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Comparison of Fentanyl 25 Mcg Versus Dexmedetomidine 5 Mcg as Adjuvants to Intrathecal Levobupivacaine Heavy in Lower Limb and Lower Abdominal Surgeries

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Abstract
Background ans Aim: *Spinal anaesthesia with local anaesthetics alone has limited duration.Adjuvants like fentanyl and dexmedetomidine enhance block characteristics and prolong analgesia. This study compared the efficacy of fentanyl versus dexmedetomidine as adjuvants to intrathecal hyperbaric levobupivacaine.* ***Methods:*** *A prospective, comparative, randomized study was conducted on 40 ASA I-II patients aged 18-60 years undergoing lower limb and lower abdominal surgeries. Patients were randomly allocated into two groups: Group LF receiving 3 ml of hyperbaric 0.5% levobupivacaine with fentanyl 25 µg (n=20) and Group LD receiving 3 ml of hyperbaric 0.5% levobupivacaine with dexmedetomidine 5µg (n=20). Primary outcomes included onset and duration of sensory and motor blocks.* ***Results:*** *Group LF demonstrated faster onset of sensory block (4.95±0.37 min vs 5.44±0.48 min, p=0.001) and motor block (7.82±0.34 min vs 8.04±0.31 min, p=0.04) compared to Group LD. Group LD showed significantly prolonged duration of sensory block (175.30±10.38 min vs 157.00±8.55 min, p<0.001), motor block (270.00±9.79 min vs 230.25±10.92 min, p<0.001), and postoperative analgesia (316.15±13.72 min vs 241.15±11.16 min, p<0.001). Group LD required fewer rescue analgesics (1.90±0.72 vs 3.45±0.69, p<0.001). Pruritis was more common in Group LF (25% vs 0%, p=0.02) while bradycardia was more frequent in Group LD (20% vs 0%, p=0.04).* ***Conclusion:*** *Dexmedetomidine provides superior prolongation of sensory and motor blocks with extended postoperative analgesia compared to fentanyl, though fentanyl demonstrates faster onset. Both adjuvants show acceptable safety profiles with minimal significant adverse effects.*

Keywords: *Levobupivacaine, Dexmedetomidine, Fentanyl, Spinal anaesthesia, Lower limb surgery*

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I. INTRODUCTION

Spinal anaesthesia remains the most preferred regional anaesthetic technique for infraumbilical surgical procedures due to its rapid onset, reliable distribution of sensory and motor blockade, and excellent patient satisfaction (1). The technique offers numerous advantages including cost-effectiveness, ease of administration, and reduced postoperative complications compared to general anaesthesia (2). However, the primary limitation of spinal anaesthesia using local anaesthetics alone is its relatively short duration of action, necessitating early postoperative analgesic intervention and potentially limiting its application in prolonged surgical procedures (3).

To overcome these limitations and enhance the quality and duration of spinal anaesthesia, various adjuvants have been investigated and incorporated into clinical practice. Multiple pharmacological agents including opioids such as morphine, fentanyl, and sufentanil, alpha-2 adrenergic agonists including dexmedetomidine and clonidine, magnesium sulfate, neostigmine, ketamine, and midazolam have been studied as potential adjuvants for intrathecal local anaesthetics (4). Among these, opioids and alpha-2 adrenergic agonists have emerged as the most commonly utilized adjuvants in contemporary anaesthetic practice due to their favorable efficacy profiles and acceptable safety margins (5).

Levobupivacaine, the pure S-enantiomer of racemic bupivacaine, has gained considerable attention and widespread clinical acceptance as a safer alternative to its racemic counterpart. This improved safety profile is attributed to its reduced cardiotoxicity and neurotoxicity compared to bupivacaine, while maintaining similar clinical efficacy in providing adequate sensory and motor blockade (6). The reduced systemic toxicity of levobupivacaine is particularly advantageous in patients with cardiovascular comorbidities, making it an attractive choice for neuraxial anaesthesia (7). The availability of hyperbaric levobupivacaine has further

expanded its clinical utility in spinal anaesthesia, providing predictable block characteristics with improved safety margins compared to traditional bupivacaine formulations (8).

Fentanyl, a potent synthetic lipophilic mu-opioid receptor agonist, has been extensively studied and widely employed as an intrathecal adjuvant. Its lipophilic nature facilitates rapid onset of action and excellent penetration into the spinal cord, resulting in enhanced quality of intraoperative anaesthesia and improved early postoperative analgesia (9). The optimal dose of intrathecal fentanyl has been established through multiple clinical trials, with doses ranging from 10 to 25 micrograms providing effective analgesia while minimizing adverse effects such as respiratory depression, pruritus, and urinary retention (10). The addition of fentanyl to local anaesthetics has been shown to improve the quality of sensory block, reduce intraoperative visceral pain, and enhance patient comfort during surgical procedures (11).

Dexmedetomidine, a highly selective alpha-2 adrenergic receptor agonist with a selectivity ratio of approximately 1600:1 for alpha-2 versus alpha-1 receptors, represents a newer class of neuraxial adjuvants that has generated considerable research interest (12). The mechanism of action of dexmedetomidine in the neuraxial space involves binding to alpha-2 adrenoreceptors in the dorsal horn of the spinal cord, resulting in inhibition of nociceptive neurotransmitter release and hyperpolarization of postsynaptic neurons (13). This unique mechanism provides both analgesic and sedative effects without significant respiratory depression, making it an attractive alternative to opioid-based adjuvants (14). Additionally, dexmedetomidine has been shown to provide dose-dependent prolongation of both sensory and motor blockade while maintaining hemodynamic stability and reducing postoperative analgesic requirements (15).

AIMS

Primary Objective:

To compare fentanyl 25 mcg versus dexmedetomidine 5 mcg as adjuvants to intrathecal hyperbaric levobupivacaine 0.5% with regards to onset and duration of sensory and motor blockade in patients undergoing lower limb and lower abdominal surgeries.

Secondary Objective:

To compare the two groups with regards to duration of postoperative analgesia, hemodynamic parameters, and incidence of adverse effects including sedation, nausea, vomiting, pruritus, hypotension, bradycardia, and respiratory depression.

II. MATERIALS AND METHODS

Study Design and Ethics

This prospective, comparative, randomized double-blind study was conducted at Sapthagiri Institute of Medical Sciences and Research Centre, Bengaluru, after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants prior to enrollment in the study. The study was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice guidelines.

Sample Size Calculation

Based on literature from a previous study by Srivastava Neha et al (2024) examining the mean difference in onset of motor block between fentanyl and dexmedetomidine groups, the standard deviation for Group LF was 0.85 minutes and for Group LD was 0.56 minutes, with a mean difference between samples of 0.51 minutes. Using a significance level of 0.05 and power of 0.80, the required sample size was calculated as 19 patients per group, which was rounded up to 20 patients per group. The total sample size was therefore 40 subjects for both groups combined.

Inclusion Criteria

Patients meeting the following criteria were included in the study: provision of informed written consent, age between 18-60 years, American Society of Anesthesiologists (ASA) physical status I and II, and patients scheduled for elective lower abdominal and lower limb surgery under spinal anaesthesia. Only patients suitable for neuraxial blockade without contraindications were enrolled.

Exclusion Criteria

Patients were excluded if they had any of the following: coagulation disorders or anticoagulant therapy, pregnancy, local infection at the site of injection, uncontrolled diabetes mellitus, cardiovascular diseases including significant valvular disease or congestive heart failure, renal or liver diseases, epilepsy or psychiatric disorders, known allergy to study drugs including local anaesthetics or adjuvants, patient refusal for spinal anaesthesia, or inability to understand or communicate effectively for proper assessment of study parameters.

Randomization and Blinding
Patients were randomly allocated into two groups using computer-generated random numbers to ensure unbiased allocation. The randomization sequence was concealed until the time of drug preparation. Both patients and the anaesthesiologist performing assessments were blinded to the group allocation. Study drugs were prepared by an anaesthesiologist not involved in patient care or data collection to maintain blinding integrity throughout the study period.

Anaesthetic Technique
All patients were kept nil per oral for a minimum of 8 hours before surgery according to institutional fasting guidelines. Upon arrival in the operating theatre, standard monitoring including pulse oximetry, non-invasive blood pressure measurement, and electrocardiography was established. Baseline hemodynamic parameters including heart rate, systolic and diastolic blood pressure, and oxygen saturation were recorded and continued to be monitored throughout the intraoperative and postoperative periods.
Intravenous access was secured using an 18-gauge cannula, and preloading was performed with Ringer's lactate solution at a rate of 10 ml/kg. Under strict aseptic technique, spinal anaesthesia was administered by an experienced anaesthesiologist with the patient in the sitting position. The procedure was performed at the L3-L4 intervertebral space using a 26-gauge Quincke spinal needle via the midline approach.

Study Groups and Drug Administration
Patients were allocated to one of two groups:

- **Group LF (n=20):** Received 3.5ml drug (3ml of hyperbaric 0.5% levobupivacaine plus fentanyl 25 µg intrathecally)

- **Group LD (n=20):** Received 3.5ml drug (3ml of hyperbaric 0.5% levobupivacaine plus dexmedetomidine 5µg in 0.5ml normal saline intrathecally)

After confirmation of free flow of clear cerebrospinal fluid, the study drugs were injected slowly over approximately 30 seconds. Patients were then immediately positioned supine, and supplemental oxygen was administered at 4 liters per minute via nasal cannula.

Assessment Parameters

Sensory Block Assessment
The level of sensory block was assessed bilaterally in the midclavicular line using loss of pinprick sensation with a 23-gauge hypodermic needle at dermatomal levels. Testing was performed every 2 minutes until the highest sensory level of T6 was achieved and stabilized through consecutive tests. The sensory score was graded as: 0 = sharp pain, 1 = touch sensation only, 2 = no sensation. Onset of sensory block was defined as the time taken to attain sensory level of T6 dermatome from the time of injection. Duration of sensory block was measured as the time from injection to sensory regression to T10 dermatome level.

Motor Block Assessment
Motor block was assessed using the modified Bromage scale: 0 = patient able to move hip, knee, and ankle; 1 = patient unable to move hip but able to move knee and ankle; 2 = patient unable to move hip and knee but able to move ankle; 3 = patient unable to move hip, knee, and ankle. Onset of motor block was defined as the time to reach Bromage scale 3 from the time of injection. Duration of motor block was measured as the time to return to Bromage scale 0.

Postoperative Analgesia Assessment
Duration of postoperative analgesia was measured as the time from injection of study drugs to the time when Visual Analogue Scale (VAS) score reached 4 or greater. VAS scores were assessed at regular intervals postoperatively, and the number of rescue analgesics required in the 24-hour postoperative period was recorded.

Hemodynamic Monitoring
Heart rate, systolic blood pressure, diastolic blood pressure, and oxygen saturation were recorded at baseline and at regular intervals throughout the procedure and postoperative period. Hypotension was defined as a decrease in systolic blood pressure of more than 20% from baseline or an absolute value below 90 mmHg. Bradycardia was defined as a heart rate below 60 beats per minute.

Sedation and Adverse Effects

Sedation level was monitored using the Ramsay Sedation Score: 1 = anxious, agitated, or restless; 2 = cooperative, oriented, tranquil; 3 = responds to commands; 4 = brisk response to loud auditory stimulus; 5 = sluggish response to loud auditory stimulus; 6 = no response to loud auditory stimulus. The incidence of adverse effects including nausea, vomiting, pruritus, shivering, hypotension, bradycardia, and respiratory depression was recorded and managed appropriately.

Statistical Analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) for Windows Version 22.0 (Released 2013, Armonk, NY: IBM Corp.). Descriptive analysis was conducted using mean and standard deviation for quantitative variables and frequency with proportions for categorical variables. Student's t-test (two-tailed, independent) was used to compare quantitative parameters including mean age, onset and duration times of sensory and motor blocks, duration of analgesia, VAS scores, and hemodynamic parameters between the two groups. Chi-square test was used to compare categorical data including gender distribution, ASA grades, number of additional analgesics required, and incidence of side effects between groups. The level of statistical significance was set at $p<0.05$.

III. RESULTS

Demographic and Baseline Characteristics

A total of 40 patients were enrolled and completed the study, with 20 patients in each group. The demographic characteristics and baseline parameters are presented in Table 1. There were no statistically significant differences between Group LF and Group LD in terms of age, weight, ASA physical status distribution, gender distribution, or duration of surgery (all p-values > 0.05), indicating successful randomization and comparable baseline characteristics between the groups.

Table 1: Demographics and Baseline Parameters

Parameter	Group LF (n=20)	Group LD (n=20)	p-value	Significance
Age (years), Mean ± SD	39.90 ± 11.97	38.80 ± 14.03	0.89	No
Weight (kg), Mean ± SD	67.37 ± 8.95	65.51 ± 6.86	0.47	No
ASA Grade I, n (%)	12 (60.0%)	10 (50.0%)	0.53	No
ASA Grade II, n (%)	8 (40.0%)	10 (50.0%)	0.53	No
Male gender, n (%)	13 (65.0%)	11 (55.0%)	0.52	No
Female gender, n (%)	7 (35.0%)	9 (45.0%)	0.52	No
Duration of Surgery (min), Mean ± SD	116.60 ± 14.24	117.50 ± 13.87	0.84	No

Block Characteristics

The primary outcomes related to sensory and motor block characteristics are summarized in Table 2. Significant differences were observed between the groups in all measured parameters related to block onset, duration, and quality.

Table 2: Block Characteristics and Analgesia

Parameter	Group LF (n=20)	Group LD (n=20)	p-value	Significance
Onset of Sensory Block (min), Mean ± SD	4.95 ± 0.37	5.44 ± 0.48	0.001	Yes
Onset of Motor Block (min), Mean ± SD	7.82 ± 0.34	8.04 ± 0.31	0.04	Yes
Duration of Sensory Block (min), Mean ± SD	157.00 ± 8.55	175.30 ± 10.38	<0.001	Yes
Duration of Motor Block (min), Mean ± SD	230.25 ± 10.92	270.00 ± 9.79	<0.001	Yes
Duration of Analgesia (min), Mean ± SD	241.15 ± 11.16	316.15 ± 13.72	<0.001	Yes
Rescue Analgesics (mean number), Mean ± SD	3.45 ± 0.69	1.90 ± 0.72	<0.001	Yes

Onset of Blocks

Group LF demonstrated significantly faster onset of sensory block compared to Group LD (4.95 ± 0.37 minutes vs 5.44 ± 0.48 minutes, p=0.001), representing approximately a 9% faster onset time. Similarly, the onset of motor block was significantly faster in Group LF compared to Group LD (7.82 ± 0.34 minutes vs 8.04 ± 0.31 minutes, p=0.04), though the absolute difference was smaller at approximately 0.22 minutes.

Duration of Blocks

Group LD showed significantly prolonged duration of sensory block compared to Group LF (175.30 ± 10.38 minutes vs 157.00 ± 8.55 minutes, $p<0.001$), representing an 18.3-minute or approximately 12% longer duration. The duration of motor block was also significantly longer in Group LD compared to Group LF (270.00 ± 9.79 minutes vs 230.25 ± 10.92 minutes, $p<0.001$), with a difference of approximately 40 minutes or 17% longer duration.

Postoperative Analgesia

The duration of postoperative analgesia was significantly extended in Group LD compared to Group LF (316.15 ± 13.72 minutes vs 241.15 ± 11.16 minutes, $p<0.001$), representing approximately 75 minutes or 31% longer analgesic duration. Correspondingly, patients in Group LD required significantly fewer rescue analgesics compared to Group LF (1.90 ± 0.72 vs 3.45 ± 0.69, $p<0.001$), indicating superior postoperative pain control with dexmedetomidine.

Sedation Scores and Adverse Effects

The incidence of sedation and adverse effects is presented in Table 3, showing distinct safety profiles between the two groups.

Table 3: Sedation Scores and Adverse Effects

Adverse Effect	Group LF (n=20)	Group LD (n=20)	p-value	Significance
	n (%)	n (%)		
Sedation Score 2	20 (100%)	12 (60%)	0.002	Yes
Sedation Score 3	0 (0%)	8 (40%)	0.002	Yes
Shivering	2 (10%)	0 (0%)	0.15	No
Nausea/Vomiting	1 (5%)	1 (5%)	1.0	No
Pruritus	5 (25%)	0 (0%)	0.02	Yes
Hypotension	2 (10%)	5 (25%)	0.21	No
Respiratory Depression	0 (0%)	0 (0%)	-	No
Bradycardia	0 (0%)	4 (20%)	0.04	Yes

Sedation Patterns

All patients in Group LF (100%) achieved a Ramsay Sedation Score of 2 (cooperative, oriented, tranquil), while only 60% of patients in Group LD reached this level of sedation ($p=0.002$). Notably, 40% of patients in Group LD achieved a deeper level of sedation with a Ramsay Score of 3 (responds to commands), while no patients in Group LF reached this level ($p=0.002$). This indicates that dexmedetomidine provides more pronounced sedative effects compared to fentanyl.

Adverse Effects Profile

Pruritus was significantly more common in Group LF, affecting 25% of patients compared to 0% in Group LD ($p=0.02$). This finding is consistent with the known opioid-related side effect profile of fentanyl. Conversely, bradycardia was observed exclusively in Group LD, affecting 20% of patients compared to 0% in Group LF ($p=0.04$), which aligns with the alpha-2 agonist properties of dexmedetomidine.

Other adverse effects showed no significant differences between groups. Shivering occurred in 10% of Group LF patients with none in Group LD ($p=0.15$). Nausea and vomiting occurred equally in both groups (5% each, $p=1.0$). Hypotension was more frequent in Group LD (25%) compared to Group LF (10%), but this difference was not statistically significant ($p=0.21$). Importantly, no cases of respiratory depression were observed in either group, indicating the safety of both adjuvant regimens at the doses used.

Hemodynamic Stability

Both groups maintained hemodynamic stability throughout the study period. While there were episodes of hypotension and bradycardia as noted above, these were generally mild and responded well to standard treatment protocols. No patients required intensive interventions for hemodynamic instability, and all episodes were managed successfully with intravenous fluids and, when necessary, vasopressors or anticholinergic medications.

IV. DISCUSSION

This prospective randomized study compared the clinical efficacy and safety profiles of fentanyl 25 mcg and dexmedetomidine 5 mcg as adjuvants to intrathecal hyperbaric levobupivacaine 0.5% in patients undergoing lower limb and lower abdominal surgeries. Our findings demonstrate distinct advantages and characteristics for each adjuvant, with dexmedetomidine providing superior block prolongation and postoperative analgesia, while fentanyl offers faster block onset.

Onset of Sensory and Motor Blocks

Our study revealed that fentanyl provided significantly faster onset of both sensory and motor blocks compared to dexmedetomidine. This finding is consistent with several previous investigations that have compared these adjuvants in neuraxial anesthesia. Srivastava Neha et al. reported similar results when comparing dexmedetomidine 10 mcg versus fentanyl 25 mcg as adjuvants to hyperbaric levobupivacaine, finding that onset times were significantly shorter in the fentanyl group (16). Similarly, Gulwatan Singh Kang et al. demonstrated that fentanyl 25 mcg provided earlier onset of sensory and motor blocks compared to dexmedetomidine 3 mcg when added to 0.5% isobaric levobupivacaine in lower limb surgeries (4).

The faster onset observed with fentanyl can be attributed to its lipophilic nature and direct action on spinal cord mu-opioid receptors, which facilitates rapid penetration and immediate analgesic effects. In contrast, dexmedetomidine's mechanism of action through alpha-2 adrenoreceptors in the dorsal horn requires more time to establish the neuronal hyperpolarization and inhibition of nociceptive transmission that characterizes its analgesic effects.

Gupta et al. also confirmed these findings in their study comparing 10 mcg dexmedetomidine with fentanyl as adjuvants to hyperbaric levobupivacaine, demonstrating significantly faster onset of sensory and motor blockade in the fentanyl group (17). This consistent pattern across multiple studies suggests that the choice between these adjuvants may depend on the clinical priority: faster onset with fentanyl versus prolonged duration with dexmedetomidine.

Duration of Sensory and Motor Blocks

Our results clearly demonstrate the superior ability of dexmedetomidine to prolong both sensory and motor blocks compared to fentanyl. Group LD showed an 18.3-minute longer sensory block duration and a 40-minute longer motor block duration compared to Group LF. This finding aligns with the established literature on alpha-2 agonists' ability to prolong local anaesthetic effects.

These results are consistent with the findings of Srivastava Neha et al., who reported significantly longer duration of sensory and motor blocks in the dexmedetomidine group compared to fentanyl (16). Similarly, Gulwatan Singh Kang et al. concluded that low-dose dexmedetomidine provided longer duration of sensory and motor blocks with prolonged postoperative analgesia compared to fentanyl (4). The prolonged block duration with dexmedetomidine likely results from its action on voltage-gated sodium channels in addition to its primary alpha-2 receptor effects, leading to enhanced local anaesthetic potency and duration.

Shweta Jain et al. also demonstrated that dexmedetomidine 5 mcg provided longer duration of action compared to fentanyl 25 mcg when used as adjuvants to hyperbaric levobupivacaine, supporting the consistent finding that dexmedetomidine offers superior block prolongation (18). The clinical significance of this prolonged block duration extends beyond the immediate perioperative period, potentially reducing the need for additional interventions and improving overall patient satisfaction.

Postoperative Analgesia

One of the most clinically significant findings of our study was the superior postoperative analgesia provided by dexmedetomidine. Group LD demonstrated a 75-minute longer duration of analgesia and required significantly fewer rescue analgesics compared to Group LF. This represents a 31% improvement in analgesic duration, which has substantial implications for postoperative pain management and patient comfort.

This finding is supported by multiple studies in the literature. Al-Ghanem et al. found that 5 mcg dexmedetomidine produced more prolonged analgesia compared to 25 mcg fentanyl when added to isobaric bupivacaine (19). The extended analgesia with dexmedetomidine can be attributed to its unique pharmacological properties, including its ability to modulate pain transmission at multiple levels of the neuraxis and its longer half-life compared to fentanyl.

The reduced requirement for rescue analgesics in the dexmedetomidine group is particularly important from both patient comfort and healthcare resource utilization perspectives. Fewer analgesic interventions mean reduced nursing workload, decreased potential for medication-related adverse effects, and improved patient satisfaction scores. This finding supports the growing body of evidence suggesting that dexmedetomidine may be a preferred adjuvant for procedures where prolonged postoperative analgesia is desired.

Sedation Characteristics

An interesting finding in our study was the different sedation profiles between the two groups. While all patients in Group LF achieved a Ramsay Sedation Score of 2, 40% of patients in Group LD achieved deeper sedation with a score of 3. This enhanced sedation with dexmedetomidine represents both an advantage and a consideration for clinical practice.

The sedative properties of dexmedetomidine result from its action on alpha-2 receptors in the locus coeruleus, producing a unique conscious sedation that allows patients to remain arousable and cooperative. This type of sedation is often described as more natural and comfortable for patients compared to other sedative agents. However, the degree of sedation must be carefully monitored, particularly in ambulatory surgery settings where early mobilization is desired.

Adverse Effects Profile

Our study revealed distinct adverse effect profiles for the two adjuvants. Pruritus was significantly more common in the fentanyl group (25% vs 0%), which is consistent with the known opioid-related side effect profile. This finding aligns with previous studies demonstrating that opioid-induced pruritus is a common complication of neuraxial opioid administration, likely mediated through central mu-opioid receptor activation in the trigeminal nucleus.

Conversely, bradycardia was observed exclusively in the dexmedetomidine group (20% vs 0%), reflecting the alpha-2 agonist's effects on the cardiovascular system. Raghavi et al. reported similar findings with a higher incidence of bradycardia in the dexmedetomidine group compared to fentanyl when used as adjuvants to isobaric levobupivacaine (20). While this bradycardia was generally mild and well-tolerated in our study, it represents an important consideration for patient selection and monitoring protocols.

Anjali Bhure et al. also reported a higher incidence of bradycardia in patients receiving dexmedetomidine compared to fentanyl (65% vs 7.5%) when used as adjuvants to levobupivacaine (21). The variation in incidence rates across studies may reflect differences in dosing, patient populations, or definition criteria for bradycardia.

Hemodynamic Considerations

Both adjuvants demonstrated acceptable hemodynamic profiles in our study. While hypotension occurred more frequently in the dexmedetomidine group (25% vs 10%), this difference was not statistically significant. The hemodynamic effects of dexmedetomidine are generally predictable and manageable, resulting from its peripheral alpha-2 receptor effects causing initial vasoconstriction followed by central sympatholysis.

Kapil Rastogi et al. compared dexmedetomidine and fentanyl as adjuvants to intrathecal levobupivacaine and found that adverse reactions including hypotension, nausea, vomiting, and shivering occurred in both groups but without statistical significance, supporting the overall safety of both adjuvants (1).

Clinical Implications

The results of our study have important implications for clinical practice. The choice between fentanyl and dexmedetomidine as adjuvants to intrathecal levobupivacaine should be individualized based on the specific clinical scenario and desired outcomes. For procedures where rapid onset is prioritized, such as emergency surgeries or cases where time efficiency is critical, fentanyl may be the preferred choice. Conversely, for longer procedures or cases where extended postoperative analgesia is desired, dexmedetomidine offers superior benefits.

The reduced requirement for postoperative analgesics with dexmedetomidine has implications for enhanced recovery protocols and may contribute to earlier hospital discharge and improved patient satisfaction. However, the increased incidence of bradycardia with dexmedetomidine requires appropriate patient selection and monitoring protocols, particularly in patients with underlying cardiovascular conditions.

Study Limitations

Our study has several limitations that should be acknowledged. The sample size, while adequate for statistical significance based on power analysis, was relatively small with only 20 patients in each group. The study was conducted at a single center with a homogeneous patient population of ASA I-II status, which may limit the generalizability of findings to higher-risk patient populations. Additionally, we did not evaluate long-term outcomes beyond the immediate postoperative period, and the study was limited to specific surgical types.

Future research should consider larger multicenter trials with diverse patient populations, evaluation of different dose ranges for both adjuvants, and assessment of long-term outcomes including chronic pain development. Studies comparing these adjuvants in higher-risk patient populations (ASA III-IV) would also provide valuable clinical information.

V. CONCLUSION

This study demonstrates that both fentanyl 25 mcg and dexmedetomidine 5 mcg are effective and safe adjuvants to intrathecal hyperbaric levobupivacaine 0.5% for lower limb and lower abdominal surgeries. Fentanyl provides faster onset of sensory and motor blocks, making it suitable for procedures where rapid onset is prioritized. However, dexmedetomidine offers superior prolongation of sensory and motor blocks with significantly extended postoperative analgesia and reduced rescue analgesic requirements.

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