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ORIGINAL ARTICLE

Effect of Dexamethasone Versus Dexmedetomidine as an Adjuvant to Intrathecal Hyperbaric Bupivacaine on Sensory Block and Postoperative Analgesia in Elective Ceserean Section

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ABSTRACT

Background: Spinal anesthesia is typically used for caesarean sections. For a brief duration, it effectively manages postoperative pain. This study aimed to improving the quality of anesthesia and postoperative pain by adding intrathecal dexamethasone or dexmedetomidine as adjuvants to hyperbaric bupivacaine in elective Cesarean section. **Methods:** This prospective randomized controlled double blind clinical study, included Forty Eight parturients prepared for cesarean section were divided into three groups, each of 16 parturients. Group C who received 1ml saline added to 10mg hyperbaric bupivacaine. Group D who received 4mg of dexamethasone (1 ml) added to 10mg hyperbaric bupivacaine. Group M who received 10mcg of dexmedetomidine diluted in 1ml saline added to 10mg hyperbaric bupivacaine. **Results:** There was a significant difference between the studied groups regarding the visual analog scale at 6,12,18 and 24 hours, as group M had a lower VAS scale when compared with the other two groups. The onset of sensory block, groups D and M demonstrated significantly accelerated sensory block onset compared to group C, group M exhibited the most prolonged sensory block duration with the mean of (310±21.01) minutes, surpassing both group D and group C. Group D consumed substantially less nalbuphine overall than group C, with a mean of 22.19±3.64 compared to group C mean of 29.38±6.29. Group M had a mean of 7.81±3.15 which was significantly lower than both group C and group D. **Conclusion:** Dexmedetomidine provides significantly longer postoperative analgesia with less analgesics requirement during the first 24 hours post operatively compared to dexamethasone.

Keywords: Spinal anesthesi, Caesarean sections, Dexamethasone , Dexmedetomidine

INTRODUCTION

Spinal anesthesia is the method of choice for ceserean sections, because of its ease of use, dependability, low risk of aspiration and airway difficulties and capacity to facilitate of postoperative analgesia. Maternal-infant bonding and good breastfeeding are established when the mother is awake at the time of the child's birth and is not exposed to possibly depressive medicines [1].

The most widely used local anesthetic in regional anesthesia for cesarean sections since 1982 is bupivacaine. But both its duration and postoperative analgesia are still somewhat short[2].

Numerous studies have demonstrated that dexamethasone, one of several additives used in intrathecal anesthesia, prolongs the duration of peripheral blocks in both human and animal models. Dexamethasone blocks transmission in nociceptive C-fibers and neural discharge to produce analgesic and anti-inflammatory effects. It extends the duration of anesthesia when administered as

an adjuvant in intrathecal anesthesia or peripheral nerve blocks [3].

Dexmedetomidine has no discernible effect on breathing but has sedative, analgesic, and anti-sympathetic properties [4].

The use of dexmedetomidine for anesthesia during cesarean sections has drawn increasing interest. Dexmedetomidine can be utilized as an auxiliary for both general anesthesia and intrathecal anesthetic during cesarean sections, according to studies [5].

It can decrease the quantity of anesthetic medications used, avoid and lessen anesthetic unpleasant reactions, and increase the anesthetic effects [6]. This study aimed to improving the quality of anesthesia and postoperative pain by adding intrathecal dexamethasone or dexmedetomidine as adjuvants to hyperbaric bupivacaine in elective Cesarean section.

METHODS

This prospective randomized controlled double blind clinical study was conducted over the period of one year at Zagazig University college of medicine from January to December 2024 after receiving approval from the Institutional Review Board (IRB# 11182-17-10-2023). This study involved a random sample of 48 parturients undergoing cesarean sections in the operating rooms of the anesthesia, critical care, and pain management departments at Zagazig University hospitals. The World Medical Association's Code of Ethics for Human Studies, known as the Declaration of Helsinki, was followed when conducting the inquiry.

Double blinded; the physician recording the outcomes and the patient were not informed of the patients group.

Sample size:

The group of patients received dexamethasone as an adjuvant first call time for analgesics was 2.86±0.79 (hours), group of patients received dexmedetomidine as an adjuvant to bupivacaine first call time for analgesics was 4.93±1.86 (hours), and After receiving spinal bupivacaine and 1 cm of normal saline, the group of patients' initial analgesic call time was 2.41 ± 0.78 hours, confidence level is 95% two side, 90% power of study, 10% of total number of cases will be added to compensate for the dropout, so the total sample will be 48, 16 patients will be allocated in each group [9].

Written informed consent, age between 21 and 40 years, body mass index between 18.5 and 35 kg/m^2, American Society of Anesthesiologists (ASA) Grade II patients, gestational age >37 weeks and single fetus, surgery lasting less than an hour, and parturients scheduled for elective cesarean sections under spinal anesthesia were the requirements for inclusion. Patients with absolute contraindications to intrathecal anesthesia (e.g., refusing intrathecal anesthesia or having local pathology in the lumbar spine region), pregnancy complications (e.g., placenta accreta, preeclampsia, or eclampsia), drug allergies, medical conditions affecting the kidneys, liver, or heart, alcoholism, opium addiction, or use of any drug that alters pain perception, and patients receiving anticoagulant therapy were excluded.

Three equal groups of 16 parturients each were randomly assigned to patients using a computer-generated randomization table. Group C parturients (n=16) received 1 cc of saline and 10 mg of hyperbaric bupivacaine. Parturients in Group D (n=16) were given 10 mg of hyperbaric bupivacaine together with 4 mg of dexamethasone (1 ml). Parturients in Group M (n=16) were given 10 mg of hyperbaric bupivacaine along with 10 mcg of dexmedetomidine diluted in 1 ml of saline. Three milliliters of total volume were administered intrathecally to each of the three groups.

Preoperative:

A thorough history, any known drug allergies, a general and systemic examination, and a local evaluation of the lumbar spine region were all part of the preanesthetic check-up, which was performed the day before surgery. The patient's weight, height, blood pressure, respiration rate, and pulse rate were recorded. ECG and laboratory tests (complete blood count, hemoglobin, platelets, and white blood cells (WBCs), All patients had relevant investigations, including comprehensive liver and renal function tests, coagulation profiles (PT, PTT, and INR), random blood sugar, and hepatitis markers (A, B, and C).

In order to gauge the patient's present level of discomfort, the Visual Analogue Scale (VAS) 0–10, where 0 denotes "no pain" and 10 denotes "the worst pain imaginable," was also described to them [7]. Prior to surgery, all parturients were maintained nil orally (2 hours for clear fluid, 6 hours for light meals, and 8 hours for fatty meals).

Intraoperative:

All of the monitors, including the five-lead ECG, pulse oximetry, and noninvasive blood pressure, were connected when the patient entered the operating room (OR). At baseline, measurements were made of heart rate (HR), oxygen saturation (SPO2), and mean arterial blood pressure (MAP). A preload of 10 ml/kg intravenous crystalloid solution was administered. In order to get spinal anesthesia, the patient sat up straight at the edge of the operating table, with their feet resting on a stool and their legs dangling off at the end, back to the healthcare provider. Patients rolled their upper backs and shoulders forward. Depending on the patient group, spinal anesthesia was initiated at L3-L4 or L4-L5 using aseptic method with a spinal Quinke needle 25. For left uterine displacement, the patient then lay supine with a pillow beneath her right buttock.

During the first twenty minutes of the process, HR, SPO2 and MAP were recorded every five minutes. After that, they were measured every ten minutes. Syntocinon was infused at a rate of 10 IU per milliliter after the delivery and clamping of the umbilical chord.

Procedure:

Following a 30-minute local anesthetic injection, the patients' heart rates, arterial blood pressures, and oxygen saturation levels were checked every five minutes, and then every fifteen minutes after that. The patient was kept in a supine position until the appropriate level (T10 dermatome) was reached, and sensory block was evaluated with a pin prick every two minutes. The Bromage scale was assessed to attain Bromage 3 prior to surgery[8]. Intravenous atropine (0.04 mg/kg) was used to treat heart rate drops below 60 beats per minute, while fluid boluses and to treat mean arterial pressure reductions below 20% of the baseline, 5 mg intravenous increments of ephedrine were administered.

Postoperative:

Post-Anesthesia Care Unit (PACU) transfers were made for parturients. For one hour, vital signs (MAP, HR, and SPO2) were taken in the PACU every fifteen minutes. As a conventional analgesic, all parturients were given paracetamol at a dose of 15 mg per kg every 8 hours, with a daily limit of 4 gm.

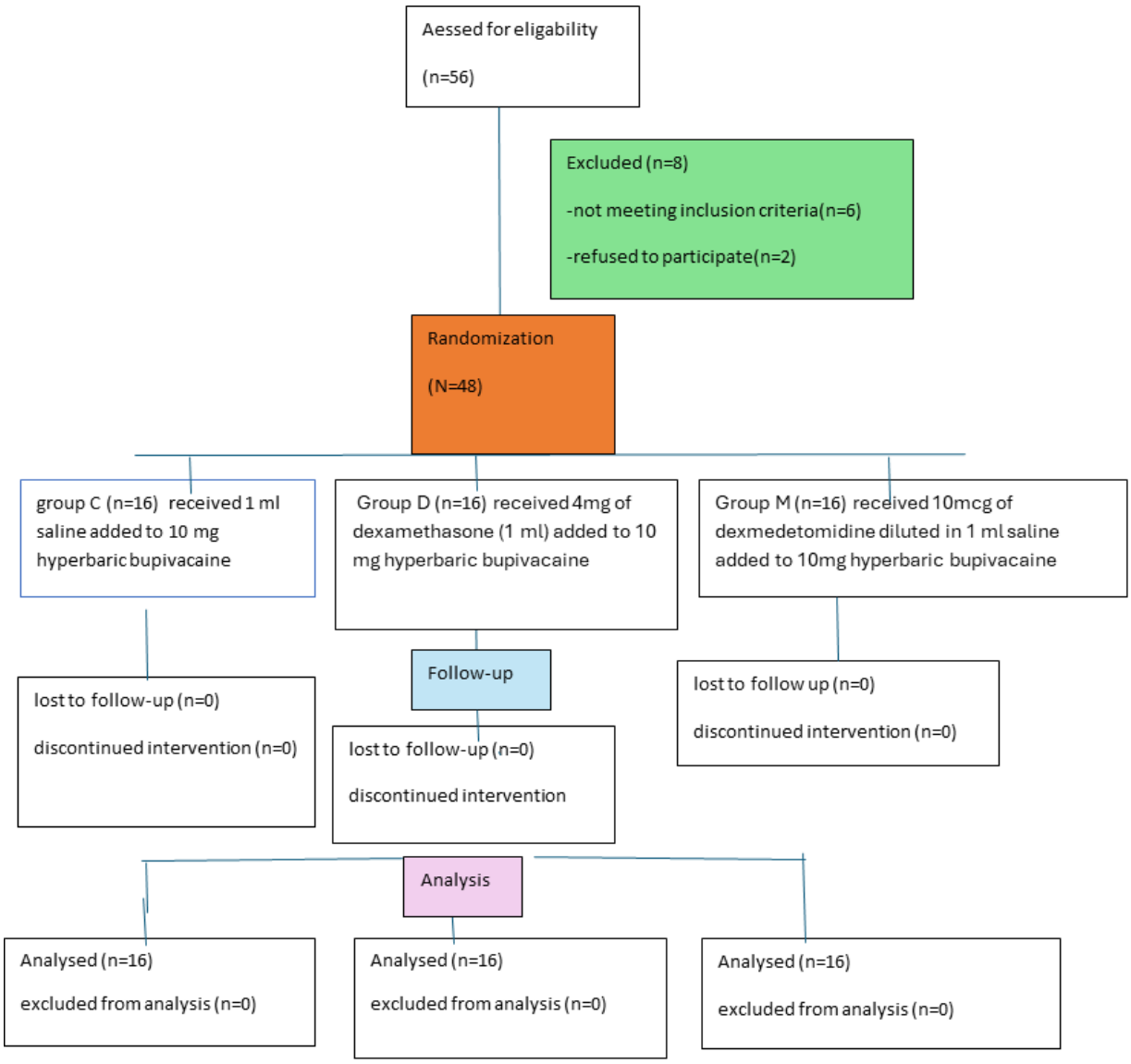
Postoperative analgesia was measured using a visual analogue scale (VAS) with a range of 0 to 10 (0 being no pain and 10 being the most severe pain). VAS was assessed every 30 minutes during the first hour and then again at 2, 4, 6, 12, 18, and 24 hours after surgery. In patients with a VAS of at least three, nalbuphine (0.15 mg/kg IV) was administered. Ten milligrammes of intravenous metoclopramide were used to treat postoperative nausea and vomiting.

Outcome measures:

Outcome measures were assessed and compared between the three groups; **Primary outcome measure** time to first analgesic request. **Secondary outcome measures o**nset and duration of sensory blockade, postoperative pain VAS scores **i**ncidence of nausea, vomiting and pruritus, intraoperative hemodynamic stability and neonatal outcomes as APGAR score was measured at 1 min and 5 min after birth[10].

Statistical analysis

IBM SPSS 23.0 for Windows, a database software tool, was used to code, input, and analyze the gathered data (SPSS Inc., Chicago, IL, USA). Chi-Square X2 analysis to determine if two or more categorical variables were related, a non-parametric test was employed. When the presumption that "less than 20% of cells have expected count less than 5" is not met, Fisher's exact test (f) is employed. Standard deviation (SD) or mean ± SD were used to express quantitative data. $P < 0.05$ was regarded as a statistically significant value.



Study flow chart (Consort)

RESULTS:

Forty-eight patients were enrolled in the present study as shown in flow chart.

Regarding patients' characteristics, table (1) showed no significant difference between the studied groups (*P>0.05)*.

Figure (1) revealed a statistically significant difference in heart rate across the groups under research, with group C having a greater heart rate throughout the study period than the other two groups, with the exception of those times when group D had a higher heart rate at 20 minutes and 4 hours (P<0.001).

Figure (2) revealed that during the first six hours of the trial, there was no discernible change in the mean arterial pressure between the groups; however, at 10, 20, 30, 45, 60, 75, 4 and 6 hours, there was a statistically significant difference between the groups. Group M had a higher mean arterial pressure during the first six hours of the study than the other two groups (P<0.001).

Table (2) and figure (3) showed that the onset of sensory block, group C had a mean of 5.31 ± 0.87, group D had a mean of 4.63 ± 0.62. Group M had a mean of 4.56 ± 0.51, both groups were significantly lower than group C *(P<0.001)*. As regards the duration of sensory block, group C had a mean of 194.9 ± 11.05, group D had a mean of 220.4 ± 50.76 which was significantly higher than group C *(P<0.001)*. Group M had a mean of 310 ± 21.01 which was significantly higher than both group C *(P<0.001)* and group D *(P<0.001)*.

Table (3) demonstrated that, when comparing the visual analog scale at 6, 12, 18, and 24

hours, there was a statistically significant difference between the groups under study, with group M having a lower VAS scale than the other two groups *(P<0.001)*.

Table (4) and figure (4) showed that the total nalbuphine consumption, group C had a mean of 29.38 ± 6.29, group D had a mean of 22.19 ± 3.64 which was significantly lower than group C *(P<0.001)*. Group M had a mean of 7.81 ± 3.15 which was significantly lower than both group C *(P<0.001)* and group D *(P<0.001)*.

Table (5) revealed no discernible variation in the APGAR scores at 1 and 5 minutes across the groups under study (P>0.05).

Table (6) showed that no significant difference between the studied groups regarding adverse effects *(P>0.05)*.

Table 1: Patients characteristics among the studied groups

Variables		Group C (n=16)	Group D (n=16)	Group M (n=16)	P Value
Age *(years)*	*Mean ± SD*	30.4 ± 6.26	29.9 ± 4.79	29.4 ± 5.66	
	Range	(21 – 39)	(21 – 36)	(22 – 40)	0.91
BMI *(kg/m²)*	*Mean ± SD*	29.9 ± 3.03	28.3 ± 4.12	28.6 ± 4.23	
	Range	(24.1 – 34.2)	(21.4 – 34)	(21 – 34)	0.41

**One way ANOVA test, Non-significant: P >0.05, Significant: P ≤0.05*

Table 2: Comparison of onset and duration of sensory block among the studied groups

		Group C (n=16)	Group D (n=16)	Group M (n=16)	*P Value	Post-Hoc
Onset of sensory block *(minutes)*	*Mean ± SD*	5.31 ± 0.87	4.63 ± 0.62	4.56 ± 0.51		P1**<0.0163**
	Range	(4.4 – 6.2)	(4 – 5.3)	(4 –5)	**<0.001**	P2**<0.0057** P3**<0.7297**
Duration of sensory block *(minutes)*	*Mean ± SD*	194.9 ± 11.05	220.4 ± 50.76	310 ± 21.01		P1**<0.001**
	Range	(180 – 216)	(220 – 238)	(270 – 340)	**<0.001**	P2**<0.001** P3**<0.001**

**P=One way ANOVA test (Comparison between the three groups), P1=Comparison between Group C & Group D, P2=Comparison between Group C & Group M, P3=Comparison between Group D & Group M*

Table 3: Comparison of visual analog scale among the studied groups

VAS		Group C (n=16)	Group D (n=16)	Group M (n=16)	*P Value	Post-Hoc
2 hours	*Mean ± SD*	2	2	2		
	Range	(2 – 2)	(2 – 2)	(2 – 2)	1.00	-
4 hours	*Mean ± SD*	2	2	2		
	Range	(2 – 2)	(2 – 2)	(2 – 2)	1.00	-
6 hours	*Mean ± SD*	3.31 ± 0.48	3.44 ± 0.51	2.63 ± 0.72		P1=0.82
	Range	(3 – 4)	(3 – 4)	(2 – 4)	**0.003**	P2=**0.005** P3**<0.001**
12 hours	*Mean ± SD*	4.88 ± 0.62	4.5 ± 0.52	3.31 ± 0.48		P1=0.13
	Range	(4 – 6)	(4 – 5)	(3 – 4)	**<0.001**	P2**<0.001** P3**<0.001**
18 hours	*Mean ± SD*	4.94 ± 0.44	4.63 ± 0.5	3.69 ± 0.48		P1=0.16
	Range	(4 – 6)	(4 – 5)	(3 – 4)	**<0.001**	P2**<0.001** P3**<0.001**
24 hours	*Mean ± SD*	6 ± 0.63	5.13 ± 0.81	3.69 ± 0.48		P1=**0.001**
	Range	(5 – 7)	(4 – 6)	(3 – 4)	**<0.001**	P2**<0.001** P3**<0.001**

P=One way ANOVA test (Comparison between the three groups), P1=Comparison between Group C & Group D, P2=Comparison between Group C & Group M, P3=Comparison between Group D & Group M

Table 4: Comparison of total nalbuphine consumption among the studied groups

		Group C (n=16)	Group D (n=16)	Group M (n=16)	*P Value	Post-Hoc
Total nalbuphine *(mg)*	*Mean ± SD*	29.38 ± 6.29	22.19 ± 3.64	7.81 ± 3.15	**<0.001**	P1**<0.001** P2**<0.001** P3**<0.001**
	Range	(20 – 40)	(15 – 30)	(5 – 15)		

P=One way ANOVA test (Comparison between the three groups), P1=Comparison between Group C & Group D, P2=Comparison between Group C & Group M, P3=Comparison between Group D & Group M

Table 5: Comparison of APGAR score among the studied groups

APGAR score		Group C (n=16)	Group D (n=16)	Group M (n=16)	*P Value	Post-Hoc
1 minute	*Mean ± SD*	8.69 ± 0.87	8.19 ± 0.83	8.75 ± 0.78	0.13	P1=0.21 P2=0.98 P3=0.15
	Range	(7 – 10)	(7 – 9)	(7 –10)		
5 minutes	*Mean ± SD*	9.75 ± 0.45	9.69 ± 0.48	9.81 ± 0.4	0.73	P1=0.92 P2=0.92 P3=0.71
	Range	(9 – 10)	(9 – 10)	(9 – 10)		

P=One way ANOVA test (Comparison between the three groups), P1=Comparison between Group C & Group D, P2=Comparison between Group C & Group M, P3=Comparison between Group D & Group M

Table 6: Comparison of adverse effects among the studied groups

Outcomes (n. %)	Group C (n=16)	Group D (n=16)	Group M (n=16)	*P Value
Nausea or vomiting	2 (12.5%)	2 (12.5%)	2 (12.5%)	1.00
Bradycardia	2 (12.5%)	1 (6.3%)	2 (12.5%)	1.00
Hypotension	2 (12.5%)	2 (12.5%)	1 (6.3%)	1.00

P=Fisher exact test (Comparison between the three groups).

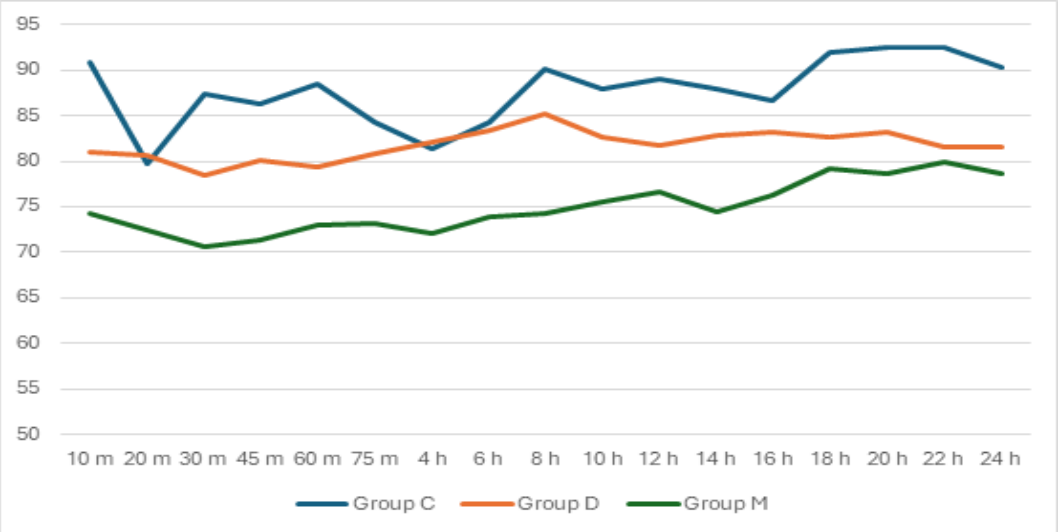


Figure 1: Line graph showing the heart rate change among the studied groups

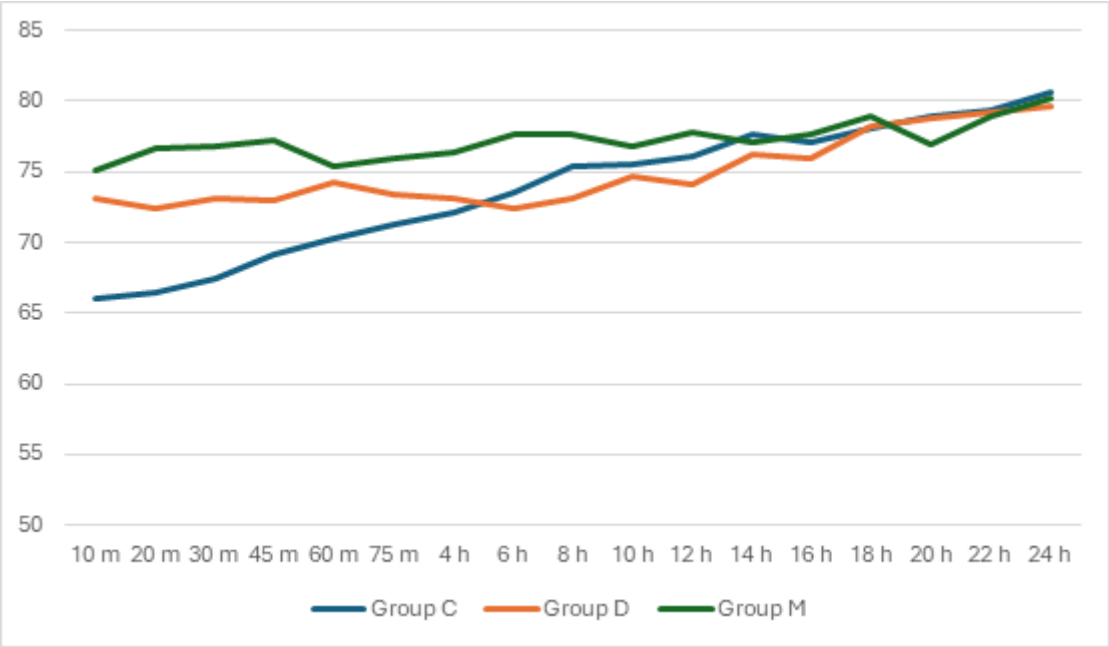


Figure 2: Line graph showing the mean arterial pressure change among the studied groups

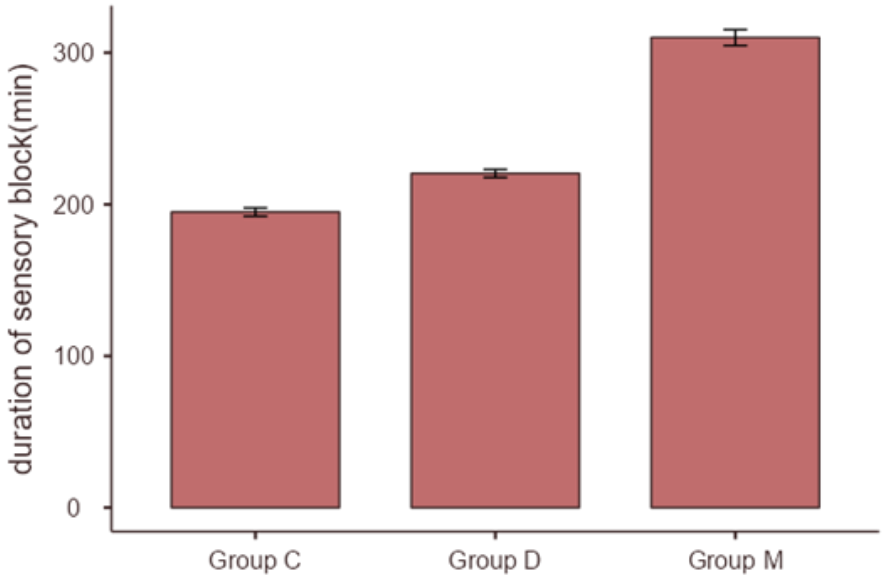


Figure 3: Bar chart showing the duration of sensory block among the studied groups

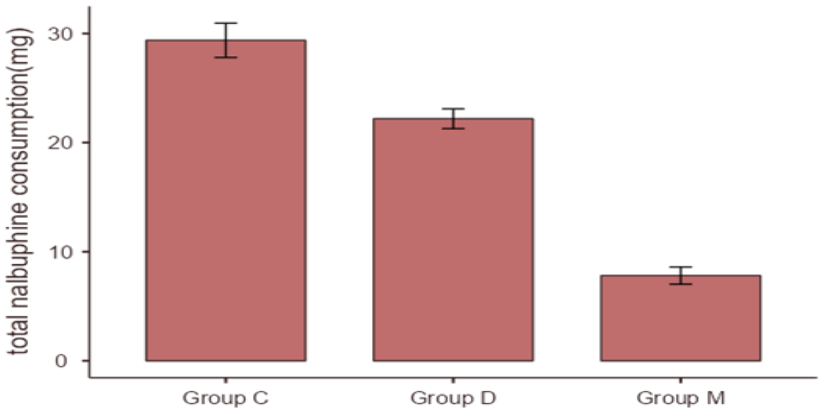


Figure 4: Bar chart showing the total nalbuphine consumption among the studied groups.

DISCUSSION

When dexmedetomidine was given to intrathecal bupivacaine, it was discovered to prolong the sensory blockage and the time to first request analgesia in comparison to both bupivacaine alone and dexamethasone. This was observed in connection with the sensory block's onset and endurance. For anesthesia of the spine, we found that combining dexmedetomidine with bupivacaine produced a much longer duration of sensory block, with a mean of 310±21.01 minutes and a mean start of sensory block of 4.56±0.51, which was consistent with the findings of the study by Shukla et al [11]. They found that, in contrast to magnesium sulfate administered with intrathecal bupivacaine, dexmedetomidine prolonged the duration and postponed the onset of spinal anesthesia [11].

According to a another study, intrathecal dexmedetomidine was superior to clonidine and fentanyl because it produced a longer-lasting motor and sensory block and decreased the need for further analgesics [12].

The current study's findings were consistent with research comparing dexmedetomidine and clonidine at varying dosages as bupivacaine adjuncts, which discovered that dexmedetomidine extended longer than clonidine did in terms of sensory and motor block duration.

Many authors have used dexamethasone Tkachenko et al[13], Moeen et al [14], Gupta et al[15] and dexmedetomidine [16-19] as supplements to local anesthetics and have demonstrated significant results; nonetheless, there is minimal evidence and disagreement over their safety and recommended dosages.

Additionally, our results align with those of Hassan, Gonapa, and Elzayyat, who discovered the same noteworthy distinctions between the two adjuvants [20-22].

A selective agonist of alpha-adrenoreceptors is dexmedetomidine. In neuroaxial and peripheral anesthesia, it can extend the duration of analgesia and anesthesia [16–19]. Furthermore, it has no connection to respiratory depression [20]. In a preclinical study and in clinical practice, intrathecal dexmedetomidine did not appear to cause any neurological impairment [15].

In terms of total nalbuphine intake, the dexmedetomidine group consumed 7.81±3.15 mg, while the dexamethasone group consumed 22.19±3.64 mg. Among others, our findings concurred with those of [20-26].

In a study of 60 adult patients undergoing lower limb orthopaedic surgery, as adjuvants to intrathecal bupivacaine anesthesia, intrathecal dexmedetomidine and dexamethasone were investigated. They discovered that dexmedetomidine produced longer postoperative analgesia and spinal anesthesia duration [20].

Furthermore, in a prospective randomized research, Gonapa et al. compared dexmedetomidine and dexamethasone as bupivacaine adjuncts for caudal analgesia in pediatric patients undergoing lower abdomen surgeries. They discovered that prolonged postoperative analgesia was associated with dexmedetomidine [21].

Mazy et al. for postoperative analgesia following caesarean sections, dexamethasone and dexmedetomidine were investigated as adjuncts to preperitoneal bupivacaine; it was demonstrated that dexmedetomidine generated better analgesia than dexamethasone [24].

Dexmedetomidine and dexamethasone were investigated by Thakur et al. as bupivacaine adjuncts in transverse abdominis plane block for postoperative analgesia following cesarean delivery using the subarachnoid block. They discovered that the combination of bupivacaine with dexmedetomidine and dexamethasone reduced postoperative pain, prolonged analgesia, and reduced the need for additional analgesics. The dexmedetomidine group reported analgesia that lasted for a long time [25].

To find out how well dexmedetomidine and dexamethasone work as analgesics when combined with bupivacaine during fascia iliaca block during procedures for proximal femur fractures, Sana et al. planned a prospective, double-blind, randomised, and controlled trial. Compared to dexamethasone,

they showed that the addition of dexmedetomidine produced superior postoperative analgesia [26].

There was no discernible difference between the groups under study in terms of the negative effects of intrathecal dexamethasone or dexmedetomidine. Nonetheless, a 2024 meta-analysis demonstrated the superiority of dexamethasone in lowering nausea and vomiting. This is because the previous trial utilized a dose of 8 mg of dexamethasone, whereas this study used 4 mg [27].

According to the study's findings, the duration of sensory blockage was extended by over 100% when intrathecal bupivacaine was combined with dexmedetomidine instead of bupivacaine alone. However, when dexamethasone was added to intrathecal bupivacaine, the duration of sensory blocking was increased by 33.3%. There is debate regarding the cost-effectiveness of the two medications because dexmedetomidine has a higher physical cost than dexamethasone. Nevertheless, the intangible expenses (hospitalization, infection of the wound, stay in the intensive care unit if required, antibiotics, etc.) must be considered while selecting a drug.

LIMITATIONS:

Even though this study provides useful information regarding the efficacy of dexamethsone or dexmedetomidine in elective cesarean sections, there are several limitations to consider. Even if the sample size was sufficient to identify meaningful changes, future research could use a bigger sample size to boost the power of the results.

Conclusion:

We can draw the conclusion that both medications could be added to bupivacaine intrathecally without risk. Compared to dexamethasone, dexmedetomidine offers noticeably longer postoperative analgesia and requires less analgesics during the first 24 hours after surgery. Additionally, the sensory blackout caused by these medicines occurs quickly. To ascertain the ideal dosage of dexamethasone and dexmedetomidine and to evaluate the intrathecal route's safety, more dose-response studies are required.

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