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A Comparative Study of Efficacy of Dexmedetomidine and Fentanyl As an Adjuvant to Inrathecal Bupivacaine for Lower Limb and Lower Abdominal Surgeries

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Abstract

Background: Many adjuvants have been tried to improve the duration of spinal anesthesia and quality of analgesia both intraoperatively and postoperatively to overcome the disadvantages of spinal anesthesia. *Aims:* The aim of this study was to evaluate the onset and duration of sensory and motor block, hemodynamic effect, postoperative analgesia and adverse effects of dexmeditomedine or fentanyl given with hyperbaric bupivacaine for spinal anesthesia. *Materials and Methods:* 120 patients were divided into two groups of sixty each undergoing lower limb and lower abdominal surgeries with ASA Grade 1 and 2. Patients were randomly allocated to receive either *Group BD*: 0.5% Hyperbaric Bupivacaine 15 mg + 5 μg Dexmedetomidine; *Group BF*: 0.5% Hyperbaric Bupivacaine 15 mg + 25 μg Fentanyl intrathecally. *Results:* Patients in dexmedetomidine group showed a significantly prolonged duration of motor and sensory block than patients in fentanyl group. *Conclusions:* Addition of dexmedetomidine potentiates bupivacaine spinal anesthesia by increasing significantly the duration of motor and sensory blockage with hemodynamic stability and reduced rescue analgesics as compared to fentanyl.

Keywords: Bupivacaine; Spinal anesthesia; Dexmedetomidine; Fentanyl.

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Introduction

Spinal anesthesia is a popular and common technique for lower abdominal surgeries. It is simple to perform, offers rapid onset of action, relatively less side-effects and early patient's discharge has made this the choice of many surgical procedures.[1]

However, postoperative pain control is a major problem because spinal anesthesia using only local anesthetics is associated with relatively short duration of action and thus early analgesic intervention is needed in the postoperative period. A number of adjuvants such as clonidine, midazolam, fentanyl and others have been used with local anesthetics' in spinal anaesthesia to avoid intra operative visceral and somatic pain and prolong the effect of spinal anaesthesia.[2,3]

The addition of Fentanyl to hyperbaric bupivacaine improves the quality of intraoperative and early postoperative subarachnoid block.[5] The addition of opioids to local anesthetic solutions have disadvantages such pruritis and respiratory depression.

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Dexmedetomidine, a highly selective α_2 agonist with a relative high ratio of α_2/α_1 activity (1620:1) possesses all these properties but lack respiratory depression, which makes it a safe adjuvant.[4]

Materials and Methods

This study was conducted after approval from ethical committee of institution. Written informed consent was taken from all patients.

The study population of 120 patients, age and sex matched was randomly divided by computer generated slip in to two groups with 60 patients in each group:

Group D: received 0.5% Bupivacaine 15 mg + Dexmedetomidine 5 mcg.

Group F: received 0.5% Bupivacaine 15 mg + Fentanyl 25 mcg.

Inclusion criteria: were adult patients aged between 18 and 60 years belonging to ASA Grade 1 and 2, of both sex undergoing lower limb and lower abdominal surgeries.

Exclusion criteria: were Patient refusal, infection at the site of injection, hypersensitivity to drugs, bleeding diathesis, heart blocks, peripheral neuropathy and patients with cardiac, pulmonary, hepatic or renal disorder.

Patients were shifted to OT table; IV access was obtained on the forearm with 18 Gauge IV cannula and Lactated Ringer's solution 500 ml infused intravenously before the block. The monitors were connected to the patient which include noninvasive blood pressure, pulse oximeter. Baseline PR, BP, RR and SpO_2 were recorded.

Under strict aseptic precautions, lumbar puncture was performed by using disposable Quincke spinal needle (25 G) at L3-L4 intervertebral space and study drug was injected after confirming CSF free flow. Patients were monitored continuously using noninvasive blood pressure, pulse oximeter and electrocardiogram.

Hypotension defined as a decrease of systolic blood pressure by more than 30% from base line, was treated with IV doses of ephedrine 5 mg and IV fluid as required. Bradycardia was defined as < 50 beats/min, treated with IV atropine 0.6 mg. Incidence of adverse effects noted. Sensory testing was assessed by loss of pin prick sensation to hypodermic needle and dermatome levels were tested every 2 minute until the highest level has stabilized. Testing was then conducted every 10 minutes until the point of two segment regression of the block was observed and continued till the recovery of S2 dermatome. Postoperatively pain score was recorded by Visual analog pain scale at 3, 6 and 12 hours. Injection diclofenac was given intramuscularly as rescue analgesia when VAS was > 4.

The data obtained were entered in a Microsoft Excel sheet, and statistical analysis was performed using statistical package for the social sciences (Verson 17). Results are presented as drawings, Mean ± SD, counts and percentages. Results were compared using Independent *t*-test, Mann Whitney *U*-test and Friedman test with Dunn's post hoc test. For all tests, significant was achieved at $p < 0.05$.

Results

The groups were comparable with age, sex, height, weight has shown in Table 1, which shows no significant difference. The meantime for onset of sensory block in Group BF was 3.1 ± 0.75 minutes and in Group BD was 3.25 ± 0.95 min. The onset of sensory block in both groups was statistically not significant. The meantime for onset of motor block in Group BF was 5.38 ± 1.1 min. and in Group BD was 5.9 ± 1.32 min. There was no statistically significant difference in two groups with regard to onset of motor block. The time for two segment regression was considerably slower in Group BD with 132.27 + 9.5 min compared to Group BF which was 97.57 + 8.8 min. The difference was statistically significant.

Table 1: Demographic profile

Variables	Group I (BF)		Group II (BD)		Mann Whitney *U*-test/*t*-test	*p* - value	Remark
	Mean	SD	Mean	SD			
Age	37.29 (35)	11.85	37.37 (35, 5)	11.984	$U = 1752$	$p = 0.928$	NS
Sex Male/Female	41:19	–	41:19	–	–	–	–
Height	5.58 (5.6)	0.28	5.50 (5.5)	0.29	$U = 993$	$p = 0.151$	NS
Weight	59.71 (59)	7.9	59.82 (60)	9.369	$t = 0.0633$	$p = 0.949$	NS

NS: Not Significant.

The mean duration of sensory block (time for complete sensory recovery) in Group BF was 209.98 + 12.3 min and in Group BD was 300.15 + 18.53 min. There was statistically significant difference in duration of sensory recovery, (Table 2).

The mean duration of motor recovery in Group BF was 186.5 ± 13.22 min. and in Group BD was 272.92 ± 23.32 min. There was highly significant difference between two groups regarding motor recovery, Table 2. The mean duration of complete analgesia in Group BF 174.63 ± 23.79 min. and in Group BD was 291.78 ± 52.12 min. There was statistically significant difference in both groups with regards to duration of complete analgesia. The mean duration of effective analgesia in Group BF was 211.25 ± 21.43 min and in Group BD was 351.3 ± 36.3 min.

Table 2: Recovery parameters

Recovery parameters	Group BF	Group BD	Mann Whitney *U*-test	*p* - value
Time to two segment regression	97.57 (100) 8.81	132.27 (132) 9.51	15.50	$p < 0.001$ HS
Time to complete sensory recovery	209.98 (210.0) 12.30	300.15 (304) 18.53	0.500	$p < 0.001$ HS
Time to complete motor recovery	186.5 (184.5) 13.22	272.92 (277) 23.32	3.00	$p < 0.001$ HS

There is highly significant difference in between two groups with regard to effective analgesia. In Group BF first rescue analgesia was given after 228 minutes and in Group BD 381 minutes which is highly significant. At any interval the two groups did not differ significantly with respect to heart rate, Fig. 1. In Group BD five patients had bradycardia which was treated by 0.6 mg Atropine successfully. In Group BF no incidence of bradycardia. In BF Group 8.3% patients had nausea, 5% patients had vomiting, 3.33% patients had bradycardia, 3.3% patients had hypotension. In BD Group 3.3% patients had nausea, 8.33% patients had bradycardia, 11.6% patients had hypotension.

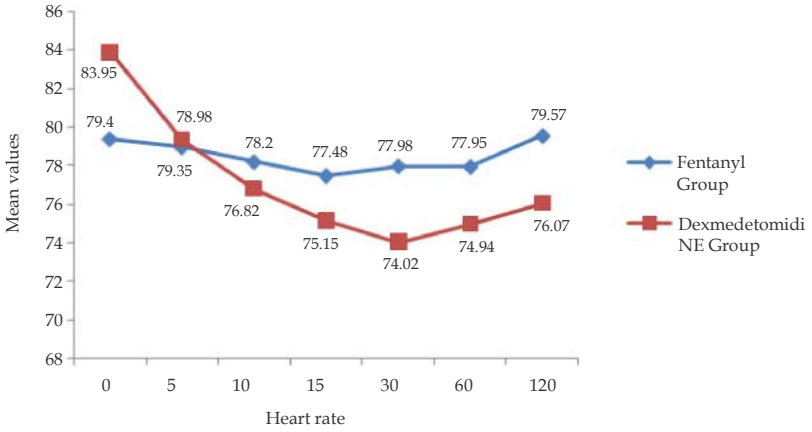

Fig. 1: Heart rate

Discussion

The analgesic effect of α_2 agonist is mediated through stimulation of α_{2C} and α_{2A} receptor in dorsal horn, thus directly suppressing pain transmission by reducing the release of pronociceptive transmitters, substance *p* and glutamate, and hyperpolarization of interneurons.[6]

Local anesthetic agents act by blocking sodium channels. The prolongation of effect may result from synergism between local anesthetic and α_2-adrenoceptor agonist, while the prolongation of the motor block of spinal anesthetics may result from the binding of α_2-adrenoceptor agonists to motor neurons in the dorsal horn[7]. Fentanyl is a lipophilic μ-receptor agonist opioid. Intrathecally, fentanyl exerts its effect by combining with opioid receptors

in the dorsal horn of spinal cord and may have a supraspinal spread and action.[8]

In our study, the intrathecal dose of Dexmedetomidine selected was based on previous study conducted by Rajni Gupta et al.[9] Our study showed, the addition of 5 mcg Dexmedetomidine with hyperbaric bupivacaine significantly increased duration of both sensory and motor block. Rajni Gupta et al.[9] had studied the effect of addition of 5 mcg Dexmedetomidine or 25 mcg Fentanyl intrathecal to 12.5 mg hyperbaric Bupivacaine for lower abdominal surgeries concluded that duration of sensory block, motor block, analgesia and time to rescue analgesic was significantly longer in Dexmedetomidine as compared to Fentanyl group, our results correlate with this study. Al-Ghanem *et al.* had studied the effect of addition of 5 μg Dexmedetomidine or 25 μg fentanyl intrathecal to 10 mg isobaric bupivacaine in vaginal hysterectomy and concluded that 5 μg Dexmedetomidine produces more prolonged motor and sensory block as compared with 25 µg fentanyl.[10] In our study, in the Dexmedetomidine group we found longer duration of both sensory and motor blockade, stable hemodynamic condition, and good patient satisfaction.

In our study, there was significant difference with respect to change in mean systolic blood pressure in both groups. But with regard to diastolic blood pressure there is statistically significant difference in reduction of mean diastolic blood pressure but not clinically (to become clinically significant, reduction in blood pressure should be more than 30%).

On the basis of the present, clinical comparative study, we can conclude that the addition of 5 mcg Dexmedetomidine to intrathecal hyperbaric bupivacaine for lower limb and lower abdominal surgeries appears to be an attractive choice as compared to 25 mcg Fentanyl. It provides a longer duration of both sensory and motor blockade, good quality of both Intraoperative and postoperative analgesia with minimal side-effects and better hemodynamic stability.

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