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Comparison of Analgesic Efficacy of Ultrasound Guided Subcostal Transversus Abdominis Plane Block with Port Site Infiltration Following Laparoscopic Cholecystectomy

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ABSTRACT

Background: Patients have significant pain following laparoscopic cholecystectomy. Several modalities have been used to manage this pain. Subcostal transversus abdominis plane (TAP) block is one of the components of multimodal analgesia and has been described as an effective technique for postoperative pain management. This study compares the impact of subcostal TAP block with port site local infiltration following laparoscopic cholecystectomy for postoperative pain and opioid consumption.

Methods: This is a prospective, randomized, interventional study. Sixty patients were enrolled and divided into two groups having 30 patients in each group. Group A received bilateral ultrasound guided subcostal TAP block with 10 mL of 0.25% bupivacaine after the completion of surgery. Group B received similar amount of local anesthetic infiltrated over all the laparoscopic port sites. Pain at rest and on movement was assessed using VAS scale in post-operative period at 0 min, 30 min, 2, 4, 6, 12 and 24 hours. Time of first rescue analgesic requirement and total opioid consumption over 24 hours were recorded.

Results: Patients receiving Subcostal TAP block had reduced postoperative pain as compared to port site infiltration and statistically significantly in first two hours after surgery. The 24 hours opioids consumption was significantly less ($125\text{mg} \pm 25.42$ versus $175\text{mg} \pm 25.42$, $p < 0.001$) in Subcostal TAP block group. Time for request of first rescue analgesic was prolonged in patients receiving the Subcostal TAP block (3.20 ± 0.84 hours vs 1.70 ± 0.65 hours, $p < 0.001$).

Conclusions: Ultrasound guided bilateral Subcostal TAP block provides effective post-operative analgesia and reduces opioid consumption in patients undergoing laparoscopic cholecystectomy.

Keywords: Laparoscopic cholecystectomy; post-operative analgesia; subcostal TAP block.

INTRODUCTION

Laparoscopic cholecystectomy is a minimally invasive surgery however patients experience a significant amount of pain in post-operative period. Adequate pain management permits early mobilization, decreases postoperative complications, prevents the stress response and allows early hospital discharge.¹⁻⁶

Pain following laparoscopic cholecystectomy is multifactorial. It can be due to carboperitoneum, hepatic bed disturbances, peritoneal stretching and port site incision. Various modalities have been used to alleviate pain such as intravenous opioids, patient-controlled analgesia, local infiltration, thoracic epidural block and non-steroidal anti-inflammatory drugs. These modalities are found to be insufficient to control such pain; hence a multi-modal approach should be employed.⁶⁻⁷

Ultrasound guided subcostal TAP block is an effective component of multimodal analgesia and a well-established approach for postoperative pain management. It blocks the thoracolumbar intercostal nerves of anterior abdominal compartment by introducing local anaesthetics.⁸⁻¹¹ So, this study is designed to compare the postoperative analgesic efficacy of subcostal TAP block with port site infiltration in patients undergoing elective laparoscopic cholecystectomy.

METHODS

This is a prospective, randomized, interventional study, carried out at a tertiary care hospital of Nepal. After ethical clearance from Institutional Review Board, 60 patients of American Society of Anesthesiologists Physical Status (ASA-PS) I and II of either sex, aged 18-60 years, scheduled to undergo elective four port

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laparoscopic cholecystectomy under general anaesthesia were enrolled. Patients with a history of allergy to local anaesthetics, psychiatric illness, substance abuse and opioid dependent were excluded from the study.

Detailed pre-anesthetic evaluation was done a day prior to surgery and written informed consent was taken. In preoperative assessment, patients were educated regarding the visual analog scale (VAS) in which 0 means no pain and 10 representing the worst imaginable pain. Patients were kept nil per oral for 8 hours prior to surgery. On the day of surgery, in operation theatre intravenous access was open with 18G cannula. All the patients received general anaesthesia with standard ASA monitoring. Anaesthesia was induced by fentanyl (2 mcg/kg), propofol (2 mg/kg), and vecuronium (0.8 mg/kg). Maintenance was done with oxygen, isoflurane, intermittent dose of vecuronium and positive pressure ventilation. All patients received injection paracetamol 1 gm immediately after induction. Injection ondansetron 4 mg was given after removal of gall bladder as a prophylactic antiemetic.

After the end of surgery, patients were randomly divided into two groups having 30 patients in each; by using a computer generated random numbers. Group A received ultrasound guided subcostal TAP block. A linear array ultrasound probe with a 6-13 MHz frequency (Micromaxx™ Sonosite, Inc., Bothell, WA 98021, USA) was used. Under aseptic precautions the transducer was placed 2 cm below the xiphisternum and parallel to the costal margin, and then moved along the subcostal edge to identify the neuro-fascial plane between rectus abdominis and the transversus abdominis muscle. Once these structures were identified Colour Doppler was used to see any vessels in the direction of needle insertion. A 22 G × 100 mm needle (Stimuplex needle B-Brown, Germany) was introduced in-plane 2-3 cm lateral to the transducer, under direct ultrasound visualization, 1-2 ml of solution was injected in the neurofascial plane between rectus abdominis muscle and the transversus abdominis muscle. After confirming the correct placement of the needle and the negative aspiration, the rest of the local anaesthetic was injected (10 ml 0.25% bupivacaine). The block then performed on the opposite side using an identical technique and with similar volume of local anaesthetic. The ultrasound guided Subcostal TAP block was performed by consultant anesthesiologist sufficiently experienced (performing > 50 subcostal TAP blocks before). The Group B received 20 ml of 0.25% Bupivacaine infiltrated locally in all the four laparoscopic port sites.

After completion of the surgical procedure and

emergence from anaesthesia, patients were shifted to the post-operative ward. Injection Paracetamol 1 g 6 hourly was given as postoperative analgesic in both groups. The severity of pain assessment was done using VAS scale postoperatively at 0 minutes, 30 minutes, 1, 2, 4, 6, 12 and 24 hours. All patients were asked to give scores for their pain at each time point. VAS at rest and on movement (on coughing and/or flexing the knees) was recorded. At any point of time if VAS score is ≥ 4 , injection pethidine 0.5 mg/kg was given intravenously. Time to first pethidine requirement and total pethidine consumption over 24 hrs were recorded.

Postoperative vomiting was managed with injection ondansetron 4 mg intravenously and recorded. At all the time points, patients were monitored for any signs of Local anaesthesia (LA) toxicity, and the sites of injection of the Subcostal TAP block had inspected to detect haematomas or local infections.

The sample size estimation was based on mean VAS score at 2 hours from a previous study,⁸ where patients received subcostal TAP block following laparoscopic cholecystectomy. Taking confidence interval of 95% and power of study as 80%, the calculated sample size was 30.

Data entry was done in EpiData Manager Version 4.2 and statistical analysis was performed by using IBM SPSS version 20. Age, weight, duration of surgery, total 24 hours Pethidine requirement, the VAS score for pain and the time to first opioids analgesic consumption were compared by independent Student's T-test. Gender, ASA grade, proportion of patients having PONV compared by using Chisquare test. p-value of < 0.05 was considered as significant.

RESULTS

All the sixty enrolled patients had completed the study. Both groups were comparable in terms of age, gender, body weight, ASA-PS and duration of surgery (Table 1).

Table 1. Demographic data.

| Variables | Subcostal TAP Block (n=30) | Port Site Infiltration (n=30) | p-value |
|----------------------------|----------------------------|-------------------------------|---------|
| Age(yrs) | 42.47±14.41 | 45.93±14.34 | 0.35* |
| Gender (M/F) | 11/19 | 8/22 | 0.40† |
| Weight (Kg) | 62.98±7.45 | 63.03±8.5 | 0.94* |
| ASA-PS (I/,II) | 21/9 | 22/8 | 0.77† |
| Duration of surgery (mins) | 77.17±32.23 | 73.00±15.57 | 0.54* |

* Values are given as mean ± standard deviation; † Chi square test

The VAS scores at rest are shown in figure 1. The subcostal TAP block receiving patients had lower VAS scores but statistically significant only in the initial two hours postoperatively.

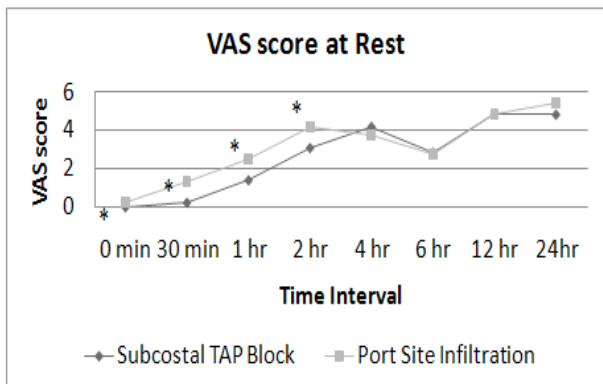


Figure 1. VAS score at Rest. *indicates significantly lower VAS score (p <0.05).

However, VAS scores at movement (figure 2) was found statistically significant only up to one hour postoperatively in patients receiving subcostal TAP block.

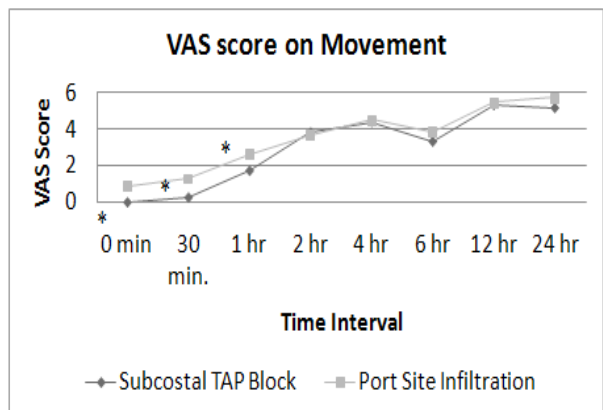


Figure 2. VAS score on movement. *indicates significantly lower VAS score (p <0.05).

Time for request of first rescue analgesia was significantly prolonged (p <0.001) in patients receiving subcostal TAP block. The overall 24 hours opioids consumption was significantly less (p <0.001) in patients with Subcostal TAP block (Table 2).

Table 2. Analgesic consumption.

| Variables | Subcostal TAP Block (n=30) | Port Site Infiltration (n=30) | p-value |
|---------------------------|----------------------------|-------------------------------|---------|
| Total opioids consumption | 125±25.42 | 175±25.42 | <0.001 |

| | | | |
|---|-----------|-----------|--------|
| Time for 1 st request of opioids (hours) | 3.20±0.84 | 1.70±0.65 | <0.001 |
|---|-----------|-----------|--------|

The post-operative nausea and vomiting (PONV) was 4 (13.33) % in the TAP block group and 6(20) % in local infiltration group, but it is not statistically significant. Complications like local anesthesia toxicity, local infection or haematoma were not seen during the study period.

DISCUSSION

Postoperative pain management is an essential and important component of postoperative care. Adequate Pain control after surgery permits rapid mobilization, decreases the postoperative complication, better patient satisfaction and allows early hospital discharge. Post-operative pain after laparoscopic cholecystectomy is multifactorial; which can be due to hepatic bed dissection, intraoperative traction, stretching of peritoneal cavity and port site incisions.¹²

The conventional methods of post-operative pain management following laparoscopic cholecystectomy are opioid administration, thoracic epidural analgesia and local anaesthesia infiltration. Opioid administration causes respiratory depression, sedation, nausea vomiting, constipation and delayed hospital discharge.¹³ Thoracic epidural analgesia is difficult to perform and have risk of spinal haematoma or abscess and dural puncture.¹⁴ Recent literatures revealed that multimodal analgesia technique has been used to enhance the analgesic effect. Subcostal TAP block is one of the effective components of multimodal analgesia and a well-established approach for postoperative pain management in abdominal surgeries.^{2,12,15,16}

The subcostal approach is a variation of TAP block that provides effective analgesia in the supraumbilical abdominal surgeries, was described by Hebbard et al.¹⁷ The conventional port site local infiltration is a blind technique that blocks sensory nerves of the anterior abdominal wall. Nevertheless, the degree of block achieved can be unpredictable due to the lack of clearly defined anatomic landmarks, uncertainty of needle positioning, and the local anesthetic being not deposited in the correct anatomical plane. Whereas the ultrasound guided Subcostal TAP block assures the accurate deposition of the local anaesthetics in the precise neurofascial plane and effectively inhibit the sensation of the myocutaneous sensory nerve T6-L1. Present study further confirms the better analgesia with the USG guided subcostal TAP block.

Till date, several studies have addressed this block

technique for post-operative pain management. Ra et al.,¹² Peterson et al.¹⁵ and El-Dawlatly² described that TAP block provided effective postoperative analgesia in laparoscopic cholecystectomy but Ortiz et al.¹⁸ did not find any statistical significance in postoperative pain and analgesic consumption in patients receiving TAP block as compared to port-site local infiltration group. These contradictory results might be justified by differences in their methodology, type of TAP block (subcostal vs posterior approach, blind vs ultrasound guided technique), the timing of the block (before vs after surgery) and the doses of local anesthetics.

This study compared bilateral subcostal TAP block with port-site infiltration and found better analgesia as evidenced by lower VAS scores, delayed request for first rescue analgesia and significantly decreased 24 hours opioids consumption. Shin et al.¹⁶ also demonstrated lower pain scores and decreased opioid consumption in oblique subcostal TAP block as compared to conventional TAP block.

In four ports laparoscopic cholecystectomy, one of the ports would be at the epigastric region for which more anterior block is desirable. The block can be achieved up to the T6 dermatome by using bilateral subcostal TAP block, which can submerge more nerve segments of anterior abdominal wall and increase the area of diffusion providing better analgesic effect. For distal port, after injection of 1- 2 mL of local anesthetic to separate RA and TA muscles, the needle is further advanced under ultrasound guidance laterally which allows for a more lateral spread of the local anesthetic and provides the effective analgesia to the distal port.^{5-7,19,20} This finding was further confirmed by our study.

In present study, the time to request for first rescue analgesia was significantly prolonged in patients receiving subcostal TAP block as compared to port site infiltration (3.20±0.84 hrs, 1.70±0.65 hours, p<0.001). The total opioid consumption in first 24 hours was significantly lower in subcostal TAP block group (125±25.42 vs 175±25.42, p<0.001). Ibrahim et al.²¹ and Shin et al.¹⁶ also found that the total opioid consumption was significantly decreased in first 24 hrs in patients receiving oblique subcostal TAP block. Our findings are comparable with these recent studies.^{21,22}

During the study period no local anesthesia systemic toxicity was noted. This might be due to the use of real time ultrasound and low volume of local anesthetics used. The incidence of nausea and vomiting was found to be less and statistically insignificant. Which might be the result of decreased consumption of postoperative opioids.

CONCLUSIONS

This study concludes that the ultrasound guided bilateral Subcostal TAP block provides better postoperative analgesia and reduces postoperative opioid requirements as compared to port site infiltration. It is safe and effective component of multimodal analgesia for the post-operative pain management in patients undergoing laparoscopic cholecystectomy.

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