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Study on Intrathecal Dexmedetomidine and Fentanyl as an Adjuvant to Hyperbaric Bupivacaine for Postoperative Analgesia in Perianal Surgeries Under Saddle Block

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Abstract

***Background*:** Saddle block anesthesia is widely used for perianal surgeries; however, postoperative analgesia remains limited when local anesthetics are used alone. This study aimed to compare the effects of intrathecal dexmedetomidine and fentanyl as adjuvants to hyperbaric bupivacaine in saddle block for perianal surgeries ***Methods*:** This observational study in the Department of Anaesthesia, Analgesia, and Intensive Care Medicine at Bangabandhu Sheikh Mujib Medical University Hospital enrolled 64 adults (ASA I–II, 40–60 years) undergoing perianal surgery under saddle block, randomly receiving hyperbaric bupivacaine 7.5 mg with fentanyl 15 µg or dexmedetomidine 5 µg; outcomes included duration of analgesia, pain, sensory and motor block, hemodynamics, patient satisfaction, and adverse events, analyzed using SPSS v23.0. ***Results*:** Among 64 patients (mean age 45.3 ± 8.5 years; 48 males, 75%), postoperative VAS scores were lower in the dexmedetomidine group at all time points (peak 4 h: 2.75 vs 3.75). Duration of analgesia was longer with dexmedetomidine (278.5 ± 16.2 min) than fentanyl (198.7 ± 25.2 min, P = 0.0001). Motor and sensory block durations were also prolonged (162.5 vs 126.5 min and 292.1 vs 205.6 min, respectively). Hemodynamics remained stable, and adverse events were minimal (hypotension 2/32 vs 0/32; nausea/vomiting 5/32 vs 8/32; pruritus 4/32 vs 0/32). ***Conclusion*:** Dexmedetomidine as an adjuvant to hyperbaric bupivacaine in perianal surgeries under saddle block offers longer analgesia, lower pain scores, and faster sensory block onset than fentanyl.

Keywords: Bupivacaine, Intrathecal Adjuvant, Dexmedetomidine, Fentanyl, Saddle Spinal Block.

INTRODUCTION

Saddle block is a commonly used anaesthetic technique for perianal surgeries, providing selective sensory and motor blockade in the perineal region. By administering a small dose of hyperbaric local anaesthetic with the patient in a seated position, the block is confined to the lower sacral segments, minimizing sympathetic involvement and reducing the risk of hypotension. This targeted approach also allows for early mobilization and faster postoperative recovery, making it a preferred technique for short-duration procedures such as hemorrhoidectomy and fistulectomy [1]. Typically, 1–1.5 mL of hyperbaric 0.5% bupivacaine is used, which ensures adequate sensory block and relaxation of the anal sphincter, facilitating surgical manipulation [3]. Despite its effectiveness for intraoperative anaesthesia, postoperative analgesia is often limited when only local anaesthetic is used, and patients frequently experience moderate to severe pain following perianal surgery [2].

To improve postoperative analgesia and enhance block quality, intrathecal adjuvants such as morphine, fentanyl, clonidine, ketamine, and midazolam are commonly employed. Dexmedetomidine, a highly selective α_2-adrenoceptor agonist, has gained attention due to its ability to provide effective intraoperative analgesia, prolong postoperative pain relief, and maintain haemodynamic stability with fewer side effects [4-6]. Fentanyl, a synthetic opioid, is another frequently used intrathecal adjuvant, offering rapid onset and potent analgesic effect, though it is associated with side effects such as pruritus, nausea, and respiratory depression. The

choice of adjuvant can significantly influence the onset and duration of sensory and motor blockade, the intensity of postoperative pain, and overall patient satisfaction.

Despite widespread use, there is limited direct evidence comparing intrathecal dexmedetomidine and fentanyl for saddle block in perianal surgeries in the context of Nepal, where postoperative pain management protocols may differ. Most previous studies have focused on other regional anaesthesia techniques or surgical populations, leaving a gap in knowledge regarding optimal analgesic strategies for this setting. Therefore, this study aimed to compare intrathecal dexmedetomidine and fentanyl as adjuvants to hyperbaric bupivacaine in perianal surgeries performed under saddle block, with a focus on postoperative analgesia duration, block onset and duration, haemodynamic stability, and adverse events.

Objective

- To compare the efficacy of intrathecal dexmedetomidine and fentanyl as adjuvants to hyperbaric bupivacaine for postoperative analgesia in patients undergoing perianal surgeries under saddle block.

METHODOLOGY & MATERIALS

This observational, analytical study was carried out in the Department of Anaesthesia, Analgesia, and Intensive Care Medicine at Bangabandhu Sheikh Mujib Medical University Hospital, Bangladesh, from October 2021 to September 2022. A total of 64 adult patients scheduled for elective perianal surgeries under saddle block were enrolled to compare the effectiveness of intrathecal dexmedetomidine and fentanyl as adjuvants to hyperbaric bupivacaine. Participants were selected based on predefined inclusion and exclusion criteria and randomly allocated into two groups: Group A (n = 32) received hyperbaric bupivacaine 7.5 mg (1.5 mL) with fentanyl 15 µg (30 U), while Group B (n = 32) received hyperbaric bupivacaine 7.5 mg (1.5 mL) with dexmedetomidine 5 µg (10 U).

Inclusion Criteria

- Age 40–60 years of either sex
- Scheduled for perianal surgery with expected duration < 60 minutes
- American Society of Anesthesiologists (ASA) physical status I or II
- Patients scheduled for uncomplicated hemorrhoidectomy or anal fistula surgery

Exclusion Criteria

- Patient refusal
- Age < 40 years or > 60 years
- Pregnancy
- Infection at the lumbar/back region
- History of spine surgery, heart block, cardiac conduction defects, arrhythmias, coagulopathy, mental or neurological disorders
- Hypersensitivity to local anesthetics, dexmedetomidine, or fentanyl
- Intake of analgesic medication within the last 24 hours
- Concurrent use of alpha-adrenergic antagonists, calcium channel blockers, ACE inhibitors/angiotensin receptor blockers, beta-blockers, anti-arrhythmic drugs, or anticoagulants

Ethical clearance was obtained from the Institutional Review Committee (Reference number: IRC/3456), and written informed consent was obtained from all participants.

The primary outcome was the duration of analgesia, defined as the time to first request for analgesia. Based on previous trials comparing bupivacaine plus dexmedetomidine (10 µg) versus bupivacaine plus fentanyl (25 µg), which reported a mean difference of approximately 111 minutes (399.6 ± 72.4 vs 288.8 ± 35.5 min) [7], a conservative mean difference of 45 minutes with a pooled standard deviation of 60 minutes was considered for sample size estimation.

Secondary outcomes included pain intensity, onset and duration of sensory and motor block, perioperative hemodynamic parameters, patient satisfaction, and adverse events. Sensory block was assessed using the pinprick method, while motor block was evaluated with the Bromage scale. Pain intensity was recorded using a numerical rating scale (0–10). Perioperative hemodynamic parameters and adverse events were monitored and recorded throughout the study.

All data were entered and analyzed using SPSS version 23.0 (SPSS Inc., Chicago, Illinois, USA), with continuous variables expressed as mean ± SD and categorical variables as frequency and percentage.

RESULTS

Table 1: Demographic and Preoperative Characteristics of the Study Participants (n = 64)

Characteristic		Group A (n = 32)	Group B (n = 32)	Total (n = 64)	Mean ± SD
Age (years)	40–49	21 (65.63%)	20 (62.50%)	41 (64.06%)	45.3 ± 8.5
	50–60	11 (34.38%)	12 (37.50%)	23 (35.94%)	
Gender	Female	7 (21.88%)	9 (28.13%)	16 (25.00%)	
	Male	25 (78.13%)	23 (71.88%)	48 (75.00%)	

Characteristic		Group A (n = 32)	Group B (n = 32)	Total (n = 64)	Mean ± SD
ASA Status	ASA I	19 (59.38%)	18 (56.25%)	37 (57.81%)	
	ASA II	13 (40.63%)	14 (43.75%)	27 (42.19%)	

The majority of patients were aged 40–49 years (41 patients, 64.1%), followed by those aged 50–60 years (23 patients, 35.9%), with a mean age of 45.3 ± 8.5 years. Male patients predominated (48 patients, 75.0%). Most patients were classified as ASA I (37 patients, 57.8%), with the remainder as ASA II (27 patients, 42.2%). The groups were comparable in terms of age, gender, and ASA status.

Table 2: Postoperative Pain Scores Assessed by Visual Analog Scale at Different Time Intervals (n = 64)

Time Point	Group A (n = 32) Mean ± SD	Group B (n = 32) Mean ± SD
At PACU	1.25 ± 1.0	1.0 ± 1.1
2 Hours	2.5 ± 1.1	1.5 ± 1.1
4 Hours	3.75 ± 1.1	2.75 ± 1.1
6 Hours	2.0 ± 1.1	1.0 ± 0.7

VAS scores were consistently lower in Group B compared to Group A at all postoperative time points. At PACU, the mean VAS was 1.25 ± 1.0 in Group A and 1.0 ± 1.1 in Group B. At 2 hours, the scores increased to 2.5 ± 1.1 in Group A versus 1.5 ± 1.1 in Group B, peaking at 4 hours (3.75 ± 1.1 vs 2.75 ± 1.1). By 6 hours, the scores decreased to 2.0 ± 1.1 in Group A and 1.0 ± 0.7 in Group B.

Table 3: Comparison of Duration of Analgesia Between Groups (n = 64)

Parameter	Group A (n = 32) Mean ± SD	Group B (n = 32) Mean ± SD	P-value	Mean Difference	Pooled SD
Duration of Analgesia (minutes)	198.7 ± 25.2	278.5 ± 16.2	0.0001*	79.8	20.97

The mean duration of analgesia was significantly longer in one group (278.5 ± 16.2 minutes) compared to the other (198.7 ± 25.2 minutes), with a mean difference of 79.8 minutes (P = 0.0001).

Table 4: Intraoperative Hemodynamic Parameters (Systolic, Diastolic, and Mean Arterial Pressure) at Different Time Intervals (n = 64)

Time Point	SBP (mmHg) Group A	SBP (mmHg) Group B	DBP (mmHg) Group A	DBP (mmHg) Group B	MAP (mmHg) Group A	MAP (mmHg) Group B
Pre-anesthesia	121.3 ± 7.2	119.4 ± 7.4	79.6 ± 6.0	78.2 ± 9.4	69.60 ± 11.6	68.93 ± 9.1
5 min	117.3 ± 5.3	116.3 ± 7.5	63.9 ± 5.2	61.2 ± 9.6	70.45 ± 8.2	67.90 ± 9.5
10 min	115.3 ± 7.1	115.5 ± 5.1	69.6 ± 5.6	68.5 ± 9.5	75.40 ± 7.9	74.25 ± 10.2
15 min	115.6 ± 11.2	114.3 ± 4.8	67.6 ± 7.4	61.5 ± 9.7	76.92 ± 8.1	69.18 ± 9.5
20 min	117.9 ± 4.7	118.3 ± 4.2	68.5 ± 7.1	62.9 ± 9.7	76.31 ± 8.6	68.73 ± 9.1
30 min	114.6 ± 15.6	115.8 ± 5.0	72.5 ± 6.8	67.9 ± 8.7	71.57 ± 10.2	65.18 ± 7.5
45 min	117.6 ± 11.6	119.3 ± 8.2	69.5 ± 5.6	65.9 ± 6.3	71.05 ± 9.3	68.46 ± 11.4
60 min	118.3 ± 5.1	117.2 ± 5.8	73.7 ± 9.8	70.9 ± 8.3	69.55 ± 6.8	66.52 ± 7.1

Systolic, diastolic, and mean arterial pressures remained stable throughout the intraoperative period. SBP ranged from 114.6 ± 15.6 to 121.3 ± 7.2 mmHg, DBP varied between 61.2 ± 9.6 and 79.6 ± 6.0 mmHg, and MAP ranged from 65.18 ± 7.5 to 76.92 ± 8.1 mmHg. No clinically significant intergroup differences were observed at any time point.

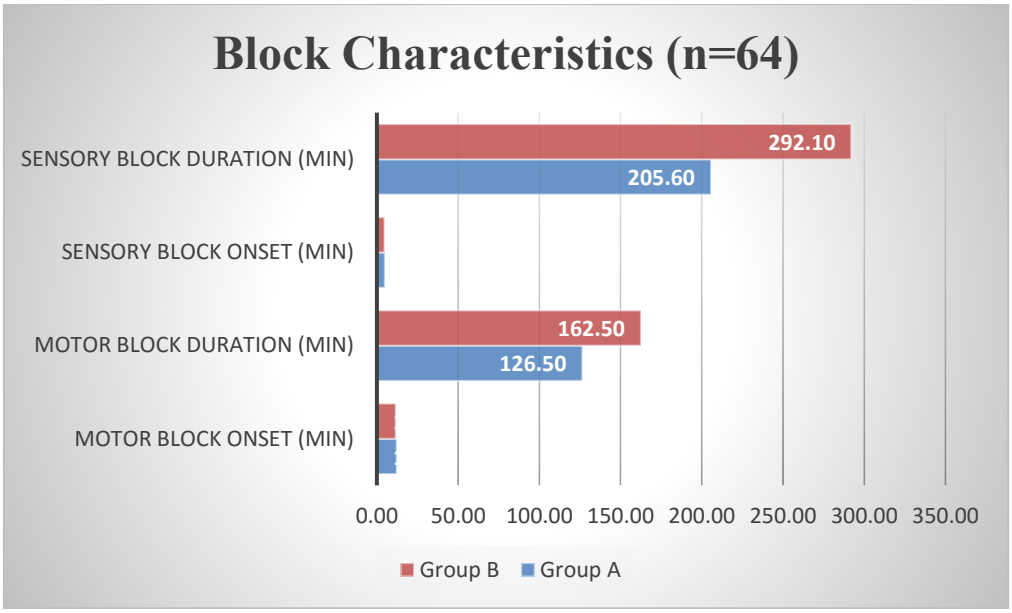

Figure 1: Comparison of Motor and Sensory Block Onset and Duration Between Groups

Motor block onset was slightly faster in Group B (11.58 minutes) compared to Group A (12.26 minutes). The duration of motor block was prolonged in Group B (162.5 minutes) versus Group A (126.5 minutes). Similarly, sensory block onset was comparable between groups (4.65 vs 4.82 minutes), but sensory block duration was markedly longer in Group B (292.1 minutes) compared to Group A (205.6 minutes).

Table 5: Incidence of Adverse Events During the Study Period (n = 64)

Adverse Event	Group A (n, %)	Group B (n, %)
Hypotension	2 (6.25%)	0 (0%)
Nausea/Vomiting	5 (15.63%)	8 (25.00%)
Pruritus	4 (12.50%)	0 (0%)

Adverse events were minimal and manageable. Hypotension occurred in 2 patients (6.3%) in one regimen and none in the other. Nausea and vomiting were observed in 5 patients (15.6%) versus 8 patients (25.0%), and pruritus occurred in 4 patients (12.5%) versus none.

DISCUSSION

This observational analytical study was conducted to compare the effectiveness of intrathecal dexmedetomidine and intrathecal fentanyl as adjuvants to hyperbaric bupivacaine in perianal surgeries under saddle block.

The duration of analgesia was shorter in Group A, with rescue analgesia required at approximately 198 minutes, whereas Group B experienced longer analgesia, requiring rescue analgesia at around 278 minutes. A downward trend in Visual Analog Scale (VAS) scores was observed in both groups over time. This effect may be attributed to the analgesic properties of dexmedetomidine, which act by depressing the release of C-fiber transmitters and hyperpolarizing postsynaptic dorsal horn neurons. Local anesthetic agents, such as bupivacaine, act by blocking sodium channels. The prolonged analgesic effect in Group B may result from a synergistic interaction between the local anesthetic and the α2-adrenoceptor agonist. These findings are consistent with previous studies, including Seyam *et al*., who reported a significantly longer duration of analgesia and lower postoperative pain scores with intrathecal dexmedetomidine compared to fentanyl in perianal surgeries [7-11].

The difference in the duration of analgesia between the groups was statistically significant ($p < 0.05$). This aligns with the findings of Saadawy *et al*. [12], who concluded that dexmedetomidine is a promising adjunct to bupivacaine, providing excellent analgesia over a 24-hour period. Similarly, Xiang *et al*. [13] reported that the addition of dexmedetomidine to bupivacaine prolonged the duration of postoperative analgesia. Fewer patients in Group B required rescue analgesia, likely due to the combined analgesic and sedative effects of dexmedetomidine [14].

In the present study, the onset of both sensory and motor block was faster in Group B. This finding is consistent with reports by Gantasala *et al*. [15] and Bi *et al*. [5], who observed that the mean onset of sensory and motor block in the dexmedetomidine group was faster, although the difference between groups was not statistically significant. Motor and sensory block duration was also longer in Group B, in line with findings

by Gantasala *et al*. [15], Gautam *et al*. [16], and Sudheesh *et al*. [17]. The prolongation of sensory block may result from synergism between local anesthetic and α2-adrenoceptor agonists, while the extended motor block may be due to the binding of α2-adrenoceptor agonists to motor neurons in the dorsal horn [17].

Hemodynamic parameters, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP), were monitored throughout the study. HR was not significantly different between groups at pre-anesthesia and 5 minutes after anesthesia, but a decrease in HR was observed in Group A after 30 minutes. At 45 minutes, the difference in HR between groups was significant, with HR stabilizing in Group B by the end of the follow-up period. These observations are consistent with Bajwa *et al*. [18], who reported that dexmedetomidine exhibits a negative chronotropic effect approximately 30–35 minutes after administration. Thereafter, HR remained stable in both groups, ranging from 56 to 70 beats per minute.

Intraoperative SBP remained stable in both groups, with no statistically significant differences. DBP and MAP were also stable, although from 15 to 45 minutes, mean DBP and MAP were significantly lower in Group B compared to Group A. Hemodynamic stability is a notable feature of both dexmedetomidine and fentanyl administration [19]. Although intrathecal dexmedetomidine has been reported to cause hypotension [20-21], no episodes of hypotension occurred in Group B, though DBP and MAP were significantly reduced compared to Group A, reflecting its mild hypotensive effect.

Adverse events, including hypotension, pruritus, nausea, and vomiting, were observed in Group A, whereas only nausea and vomiting were observed in Group B. These differences were not statistically significant. Similar findings regarding nausea and vomiting were reported by Gautam *et al*. [16]. Patient satisfaction was also comparable between the two groups, with no statistically significant difference.

Limitations of the study

The study had a few limitations:

- Assessment of sensory block in the perianal region posed privacy concerns.
- There is a potential for personal bias in observations and assessments.

CONCLUSION

Dexmedetomidine, when used as an adjuvant to hyperbaric bupivacaine in perianal surgeries under saddle block, provided a longer duration of analgesia, lower pain intensity, and a faster onset of sensory block compared to fentanyl.

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