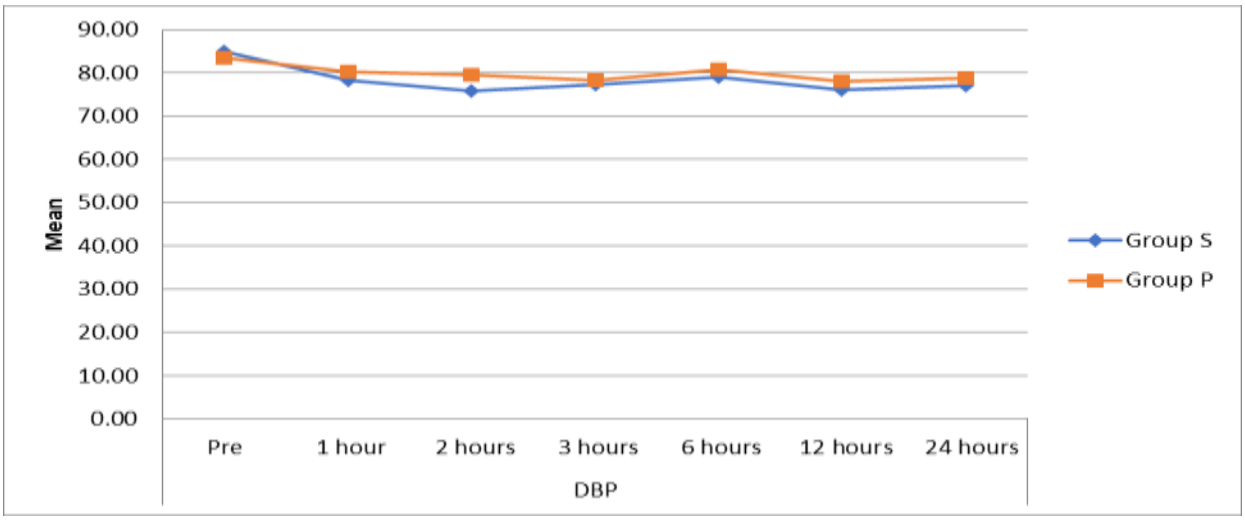

Figure 2: Diastolic blood pressure distribution

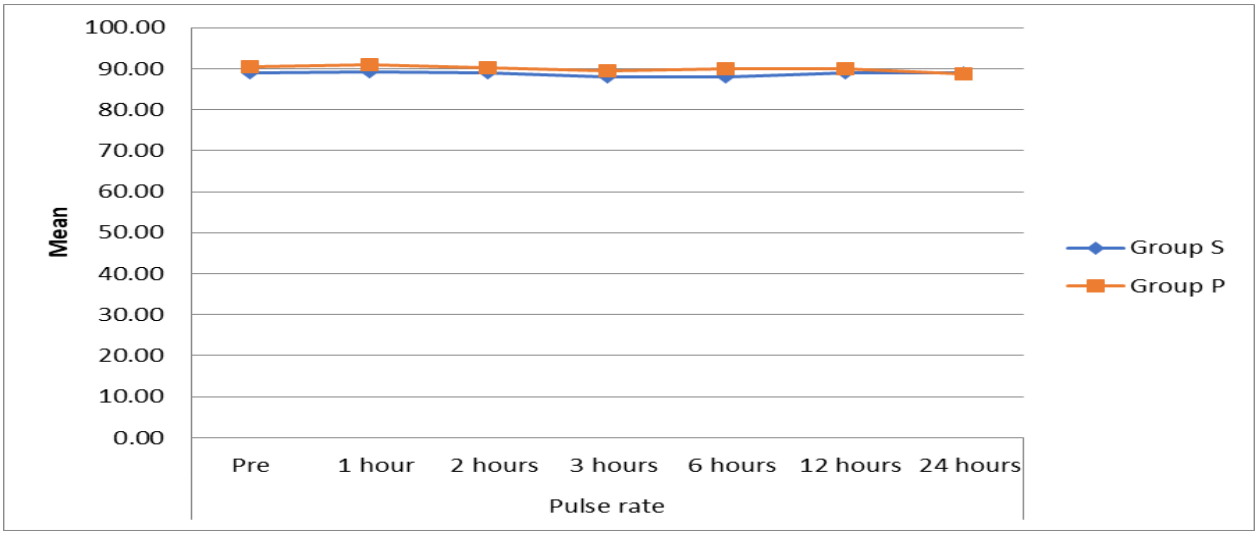

Figure 3: Comparison of Heart rate

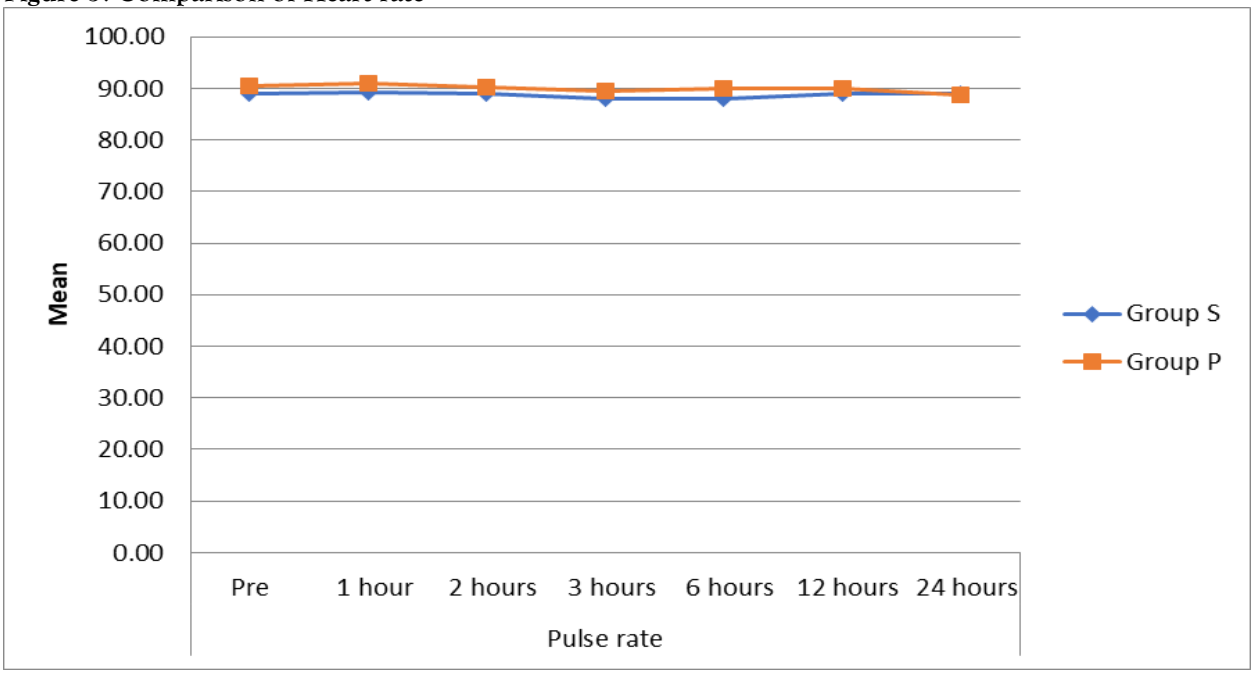

Figure 4: MAP DISTRUBITION

Pain assessment (VAS scores):

Postoperative pain scores measured by the Visual Analogue Scale (VAS) were consistently lower in Group S compared to Group P at several intervals. Significant differences were observed at 1, 2, and 12 hours ($p<0.05$), with Group S patients reporting reduced pain. At 3, 6, and 24 hours, no statistically significant differences were noted between groups.

Table 1: Comparison of VAS Scores Between Group S and Group P

Time (hrs)	Group	N	Mean	Std. Deviation	P value	Significance
1	S	30	2.57	0.568	**0.001**	Significant
	P	30	3.90	0.305		
2	S	30	2.40	0.563	**0.008**	Significant
	P	30	3.50	0.509		
3	S	30	2.73	0.681	0.200	Not Significant
	P	30	2.97	0.750		
6	S	30	3.60	0.770	0.214	Not Significant
	P	30	3.80	0.407		
12	S	30	3.33	0.844	**0.026**	Significant
	P	30	3.73	0.450		
24	S	30	2.77	0.626	0.068	Not Significant
	P	30	3.01	0.305		

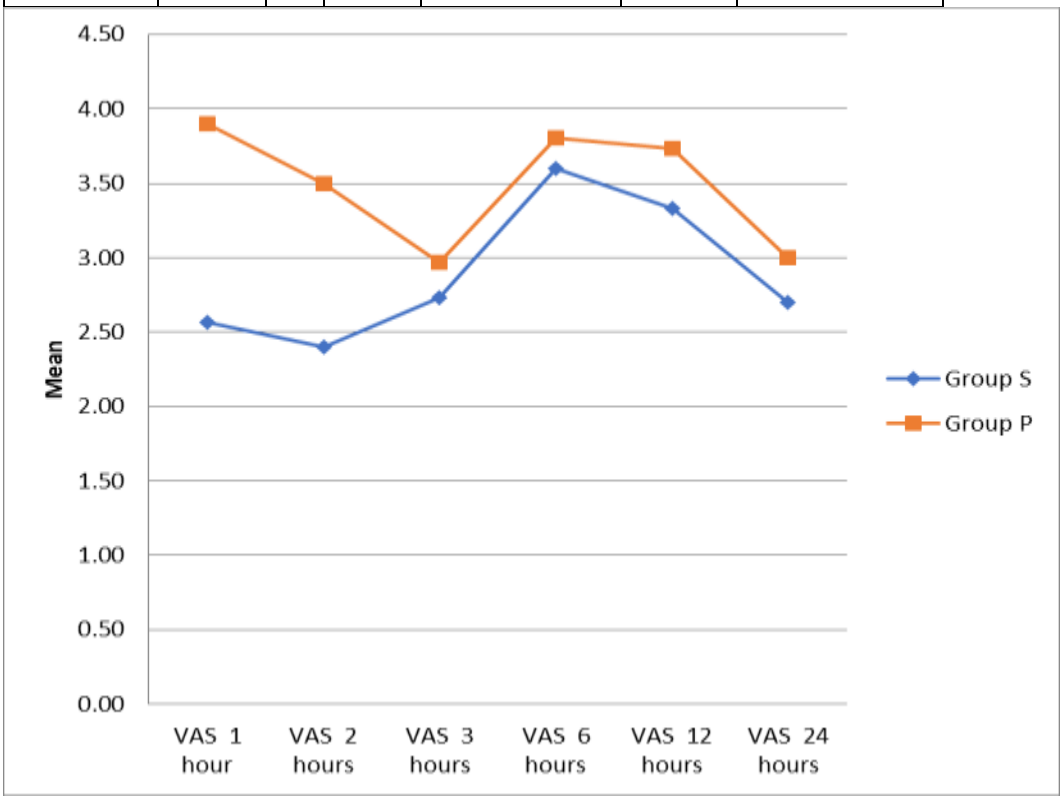

Figure 5: VAS DISTRUBITION

Analgesic requirement:

The mean time to first rescue analgesic request was markedly prolonged in the subcostal TAP block group (5 hours 15 minutes) compared to the port-site infiltration group (1 hour 10 minutes), which was statistically significant. This finding highlights the extended duration of effective analgesia achieved with the TAP block. The mean total rescue analgesic consumption over 24 hours was also significantly lower in Group S, with fewer patients requiring multiple doses of tramadol. In contrast, patients in Group P demonstrated higher and earlier demand for supplemental analgesia, particularly evident at 6 and 24 hours postoperatively, where the difference was statistically significant.

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TABLE 2: Comparison of 1st rescue analgesic time

Groups		N	Mean	Std. Deviation	P value	
Time to first rescue analgesia(Hrs)	Group S	26	5.15	1.64	0.000	Sig
	Group P	30	1.10	0.31		

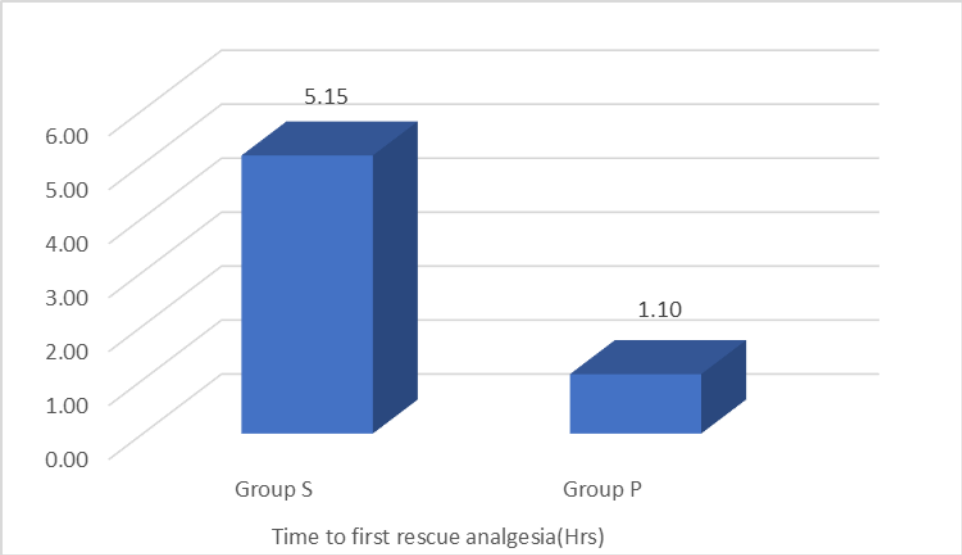

Figure 6: Comparison of 1st rescue analgesic time

TABLE 9: Total dose of rescue analgesic

Parameter	Group	N	Mean	Std. Deviation	P value	Significance
Total dose (mg) – 6 hrs	S	30	46.67	22.49	**0.000**	Significant
	P	30	98.33	9.13		
Total dose (mg) – 24 hrs	S	30	83.33	35.56	**0.000**	Significant
	P	30	141.67	23.06		

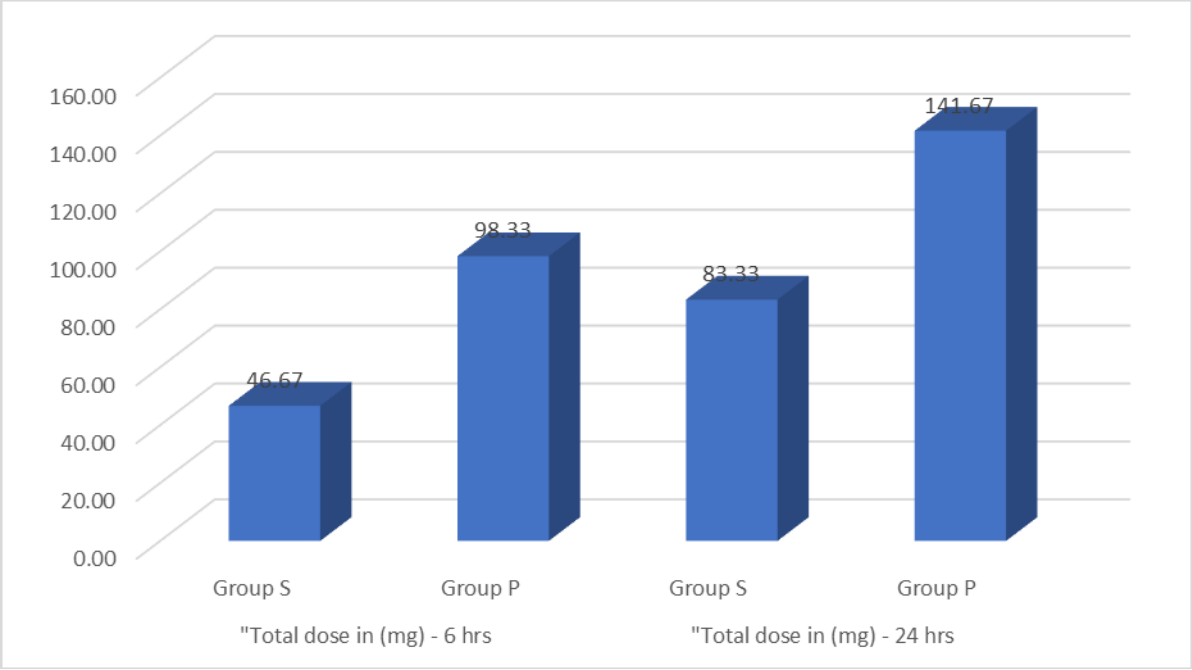

Figure 7: Total dose of rescue analgesic

DISCUSSION

Blocks such as truncal blocks have become a widely used technique for managing postoperative pain, particularly in abdominal surgeries involving both anterior and posterior approaches. The introduction of ultrasound in anesthetic practice has significantly enhanced the accuracy and effectiveness of these blocks, providing real-time imaging that helps reduce failure rates and minimize toxicity. Effective postoperative analgesia plays a crucial role in ensuring optimal perioperative care.

Truncal nerve blocks offer several benefits, including reduced perioperative stress, improved patient comfort, decreased opioid consumption, fewer side effects, and a lower need for additional pain relief following elective laparoscopic cholecystectomy.

Results and Comparison with Previous Studies

A study by Indususeela et al. (2018)[13] used 20 mL of 0.25% bupivacaine for bilateral subcostal TAP blocks along with 5 mL of 0.5% bupivacaine at each of the four port sites. Pain was assessed using the Numerical Rating Scale (NRS) at 1, 2, 3, 6, 12, and 24 hours. They found pain scores consistently lower in the TAP block group, except at the 1-hour mark. In our study, significant reduction in pain was observed only for 5 hours postoperatively.

Mukherjee et al. (2016)[15] administered a mixture of bupivacaine (0.5%) and lignocaine (2%) with adrenaline for subcostal TAP block. They reported that 63% of TAP patients had pain scores below 3 for up to 18 hours, compared with only 17% of the placebo group for 12 hours. The addition of adrenaline may explain the longer duration compared to our study, where relief lasted 5 hours. Tolchard et al. (2012)[14] recorded VAS at 1, 4, and 8 hours and showed significant reduction for 8 hours, which was slightly longer than our findings.

Time to First Rescue Analgesia

In our study, the mean time to first rescue analgesia was:

- Group S (TAP block): 5 h 15 min
- Group P (Port-site infiltration): 1 h 10 min ($p = 0.000$)

Indususeela et al.[13] reported a longer mean duration (8.5 h vs 4.8 h), while Beena et al. (2013) also found delayed analgesic need with ultrasound-guided TAP block (547 min vs 49 min), likely due to larger drug volume and higher concentration.

Total Rescue Analgesic Dose

In our study:

- At 6 hours: Group S used 46 mg tramadol vs 96 mg in Group P
- At 24 hours: Group S used 83 mg vs 141 mg in Group P

Both were statistically significant. Beena et al. (2013)[16] similarly reported lower tramadol use in TAP patients (103.8 ± 32 mg vs 235.8 ± 47.5 mg). Tolchard et al. (2012)[15] found a 50% reduction in rescue use in the first 8 hours, and Indususeela et al.[13] also noted significantly less requirement in TAP patients.

Hemodynamic Variables and Safety

No prior studies compared hemodynamic changes directly. In our study, Group P had higher SBP at 1, 2, and 6 hours; DBP at 1 and 2 hours; and HR at 1 and 6 hours compared to Group S. MAP remained comparable except at 1 hour. No complications such as bleeding, hematoma, or allergic reactions were observed.

Safety and Complications

No complications related to peritoneal or visceral puncture were observed in our study. However, Farooq M. & Carey M. (2008)[17] reported a case of liver trauma caused by a blunt regional anesthesia needle during a TAP block. To minimize risks, proper anatomical knowledge, ultrasound guidance, and safe injection techniques are essential. Using ultrasound for real-time confirmation of needle position has shown great potential in reducing complications.

CONCLUSION

Ultrasound-guided subcostal TAP block for laparoscopic cholecystectomy provides longer postoperative analgesia and significantly reduces opioid requirements compared to port-site infiltration. It is a safe, effective, and reliable technique that enhances recovery and patient comfort without added complications.

Recommendations

Clinical practice:

Subcostal TAP block should be considered the preferred analgesic technique in laparoscopic cholecystectomy. It offers superior pain relief, reduced opioid use, and prolonged analgesic duration compared to port-site infiltration. Ropivacaine may be advantageous over bupivacaine due to its lower cardiotoxicity and better

sensory–motor profile. Ultrasound guidance improves accuracy and safety, supporting its integration into multimodal pain management strategies.

Further research:

Larger studies across diverse populations and different surgical procedures are required to confirm these findings. Future work should also explore long-term outcomes, patient satisfaction, and the role of varying anesthetic combinations in enhancing recovery.

Limitations

- The study assessed only short-term outcomes; long-term efficacy and complications were not evaluated.
- Only female patients were included, limiting generalizability across genders.
- The study population was relatively homogenous, restricting applicability to broader patient groups.
- The small sample size may reduce external validity.

Despite these limitations, the study contributes valuable evidence supporting the clinical use of ultrasound-guided subcostal TAP block over port-site infiltration in laparoscopic cholecystectomy

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