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Comparison between the Effect of Fentanyl and Dexmedetomidine in Different Doses Intrathecally Adjuvant to Bupivacaine for Lower Abdominal Surgeries

Mohammed Al Saeed Abu Hattab*, Mohamed Mohamed Abo Elenain, Muhammed Jamal Bakheet, Osama Helal Ahmed, Medhat Helaly Allam

Anesthesia, Intensive Care and Pain Management Department, Faculty of Medicine, Al-Azhar University, Assiut, Egypt
***Corresponding author:** Mohammed Al Saeed Abu Hattab, **Email:** drmhmdabuhtb@gmail.com

ABSTRACT
Background: Spinal anaesthesia has many advantages, such as quick action and a reduced recovery time in the postanesthesia care unit, which makes it a reliable and safe choice for surgeries involving the lower legs and abdomen.
Objective: This research aimed to evaluate the effects of intrathecal hyperbaric bupivacaine given in three different doses, namely 5 µg, 10 µg, and 15 µg, both on its own and in conjunction with either fentanyl or dexmedetomidine.
Methods: This prospective, double-blind, randomised trial involved 200 patients, comprising both males and females aged between 21 and 50, who were having scheduled lower abdominal surgery with spinal anaesthesia. Each of the five groups of patients was given an intrathecal injection of a mix that consisted of 15 mg bupivacaine at 0. 5% concentration and a total volume of 3. 5 ml, which contained 0. 5 ml of normal saline. An extra 0. 5 ml of normal saline was provided to Group I, while Group II got 0. 5 ml that included 25µg fentanyl, Group III was administered 0.5ml with 5µg dexmedetomidine, Group IV received 0.5ml with 10µg dexmedetomidine, and Group V received 0.5ml with 15µg dexmedetomidine.
Results: Groups D1, D2, and D3 required significantly more time to provide initial rescue analgesia than groups C and F. At 10 minutes, group D3's heart rate was noticeably lower than that of groups C, F, D1, and D2. Groups D1, D2, and D3 had considerably lower mean arterial pressures than group C. Compared to groups C, F, D2, and D2, group D3 had considerably greater levels of hypotension, bradycardia, and patient satisfaction.
Conclusions: The results show that Dexmedetomidine and Fentanyl helped maintain stable breathing, making them useful additions to spinal anesthesia.
Keywords: Fentanyl, Dexmedetomidine, Intrathecally, Bupivacaine, Lower Abdominal Surgeries.

INTRODUCTION

Dissatisfied patients, cardiovascular events, inadequate breathing, and slowed wound healing are among the unfavourable outcomes that are associated with postoperative discomfort [1].
The management of postoperative pain is a daily challenge for anesthesiologists, regardless of the significant progress made in postoperative pain pharmacotherapy [2].
For abdominal and lower limb surgery, spinal anaesthesia is a safe and reliable kind of anaesthesia that has the advantages of an instantaneous impact, affordability, and simplicity of administration, as well as a comparatively low rate of side effects and a shorter stay in the post-anesthesia care unit [3]. These benefits may be outweighed by a shorter period of effect, or a higher chance of delayed motor function recovery, thus postponing walking and extending hospital stay time [4].
As a result, numerous adjuvants have been tested to boost the pain-relieving properties of bupivacaine. Research has shown that opioids can extend the duration of anesthesia and pain relief, and they have been found to enhance the quality of pain relief and maintain stable blood pressure levels. The reason for combining opioids and local anesthetics is that each of these drug categories targets pain in a distinct location. Opioids act at the spinal cord's receptor location, whereas local anaesthetics act at the individual nerve axon [5]. Fentanyl, a lipophilic opioid that acts quickly after intrathecal administration, improves haemodynamic stability, post-operative analgesia, and the

quality of anaesthesia without producing major adverse effects [6].

In combination with localised anaesthesia, dexmedetomidine, a highly selective α2-adrenergic agonist, has the ability to reduce discomfort and induce sleep [7].

Research has been done on the effectiveness of dexmedetomidine as an adjuvant to intrathecal local anaesthesia, due to its rationale in regional anesthesia stemming from its status as a more selective α 2-adrenoreceptor agonist [8].

The purpose of this research was to evaluate how intrathecal hyperbaric bupivacaine, administered at three different dosage amounts (5 μg, 10 μg, and 15 μg), affects outcomes when used by itself or together with fentanyl, and in combination with dexmedetomidine.

PATIENTS AND METHODS

200 patients of both sexes, aged 21 to 50, with body mass indexes (BMIs) between 18 and 30, who were categorised as having physical status grades I and II by the American Society of Anaesthesiologists (ASA), participated in a prospective, randomised, double-blind trial. Under spinal anaesthesia, these individuals had elective lower abdominal operations. Following the approval from the Ethical Committee of AlAzhar University Hospitals in Assiut, Egypt, with the approval code 72, dated 10/4/2022, the research was conducted between May 2022 and May 2023. The patients gave their written informed consent.

Patients were excluded if they had conditions that made spinal anaesthesia unsafe or if they had a known allergy to any of the medications involved in the study, pregnancy, and emergency surgeries, as well as a history of cardiac arrhythmia or bleeding disorders, an ASA classification of grade III to IV, and a BMI of more than 30 or less than 18.

Randomized and Blindness

Using computer software, an assistant anaesthesiologist divided the two hundred patients into five equal groups at random. Every group was given a total of 3. 5 ml, which included 15 mg of a 0. 5% bupivacaine solution along with 0. 5 ml of standard saline. 25 μg of fentanyl was given to 0.5 ml in Group I. Group II participants received 0.5 ml of ordinary saline along with 5 μg of dexmedetomidine. Simultaneously, Group III (also known as Group D1) was given 5 μg of dexmedetomidine in 0.5 ml, Group IV (also known as Group D2) was given 10 μg in 0.5 ml, and Group V (also known as Group D3) was given 15 μg in 0.5 ml.

Every patient had a full evaluation that included a physical examination, a detailed medical history, and a number of diagnostic procedures, including such as a complete blood count (CBC), prothrombin time (PT), tests for bleeding and clotting, blood urea levels, serum creatinine levels, liver enzyme tests, electrocardiography (ECG), and a plain chest X-ray.

A pre-anesthetic evaluation was conducted for all patients, which involved an explanation of the patient's visual analogue scale (VAS) test score. Prior to surgery, all patients had been fasting for 8 hours. All patients were transported to the operating theatre, where a preoperative checklist ensured that every necessary item was in place, including anesthesia equipment such as the machine, oxygen delivery systems, airway management tools, all t

he equipment needed for resuscitation, including a crash cart. Patients were monitored and their blood pressure (BP), heart rate (HR), oxygen saturation (SpO2), respiratory rate (RR), and continuous electrocardiogram (lead II) were shown on a multichannel screen. The measurements from the baseline data were saved and maintained exactly as they were. Before spinal anaesthesia, each patient received a ringer lactate solution at a rate of 5–10 millilitres per kilogramme of body weight, and an 18G intravenous cannula was placed for access.

Anesthesia technique

The procedure was carried out with the patient seated, involving a lumbar puncture at the L3-4 intervertebral level using a 25-gauge Quincke spinal needle via a paramedian approach under strict aseptic conditions. Verification of the spinal needle's correct placement in the subarachnoid space was confirmed through the aspiration of cerebrospinal fluid, and the study medication was administered intrathecally over a 5-10 second period, with all patients placed in a supine position following the injection. The solution for each group was prepared by another anesthetist not included in the study as mentioned in the grouping using bupivacaine (sunnypivacaine from Egypt), fentanyl

(fentanyl-hamein from Sunny, Egypt), and dexmedetomidine (Precedex, manufactured by Hospira, Inc. in the USA). The sensory and motor blockade was assessed every two minutes following the drug's administration until the peak level of block was achieved. Sensory levels were then continuously monitored every 10 minutes until the effect had diminished by 2 segments. The level was then checked every 20 minutes until the sensation was detected at the S1 dermatome.

The lack of pinprick feeling at the midclavicular line was used to assess the sensory blocking. The modified Bromage scale, which defined as a tool for evaluating motor function, was used to evaluate the motor blockage.

Initial hemodynamic monitoring was followed by measures every two minutes for the first ten minutes, then every five minutes, and finally every fifteen minutes for the first hour, culminating in monitoring at the conclusion of the procedure.

Estimates of HR, non-invasive blood pressure (NIBP), SpO2, and VAS were taken at 4-, 6-, 8-, 12-, 16-, 20-, and 24-hour intervals after surgery. Measurements were recorded each hour during the initial two hours in the post-anesthesia care unit (PACU). The total dose of ketorolac administered and the duration of the initial rescue analgesic administration were documented.

Postoperative complications, characterized by low blood pressure (classified as mean arterial pressure below 25% of its baseline or systolic blood pressure below 90mmHg), were managed with a 5mg dosage of Ephedrine (ephedrine sulfate, produced by MISR co in Egypt), with the dosage then increased. Bradycardia, characterised by a heart rate of less than 50 beats per minute, was treated with 0.5 milligrams of Atropine, specifically the sulphate form manufactured by Misr Company in Egypt. Treatment of vomiting was carried out with Danset 8mg, a product supplied by INAD Pharma for ADWIA in Egypt. Nausea, shivering, pruritus and respiratory depression (RR <8cpm or SPO2 <95%) was treated with O2 supplementation.

Other results measured were heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, oxygen levels, total amount of pain relief given, possible issues such as slow heart rate, feeling sick, throwing up, breathing difficulties, and irregular heartbeat, along with patient contentment. The whole dosage of rescue analgesia, haemodynamic stability (HR, SBP, DBP, MAP, and SPO2), problems (nausea, vomiting, bradycardia, respiratory depression, and arrhythmia), and patient satisfaction were the secondary outcomes.

Sample Size Calculation:

The software G*Power was utilized in version 3.1.9.7, developed by Universität Kiel, Germany. The mean ± standard deviation duration of analgesia (the primary outcome measure) was (2.6±0.75 vs. 3.5±0.72) in group I and group II, as reported by **Bajwa et al. [9].** The choice of sample size was made with consideration for three key elements: an effect size of 0.849, a 95% confidence interval, and a study power of 97%. Each group was expanded by adding five additional cases to mitigate the effects of dropout, resulting in a group ratio of 1:1:1:1:1. Consequently, we are enrolling 40 patients in each of the study groups.

Statistical analysis

IBM©, Chicago, IL, USA's SPSS version 27 was used for the statistical analysis. The Shapiro-Wilks test and histograms were used to verify that the data distribution was normal. Results were presented as mean and standard deviation after ANOVA (F) testing and a Post-Hoc Tukey test were used to analyse quantitative parametric data. For group comparison, the Kruskal-Wallis and Mann Whitney tests were used to provide quantitative nonparametric data as median and interquartile range (IQR). Qualitative variables were analysed using a X^2-test and were expressed as frequencies and percentages. A two-tailed test was considered statistically significant if the P value was less than 0.05.

RESULTS

After 227 patients had their eligibility evaluated, 19 of them did not fit the requirements, and 8 of them declined to take part in the research. Four groups of 40 patients each were randomly selected from the remaining patients. They were all investigated further and subjected to statistical analysis. Figure 1

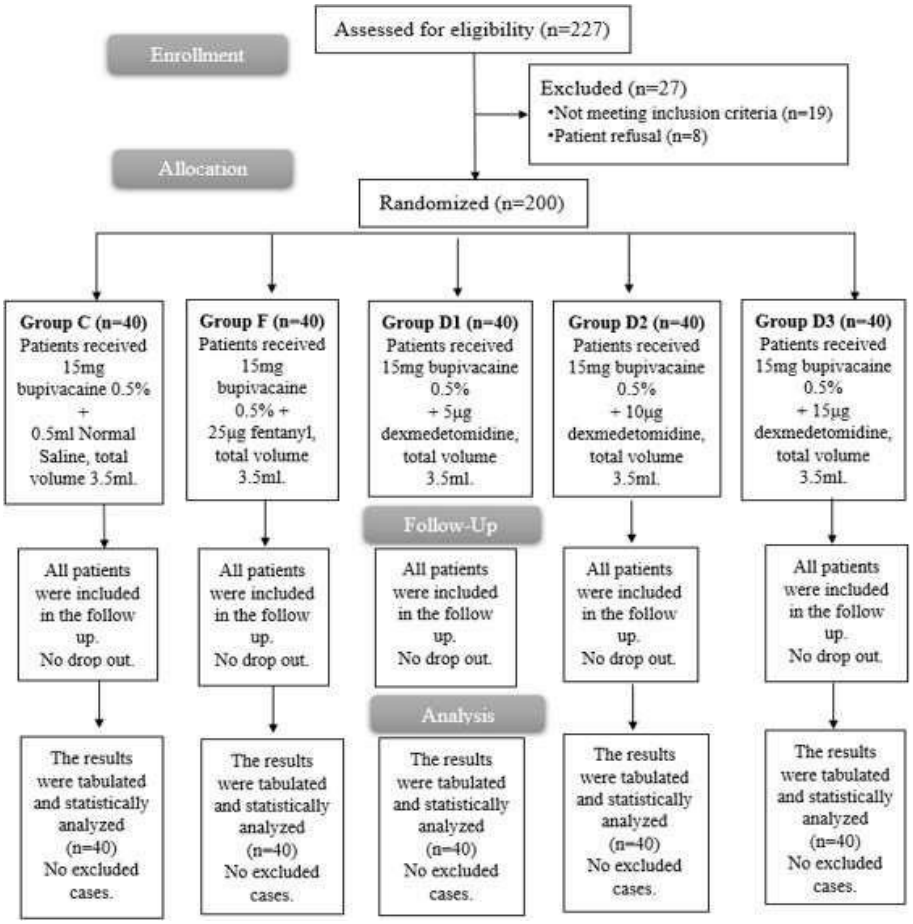

Figure 1: The CONSORT flow diagram illustrates participant progression through each stage of the trial

Table 1 shows that demographic data and surgery duration were not significantly different between the compared groups.

Table 1: Demographic information and the length of surgical procedures are compared in the studied groups

		Group C (n=40)	Group F (n=40)	Group D1 (n = 40)	Group D2 (n=40)	Group D3 (n=40)	P
Age (years)		32.6±7.08	36±7.14	34.7±7.12	35.3±5.5	35.7±8.61	0.105
Sex	**Male**	22(55.0%)	17(42.5%)	18(45.0%)	21(52.5%)	16(40.0%)	0.637
	Female	18(45.0%)	23(57.5%)	22(55.0%)	19(47.5%)	24(60.0%)	
Weight (Kg)		76.2±12.11	78.7±11.69	75.7±10.17	81.3±11.01	80.3±7.38	0.356
Height (cm)		165.5±6.82	166.1±6.64	167.7±7.14	169.3±7.65	168.1±5.87	0.844
BMI (kg/m^2)		27.9±4.82	28.6±4.42	27.1±4.43	28.6±4.85	28.5±3.53	0.305
ASA physical status	**I**	23(57.5%)	25(62.5%)	22(55.0%)	21(52.5%)	24(60.0%)	0.827
	II	17(42.5%)	15(37.5%)	18(45.0%)	19(47.5%)	16(40.0%)	
Duration of surgery (min)		76.8±7.12	73.1±9.38	78.8±8.53	76.3±5.75	77.8±7.92	0.127

Data are presented as mean ± SD or frequency (%). BMI: Body mass index, ASA: American society of anesthesiologists.

There were not many variations in heart rate (HR) between group C and the combinations of groups F, D1, and D2. At this 10-minute mark, however, the HR in group D3 was significantly lower than that of groups C, F, D1, and D2 ($P < 0.001$). At this interval, group D1 showed a substantial decrease in heart rate compared to groups C and F, while group D2 exhibited an even more pronounced drop in heart rate relative to groups C, F, and D1. The HR in group F was significantly lower than in group C with a p-value of less than 0.05. Significant differences in human resources between groups D1

and D2 were not observed at 15- and 30-minute intervals.

No discernible difference in heart rate was observed between groups C and F, or between groups D1 and D2, at 45 and 60 minutes. Group D3's heart rate was significantly lower than group C's, with a p-value less than 0.05. At baseline and at 2, 4, 6, and 8 minutes, no significant differences were found in mean arterial pressure across the five groups. Groups D1, D2, and D3 displayed substantially lower mean arterial pressure (MAP) than group C, with a statistically significant difference ($P < 0.05$), and at 10 minutes, group D3 had a notably lower MAP than groups C, F, D1, and D2, with a highly significant difference ($P < 0.001$). At this specific time point, the mean arterial pressure (MAP) for group D1 was notably lower compared to groups C and F. In contrast, group D2 showed a significantly lower MAP than groups C, F, and D1. Additionally, the MAP for group F was significantly reduced compared to group C, with a pvalue of under 0. 05. There were no significant differences in the MAP values of groups D1 and D2 at the 15 or 30minute marks. Furthermore, at both the 45 and 60minute intervals, no substantial differences in MAP were observed between groups C and F or D1 and D2. Moreover, the MAP for group D3 was significantly less than that of group F ($P < 0. 05$). There were no appreciable variations in MAP between groups D1, D2, and D3 following the procedure.

The SpO2 levels did not show significant differences across all time intervals among the five groups.

Figure 2

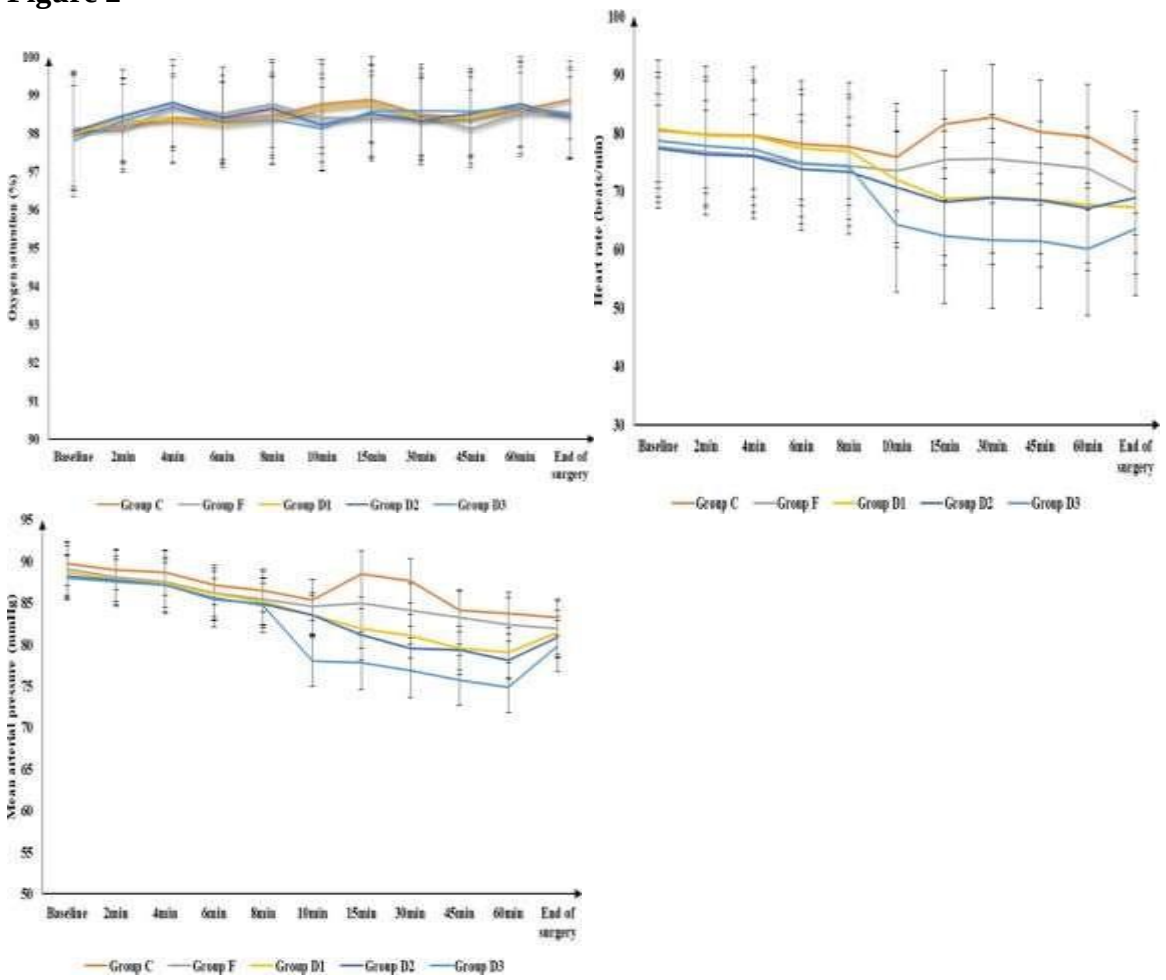

Figure 2: (A) Heart rate, (B) mean arterial pressure and (C) oxygen saturation in the studied groups

Groups F, D1, D2, and D3 demonstrated a significantly shorter time to achieve the highest level of sensory block and to initiate Bromage 3 compared to Group C, with a significance level of $P<0.001$. When comparing Groups D1 and D2 to Group D3, the latter exhibited a notably faster response time, achieving significance at $P<0.05$. Furthermore, Groups D1, D2, and D3 experienced a significant reduction in time relative to Group F, with $P<0.05$ indicating statistical significance. No significant differences were observed between Groups D2 and D1. The duration for two-segment regression in

Groups D1, D2, and D3 was considerably longer than in Group C, with a significant difference noted at P<0.001, and also significantly longer than that of Group F, where P<0.05 was applicable. Group D2 had a longer duration than Group D1, while Group D3's duration was significantly greater than both D1 and D2, with P<0.05 indicating the significant difference. Groups C and F did not show any significant differences. In comparison to Group C, the time required to reach Bromage 0 was significantly reduced in Groups F, D1, D2, and D3, with P<0.001. The onset times in Groups D1, D2, and D3 were significantly shorter than in Group F (P<0.05). Although no significant differences were found between Groups D3 and D2, a significant difference was noted between Groups D2 and D1. Additionally, Group D3 had a significantly shorter onset time compared to Group D1 (P<0.05).
Regarding block duration, Groups F, D1, D2, and D3 exhibited a significantly longer duration compared to Group C (P<0.001). Moreover, the durations for Groups D1, D2, and D3 were significantly extended compared to Group F (P<0.05). Among the groups, Group D3 had the longest duration, showing a significant difference when compared to Group D1 (P<0.05), while a significant difference was also observed between Groups D2 and D1. However, no significant difference was identified between Groups D3 and D2. **Table 2**

Table 2: Compares the times needed to achieve peak sensory block, the onset of block effects, and block duration, alongside the regression times for two segments as well as the time to reach Bromage 3 and 0 among the analyzed groups.

	Group C (n=15)	**Group F (n=15)**	**Group D1 (n=15)**	**Group D2 (n=15)**	**Group D3 (n=15)**	**P**
Time to attain peak sensory block level (min)	13.8±3.56	11.2±2.72	9.2±2.46	7.8±2.84	5.9±2.51	**<0.001***
	P1	**<0.001***	**<0.001***	**<0.001***	**<0.001***	
	P2		**0.014***	**<0.001***	**<0.001***	
	P3			0.199	**<0.001***	
	P4				**0.026***	
Onset of sensory block (min)	10.9±2.1	8.9±1.56	6.4±1.75	4.9±1.31	2.8±1.41	**<0.001***
	P1	**<0.001***	**<0.001***	**<0.001***	**<0.001***	
	P2		**<0.001***	**<0.001***	**<0.001***	
	P3			**<0.001***	**<0.001***	
	P4				**<0.001***	
Time of two segment regression (min)	66±22.3	76.7±23.97	92.3±21.97	111.9±29.64	128.7±25.65	**<0.001***
	P1	0.315	**<0.001***	**<0.001***	**<0.001***	
	P2		**0.043***	**<0.001***	**<0.001***	
	P3			**0.005***	**<0.001***	
	P4				**0.024***	
Onset to Bromage 3 (min)	13.3±1.79	11.9±1.41	10.4±1.13	10±0.88	8.7±1.16	**<0.001***
	P1	**<0.001***	**<0.001***	**<0.001***	**<0.001***	
	P2		**<0.001***	**<0.001***	**<0.001***	
	P3			0.486	**<0.001***	
	P4				**<0.001***	
Onset to Bromage 0 (min)	10.9±2.13	9.9±1.55	8.8±0.98	7.5±1.11	7.1±0.78	**<0.001***
	P1	**0.011***	**<0.001***	**<0.001***	**<0.001***	
	P2		**0.006***	**<0.001***	**<0.001***	
	P3			**<0.001***	**<0.001***	
	P4				0.653	
	428.9±25.46	449.9±25.43	467.7±21.92	503.1±22.65	511.3±25.41	**<0.001***
Duration of block (min)	**P1**	**0.001***	**<0.001***	**<0.001***	**<0.001***	
	P2		**0.011***	**<0.001***	**<0.001***	
	P3			**<0.001***	**<0.001***	
	P4				0.549	

Data are shown as mean ± standard deviation or frequency (%). The calculated p value is less than 0.05, indicating statistical significance. The pairwise comparisons included the following P values: P1: between group C and groups F, D1, D2, and D3; P2: between group F and groups D1, D2, and D3; P3: between group D1 and groups D2 and D3; P4: between group D2 and group D3.

At one hour, twelve hours, sixteen hours, twenty hours, and twenty-four hours, there were no discernible variations in the five groups' VAS scores. However, groups D1, D2, and D3 had substantially lower VAS ratings than groups C and F at 2, 4, and 6 hours. Group D3 had considerably lower scores than both groups D1 and D2, although there was no significant difference between them ($P < 0.05$). Groups D1, D2, and D3 had lower scores than group F at 8 hours, with group D3 having considerably lower scores than groups D1 and D2 ($P < 0.05$), but there was no significant difference in VAS values between groups F and C. **Table 3**

Table 3: VAS score between studied groups

	Group C (n=40)	**Group F (n=40)**	**Group D1 (n = 40)**	**Group D2 (n=40)**	**Group D3 (n=40)**	**P**
1h	1(1-2)	1(1-2)	1(1-2)	2(1-2)	2(1-2)	0.372
2 h	4(2–5.75)	2(2-3)	2(1-3)	2(1–2.75)	1(1-1)	**<0.001***
	P1	**<0.001***	**<0.001***	**<0.001***	**<0.001***	
	P2		**0.029***	**0.012***	**<0.001***	
	P3			0.333	**0.009***	
	P4				**0.023***	
4 h	2.5(2-3)	4(3-5)	2(1-2)	2(1–2.75)	1(1-1)	**<0.001***
	P1	**0.016***	**<0.001***	**0.006***	**<0.001***	
	P2		**<0.001***	**<0.001***	**<0.001***	
	P3			0.259	**0.037***	
	P4				**0.001***	
6 h	3(3-5)	4(2-6)	2(2-4)	3(2.25-4)	2(1-4)	**<0.001***
	P1	**0.048***	**0.005***	**0.045***	**<0.001***	
	P2		**0.038***	**0.048***	**0.004***	
	P3			0.409	**0.042***	
	P4				**0.004***	
8 h	4(2-5)	4(3-5)	3(3-3)	3(1-5)	1(1-4)	**<0.001***
	P1	0.216	**0.022***	**0.019***	**<0.001***	
	P2		**<0.001***	**<0.001***	**<0.001***	
	P3			0.958	**0.038***	
	P4				**0.038***	
12 h	4(3-5)	4(3-5)	4(3-5)	4(2-5)	3(2–3.75)	0.09
16 h	4(3-5)	4(2-5)	4(2-5)	3(2-4)	4(2–5)	0.540
20 h	4(3-5)	4(3-5)	4(2-5)	4(2-5)	3.5(2–4)	0.572
24 h	4(3-5)	4(3-5.75)	4(3-5)	4(3-5)	4(2–4)	0.260

Data are presented as median (IQR). * Significant p value <0.05.VAS: visual analogue scale score.

Groups D1, D2, and D3 demonstrated a notably extended time to the initial administration of rescue analgesia compared to groups C and F. Among these, group D3 exhibited a significantly longer duration than both D1 and D2; however, no statistically significant difference was found between D1 and D2 ($P < 0.05$). Furthermore, group D1 utilized a significantly lower total amount of ketorolac than groups C and F, while both groups D2 and D3 also showed a considerable reduction in consumption compared to groups C and F, achieving statistical significance at $P < 0.05$. No significant differences were observed between groups D1 and D2, D2 and D3, or C and F. Table 4

Table 4: Time to first rescue analgesia and total Ketorolac consumption among studied groups

	Group C (n=40)	Group F (n=40)	Group D1 (n = 40)	Group D2 (n=40)	Group D3 (n=40)	P
Time to first rescue (h)	2.6±0.75	3.5±0.72	6.4±0.7	6.6±1.24	7.9±1.57	**<0.001***
	P1	**<0.001***	**<0.001***	**<0.001***	**<0.001***	
	P2		**<0.001***	**<0.001***	**<0.001***	
	P3			0.875	**<0.001***	
	P4				**<0.001***	
Total ketorolac consumption (mg)	134.3±17.96	128.3±21.47	102.8±19.08	105.8±17.96	93.8±21.68	**<0.001***
	P1	0.653	**<0.001***	**<0.001***	**<0.001***	
	P2		**<0.001***	**<0.001***	**<0.001***	
	P3			0.960	0.249	
	P4				0.054	

Mean ± SD * Significant p value <0.05 is how the data are shown. P1: The difference in P values between groups C and F, D1, D2, and D3. Group F and (group D1, group D2, and group D3) is represented by P2. Group D1 and (group D2 and group D3) is represented by P3. Group D2 and (group D3) is represented by P4.

Group D3 saw substantially greater levels of hypotension, bradycardia, and patient satisfaction compared to groups C, F, D2, and D2 (P <0.05). The groups under study showed little differences in PONV and respiratory depression. None of the patients in either group experienced an arrhythmia. Table 5

Table 5: Complications and patients' satisfaction between studied groups

	Group C (n=40)	Group F (n=40)	Group D1 (n = 40)	Group D2 (n=40)	Group D3 (n=40)	P
Hypotension	1(2.5%)	2(5.0%)	6(15.0%)	9(22.5%)	14(35.0%)	**0.016***
Bradycardia	1(2.5%)	1(2.5%)	4(10.0%)	7(17.5%)	13(32.5%)	**0.04***
Arrhythmia	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	**---**
Respiratory depression	0(0.0%)	0(0.0%)	1(2.5%)	2(5.0%)	3(7.5%)	0.291
PONV	0(0.0%)	2(5.0%)	3(7.5%)	3(7.5%)	5(12.5%)	0.368
Patient satisfaction						
Satisfied	12(30.0%)	17(42.5%)	23(57.5%)	25(62.5%)	32(80.0%)	**<0.001***
Partial satisfied	22(55.0%)	21(52.5%)	16(40.0%)	15(37.5%)	8(20.0%)	

Data are presented as frequency (%). * Significant p value <0.05. PONV: postoperative nausea and vomiting.

DISCUSSION

Spinal anesthesia has become a fundamental aspect of contemporary anesthetic practice, particularly for surgeries involving the lower abdomen. The method includes injecting local anesthetics straight into the subarachnoid area, leading to a rapid development of sensory and motor block [10].

In this study, notable heart rate drops in group D3 were seen at specific time points, starting from 10, 15, 30, 45, and 60 minutes. In contrast, the heart rate and mean arterial pressure were notably reduced in the Dexmedetomidine groups when assessed against the Fentanyl group and the Control group. These results support the sedative properties of Dexmedetomidine, which could be advantageous in alleviating stress responses during surgical procedures and enhancing cardiovascular stability both during and after the operation.

Kumar et al.[1] have found that dexmedetomidine results in a substantial decrease in heart rate, consistent with the findings of the present study. **Kumar et al.**[1] supported significant reduction in HR with dexmedetomidine, like the current study.

Group D3 showed notable reductions in mean arterial pressure (MAP) at various points during the surgical process, starting at 10 minutes and continuing all the way through. According to **Gupta et**

al. [10], individuals in the dexmedetomidine group exhibited a more consistent mean arterial pressure. The results of the current investigation align with those that have been observed. While the findings of the current investigation indicated a more stable MAP with dexmedetomidine, **Sriganesh et al. [11]** found no significant difference in MAP between the two groups.

SpO2 levels between groups showed no significant disparities, suggesting that combining Dexmedetomidine and Fentanyl with Bupivacaine does not negatively impact SpO2, thereby augmenting the overall safety of these medications during surgical procedures.

Similar to the current study, **Khosravi et al. [12]** found consistent SpO2 levels in both groups.

SpO2 levels remained constant across all groups. **Mahendru et al. [13]** found lower SpO2 levels in patients treated with dexmedetomidine compared to those who received fentanyl and the control group, suggesting potential respiratory complications associated with dexmedetomidine, which contradicts the findings of this current study.

According to this study, groups D1, D2, and D3 had sensory and motor block onset faster and persisted longer than groups C and F. The most significant differences were seen in the group assigned to D3. Based on the findings of this study, **Bajwa et al. [9]** indicated that individuals in the dexmedetomidine groups reached the highest level of sensory block more quickly than those in the control group. In contrast, **Park et al. [14]** noted no meaningful difference in the time needed for both groups to show a twosegment regression of the sensory block, suggesting that intrathecal fentanyl did not significantly influence the length of the sensory block.

The research revealed important differences in VAS pain scores across the different groups. The investigation by **Kanazi et al.[15]** found that participants in the D1, D2, and D3 groups reported experiencing less pain than those in the other groups.

Studies [15] showed that patients experienced significantly lower pain ratings with dexmedetomidine treatment compared to fentanyl, this aligns with what we found in our current study. Research by **Mehta et al.[16]** revealed similar pain scores among all groups, suggesting that the variations we noticed in this study could be linked to personal experiences of pain. The time before patients first asked for pain relief was much longer in the Dexmedetomidine groups when compared to both the fentanyl group and the control group, indicating that Dexmedetomidine is effective in extending the duration of analgesia, which in turn reduces the need for subsequent pain relief.

The requirement for pain medication after surgery. In agreement with the current study's findings, **Jyothi et al. [17]** discovered that dexmedetomidine substantially lengthened the period before the initial analgesic request compared to fentanyl. A study by **Gupta et al. [10]** found Dexmedetomidine had a more effective impact on prolonging analgesia compared to fentanyl, in line with the current research.

Shukla et al. [18] noted comparable times to the first analgesic request between dexmedetomidine and fentanyl, suggesting a comparable duration of analgesia, in contrast to the current study's results, which found significantly longer times in the dexmedetomidine groups.

The current study found that the overall quantity of postoperative pain medication (Ketorolac) used was substantially lower in the Dexmedetomidine groups (D2 and D3) than in the fentanyl group.

Experimental and control groups. Our findings agree with the research by **Kumar et al. [1]** which showed that individuals receiving dexmedetomidine required significantly less pain relief after surgery compared to those in the fentanyl and control groups.

When looking at the other groups, the Dexmedetomidine group experienced a notably higher rate of issues like bradycardia and hypotension. However, there were no clear differences in postoperative nausea and vomiting or respiratory depression among the groups. The absence of arrhythmia in any group suggests that, although dexmedetomidine is effective for pain relief, it is linked with an elevated risk of hypotension and bradycardia, necessitating cautious management, in line with our previous research. **Soni et al. [19]** observed significantly higher instances of hypotension and bradycardia in patients treated with Dexmedetomidine, in contrast, **Mohamed et al. [20]** found no notable discrepancies in complications, which is in opposition to the current study's findings of increased occurrences in Group D3.

In this current investigation, Group D3 exhibited the highest patient satisfaction rates, which is consistent with study conducted by **Abdelhamid and El-Lakany** [21] revealed greater patient satisfaction with the use of dexmedetomidine over fentanyl.

The study was hampered by a relatively small sample size. The research took place at a solitary site. The results may not be generalisable to other groups because of the unique demographic and health profiles of the study participants. Concentrating solely on short-term postoperative results without considering long-term consequences and difficulties. Subjective pain was evaluated using the visual analogue scale (VAS), a measure that can be affected by each person's level of pain tolerance. The standard dosing of Dexmedetomidine and Fentanyl may not have been suitable for every patient.

CONCLUSIONS

Dexmedetomidine exhibited enhanced analgesic effects, longer-lasting blocks, and greater patient satisfaction at higher doses when compared to fentanyl and control groups. Dexmedetomidine use was linked to increased occurrences of hypotension and bradycardia.

Close monitoring is crucial during the administration process. Dexmedetomidine and Fentanyl preserved respiratory stability, thus making them useful additives in spinal anaesthesia.

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