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Comparative study on Postoperative Analgesia with Transversus Abdominis Plane block to Local Anesthetic Infiltration with Ropivacaine in Laparoscopic Cholecystectomy

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Abstract

Introduction: Pain is distressing and detrimental in post-operative patients. We compared post operative analgesia provided by the ultrasound guided transversus abdominis plane block to the local anesthetic infiltration of ropivacaine in patients who underwent laparoscopic cholecystectomy.

Methodology: We conducted comparative, interventional study among 100 patients. The patients were randomly assigned into two groups having 50 in each group. The TAP block group received 20 ml of 0.2% Ropivacaine each on bilateral transversus abdominis plane with ultrasound guidance at the end of surgery. For Local infiltration group (n=50), 20 ml of 0.2% ropivacaine was deposited intraperitoneally in the gall bladder bed and under the right crus of diaphragm before abdominal de-sufflation. Local infiltration group also received infiltration with ropivacaine (0.2%) 20 ml total on three port sites. Visual analog scale at rest and movement measured at 2, 4, 8, 12 and 24 hours after intervention was our primary outcome. Secondary outcome measures were duration of analgesia, total pethidine consumption and ketorolac consumption for the first 24 hours postoperative period.

Result: Visual analogue pain score at rest at 2, 4 and 8 hours and on movement at 2 hours and 4 hours was significantly lower in TAP block group compared to Local infiltration group. TAP block group had significant difference in duration of analgesia compared to Local infiltration group (361 vs 153 min, $p < 0.05$). TAP block group also had significantly lower consumption of pethidine and ketorolac during the first 12 hours compared to Local infiltration group ($p < 0.05$).

Conclusion: Transversus abdominis block had lower pain score, increased duration of postoperative analgesia and reduced requirement of rescue drugs in the post operative period compared to combined port site and intraperitoneal local infiltration.

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Introduction

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage.[1] Pain treatment increases speed of recovery, decreases length of stay, reduces hospital costs, increases patient satisfaction, increases productivity and quality of life.[2]

Intravenous opioids have been used for decades for post operative analgesia. Side effects of opioids administration include nausea, vomiting, respiratory depression, constipation, tolerance, sedation, dizziness, physical dependence, and addiction.[3] Administration of local anesthetic in central neuraxial space is an attractive alternative for management of postoperative pain to spare use of opioids. But there are several complications associated with neuraxial blockade which include exaggerated physiological responses leading to hypotension, bradycardia, high neural blockade, urinary retention, and cardiac arrest.[4] Peripheral nerve blockade or field block with local anesthesia is helpful in managing postoperative pain effectively whilst avoiding complication associated with intravenous narcotics or neuraxial blockade.[5]

The Transversus Abdominis Plane (TAP) block is used to anesthetize and provide analgesia to the abdominal wall. The potential space between the two abdominal muscles contains the anterior rami of the lower six thoracic nerves (T7 to T12) and first lumbar nerve (L1) which supply the abdominal muscles and skin. The thoracic nerve T7 to T9 supply the skin above the umbilicus while the thoracic nerve T10 supply the umbilicus. The thoracic nerve T11, T12, ilioinguinal nerve (L1) and iliohypogastric nerve (L1) supply the skin below the umbilicus.[6] Transversus abdominis plane block covers the nerve originating from anterior rami of the lower six thoracic nerves (T7 to T12) and first lumbar nerve (L1).[7] TAP block was first introduced in 2001. Single dose local anesthetic was injected into the plane between the internal oblique and transversus abdominis muscle.[8] The use of ultrasound for TAP block has increased success rate with reduction in complication rates. Over 60% of ambulatory patients undergoing abdominal laparoscopic surgery experience moderate to severe postoperative pain.[9] The aim of this study was to compare the analgesic efficacy of ultrasound-guided TAP block using ropivacaine with local infiltration using ropivacaine at port site and gall bladder bed in patients undergoing laparoscopic cholecystectomy.

Methodology

The ethical approval for the study was taken from the institutional review board of National Academy of Medical Sciences (IRB No. 877-076077). Patients with ASA physical status I or II of either sex aged 25-70 years and posted for elective laparoscopic cholecystectomy were included in the study. Patients with any absolute contraindications to peripheral nerve blockade, uncontrolled diabetes mellitus, hepatic failure, renal insufficiency, neuropathy, myopathy, or psychiatric disease were excluded from the study. Pregnant patients and patients receiving psychiatric drugs were also excluded. We took 100 small similar sized identical papers. Fifty of the papers were labeled as 'TAP block' and the rest were labeled as 'Local infiltration'. Papers were folded with labels inside and kept in a sealed envelope. In the preoperative visit on the evening before surgery, Visual analogue scale (VAS) consisting of 10 cm line with 0 = no pain and 10 = worst possible pain was explained to the patient.

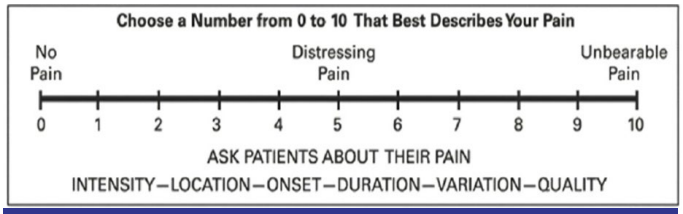

Fig 1: Visual Analogue Scale

All patients received general anesthesia with inj. midazolam 0.03 mg/kg, inj. fentanyl 2 mcg/kg, Inj. propofol 2.5 mg/kg and inj. vecuronium 0.1 mg/kg. Endotracheal intubation was done with appropriate sized endotracheal tube and anesthesia was maintained with isoflurane 1.5%. Any signs of spontaneous breathing or muscle movement intraoperatively were treated with inj. vecuronium 1mg as required. If the surgery extended beyond one and half hours, fentanyl 25 mcg was given every half hour. After completion of surgery, muscle relaxation was reversed with inj. Neostigmine 0.5 mg/kg and inj. glycopyrrolate 0.01 mg/kg. Consecutive patient sampling was done, and eligible patients were randomly allocated to two groups. An anesthesia assistant withdrew one paper from sealed opaque envelope and the allocation of the patient to either the TAP block group or Local infiltration group was done according to label on the paper. At the end of surgery for TAP block group (n=50), sterile painting with 10% betadine solution and draping of the lateral abdominal wall was done on both sides. High frequency ultrasound probe was covered with sterile cover. Then using sterile ultrasound gel, an ultrasound probe was placed transverse to the abdominal wall between the costal margin and iliac crest. We identified the layers of external oblique, internal oblique and transversus abdominis muscle along with the peritoneum and bowel loops which lie underneath the muscles. Then using in plane technique, the 18G, Tuohy needle was advanced through the tissue structures until the tip of the needle was between the plane formed by internal oblique and transversus abdominis muscle. Upon reaching the plane, 3 ml of normal saline was injected to confirm the correct needle position after which injection Ropivacaine (0.20 %) 20 ml on each side was administered. The ultrasound image showing enlargement of hypoechoic space in transversus abdominis plane on injection of ropivacaine confirmed the correct instillment of a drug in the right space. For Local infiltration group, 20 ml of 0.2% ropivacaine was deposited intraperitoneally in the gall bladder bed and under the right crus of diaphragm before

abdominal de sufflation. Local infiltration Group (n=50) also received infiltration with ropivacaine (0.20%) 20 ml total on three port sites. In both groups, pain was assessed with VAS and recorded at 2, 4, 8, 12 and 24 hours after completion of surgery. Duration of analgesia was defined as the time interval between the end of TAP block or local infiltration and the time of first complaint of pain by the patient. At any point of time if VAS was >3, injection pethidine 0.5 mg/kg and injection promethazine 0.25 mg/kg was given via intravenous route. If pain persisted for more than 15 min after giving intravenous pethidine, injection ketorolac 30 mg intravenous was given.

Sample size: Suseela I et al used the numerical rating scale (NRS) consisting of 10 points similar to Visual analogue scale.[13] She compared Transversus abdominis block with local site port infiltration in patients undergoing lap cholecystectomy. The pooled standard deviation (σ) for NRS at two hours was 0.4118. We hypothesized that the minimum difference between the two groups would be 0.25 (d=0.25). We took a confidence level of 95% and power of 80%. Then using the formula $n = (Z_{\alpha/2}+Z_{\beta})^2 * 2*\sigma^2 / d^2$, we calculated the sample size of 43 in each group. Considering the possible 10% dropout, we required 50 patients in each group.

Statistical analysis: Continuous variables were expressed as mean ± standard deviation while categorical variables were expressed as frequency and percentage. Continuous variables were compared between the two groups using independent sample student t test while chi square test was used to compare the categorical variables. When more than 20% of the contingency cell contained expected frequency less than 5, fisher's exact test was used for categorical variable. P value < 0.05 was taken as statistically significant. All the analysis was done with SPSS version 25.

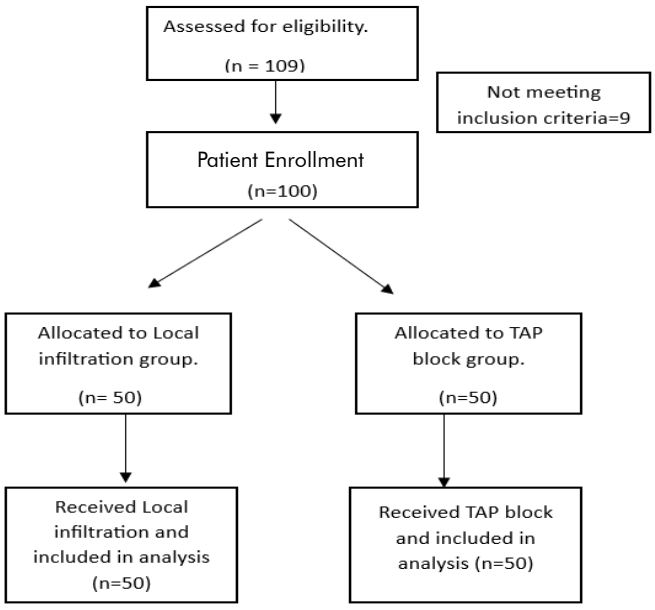

Fig 2: Flow chart of a study.

Results

There was no significant difference in the distribution of age, sex, weight, and ASA grade between the two groups.

Table 1: Demographic data of the patient

Variables	TAP block group (n=50)	Local infiltration group (n= 50)	P value
Age (years) mean +/-SD	38.5 ±5.6	41.2 ± 7.2	0.08
Sex Male/Female	33/17	29/21	0.40
Weight (kg) mean +/- SD	58.3 ±9.7	54 ±10.6	0.07
ASA I/II	39/11	35/15	0.36

ASA: American society of anesthesiologist classification.

We observed that 6 (12%) out of 50 patients in the TAP block group required rescue analgesia in the first 6 hours while 42 (84%) out of 50 patient required rescue analgesia in the Local infiltration group which was significantly different between the two groups (p < 0.001). VAS at rest was significantly lower in the TAP block compared to Local infiltration group at 2 hours, 4 hours and 8 hours. There was no significant difference in VAS at rest after 8 hours between the two groups. VAS on movement was significantly lower in the TAP block group at 2 hours and 4 hours. There was no significant difference in VAS on movement between the two groups after 4 hours.

Table 2: Visual analog scale at rest

VAS (Hour)	TAP block Group (mean± SD)	Local infiltration group (mean ± SD)	P value
2	0.08 ±0.01	1.09 ±1.19	<0.001
4	0.45 ±0.87	3.91 ±2.36	<0.001
8	3.34 ± 2.69	4.34 ±2.67	0.02
12	3.72 ±2.74	3.98 ±3.10	0.13
24	2.45 ±1.96	2.28 ±2.1	0.18

VAS: Visual analog scale

Table 3: Visual analog scale on movement

VAS (Hour)	TAP block group (mean ± SD)	Local infiltration group (mean ± SD)	P value
2	0.08 ±0.02	1.21 ±1.03	<0.001
4	0.78 ±0.90	3.97±2.73	<0.001
8	4.56±2.90	4.66±2.41	0.43
12	5±1.34	4.22±2.07	0.06
24	2.60±1.84	2.09±2.05	0.12

VAS: Visual analog scale

Time to first rescue analgesia was 361±72 min in TAP block

group and 153 ±21 min in Local infiltration group which was statistically significant (p< 0.001). There was a significant difference in pethidine and ketorolac consumption between the two groups during the first 12 hours of postoperative period. The TAP block group had significantly lower pethidine and ketorolac consumption. However, there was no significant difference in pethidine and ketorolac consumption between the two groups after 12 hours. The total pethidine and ketorolac consumption over 24 hours was also significantly lower in the TAP block group.

Table 4: Total pethidine consumption in milligram (mg)

Time Interval (Hour)	TAP block group (Mean)	Local infiltration group II (Mean)	P value
0-6	4.80	12.45	<0.001
6-12	11.12	13.06	0.007
12-24	13.05	12.95	0.23
Total in 24 hours	28.97	38.12	<0.001

Table 5: Total ketorolac consumption in milligram (mg)

Time Interval (Hour)	TAP block-Goup(Mean)	Local infiltration group II (Mean)	P value
0-6	2.20	6.60	<0.001
6-12	6.25	15.00	<0.001
12-24	16.50	16.00	0.53
Total in 24 hours	24.95	37.60	<0.001

Discussion

Postoperative pain management is very important for good surgical outcome of the patient. Inadequate pain management in the postoperative period causes sympathetic hyperactivity leading to tachycardia, hypertension, hyperglycemia.[2] Hence cardiac ischemia and heart failure may be aggravated. Hyperglycemia leads to delayed wound healing.[2] Local anesthesia infiltration at the incision site at the end of surgery is an effective way to prevent pain in the post operative period. But it is very difficult to inject the local anesthetic drugs uniformly between the muscle's layers, soft tissue and over length of incision. Such improper drug distribution in the tissue plane may lead to inadequate pain relief in the post operative period. The deposition of local anesthetics under the right diaphragm in the gall bladder bed has also been shown to reduce the severity of post operative pain and pain on deep inspiration. Such deposition was associated with significantly reduced shoulder pain.[10]

Bilateral Transversus abdominis plane block with local anesthetic drugs has emerged as an excellent way of preventing postoperative pain in a patient with abdominal surgery. The pain relief provided with TAP block also has a prolonged duration compared to other modalities of pain management.[11] Arora et al found that VAS at rest was lower in TAP group than control group in post anesthesia care unit at 0, 2, 6 hours similar to our study.[12] But in a study by Arora et al, VAS was also lower at 24 hours in the TAP group compared to our study.[12] We used 0.2% ropivacaine while Arora et al used 0.5% ropivacaine. The difference in concentration of ropivacaine may have shown prolonged effect in a study by Arora et al. Suseela et al found that time to first analgesic in group transversus abdominis plane (TAP) block and group port site infiltration was 510.3 ± 154.55 min (mean ± SD) and 292.7 ± 67.03 min (mean ± SD) respectively.[13] She observed prolonged duration of analgesia in both TAP and local infiltration group compared to our study. Suseela et al used numerical rating scale (NRS) more than 4 as a cutoff point to determine administration of first rescue analgesia while we used VAS > 3 as an indication to administer rescue analgesic. The different pain measurement tools with different cut off points may have resulted in the differences.
Milone et al found that there was significantly lower requirement of rescue analgesia in the TAP group compared to local infiltration group (14% vs. 32 %, p = 0.01) in the first 6 hours.[14] The requirement of rescue drug in TAP group was like our study. But the requirement of rescue analgesia was significantly higher in local infiltration group in our study compared to their study. We had laparoscopic cholecystectomy cases while their group constituted of patients undergoing inguinal hernia repair only. Such dissimilarity between the surgical cases may explain the higher requirement of rescue analgesic in our study.

Conclusion

Transversus abdominis block was found to provide better pain management, pain relief for prolonged period and lower requirement of rescue drugs in the post operative period compared to combined liver bed and port site local infiltration.

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Conflict of Interest: None

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