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IS DEXMEDETOMIDINE A SUPERIOR ADJUVANT FOR SEGMENTAL SPINAL ANAESTHESIA TO AID EARLY AMBULATION WITHOUT PAIN?

Anaesthesiology

Dr Prakash Kumar Sharma MD Student, Junior Resident, Department Of Anaesthesiology, Hind Institute Of Medical Sciences

Dr Nishat Nasar MD Associate Professor, Department Of Anaesthesiology, Hind Institute Of Medical Sciences

Dr. Hemant Singh MD, Assistant Professor, Department Of Anaesthesiology, Hind Institute Of Medical Sciences

Dr Rajiv Lakhotia* MD, PDCC, AdvPTExAM, International Diploma in ECMO Professor, Department of Anaesthesiology, Hind Institute of Medical Sciences *Corresponding Author

ABSTRACT

Spinal anaesthesia is the most used technique for lower abdominal surgeries as it is very economical and easy to administer. However, postoperative pain control is a major problem because spinal anaesthesia using only local anaesthetics is associated with a relatively short duration of action, and thus early analgesic intervention is needed in the postoperative period. The objective of the study is to estimate the perioperative analgesic effects of dexmedetomidine and fentanyl as an adjuvant for thoracic segmental spinal anaesthesia while aiding early ambulation and to evaluate the hemodynamic stability offered by thoracic segmental spinal anaesthesia with its adjuvant for lower abdominal surgeries. In this study 25G Quincke spinal needles were inserted through T9-T10 interspace in a sitting position using aseptic precautions to deliver the drug into intrathecal space. In this study, the mean time for onset of sensory block was significantly shorter with both dexmedetomidine and fentanyl compared to plain ropivacaine. Furthermore, the onset of sensory block was faster with the addition of dexmedetomidine to ropivacaine compared to the addition of fentanyl. Furthermore, the time to rescue analgesia was longer, and the number of top-ups needed in 24 h was lesser with the addition of dexmedetomidine, compared to the addition of fentanyl. It can therefore be concluded that both dexmedetomidine and fentanyl enhance readiness for surgery. Dexmedetomidine produced a more prolonged duration of sensory block and postoperative analgesia as compared to fentanyl, which is highly significant compared to ropivacaine. Dexmedetomidine has been shown to have an upper edge over fentanyl when used as an adjuvant to ropivacaine for thoracic segment spinal anesthesia.

KEYWORDS

Segmental spinal anaesthesia; dexmedetomidine; fentanyl; ropivacaine; post-operative analgesia.

INTRODUCTION

Spinal anaesthesia is the most commonly used technique for lower abdominal surgeries as it is very economical and easy to administer. However, postoperative pain control is a major problem because spinal anaesthesia using only local anesthetics is associated with a relatively short duration of action, and thus early analgesic intervention is needed in the postoperative period. Several adjuvants, such as clonidine and midazolam, and others have been studied to prolong the effect of spinal anaesthesia [1,2].

A common problem during lower abdominal surgeries under spinal anaesthesia is visceral pain, nausea, and vomiting. [3] The addition of 12.5 µg fentanyl to ropivacaine improves the quality of intraoperative and early postoperative subarachnoid block [4]. The addition of opioids to local anaesthetic solutions has disadvantages, such as pruritus and respiratory depression. Dexmedetomidine ($C_{13}H_{16}N_2$) a new highly selective α2-agonist, is under evaluation as a neuraxial adjuvant as it provides stable haemodynamic conditions, good quality intraoperative and prolonged postoperative analgesia with minimal side effects [5-7]. Dexmedetomidine has been approved by the Food and Drug Administration (FDA) as a short-term sedative for mechanically ventilated intensive care unit (ICU) patients. Based on earlier human studies, it is hypothesized that intrathecal 5 µg dexmedetomidine would produce more intraoperative and postoperative analgesic effects with ropivacaine in segmental thoracic spinal anesthesia with minimal side effects. [5-7]. Till date, there has been no study comparing the addition of dexmedetomidine to ropivacaine and fentanyl to ropivacaine, although various studies have compared dexmedetomidine and fentanyl with isobaric bupivacaine [5-6]. Intrathecal α_2-agonists are used as adjuvant drugs to local anaesthetics [9-11]. In previous clinical studies, intravenous dexmedetomidine resulted in a significant opioid-sparing effect as well as a decrease in inhalational anesthetic requirements [9-11].

This study envisages scientifically establishing and investigating the possibility of offering segmental spinal anaesthesia with its adjuvant for some abdominal surgeries of short to medium duration (up to 2 hrs) for its expected benefits of early ambulation and better hemodynamic stability relative to conventional spinal anaesthesia with its adjuvant reported in its literature.

MATERIALS & METHODS

A cross-sectional consecutive comparative analytical double-blind study was undertaken for the period of 18 months. Patient as per American Society of Anesthesiologists (ASA) physical status I or II, either sex, age 20– 60 years, presenting for lower abdominal surgeries, height 150 cm– 180 cm, weight 50kg – 75 kg after giving consent for participation in the study were included. Patients allergic to drug, heart block/dysrhythmia, or on therapy with adrenergic receptor antagonist, beta – blocker, calcium channel blocker, and/or ACE inhibitor, major psychiatric illness were excluded.. 60 patients classified in the American Society of Anesthesiologists classes I and II scheduled for lower abdominal surgeries were studied. The group allocation was performed by the principal investigator. Allocation concealment was done by keeping the random numbers sealed and was only opened by the principal investigator. The drugs were prepared by the principal investigator, and the names of the drugs were not marked on the syringe to maintain double-blinding. Either 2ml 0.75% (15mg) isobaric ropivacaine (group A, n= 20), 2 ml 0.75% (15mg) isobaric ropivacaine plus 5µg dexmedetomidine (group B, n = 20), and 2 ml 0.75 % (15mg) isobaric ropivacaine plus 12.5 µg fentanyl (group C, n = 20) intrathecal. All patients received alprazolam 0.25 mg and tab. ranitidine 150 mg orally, the night before surgery and the morning of surgery at 7 AM. The patients were preloaded with Lactated Ringer's solution 10 mL/kg. Monitoring included automated noninvasive blood pressure, pulse oximetry, electrocardiogram, heart rate, respiratory rate, urine output, and assessment of patient consciousness status by verbal interaction intermittently. 25G Quincke spinal needles were inserted through T9-T10 interspaces in a sitting position using aseptic precautions to deliver the drug into intrathecal space. Patients were randomly divided into the following groups: Group A—to receive 2 mL volume of 0.75% isobaric ropivacaine and Group B to receive 2ml volume of 0.75% isobaric ropivacaine plus 5 µg dexmedetomidine intrathecal and Group C to receive 2mL volume of 0.75% isobaric ropivacaine with 12.5 µg fentanyl intrathecal. An intrathecal injection was given over approximately 10–15 seconds. immediately after completion of the injection, the patient was placed in the supine position. Oxygen (4-5 L/min) was administered via a mask if the pulse oximeter reading decreases below 93%. Hypotension, defined as a decrease of systolic blood pressure by more than 20% from baseline or a fall below 90 mmHg, was treated with incremental IV

doses of mephentermine 6mg and IV fluid as required. Bradycardia, defined as heart rate <60 bpm, would be treated with IV atropine 0.6mg. The incidence of adverse effects, such as nausea, vomiting, shivering, pruritus, respiratory depression, sedation, and hypotension were recorded. Sensory anaesthesia by pinching with sponge holding forceps and dermatome levels was examined every 3min, 5min, 7min, and 9min until the sensory block of the highest level and lowest level dermatome had stabilized and determined by consecutive testing. On achieving T6 sensory blockade level, clinical anaesthesia is defined for our study. Testing is then conducted after 30min from the onset and thereafter every 10 min until the point of two-segment regression of the block is observed from caudal or cranial extension. Inj. acetaminophen 1000 mg IV was given at 30 minutes post intrathecal LA and repeated every 6 hours. Postoperatively (90 min of intrathecal dose) the pain score is recorded by using a Visual Analogue Pain scale (VAS) between 0 and 10 (0 = no pain, 10 = most severe pain), initially every 1 h for 2 h, then every 2 h for the n next 8 h and then after every 4 h till shifted to the ward from post-operative room. Inj. tramadol 100mg in 100ml NS was given intravenously as a rescue analgesic whenever VAS was ≥4 on observation timings. If after 1hr of the first rescue analgesic VAS score remains ≥4 then Inj. diclofenac AQ 75 mg IV was used as second rescue analgesic. Data was analyzed using SPSS (Statistical Package for Social Sciences) version 26.0. Results were expressed as mean and standard deviation (SD) or number or percentage. Analysis of data between groups was performed using one-way analysis of variance (ANOVA). Between the study groups data was compared using a t-test. The p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1 shows the mean comparison of the three groups' pre-op pulse rate, pre-op respiratory rate, pre-op SpO2, and time of 2-segment regression. The ANOVA results show that the results are statistically non-significant ($p>0.05$) in all the variables mentioned below, which shows that the pre-op pulse rate, pre-op respiratory rate, pre-op SpO2, and time of 2-segment regression are not statistically significant.

Table 2 shows the mean intra-operative heart rate of the three groups at different time intervals. The result shows that there was a statistically non-significant difference among the three groups at 0 minutes and 5 minutes ($p>0.05$). The intraoperative heart rate at later time intervals shows statistically significant results ($p<0.05$) with minimum heart rate seen in Group C.

0.1
45

Table 3 shows the mean comparison of the three groups based on the intra-operative SpO2. The ANOVA test result shows a statistically non-significant difference ($p>0.05$) between the three groups at different time intervals. This shows that there was not much difference in Spo2 between the three groups during the intra-operative procedure. Table 4 shows the mean VAS score at different time intervals. The result shows that the significant difference was only seen at 90 minutes between the three groups ($p<0.05$).

Table 5 shows the mean time of first micturition and total duration of analgesia among the three groups. The ANOVA test result shows that there is a statistically significant ($p<0.005$) difference between the three groups with a maximum time in Group C followed by Group B and a minimum in Group A.

DISCUSSION

Regional anesthesia plays an essential role in multimodal pain management. Spinal anaesthesia is simple to perform, uses a small dose of drugs, offers rapid onset of action, reliable surgical anaesthesia with good muscle relaxation. These advantages are sometimes offset by a relatively short duration of action and complaints of postoperative pain when the effect wears off. Spinal anaesthesia with ropivacaine hydrochloride is increasingly being used these days owing to its lack of cardiotoxicity and neurotoxicity. The efficacy of local anaesthetics can be enhanced using adjuvants such as opioids, α2 agonists, magnesium, neostigmine, and ketamine. Prolongation of the duration of spinal block is desirable both for long procedures and for postoperative pain relief.

In this study, the mean time for the onset of sensory block was significantly shorter with both dexmedetomidine and fentanyl compared to plain ropivacaine. Furthermore, the onset of sensory block was faster with the addition of dexmedetomidine to ropivacaine compared to the addition of fentanyl. These results were similar to the results of Johannes J. al. There was prolonged postoperative analgesia, lesser need for top-ups, and lesser total dose of postoperative local anesthetic with the addition of dexmedetomidine to ropivacaine as compared to fentanyl, and this was similar to the findings in the study by Bajwa et al. Furthermore, the time to rescue analgesia was longer, and the number of top-ups needed in 48 h was lesser with the addition of dexmedetomidine, compared to the addition of fentanyl. The incidence of hypotension was significantly higher with the addition of dexmedetomidine and required treatment with intravenous fluids or vasopressors.

CONCLUSION

It can therefore be concluded that both dexmedetomidine and fentanyl enhance readiness for surgery. Dexmedetomidine produced a more prolonged duration of sensory block and postoperative analgesia as compared to fentanyl, which is significant and highly significant as compared to ropivacaine. Hence dexmedetomidine is better than fentanyl when used as an adjuvant to ropivacaine for thoracic segment spinal anesthesia, and thus promises to be yet another addition to the already vast armamentarium of the present-day anesthetist. thoracic segmental spinal anaesthesia offers early ambulation as a significant added advantage.

Figures:

Fig 1: Landmark marking for thoracic spines

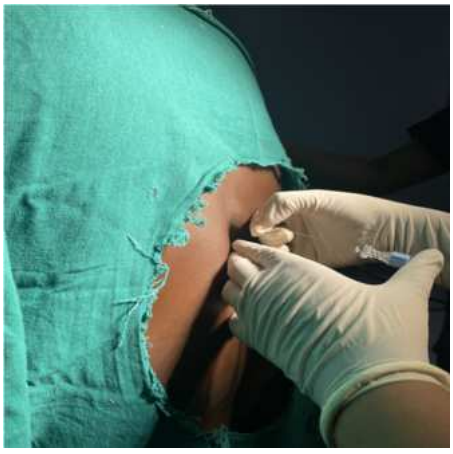

Fig 2: Intrathecal injection at T9-T10 interspace.

Tables:

1. Comparison of Pre operative pulse rate, respiratory rate, SpO2 and time of 2 segment regression in the three groups.

GROUP		Pre-op pr	Pre-op RR	Pre-op SpO2	time of 2-segment regression
A	MEAN	82.40	16.20	99.80	68.00
	SD	6.012	1.005	.410	10.052
B	MEAN	81.50	15.70	99.80	77.45
	SD	6.270	.657	.410	4.032

C	MEAN	76.65	16.25	99.55	98.80
	SD	13.546	.639	.510	13.000
P-VALUE		0.118	0.058	0.133	<0.001

2. Comparison of intra operative HR in the three groups

GROUP		IO Hr o min	IO HR 5 min	IO HR 10 MIN	IO HR 15 MIN	IO HR 20 MIN	IO HR 25 MIN	IO HR 30 MIN	IO HR 40 MIN	IO HR 50 MIN	IO HR 60 MIN	IO HR 70 MIN
A	MEAN	80.55	72.20	71.20	72.80	73.60	71.00	74.20	70.00	69.00	72.80	71.80
	SD	5.336	5.531	7.194	6.031	7.037	7.539	1.508	5.026	2.513	4.021	1.508
B	MEAN	78.35	76.15	77.30	68.00	62.00	72.00	82.00	78.00	72.00	70.00	73.40
	SD	6.037	5.905	3.373	.000	.000	.000	.000	.000	.000	.000	2.162
C	MEAN	80.45	68.35	65.20	62.00	66.00	67.00	70.00	65.00	66.00	61.00	60.00
	SD	11.422	10.059	6.701	3.554	.000	.000	.000	.000	.000	.000	.000
P- VALUE		0.625	0.007	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001

3. Comparison of intra operative SpO2 in the three groups.

GROUP		IO spo2 0 min	io spo2 5 min	io spo2 10 min	io spo2 15 min	io spo2 10 min	io spo2 15 min	io spo2 20 min	io spo2 25 min	io spo2 30 min	io spo2 40 min	io spo2 50 min	io spo2 60 min	io spo2 70 min
A	MEAN	99.60	99.60	99.60	99.60	99.60	99.55	99.60	99.60	99.60	99.60	99.60	99.60	99.60
	SD	.598	.598	.598	.598	.598	.605	.598	.598	.598	.598	.598	.598	.598
B	MEAN	99.85	99.85	99.85	99.85	99.80	99.85	99.85	99.85	99.85	99.85	99.85	99.85	99.80
	SD	.366	.366	.366	.366	.410	.366	.366	.366	.366	.366	.366	.366	.410
C	MEAN	99.85	99.85	99.85	99.85	99.85	99.85	99.85	99.85	99.85	99.85	99.85	99.85	99.85
	SD	.366	.366	.366	.366	.366	.366	.366	.366	.366	.366	.366	.366	.366
P-VALUE		0.145	0.145	0.145	0.145	0.213	0.067	0.145	0.145	0.145	0.145	0.145	0.145	0.213

4. Comparison of post-operative VAS score in the three groups.

GROUP		VAS o hrs	vas 30 min	vas 60 min	vas 90 min	vas 120 min
A	MEAN	.00	.00	.00	.60	.00
	SD	.000	.000	.000	.503	.000
B	MEAN	.00	.00	.00	1.00	2.00
	SD	.000	.000	.000	.000	.000
C	MEAN	.00	.00	.00	.25	.00
	SD	.000	.000	.000	.444	.000
P-VALUE		-	-	-	<0.001	-

5. Comparison of time of first micturiotion and total duration of analgesia in the three groups.

GROUP		TIME OF FIRST MICTURITION	TOTAL DURATION OF ANALGESIA
A	MEAN	181.75	312.00
	SD	42.404	60.315
B	MEAN	239.25	360.00
	SD	38.329	61.559
C	MEAN	250.50	435.00
	SD	41.132	34.412
P-VALUE		<0.001	<0.001

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