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Original Research Article

Comparative Study of Transverse Abdominis Plane Block (TAP) with 0.5% Bupivacaine and 0.75% Ropivacaine in the Duration of Post-Operative Analgesia in Lower Abdominal Surgeries

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Abstract:

Background: The Transversus Abdominis Plane (TAP) block is a recently introduced regional anesthesia method utilized for postoperative pain control, with the potential to serve as the primary anesthetic in a growing array of surgical procedures. TAP block enhances postoperative pain management by reducing postoperative visual analog scale scores, opioid requirements, and the time elapsed before the initial administration of rescue analgesia in patients undergoing lower abdominal surgeries.

Aims and Objectives: In our research, we employed the TAP block as the exclusive anesthetic method for elective patients undergoing Lower Abdominal Surgeries. We then compared the effectiveness of two distinct local anesthetics, namely 0.5% Bupivacaine and 0.75% Ropivacaine, in terms of their duration of anesthesia and analgesia as well as their impact on cardiovascular stability.

Materials and Methods: A prospective randomized clinical trial involved 60 patients classified as ASA I and II who met the specified inclusion and exclusion criteria. These patients were divided equally into two groups: Group B, which received an injection of 0.5% bupivacaine, and Group R, which received an injection of 0.75% ropivacaine. The dosage administered did not surpass 2.5 mg/kg body weight for any participant.

Results and Conclusion: Our study revealed that both drugs provide effective anesthesia for Lower abdominal Surgeries while maintaining hemodynamic stability. However, 0.75% Ropivacaine exhibited a significant delay in the onset of anesthesia (13.46 +/- 3.2 min) compared to 0.5% Bupivacaine (7.86 +/- 2.47 min) (P value <0.001). Furthermore, 0.75% Ropivacaine resulted in prolonged postoperative analgesia (675.54 +/- 30.31 min) compared to 0.5% Bupivacaine (573 +/- 45.72 minutes) (P value <0.001). This suggests that the Transversus Abdominis Plane (TAP) block can serve as the sole anesthetic technique for Lower abdominal surgeries.

Keywords: TAP Block, Landmark Technique, 0.5% Bupivacaine, 0.75% Ropivacaine, Lower Abdominal Surgeries.

Introduction

In the context of lower abdominal surgeries, spinal and epidural anesthesia are commonly used methods. However, patients often experience short-lived postoperative pain relief, necessitating additional analgesics such as opioids, NSAIDs, and acetaminophen. To address this issue, various approaches have been explored, including the use of adjuvants with local anesthetics in spinal anesthesia and field blocks.

Recently, the Transversus Abdominis Plane (TAP) block has emerged as a promising alternative technique. The TAP is a defined space between the internal oblique and transversus abdominis muscles, extending from the subcostal margin to the inguinal ligament and iliac crest. During a TAP block, local anesthetic is injected into this space, offering targeted pain relief for abdominal surgeries like emergency lower abdominal procedures particularly in patients with multiple comorbidities. [1] The nerves responsible for sensory and motor innervation of the abdominal wall, including the intercostal nerves (T7-T11), subcostal nerve (T12), and the iliohypogastric and ilioinguinal nerves (L1), enter the Transversus Abdominis Plane (TAP) at various levels. They traverse through this anatomical space to supply different regions of the abdominal wall, including the skin over the upper gluteal region and upper medial part of the thigh. [2]

New York School of Regional Anaesthesia journal, describes how a TAP block can provide anesthesia not only to the parietal peritoneum but also to the

skin and muscles of the anterior abdominal wall by effectively blocking these nerves. TAP block involves the injection of local anesthetics into the transverse abdominis plane, targeting nerves responsible for abdominal wall sensation. However, the choice of local anesthetic agent can significantly influence the duration and quality of postoperative analgesia. Bupivacaine and ropivacaine are two commonly used local anesthetics in TAP blocks, each with unique pharmacokinetic profiles and clinical effects. [3] Bupivacaine, a long-acting local anesthetic, has been widely used for its prolonged analgesic duration. On the other hand, ropivacaine, a newer local anesthetic agent, offers a similar duration of action with potentially fewer adverse effects on motor function and cardiac toxicity compared to bupivacaine. Therefore, a comparative study evaluating the efficacy of TAP block with 0.5% bupivacaine versus 0.75% ropivacaine in the duration of postoperative analgesia in lower abdominal surgeries is warranted to assess the potential benefits and drawbacks of each agent in this clinical setting. Such a study could provide valuable insights into optimizing postoperative pain management strategies for patients undergoing Lower abdominal procedures. [4]

Aim and Objectives

1. To compare the efficacy of Transversus Abdominis Plane (TAP) block using 0.5% Bupivacaine versus 0.75% Ropivacaine in the duration of postoperative analgesia following Lower abdominal surgeries.
2. To evaluate the duration of postoperative analgesia provided by TAP block using 0.5% Bupivacaine and 0.75% Ropivacaine in patients undergoing Lower abdominal surgeries.

Material and Methods

Following the approval from the ethics committee, a cross-sectional study is conducted at Mamata Medical College in Khammam, Telangana. The study is conducted to span a period of one year, commencing from July 2022 to June 2023.

A prospective randomized single-blind study was conducted at our institute, involving 60 patients classified as ASA grade I and II, who were undergoing elective inguinal hernia repair. Ethical approval was obtained from the institutional ethical committee prior to the commencement of the study. Patients were divided into two groups, with 30 patients allocated to each group. Group B received 30ml of 0.5% bupivacaine, while Group R received 30ml of 0.75% ropivacaine. Transversus Abdominis Plane (TAP) block was administered using a blind landmark technique via the Lumbar Triangle of Petit, utilizing a Tuohy's needle.

Patients who declined to provide consent, those classified as ASA grade III and above, individuals with uncontrolled hypertension, arrhythmias, recent myocardial infarction (within the last 6 months), recent coronary artery bypass graft (CABG) surgery, patients with heart block on a pacemaker, irreducible/obstructed scrotal hernia, coagulopathy, liver disease, renal disease, localized infection at the injection or surgical site, or allergy to local anesthetics were excluded from the study. Informed written consent was obtained from eligible participants meeting the inclusion criteria, which included patients classified as ASA grade I and II, aged between 30 and 80 years, and with a body mass index (BMI) less than 30.

Based on a review of existing literature concerning the outcome variable of interest in the present study, a sample size of 60 patients (30 in each group) was determined to achieve a statistical power of 90% with a type I error rate of 5%.

Randomization was conducted using the thick envelope method. Two anesthesiologists were involved in the procedure, with one loading and preparing the drug according to the information contained within the envelope. The other anesthesiologist, who was blinded to the loaded drug, performed the technique and assessed the patients for the required parameters

Electrocardiography, pulse oximetry, and non-invasive blood pressure monitors were connected to monitor the patients' vital signs. An 18G cannula was secured for intravenous access, and a ringer-lactate (RL) infusion was initiated for all patients at a rate of 10ml/kg/hour. Before the procedure, patients received pre-medication with midazolam at a dosage of 0.02 mg/kg body weight. Emergency resuscitation equipment was readily available.

Transversus Abdominis Plane (TAP) block was performed using a landmark technique described by Mc Donnell and others, via the lumbar triangle of Petit. An 18-gauge Tuohy's needle was used to identify the TAP. The needle was inserted perpendicular to the skin just above the highest point of the iliac crest, in the posterior axillary line, where a depression was felt in the Lumbar Triangle Of Petit (LTOP). The needle was gently advanced until a distinct "pop" was felt, indicating penetration of the external oblique fascia. Further advancement of the needle until a second "pop" was felt indicated entry into the transversus abdominis plane. After ensuring proper placement and excluding vascular injury, either 2.5 mg/kg of bupivacaine or 3.0 mg/kg of ropivacaine, up to a maximum of 30ml, was injected into the TAP. The onset of sensory block was recorded as the time elapsed between the end of local anesthetic injection and the loss of sensation above the injection site. The time for complete sensory and

motor blockade (from T10 to L1) was also noted. Hemodynamic parameters were recorded preoperatively (baseline) and every 15 minutes intraoperatively. Postoperative readings were taken every 2 hours until the patient requested the first rescue analgesia. Visual analogue scale (VAS) scores were recorded at the time of requesting rescue analgesia.

Throughout the procedure, all patients remained awake. Postoperatively, tramadol at a dosage of 1 mg/kg was administered as rescue analgesia when requested by the patients. The recorded parameters were compared between the study drugs to assess their efficacy in terms of sensory blockade onset time, complete motor blockade onset time, hemodynamic stability, and duration of analgesia.

Result

Table 1: Distribution of study subjects as per age

Description		Group B	Group R
Age	Mean	27.9	28.4
	Standard Deviation	8.59	7.3

Table 1 presents the distribution of study subjects categorized by age, with Group B having a mean age of 27.9 years and a standard deviation of 8.59, while Group R exhibits a slightly higher mean age of 28.4 years with a lower standard deviation of 7.3. This indicates that Group R tends to have less variability in age compared to Group B, despite the marginal difference in mean age between the two groups.

Table 2: Distribution of study subjects as per weight

Description		Group B	Group R
Weight (in Kilograms)	Mean	63.97	65.07
	Standard Deviation	5.92	4.94

Table 2 displays the distribution of study subjects categorized by weight, where Group B has a mean weight of 63.97 kilograms with a standard deviation of 5.92, while Group R demonstrates a slightly higher mean weight of 65.07 kilograms with a lower standard deviation of 4.94. This suggests that Group R tends to have a slightly higher average weight and less variability in weight compared to Group B, despite the minor disparity in mean weight between the two groups.

Table 3: Time taken for onset of complete Analgesia & duration of Surgery

Description	Group B	Group R	P value
Time taken for Onset of block (mins) (Mean±Std Dev)	7.86±2.47	13.46±3.20	<0.001**
Time taken for complete Block (mins) (Mean ±Std Dev)	44.00±5.08	56.15±5.88	<0.001**
Duration of surgery (mins) (Mean ±Std Dev)	90.56±6.70	91.15±8.64	0.779

There was no notable distinction observed in the duration of surgery between the two groups. In Group B, the mean duration of surgery was 90.56 minutes with a standard deviation of 6.70 minutes, while in Group R, it was slightly higher with a mean of 91.15 minutes and a standard deviation of 8.64 minutes (p=0.779). However, there was a significant difference (p<0.001) in the time it took for the onset of block and the time required for complete block between the groups.

In Group B, the mean time for onset of block was 7.86 minutes and for complete block was 44.00 minutes, whereas in Group R, these times were prolonged, with means of 13.46 minutes for onset of block and 56.15 minutes for complete block.

Table 4: Total duration of the analgesia (in Minutes)

Minutes	Group B		Group R	
	Number	%	Number	%
<550	5	16.7	0	0
550-650	22	73.3	8	26.7
>650	0	0	18	60
NA	3	10	4	13.3
Total	30	100	30	100
Mean ± SD	573.00±45.72		675.54±30.31	
P<0.001**, Significant, t test				

Table 4 presents the total duration of analgesia in minutes for two groups, Group B and Group R. In Group B, 16.7% of subjects had duration less than 550 minutes, 73.3% fell within the range of 550-650 minutes, and 10% had missing data. However, in Group R, no subjects had duration less than 550 minutes, 26.7% fell within the range of 550-650 minutes, and 60% had duration greater than 650

minutes. Mean duration ± standard deviation (SD) for Group B was 573.00 ± 45.72 minutes, whereas for Group R it was 675.54 ± 30.31 minutes. The difference between the groups was statistically significant ($p<0.001$) based on a t-test, indicating a longer duration of analgesia in Group R compared to Group B.

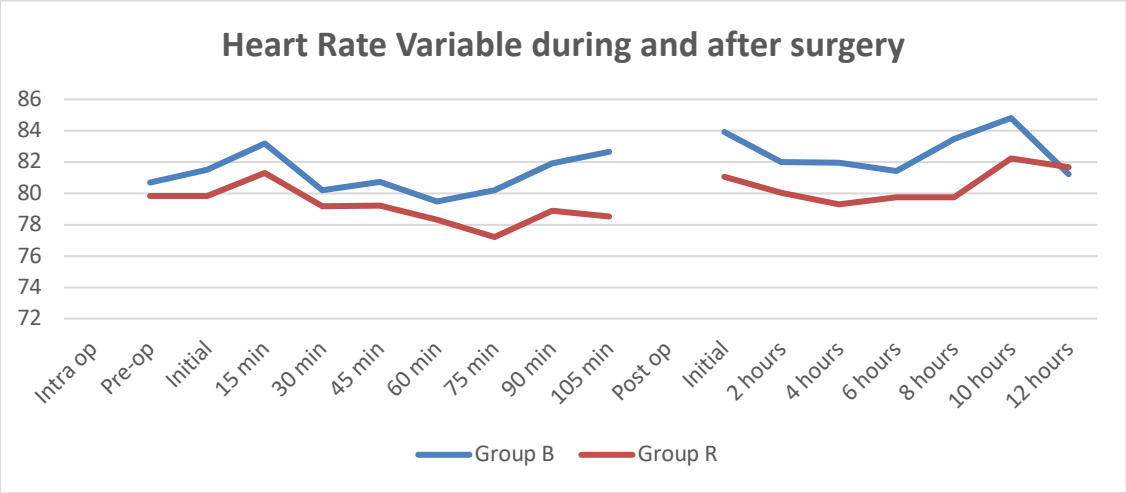

Figure 1: Heart Rate Variable during and after surgery

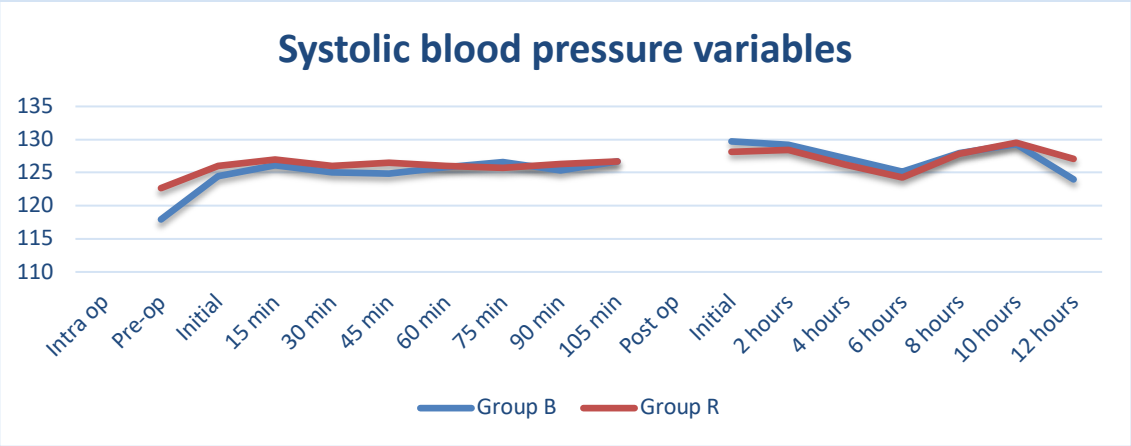

Figure 2: Systolic blood pressure variables

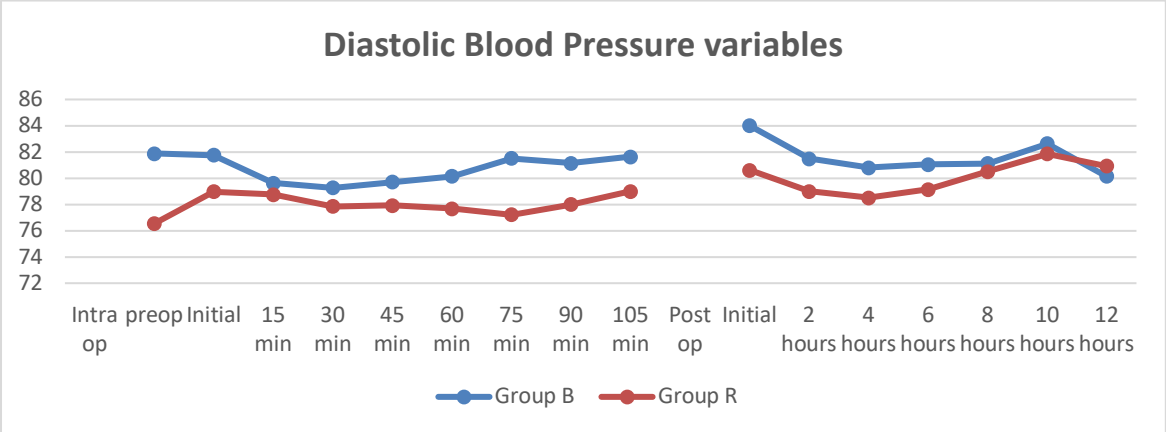

Figure 3: Diastolic Blood Pressure variables

Patients in both the groups were hemodynamically stable throughout the procedure with no significant change in heart rate, systolic and diastolic blood pressure within the group. There was no significant intra group differences in hemodynamic parameters postoperatively also. (Fig 1,2,3).

Table 5: VAS Score at first rescue analgesia

VAS Score	Group B		Group R	
	Number	%	Number	%
2	10	33.3	16	53.3
3	17	56.7	10	33.3
NA	3	10	4	13.3
Total	30	100	30	100
P=0.074, Significant, Chi-Square test				

There was no significant difference observed in the Visual Analog Scale (VAS) scores between the two groups. In Group B, 10 patients reported a VAS score of 2, while in Group R, 16 patients reported the same score. Additionally, 17 patients in Group B had a VAS score of 3 compared to 10 patients in Group R. The p-value associated with these findings was 0.074, indicating a lack of statistical significance. Furthermore, no intra or postoperative complications were noted in either group.

Discussion

The findings of the present study suggest that there were no significant differences in the duration of surgery between the groups administered with either ropivacaine (Group R) or bupivacaine (Group B). However, there was a notable discrepancy in the time it took for the onset and completion of sensory blocks. Group R exhibited a prolonged onset time for sensory block compared to Group B, with mean onset times of 13.46 minutes and 7.86 minutes, respectively. Similarly, the time required for complete sensory block was longer in Group R than in Group B, with mean times of 56.15 minutes and 44.00 minutes, respectively, and this difference was statistically significant ($p<0.001$). These findings align with the observations by Chandran et al. [5] where the onset time of sensory block tended to be faster with ropivacaine compared to bupivacaine, although not statistically significant.

However, the study by Finucane et al. [6] reported a shorter onset time for sensory block with ropivacaine compared to bupivacaine, which contrasts with the present findings. Additionally, while motor block onset time did not significantly differ between the groups in the present study, previous research by Brockway et al. [7] suggested a slower onset of motor block with ropivacaine. The time to rescue analgesia was comparable between Group R and Group B in the present study, consistent with findings by Chandran et al. [5] indicating similar durations until the need for additional analgesia in both groups. Overall, these findings contribute to the ongoing discussion regarding the comparative efficacy and onset characteristics of ropivacaine and bupivacaine in regional anesthesia A meta-analysis conducted by Baeriswyl et al. [8] examining the use of TAP block in various abdominal surgeries found a significant decrease in post-operative opioid consumption at both 6 and 24 hours post-surgery. This reduction was consistent regardless of the timing of injection or the approach used for the block. Another study by Ra YS, Kim CH, et al. [9] demonstrated decreased post-operative pain scores and reduced need for rescue analgesics in patients who received TAP block with different concentrations of levobupivacaine (ranging from 0.25% to 0.5%).

In a clinical trial by Curley and McDonnell [10] conducted in non-laparoscopic gynecological surgeries, 0.375% ropivacaine was utilized for TAP block, resulting in lower reported pain scores compared to patients who did not receive the block. However, when 0.75% ropivacaine was used, higher pain scores were observed, likely due to the different pain profile associated with larger 'open' incisions used in the surgery.

In our current study, we found that patients in the bupivacaine group had a higher incidence of post-operative nausea and vomiting (PONV) within the first hour compared to the ropivacaine group. It's possible that the higher pain scores observed in the first hour in the bupivacaine group contributed to this increased incidence of PONV. Notably, when pain scores were lower in either group, PONV scores were comparable. Patients in both the groups were hemodynamically stable throughout the procedure with no significant change in heart rate, systolic and diastolic blood pressure within the group. There were no significant intra group differences in hemodynamic parameters postoperatively also.

Conclusion

Performing a TAP block using the landmark technique effectively provides sufficient anesthesia and extends postoperative pain relief for patients undergoing inguinal hernia repair while maintaining stable hemodynamic parameters.

This technique reduces the need for analgesics such as opioids, NSAIDs, and acetaminophen in the postoperative period. When utilizing a 0.75% ropivacaine injection, there is a statistically significant prolongation of analgesia compared to using 0.5% bupivacaine, with no observed

perioperative side effects. Thus, TAP block can be safely employed for inguinal hernia repair.

Limitations

In our study, the blind double pop technique was utilized to locate the TAP, performed by an investigator with skills comparable to another investigator. While the accuracy of the block might have been improved with ultrasound-guided technique, which is an alternative method currently in use, no complications related to the dosage were encountered despite the administration of large volumes of local anesthetics, up to 30 ml.

Further research is needed to refine the optimal dose/volume required for the block and to assess its feasibility in upper abdominal surgeries.

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