

RESEARCH ARTICLE

Bupivacaine vs. Ropivacaine with Dexmedetomidine for Unilateral Inguinal Hernia Repair: A Randomized Controlled Trial

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ABSTRACT

Background: Adult inguinal hernia repair is often performed under local anesthesia because to its ease of use, quick start, affordability, and prolonged post-operative pain management. The effectiveness and safety of two local anesthetic combinations for inguinal hernia repair field block are compared in this research.

Methods: Vinayaka Missions Kirupanandha Variyar Medical College and Hospital undertook a randomized controlled study. Men between the ages of 30 and 60 patients were scheduled for surgical inguinal hernia elective procedures and were categorized as American Society of Anesthesiologists (ASA) I or II and participated in the study. They were allocated at random to either ropivacaine + dexmedetomidine or bupivacaine + dexmedetomidine as a field block. The main measure of interest was the duration until the initiation of anesthesia. Additional outcomes encompassed the assessment of the quality of surgical anesthesia, changes in hemodynamics, post-operative pain levels, and any unfavorable incidents.

Results: The groups had similar demographics and baseline characteristics. There were no discernible variations between the groups in terms of hemodynamic changes, post-operative pain levels, surgical anaesthesia quality, and the time it took for anesthesia to take effect. Both groups had a low incidence of adverse events.

Conclusion: For healthy adults (ASA I and II) undergoing inguinal hernia repair, ropivacaine + dexmedetomidine as a field block appears to be as effective and safe as bupivacaine + dexmedetomidine, suggesting it could be a suitable alternative, particularly considering its favorable safety profile and potential for enhanced patient comfort. However, larger research is needed to validate these results.

Keywords: Inguinal hernia, Local anesthesia, Ropivacaine, Dexmedetomidine, Bupivacaine.

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INTRODUCTION

Due to its numerous benefits, local anesthesia has become the preferred choice for adult inguinal hernia repair. Its simplicity, minimal pain, quick administration, and cost-effectiveness make it an attractive option for both patients and healthcare providers.^{1,2} Additionally, pre-incisional local anesthesia can offer prolonged post-operative pain relief by potentially inhibiting the production of local pain-signaling molecules, resulting in improved comfort during recovery. While various anesthetic techniques exist for hernia repair, including general anesthesia, neuraxial blockade, and regional blocks, field block for inguinal hernia surgery has emerged as a particularly promising approach.^{3,4} According to studies,

it's the most economical choice for unilateral hernia repairs, offering comparable pain control, faster recovery times, and lower associated costs compared to other techniques like central neuraxial block or general anesthesia.^{5,6}

This research aims to further explore the benefits of field block for inguinal hernia repair by comparing two specific anesthetic combinations: 0.5% bupivacaine and 0.375% ropivacaine + dexmedetomidine.

The study will evaluate the overall effectiveness of field block for repairing inguinal hernias. The length and efficacy of pain relief offered by each combination of anesthetics and the impact of field block on patient comfort and recovery time.

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By investigating these aspects, this study seeks to contribute valuable knowledge to the field of hernia repair anesthesia and potentially establish field block as an even more preferred option for this common surgical procedure.

MATERIALS AND METHODS

Study Design

The Department of Anesthesiology conducted this prospective, randomized, comparative clinical investigation of Vinayaka Missions Kirupanandha Variyar Medical College and Hospital, located in Salem, Tamil Nadu, India. The study received ethical approval with reference number VMKVMCH/2022/072 on January 28, 2022.

Participants

Male patients aged 30 to 60 years scheduled for patients who matched the specified criteria were eligible to participate in the elective inguinal hernioplasty study.

Physical state classification I or II according to the American Society of Anaesthesiologists (ASA), weight in kilograms between 40 and 65. No history of documented allergies, coagulation abnormalities, chronic analgesic therapy, or medication interactions with the study drugs and not currently using beta-blockers

Randomization

Using a computer-generated randomization sequence, eligible volunteers were randomized at random to one of two groups: Group 1 consists of a mixture of 0.5% bupivacaine and the pain reliever dexmedetomidine and group 2: Field block using a combination of 0.375% ropivacaine and dexmedetomidine.

Procedures

Both groups received pre-medication as per institutional protocol. The specific field block technique (e.g., ilioinguinal, iliohypogastric, genital femoral) was chosen based on the type of hernia repair. Infiltration of the anesthetic solution was performed under ultrasound guidance to ensure accurate needle placement and minimize risks. The primary outcome measure was the time to sensory block onset at specific anatomical landmarks. Secondary outcome measures, included quality of surgical anesthesia, hemodynamic parameters during surgery, post-operative pain scores and incidence of adverse events.

Data Analysis

Appropriate methods that fit the features of the variables were used to conduct the statistical analysis. Depending on the situation, either Mann-Whitney U tests or student tests were used for comparing groups. T-tests were used. Statistical significance was determined by looking at p -values ≥ 0.05 .

RESULTS

Beginning Point Demographics

The two groups showed similar characteristics with respect to age and weight. Table 1 shows that group 1's average age was 44.9 ± 8.6 years, while group 2's average age was $46.1 \pm$

5.3 years. Likewise, group 1's mean weight was 51.3 ± 5.3 kg, whereas Group 2's mean weight was 49.6 ± 4.0 kg. According to statistical analysis, there was little difference between the age and weight of the groups ($p > 0.05$).

Table 2 shows the two groups' baseline clinical data, which included ASA grade. The blood pressure's diastolic and systolic values, pulse rate and balance (Table 2). The average pulse rate ($p > 0.05$), average systolic $p > 0.05$ for systolic blood pressure, as well as average diastolic blood pressure ($p > 0.05$) did not vary significantly across the groups, according to the statistical analysis.

Table 3 compares group 1 and 2 sensation levels at T7 and T8 levels. Both groups had 58 participants each, with no significant differences in sensation levels observed at either level ($p > 0.05$).

Table 4 provides a comparison of ASA grades (American Society of Anaesthesiologists) between group 1 and 2. Each group consisted of 58 participants. The analysis reveals that In terms of ASA grades, there were no statistically significant variations between the two groups for both grade I and grade II ($p > 0.05$).

In Table 5, group 2 exhibited a significantly faster onset in comparison to group 1 of sensory and motor blockade ($p < 0.0001$).

Table 1: Age comparison between the two groups

years old	N (%)	
	(0.5% bupivacaine and dexmedetomidine) – BUP + DEX Group 1	(0.375% ropivacaine and dexmedetomidine) – ROP + DEX Group 2
30–39	21 (36.2)	12 (20.6)
40–49	12 (28.9)	29 (50.0)
50–59	26 (44.8)	17 (29.4)
Overall	58 (100)	58 (100)
Mean \pm SD	44.9 \pm 8.6	46.1 \pm 5.3

Table 2: Baseline characteristics including SBP, DBP and PR of the two groups

Parameters	Mean \pm SD		p-value
	BUP + DEX Group 1	ROP+ DEX Group 2	
SBP	120.4 \pm 6.3	120.2 \pm 3.4	>0.05
DBP	77.7 \pm 4.2	78.6 \pm 2.5	>0.05
Pulse rate	87.3 \pm 8.8	85.2 \pm 9.1	>0.05

Table 3: Level of sensation among two groups

Level of senses	BUP + DEX Group 1	ROP+ DEX Group 2	p-value
Th.7	13	21	
Th.8	45	37	>0.05
Total	58	58	

Table 4: Grading of patients on the basis of ASA among the two groups

ASA Grade (American Society of Anesthesiologists)	BUP + DEX Group 1	ROP+ DEX Group 2	<i>p</i> -value
I	48	51	>0.05
II	10	7	
Total	58	58	

Table 5: Onset of motor blockage (2) and sensory blockade (T10) in two groups

<i>Blockade</i>	<i>Mean ± SD</i>		<i>p</i> -value
	<i>BUP + DEX Group 1</i>	<i>ROP+ DEX Group 2</i>	
Sensation	8.1 ± 1.9	5.64 ± 3.4	< 0.0001
Motor activity	9.2 ± 6.1	5.42 ± 3.5	< 0.0001

Table 6: Values of pulse rates between the two groups at various intervals

<i>Intervals</i>	<i>Mean ± SD</i>		<i>p</i> -value
	<i>BUP + DEX Group 1</i>	<i>ROP+ DEX Group 2</i>	
3 minutes	92.7 ± 12.7	91.0 ± 12.4	> 0.05
6 minutes	87.4 ± 11.6	84.4 ± 11.8	> 0.05
15 minutes	78.6 ± 12.1	74 ± 15.4	> 0.05
30 minutes	80.4 ± 13.5	77.1 ± 12.1	> 0.05
1 hour	81 ± 7.4	80.4 ± 4.7	> 0.05
2 hours	85.6 ± 1.5	81.7 ± 4.5	> 0.05
4 hours	109.7 ± 6.0	87.8 ± 4.0	< 0.0001
8 hours	106.2 ± 9.3	110.3 ± 10.3	< 0.05

In Table 6, between groups 1 and 2, there were no significant variations in pulse rate up to 2 hours ($p > 0.05$). At 4 hours, group 2 had a significantly lower pulse rate than group 1 ($p < 0.0001$), while at 8 hours, group 2 had a significantly higher pulse rate ($p < 0.05$).

Table 7 presents systolic blood pressure (SBP) values at various intervals for both group 1 and group 2. Up until the two hours, there were no discernible differences between the two groups ($p > 0.05$). However, at the 4-hour interval, group 1 exhibited much greater significant SBP in contrast to group 2 ($p < 0.0001$). Conversely, at the 8-hour mark, group 2 demonstrated significantly higher SBP compared to group 1 ($p < 0.05$).

Table 8 illustrates diastolic blood pressure (DBP) values for BUP + DEX group 1 and ROP+ DEX group 2, indicating no significant differences up to 2 hours ($p > 0.05$), but showing that group 1 had higher DBP than group 2 at 4 hours ($p < 0.0001$), and conversely, Group 2 had higher DBP than group 1 at 8 hours ($p < 0.05$).

In Table 9, group 2 used rescue analgesia at a much greater rate than group 1 ($P < 0.0001$).

Table 7: SBP readings in the two groups at various times

<i>Intervals</i>	<i>Mean ± SD</i>		<i>p</i> -value
	<i>BUP + DEX Group 1</i>	<i>ROP+ DEX Group 2</i>	
3 minutes	121.3 ± 8.4	121.7 ± 6.2	> 0.05
6 minutes	117.6 ± 8.2	114.3 ± 4.7	> 0.05
15 minutes	112.3 ± 11.3	111.4 ± 2.8	> 0.05
30 minutes	108.6 ± 9.7	107.3 ± 2.4	> 0.05
1 hour	110.8 ± 6.3	110.4 ± 2.6	> 0.05
2 hours	113.6 ± 5.9	114.2 ± 4.7	> 0.05
4 hours	126.2 ± 4.8	115.5 ± 4.3	< 0.0001
8 hours	116.3 ± 5.1	127.6 ± 5.2	< 0.05

Table 8: DBP-values at different intervals in the two groups

<i>Intervals</i>	<i>Mean ± SD</i>		<i>p</i> -value
	<i>BUP + DEX Group 1</i>	<i>ROP+ DEX Group 2</i>	
3 minutes	76.9 ± 8.1	77.1 ± 5.8	> 0.05
6 minutes	74.8 ± 6.3	75.2 ± 5.4	> 0.05
15 minutes	71 ± 8.2	74 ± 0.0	> 0.05
30 minutes	72 ± 5.6	67.2 ± 5.1	> 0.05
1 hours	68.9 ± 4.6	68.7 ± 1.4	> 0.05
2 hours	71.3 ± 4.4	73.2 ± 4.9	> 0.05
4 hours	77.9 ± 6.2	73.1 ± 4.7	< 0.0001
8 hours	73.0 ± 6.4	84.1 ± 4.6	< 0.05

Table 9: Analgesia rescue in the two categories

<i>Variable</i>	<i>Mean ± SD</i>		<i>p</i> -value
	<i>BUP + DEX Group 1</i>	<i>ROP+ DEX Group 2</i>	
Analgesia rescue	218.4 ± 18.3	456.1 ± 23.9	< 0.0001

Table 10: S2 regression and two-segment analysis in both groups

<i>Variable</i>	<i>Mean ± SD</i>		<i>p</i> -value
	<i>BUP + DEX Group 1</i>	<i>ROP+ DEX Group 2</i>	
2 segment regression	88.0 ± 19.4	129.4 ± 12.2	< 0.001
2 segment regression	239.7 ± 21.6	296.8 ± 23.1	< 0.001

In Table 10, both two-segment and S2 regression values were much greater in group 2 than in group 1 ($p < 0.001$).

DISCUSSION

Field block has become a popular pain management technique for lower abdominal surgeries. Its simplicity and effectiveness make it a valuable tool for surgeons and anaesthesiologists

alike.^{7,8} This study specifically focused on comparing the efficacy of two anesthetic combinations for field block in inguinal hernia repair: 0.5% bupivacaine + dexmedetomidine (Group 1) and 0.375% ropivacaine + dexmedetomidine (Group 2).

Our results demonstrated comparable pain relief between the two groups. Both combinations provided sufficient anesthesia during the surgery and post-operative recovery. Interestingly, however, group 2 showed some distinct advantages:

- Patients in group 2 noticed that sensory and motor block started more quickly and reached the desired level of anesthesia quicker than those in group 1. This could be attributed to the properties of ropivacaine, which is known to have a faster onset of action than bupivacaine.

Prolonged Motor Block Duration

Group 2 also experienced a longer period of motor block, potentially leading to increased stability during surgery and reduced post-operative pain.

Reduced need for Rescue Analgesia

Patients in group 2 required less additional pain medication compared to group 1, suggesting a longer-lasting analgesic effect. This could be due to the combined action of ropivacaine and dexmedetomidine, which targets multiple pain pathways in the spinal cord.

While some minor side effects were observed in both groups, such as transient bradycardia and hypotension, these were effectively managed with standard medications.⁹ No patients in either group reported nausea or vomiting, indicating good tolerability of both anesthetic combinations.

Our findings suggest that 0.375% ropivacaine + dexmedetomidine field block for inguinal hernia repair offers potentially faster onset, longer duration of pain relief, and reduced needs for additional medication compared to 0.5% bupivacaine + dexmedetomidine. This presents a promising alternative for pain management in this type of surgery, potentially improving patient comfort and potentially decreasing healthcare costs associated with additional pain medication.¹⁰⁻¹²

Further investigation with more extensive sample sizes and extended durations of observation is necessary to validate these findings and ascertain the enduring safety and effectiveness of both anesthetic combinations for the surgical correction of inguinal hernias.

CONCLUSION

Our study suggests that 0.375% ropivacaine + dexmedetomidine field block may be a viable alternative to 0.5% bupivacaine + dexmedetomidine for inguinal hernia repair in ASA I and II patients. While both combinations offered comparable pain relief during surgery and post-operative recovery, ropivacaine + dexmedetomidine demonstrated some key advantages:

A quicker onset of motor and sensory block, potentially leading to quicker anesthesia and improved surgical efficiency, longer duration of motor block, potentially providing increased stability during surgery and reducing post-operative pain

requirements and reduced need for rescue analgesia, indicating a longer-lasting analgesic effect and potentially lower healthcare costs associated with additional pain medication. These findings require further investigation with larger-scale studies and lengthier follow-up times to verify both anesthetic combinations' long-term safety and effectiveness. However, the initial results suggest that ropivacaine + dexmedetomidine field block could be a promising approach for inguinal hernia repair, offering comparable pain relief with the potential for faster onset, longer duration, and reduced need for additional medication.

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