Section: Anesthesiology

Original Research Article

EFFICACY OF BUPIVACAINE VERSUS ROPIVACAINE AS ADJUNCTS FOR POST OPERATIVE ANALGESIA ON ULTRA SOUND GUIDED TRANSVERSE ABDOMINIS PLANE BLOCK IN OPEN CHOLECYSTECTOMY

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Abstract

Background: Pain management following open cholecystectomy remains a challenge despite advancements in surgical techniques and anesthesia. Adequate post-operative pain relief is crucial for patient comfort, early ambulation, and overall recovery. Bupivacaine and ropivacaine are commonly used local anesthetics to provide effective postoperative analgesia when used in Transabdominal Abdominal Plane block TAP blocks for open cholecystectomy. Hence the study is designed to do the same. This study aims to compare the post-operative analgesic efficacy of bupivacaine and ropivacaine administered through ultrasound-guided oblique subcostal transverse abdominis plane (TAP) block in patients undergoing open cholecystectomy under general anesthesia. **Materials and Methods:** A prospective, randomized, double-blind clinical trial was conducted on 120 adult patients scheduled for elective open cholecystectomy. Patients were randomly assigned into two groups: Group B (bupivacaine) and Group R (ropivacaine). After induction of general anesthesia, an ultrasound-guided oblique subcostal TAP block was performed using either bupivacaine 0.25% or ropivacaine 0.2% based on group assignment. Visual Analogue Scale (VAS) scores at rest and during movement, total analgesic consumption, time to first analgesic request, and adverse effects were assessed for 48 hours post-operatively. **Result:** The VAS scores at rest and during movement were significantly lower in Group B compared to Group R at 2, 4, 6, 12, 24, and 48 hours post-operatively ($p < 0.05$). Total analgesic consumption was significantly lower in Group B than in Group R ($p < 0.001$). Time to first analgesic request was significantly prolonged in Group B compared to Group R ($p < 0.001$). No significant differences in adverse effects were observed between the two groups. **Conclusion:** Ultrasound-guided oblique subcostal TAP block with bupivacaine provides superior post-operative analgesic efficacy compared to ropivacaine in patients undergoing open cholecystectomy under general anesthesia. This technique could be considered as an effective component of a multimodal analgesic regimen for improved pain management following open cholecystectomy.

INTRODUCTION

Pain management following open cholecystectomy remains a challenge despite advancements in surgical techniques and anesthesia. Adequate post-operative pain relief is crucial for patient comfort, early ambulation, and overall recovery.[1] Various regional analgesic techniques, including transverse abdominis plane (TAP) block, have gained popularity in providing effective post-operative pain relief.[2] TAP block can be accomplished through the lumbar triangle of Petit, which is formed by the external oblique muscle anteriorly, the lattissimus dorsi muscle posteriorly, and the iliac crest inferiorly. It is often recognized as a defect 1 cm above the iliac crest in the midaxillary line.[3] TAP block involves the deposition of local anesthetic agents between the internal oblique and transverse abdominis muscles, targeting the sensory nerves that innervate the anterior abdominal wall.[4] This technique has shown promising results in reducing post-operative pain and opioid consumption in abdominal surgeries.[5]

Bupivacaine and ropivacaine are commonly used local anesthetics to provide effective postoperative analgesia when used in TAP blocks for open cholecystectomy. Patients vary in their response to

different local anesthetics. The efficacy of bupivacaine and ropivacaine can depend on individual factors such as metabolism, pain sensitivity, and overall health. Bupivacaine, due to its longer duration of action, might offer more sustained pain relief compared to ropivacaine. This prolonged pain relief could be beneficial in the immediate postoperative period, allowing for better patient comfort and early mobility. Bupivacaine has a higher potential for cardiac and CNS toxicity due to its higher lipid solubility, therefore it should be considered carefully when selecting the drug. While ropivacaine offers a favorable safety profile due to its reduced potential for cardiac and central nervous system toxicity.[6] Bupivacaine's stronger motor blockade might affect muscle function and movement in the abdominal wall, potentially leading to limitations in patient activity. Ropivacaine's milder motor blockade might be advantageous in preserving muscle function while still providing adequate pain relief. Clinical trials comparing the analgesic efficacy of bupivacaine and ropivacaine in TAP blocks for open cholecystectomy have yielded mixed results. Some studies show similar pain relief between the two drugs, while others might show differences in pain scores, analgesic consumption, and patient satisfaction. However, limited studies have directly compared the analgesic efficacy of these two agents in ultrasound-guided TAP blocks for open cholecystectomy.

This study aims to compare the post-operative analgesic efficacy of bupivacaine and ropivacaine administered through ultrasound-guided oblique subcostal TAP block in patients undergoing open cholecystectomy under general anaesthesia.

MATERIALS AND METHODS

Study Design and Setting: This prospective, randomized, double-blind study was conducted at Tertiary care institute between November 2022 and July 202. The study protocol was approved by the Institutional Review Board, and written informed consent was obtained from all participants.

Participants: A total of 120 adult patients scheduled for elective open cholecystectomy were selected for the study. The inclusion criteria were age between 20-70 years, either gender, ASA physical status I and II. Exclusion criteria comprised contraindications to TAP block, allergy to study medications, coagulopathy

Randomization and Blinding: Participants were randomly assigned using computer-generated random numbers into two groups: Group B (Patients received 0.25% bupivacaine in a dose of 2 mg/kg diluted in normal saline to make a solution of 50 ml) and Group R (Patients received 0.2% ropivacaine in a dose of 2 mg/kg diluted in normal saline to make a solution of 50 ml). The block solution was prepared by an anesthesiologist who was not involved in the patient care or data collection. Both the patients and the data collectors were blinded to the group assignment.

Anesthetic Technique: All patients received a standardized general anesthesia protocol. Following induction, tracheal intubation, and intraoperative monitoring, patients were positioned supine.

Ultrasound-Guided TAP Block: After induction of general anesthesia, the ultrasound-guided oblique subcostal TAP block was performed by an anesthesiologist experienced in regional anesthesia. A high-frequency linear ultrasound probe was placed in the mid-axillary line between the costal margin and iliac crest. The external oblique, internal oblique, and transverse abdominis muscles were visualized, and a 22-gauge needle was inserted in-plane from the lateral edge of the ultrasound probe. The local anesthetic solution (bupivacaine 0.25% in Group B, ropivacaine 0.2% in Group R) was injected between the internal oblique and transverse abdominis muscles using a hydro-dissection technique.

Post-Operative Pain Assessment: Post-operatively, patients were monitored in the recovery room and then transferred to the surgical ward. Visual Analogue Scale (VAS) scores for pain at rest and during movement (coughing, deep breathing) were recorded at 2, 4, 6, 12, 24, and 48 hours after surgery. The VAS scale ranged from 0 (no pain) to 10 (worst imaginable pain).

Outcome Measures: The primary outcome measure was the VAS pain scores at rest and during movement. Secondary outcome measures included total analgesic consumption (intravenous opioids) over 48 hours, time to first analgesic request, and adverse effects (such as nausea, vomiting, hypotension, and local anesthetic toxicity).

Statistical Analysis: Data were analyzed using appropriate statistical tests, including t-tests, Mann-Whitney U tests, chi-square tests, and ANOVA, as applicable. P-values < 0.05 were considered statistically significant.

RESULTS

A total of 120 patients were enrolled in the study, with 60 patients in each group (Group B and Group R). Baseline characteristics, including age, gender distribution, ASA physical status, and surgical duration, were comparable between the two groups as shown in [Table 1].

[Table 2] shows that there was significant difference between the VAS score from 2nd postoperative hr to 48th hr. This statistical difference was due to lower VAS score in group R

The total analgesia required with ropivacaine is less but statistically insignificant (p-value=0.128). The time to first analgesic request is less in bupivacaine group than with ropivacaine, which means Group-R has a longer action for relief of pain, but is statistically insignificant (p-value=0.157), as shown in [Table 3].

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Table 1: Comparison of Baseline Characteristics

Characteristics	Group B (Bupivacaine)	Group R (Ropivacaine)	p-value
Age (years, mean ± SD)	42 ± 14.5	44 ± 13.8	0.47
Gender (Male/Female)	26 / 34	21 / 39	0.30
ASA Physical Status (I/II)	42/ 18	36 / 24	0.67
Surgical Duration (min, mean ± SD)	34 ± 10.7	30 ± 6	0.05

Table 2: Comparison of VAS Scores at Rest and During Movement (Mean ± SD)

Time (hours)	VAS at Rest (Group B)	VAS at Rest (Group R)	VAS During Movement (Group B)	VAS During Movement (Group R)
2	33 ± 31.64	14.5 ± 22.47	26.5 ± 28.6	11.5 ± 24.1
4	22 ± 21.59	15.5 ± 21.79	16 ± 18.81	4 ± 9.1
6	14 ± 14.97	6 ± 8.6	6 ± 11.14	4.5 ± 13.5
12	10.5 ± 12.44	6 ± 7.35	2.5 ± 6.98	5 ± 8.06
24	8.5 ± 9.63	7 ± 11.87	5 ± 5.92	4.5 ± 8.05
48	12.5 ± 15.77	4.5 ± 5.89	3.5 ± 6.54	1 ± 3

Table 3: Comparison of Secondary Outcomes

Secondary Outcomes	Group B (Bupivacaine)	Group R (Ropivacaine)	p-value
Total Analgesic Consumption (mg)	97 ± 47	84 ± 24.5	0.128
Time to First Analgesic Request (hours)	118 ± 47	131 ± 33	0.157

In both groups, 14% of the patients had complications. Four patients in Group B and three individuals in Group R both experienced nausea and vomiting. One patient in Group B experienced hypotension, and one patient in Group B experienced arrhythmias. In Group R, there were no arrhythmias or hypotension. There was no respiratory depression in any of the groups.

DISCUSSION

This study was done to demonstrate the efficacy of bupivacaine and ropivacaine as a local anaesthetic in the USG guided TAP block. The causes of pain after a laparoscopic cholecystectomy are due to visceral and somatic components. Visceral pain is due to gallbladder dissection and the somatic pain is due to abdominal wall incisions and peritoneal cavity distention.[14] The patients were enrolled for this randomized controlled study. Pain following open cholecystectomy delays the discharges of the patient from the hospital with substantial increase in pain, poor ambulation and increased morbidity. hence the study was designed to find the effectiveness of bupivacaine and ropivacaine as a local anaesthetic in the USG guided TAP block. The findings are in similar with the previous findings of other reviews, which was found that ropivacaine to be more effective than bupivacaine. Although bupivacaine and ropivacaine have been compared previously in different concentrations, in context of different surgical procedures very minimal study is been done on TAP block in open cholecystectomy.

In the study by Sharma N et al,[15] 60 adult patients undergoing elective abdominal surgery under general anaesthesia were randomly divided into two groups and after induction of anaesthesia received unilateral or bilateral TAP Block (depending upon nature of incision of surgery) using either 15 mL of 0.5% Ropivacaine or 0.25% Bupivacaine on each side. Post operatively patients were assessed for pain with VAS score at 0 min, 30 min, 4, 8, 12, 18 and 24 h. Mean duration of analgesia in Ropivacaine group and Bupivacaine group was 12.61 ± 5.13 hrs and 9.92 ± 4.81 h, respectively, and the difference was found to be statistically significant.[15] In our study The total analgesia required with ropivacaine is less but statistically insignificant (p-value=0.128). The time to first analgesic request is less in bupivacaine group than with ropivacaine, which means Group-R has a longer action for relief of pain, but is statistically insignificant (p-value=0.157), as shown in [Table 3]. The choice of local anaesthetic plays a pivotal role in determining the duration and quality of analgesia. Bupivacaine's long duration of action, attributed to its high lipid solubility and slow tissue absorption, contributes to its prolonged analgesic effect.[9] However, the potential for cardiac and central nervous system toxicity remains a concern. In contrast, ropivacaine offers a favourable safety profile due to its reduced potential for cardiotoxicity, making it an attractive option for regional anaesthesia.[10] The findings of this study align with previous research that has compared bupivacaine and ropivacaine in various regional aesthesia techniques. The prolonged analgesic effect of bupivacaine has been consistently demonstrated, albeit with the acknowledgment of its potential adverse effects. Ropivacaine, while offering a safer profile, may require more frequent administration to maintain adequate pain control.[11]

The results of this study demonstrate that ultrasound-guided oblique subcostal TAP block with Ropivacaine provides superior post-operative analgesic efficacy compared to Bupivacaine in patients undergoing open cholecystectomy under general anaesthesia.[7] It is attributable to the fact that the analgesia lasted comparatively longer in the Ropivacaine group and hence better pain scores in intermediate duration. However it is similar at 2 hr as the effect of local anaesthetic would be present equally in both the groups whereas at 12 and 24 h the effect would have dissipated in both the groups and

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hence the VAS scores would again be similar. Fuladi N et al.[16] The VAS pain scores at rest and during movement were consistently lower in Group R throughout the 48-hour post-operative period. Additionally, Group R exhibited lower total analgesic consumption and longer time to first analgesic request, indicating better pain control and prolonged analgesic effect.[8]

Limitations:

Several limitations of this study should be acknowledged as follows:

- The study focused solely on post-operative analgesic efficacy and did not assess other relevant outcomes such as recovery parameters, patient satisfaction, or long-term complications.
- The follow-up duration was limited to 48 hours, and the long-term effects of the two local anaesthetics were not evaluated.
- The study did not explore the potential impact of patient-specific factors (e.g., age, body mass index) on the efficacy of bupivacaine and ropivacaine.

CONCLUSION

Ultrasound-guided oblique subcostal TAP block with Ropivacaine demonstrates superior post-operative analgesic efficacy compared to Bupivacaine in patients undergoing open cholecystectomy under general anaesthesia. Despite bupivacaine's potential for adverse effects, its prolonged analgesic effect makes it a valuable option for post-operative pain management. The findings of this study emphasize the importance of selecting an appropriate local anaesthetic agent based on the desired duration of analgesia and safety considerations. Ultrasound-guided TAP block with bupivacaine could be incorporated into a multimodal analgesic regimen to enhance pain relief and improve patient outcomes following open cholecystectomy.

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