Original Article

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Ultrasound Guided versus Peripheral Nerve Stimulator Guided Transversus Abdominis Plane Block for Postoperative Analgesia in Patients undergoing Laparoscopic Cholecystectomy: A Randomised Clinical Study

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ABSTRACT

Introduction: The Transversus Abdominis Plane (TAP) block is a relatively simple technique that provides analgesia that, as part of a multimodal analgesic treatment, may be useful in the prevention of postoperative pain. Ultrasound (USG) versus Peripheral Nerve Stimulator (PNS) guided TAP blocks are being frequently given postoperatively for pain these days in laparoscopic cholecystectomy.

Aim: To assess the analgesic efficacy of USG guided and PNS guided transversus abdominis plane block in patients undergoing laparoscopic cholecystectomy.

Materials and Methods: The randomised clinical study was conducted in the Department of Anaesthesiology, Shyam Shah Medical College, Rewa, Madhya Pradesh, India, from March 2020 to June 2021. Total 90 adult patients were enrolled and randomly allocated into three groups. Group 1 (n=30) received bilateral USG guided TAP block with 20 mL of 0.375% ropivacaine along with standard postoperative analgesia regimen. Group 2 (n=30) received bilateral PNS guided TAP block with 20 mL 0.375% ropivacaine along with standard postoperative analgesia regimen. Group 3 (Control) (n=30) received standard postoperative analgesia regimen consisting of inj. paracetamol iv 1 gm (six hourly) and inj. diclofenac 75 mg i.v. (12 hourly). Each patient was assessed for VAS score, duration of analgesia, total analgesic consumption and patient satisfaction for 24 hours postoperatively.

Results: The average mean VAS score in first 24 hrs was 2.04±0.80 in group 1, 2.10±0.70 in group 2 and 3.18±0.63 in group 3. The duration of analgesia was least in group 3 (5.8±2.31 hrs) followed by group 2 (9.67±2.47 hrs) and maximum in group 1 (11.87±2.97 hrs). The total tramadol requirement in first 24 hours postoperatively was 126.67±44.98 mg in group 1, 140±62.15 mg in group 2 and 226.67±63.97 mg in group 3.

Conclusion: Postoperative analgesia with USG and PNS guided TAP block enables better pain control and less analgesic consumption. PNS guided TAP block is good alternative when compared with control for postoperative analgesia when USG machine is not available.

Keywords: Duration of surgery, Pain control, Rescue analgesic, Satisfied

INTRODUCTION

Postoperative pain is universal phenomenon, which is aggravated by associated muscle spasm and visceral distension. Anaesthesiologists have succeeded in numbing the patient's pain during surgery to a large part, but once the procedure is through, the patient must endure the agony of postoperative pain.

The effect of postoperative pain is largely psychological, causing distress and anxiety therefore most obvious motive, for relieving is on humanitarian grounds. Postoperative pain relief reduce the incidence of pulmonary complications like hypoxaemia, hypercarbia, retention of secretions, atelectasis and pneumonia and allows early movement in bed and early ambulation, thus preventing deep vein thrombosis. It will thus reduce the average postoperative hospital stay and reduce some burden on the health care delivery system.

Laparoscopic cholecystectomy is a major surgical procedure that results in substantial postoperative pain and discomfort. These patients required a multimodal postoperative pain control regimen that provides high quality analgesia with minimal side effects. Opioids, such as morphine, administered via a Patient Controlled Analgesia (PCA) device, continue to be the cornerstone of postoperative analgesic regimes for patients who have undergone laparoscopic cholecystectomy. Opioids, on the other hand, can cause serious side effects such as drowsiness, nausea and vomiting [1-3].

Although, various alternative modalities are available for postoperative analgesia such as epidural catheter placement, opioids administration, wound infiltration with local anaesthetics, Transversus Abdominis Plane (TAP) block but they are associated with noticeable complications. For example: epidural catheter placement for postoperative analgesia requires significant care, frequent "top-ups" with local anaesthetics and may be associated with local anaesthetic toxicity [4]. Likewise postoperative opioid administration is associated with higher incidence of nausea, vomiting, pruritis, respiratory depression and delayed ambulance [1-3]. There is also small evidence to hold up the use of instillation of local anaesthetics into the wound incision for postoperative pain relief. On the contrary, TAP block is a single shot technique and has negligible side effects but still provides a substantial period of postoperative analgesia.

The TAP block is a regional anaesthetic method that offers analgesia to the parietal peritoneum, as well as the skin and muscles of the anterior abdominal wall. Many authors have used TAP block effectively for postoperative pain relief [5-8].

There are three main approaches for TAP block i.e., anatomical landmark-based approach double pop technique, double pop technique with PNS guided confirmation and USG guided technique. In majority of the studies, ultrasound was used for TAP block [9-12]. Only in a few studies, "double pop" technique was used to give

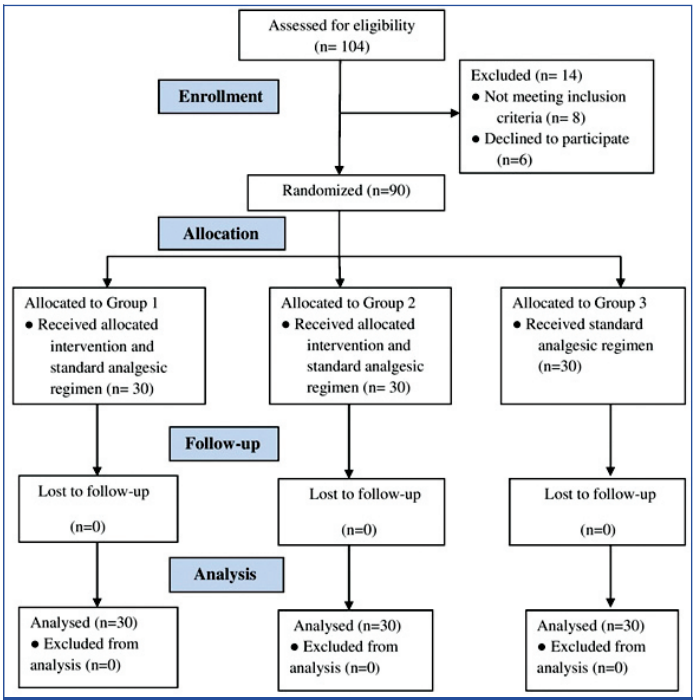
TAP block [5,6]. This is particularly significant in context of India, where most operating rooms lack the availability of USG machine because of the Preconception and Prenatal Diagnostic Techniques (PCPNDT) act and other stringent laws. Hence, there is an inertia regarding adoption of TAP block into clinical practice because of high failure rates associated with the anatomical landmark based "double pop" approach. In such scenario, use of peripheral nerve stimulator can be an effective option for confirming the placement of the needle in transversus abdominis plane. Therefore, the aim of the present study was to assess the analgesic efficacy of USG guided and anatomical landmark-based approach (double pop technique) with PNS guided TAP block in laparoscopic cholecystectomy.

MATERIALS AND METHODS

This randomised clinical study was carried out in the Department of Anaesthesiology, Shyam Shah Medical College, Rewa, Madhya Pradesh, India, from March 2020 to June 2021. The ethical clearance was obtained by the Institutional Ethics Committee (Approval number: IEC/SS/MC/2020/4225 dated February 28, 2020). The study was performed in accordance with the guidelines of the Declaration of Helsinki.

Inclusion and Exclusion criteria: Ninety adult patients with the American Society of Anaesthesiologists (ASA) grades I and II, posted for laparoscopic cholecystectomy were selected for the study. Patients who refused to give consent for the study, psychological disorders, allergy to local anaesthetics and patients who had infection at the block site were excluded from the study.

Patients fulfilling the selection criteria were randomised using computer-based randomisation software in three groups, each of 30 patients [Table/Fig-1].



[Table/Fig-1]: Consolidated Standards of Reporting Trials (CONSORT) diagram.

Group 1: Received bilateral USG guided TAP block with 20 mL of 0.375% ropivacaine along with standard postoperative analgesia regimen.

Group 2: Received bilateral PNS guided TAP block with 20 mL 0.375% ropivacaine along with standard postoperative analgesia regimen.

Group 3 (Control): Received standard postoperative analgesia regimen consisting of inj. paracetamol intravenous 1 gm (six hourly) and inj. diclofenac 75 mg intravenous (12 hourly).

A detailed history of all selected patients was taken. A thorough preanaesthetic evaluation including the airway assessment was performed. The patients were explained about the entire procedure and informed consent was taken. They were also educated about the use of Visual Analogue Scale (VAS) and patient's satisfaction scale.

Study Procedure

The patients were shifted to the operation theatre. Monitors were attached and preoperative baseline parameters viz heart rate, systolic and diastolic blood pressure, mean arterial pressure, SpO_2 and electrocardiographic tracings were observed and carefully recorded. After preoxygenation with 100% oxygen for three minutes, anaesthesia was induced with a standard anaesthetic protocol using fentanyl 2 mcg/kg, propofol 1.5-2.5 mg/kg and tracheal intubation with appropriate sized cuffed endotracheal tube was facilitated by atracurium 0.5 mg/kg. Anaesthesia was maintained with nitrous oxide (60%) and isoflurane {Minimal Alveolar Concentration (MAC) 0.8-1.2)} in oxygen. The intra-abdominal pressure was maintained at around 12 mmHg in all patients throughout the procedure.

At the end of surgery, after assuring full asepsis, TAP block was given either by anatomical landmark-based approach with PNS guided confirmation or by USG guided.

USG guided transversus abdominis plane block: The USG guided TAP block was performed using a midaxillary approach, under real time guidance with a high frequency ultrasound probe (Mindray DC30). On reaching this plane, the local anaesthetic solution was injected, which lead to expansion of the TAP, that appeared as a hypoechoic space. Careful aspiration was performed before injection to exclude vascular puncture. After confirming negative aspiration of blood, 20 mL of 0.375% ropivacaine was administered on each side in all group (US-TAP) patients.

PNS guided TAP block: An insulated 20 gauge, 17 degree bevelled loco plex needle of length 50 mm was used to conduct a bilateral TAP block using an anatomical landmark-based technique (double pop-up) with PNS guided confirmation. By stimulating the subcostal nerve contractions of the transversalis and rectus muscle can be elicited. Direct stimulation of the muscles can be ruled out by using a low intensity current (≤0.5 mA). After confirming negative aspiration of blood, 20 mL of 0.375 % ropivacaine was administered on each side in all group (PNS-TAP) patients.

At the end of surgery, residual neuromuscular block was reversed by using neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg intravenously and patients were extubated when respiration was sufficient and were awake to be able to follow commands.

Patients were transferred to the Postanaesthesia Care Unit (PACU) after the operation. A standard postoperative analgesic regimen consisting of inj. paracetamol 1 gm i.v. six hourly and inj. diclofenac (75 mg/mL) 1 mL diluted in 100 mL normal saline i.v. 12 hourly was commenced on admission to PACU in all the patients. The presence and severity of pain was assessed systematically. This assessment was performed in the PACU at 0, 2, 4, 8, 12, 18 and 24 hours after TAP block. All patients were asked to give scores for their pain at rest. Pain severity was measured using a VAS. A VAS is a measurement tool that attempts to assess a trait or attitude that is thought to range throughout a continuum of values but is difficult to measure directly [13].

The score is calculated by measuring the distance (mm) between the "no pain" anchor and the patient's mark on a 10 cm line with a ruler, yielding a range of 0-100. A higher score implies that the pain is more intense. The following cut points on the pain VAS have been recommended based on the distribution of pain VAS scores in postsurgical patients who described their postoperative pain intensity as none, mild, moderate, or severe: no pain (0-4 mm), mild pain (5-44 mm), moderate pain (45-74 mm) and severe pain (75-100 mm). If the VAS score for the patient was ≥4, even after the administration of institutional postoperative analgesic regimen, intravenous tramadol at an incremental dose of 2 mg/kg was given as rescue analgesia. The time to first dose of rescue analgesic given was recorded. The total consumption of tramadol over 24 hours was also noted.

STATISTICAL ANALYSIS

Result was analysed using Graph Pad Prism version 7.0. Data for continuous variable was presented as Mean±SD and the categorical variables were presented as frequency and percentage. Independent t-test/ Mann-Whitney U-test were done to compare the continuous variables based on the distribution of data. Chi-square and Fisher's-exact test was done to check the association between two categorical variables. The p-value <0.05 was considered as statistically significant.

RESULTS

The three groups were comparable with respect to their age, sex, weight, height and duration of surgery without any statistically significant difference [Table/Fig-2].

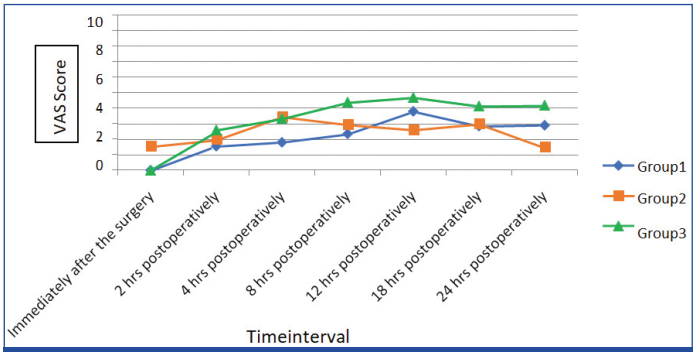
Variables	Group 1 (Mean±SD)	Group 2 Mean±SD)	Group 3 Mean±SD)	p-value (Group 1 vs 2)	p-value (Group 2 vs 3)	p-value (Group 1 vs 3)
Age (years)	36±13	38±14	38±11	0.644	0.983	0.589
Height (cms)	152±6	148±9	148±10	0.056	0.872	0.082
Weight (kgs)	52±7	52±9	52±5	0.823	0.921	0.91
Males/ Females	24/6	23/7	21/9	0.653		
Duration of surgery (mins)	45.17±10.38	46±11.48	46±12.32	0.769	0.872	0.673

[Table/Fig-2]: Demographic characteristics of patients and surgical data.

The VAS score was statistically significantly higher (p-value <0.0001) in group 3 than the groups 1 and 2 throughout the period of observation [Table/Fig-3,4]. The average mean VAS score in first 24 hours was 2.04±0.80 in group 1, 2.10±0.70 in group 2 and 3.18±0.63 in group 3.

VAS score	Group 1 (Mean±SD)	Group 2 Mean±SD)	Group 3 Mean±SD)	p-value (Group 1 vs 2)	p-value (Group 1 vs 3)	p-value (Group 2 vs 3)
Immediately after surgery	0	0	0			
After 2 hrs	1.53±0.68	1.57±0.73	2.6±0.62	0.855	<0.0001	<0.0001
After 4 hrs	1.8±0.85	2±0.59	3.33±0.08	0.292	<0.0001	<0.0001
After 8 hrs	2.33±1.15	3.4±1.17	4.37±0.72	<0.0001	<0.0001	0.001
After 12 hrs	3.77±1.28	2.97±1	4.4±0.92	0.009	0.002	<0.0001
After 18 hrs	2.82±0.87	2.63±0.72	4.13±0.73	0.337	<0.0001	<0.0001
After 24 hrs	2.9±0.88	3±0.91	4.17±0.83	0.668	<0.0001	<0.0001

[Table/Fig-3]: Comparison of mean VAS score between the groups.



[Table/Fig-4]: Comparison of mean VAS score between the groups.

Time of first request to rescue analgesic for group 1, group 2 and group 3 showing that there is the significant difference between all three groups with (p-value <0.005).

Total tramadol requirement in first 24 hours postoperatively was higher in group 3 as compared to group 1 and group 2 which was statistically significant (p-value <0.0001) while between the group 1 and group 2 difference was statistically insignificant [Table/Fig-5].

Parameters	Group 1 (Mean±SD)	Group 2 Mean±SD)	Group 3 Mean±SD)	p-value (Group 1 vs 2)	p-value (Group 1 vs 3)	p-value (Group 2 vs 3)
Time to first rescue analgesia (in min)	11.87± 2.97	9.67± 2.47	5.8± 2.31	0.003	<0.0001	<0.0001
Total analgesic requirement (in mg)	126.67± 44.98	140± 62.15	226.67± 63.97	0.345	<0.0001	<0.0001

[Table/Fig-5]: Comparison of analgesic requirements between the groups.

The [Table/Fig-6] shows that none of the patients were highly dissatisfied in group 1 and group 2 as compare to group 3. The highly dissatisfied patients were in group 3. The difference in the patient satisfaction score between groups is statistically significant (p-value <0.0001).

Patient satisfaction scale score	Group 1 n (%)	Group 2 n (%)	Group 3 n (%)	p-value
Highly satisfied	15 (50)	11 (36.7)	-	<0.0001
Satisfied	11 (36.7)	12 (40)	6 (20)	
Neither satisfied nor dissatisfied	3 (10)	5 (16.7)	6 (20)	
Dissatisfied	1 (3.3)	2 (6.6)	14 (46.7)	
Highly dissatisfied	-	-	4 (13.3)	
Mean±SD	20±22.12	20±17.81	20±17.01	

[Table/Fig-6]: Patient satisfaction score.

DISCUSSION

Postoperative pain in laparoscopic cholecystectomy is a conglomerate of three different and clinically separate components: incisional pain (somatic pain) visceral pain (deep intra-abdominal pain), and shoulder pain (presumably referred visceral pain [12]. Characteristically, the pain following laparoscopic cholecystectomy is highly variable in intensity and duration and is largely unpredictable. So, it is an essential task to provide adequate postoperative analgesia.

It was found that the average of mean VAS score in first 24 hours was lowest in ultrasound guided TAP group when compared to peripheral nerve stimulator guided TAP and control groups. Similar results were shown by Aveline C et al., who found that median VAS pain scores at rest were lower in the ultrasound guided TAP group as compared to blind ilioinguinal/iliohypogastric nerve (IHN) block with levobupivacaine at four hours (11 vs 15, p-value=0.04), at 12 hours (20 vs 30, p-value=0.0014), and at 24 hours (29 vs 33, p-value=0.013) [14].

Peng K et al., who concluded that as compared with control, ultrasound guided TAP block reduced the postoperative pain intensity both at rest and on movement at 0, 2, 4, 8, and 24 hours [15]. Kahsay DT et al., showed that VAS scores were significantly lower in the TAP block group (PNS guided) at rest, deep breathing, intentional coughing and mobilisation as compare to control group receiving conventional analgesia (p-value <0.05) [16].

In the present study, difference between group 1 and 3, 2 and 3, and 1 and 2 were statistically significant (p-value <0.05) and findings were in concordance with the studies of Mankikar MG et al., who found that time for first rescue analgesia in study group was prolonged from 4.1 hours (control) to 9.53 hours (USG TAP) p-value <0.01631 [17]. Khedkar SM et al., noted the time to rescue analgesia was more in the group who received USG guided TAP block (7.22 hours) as compared to the group who received blind (6.80 hours) block (p-value <0.05) [18].

Oak S et al., found that time for first rescue analgesia was prolonged significantly in the USG guided TAP block group (group U) (18.88±6.18 hours) as compared to the anatomical landmark guided TAP block group (group A) (8.38±2.58 hours) p-value <0.05 [19]. The total analgesic requirement in first 24 hours postoperatively was lowest in USG TAP group when compared to PNS TAP and control groups. Similar result was shown in the

study of Niraj G et al., who used morphine as rescue analgesic, found that USG guided TAP significantly reduced postoperative morphine consumption in first 24 hours 28±18 mg vs 50±19 mg (p-value=0.002) [20].

Belavy D et al., found that total morphine use in 24 hours was reduced in the bilateral USG TAP group with 0.5% ropivacaine (median 18.0 mg) when compared with the placebo group bilateral USG TAP with 0.5% saline (median 31.5 mg, p-value <0.05) [21]. Bharti N et al., observed in their study, 65% decrease in 24 hour total morphine consumption was observed in the TAP group compared with the control group (p-value <0.0001) [22].

In the present study, patient's satisfaction score was assessed at 24 hours after surgery, using a 5-point patient's satisfaction scoring system to evaluate the level of postoperative analgesic satisfaction. Patients who received USG guided and PNS guided block had high level of satisfaction than those who received only standard analgesic regimen.

Limitation(s)

The postoperative pain, which is a subjective experience and can be difficult to quantify objectively. The disadvantage of TAP block is the inability to block visceral pain, which can be substantial. The other major limitation is dermatomal limitation of block. The study was conducted in a single centre.

CONCLUSION(S)

This study concluded that postoperative analgesia with USG and PNS guided TAP block enables better pain control, less rescue analgesia consumption and less adverse event than control group who underwent laparoscopic cholecystectomy. USG guided TAP block, was better in reducing postoperative VAS score and rescue analgesia consumption than PNS guided TAP block.

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