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ORIGINAL RESEARCH

Using dexmedetomidine and fentanyl intrathecally as adjuvants to bupivacaine for lower abdominal surgeries: A comparative study

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Abstract

Background: This study was conducted to evaluate the onset and duration of sensory and motor block, hemodynamic effect, postoperative analgesia, and adverse effects of dexmedetomidine or fentanyl given intrathecally with hyperbaric 0.5% bupivacaine in lower abdominal surgeries.

Materials and Methods: Sixty ASA grade I & II patients scheduled for lower abdominal surgeries were randomly allocated to receive either 12.5 mg hyperbaric bupivacaine plus 5 μg dexmedetomidine (group D, n = 30) or 12.5 mg hyperbaric bupivacaine plus 25 μg fentanyl (group F, n = 30) intrathecal. The sensory-motor block characteristics, effects on hemodynamic parameters & analgesia were studied.

Results: Patients in group F had faster onset of motor and sensory block than group D (P = 0.000). Patients in group D had significantly longer duration of motor and sensory blockade as compared to those in group F (P = 0.000). Postoperative analgesia was significantly longer in group D than group F (P =0.000). Incidence of side effects among the two groups was not statistically significant.

Conclusions: Fentanyl has faster onset compared with Dexmedetomidine but prolonged duration of sensory and motor blockade with postoperative analgesia was seen with Dexmedetomidine without significant side effects.

Keywords: Bupivacaine, dexmedetomidine, fentanyl, spinal anaesthesia

Introduction

Spinal anesthesia 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 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, fentanyl and midazolam, and others have been studied to prolong the effect of spinal anesthesia. [1,2]

A common problem during lower abdominal surgeries under spinal anesthesia is hypotension, visceral pain, nausea, and vomiting.[3] The addition of fentanyl to hyperbaric bupivacaine improves the quality of intraoperative and early postoperative subarachnoid block.[4] The addition of opioids to local anesthetic solution has disadvantages, such as pruritus and respiratory depression. Dexmedetomidine, a new highly selective α2-agonist, is under evaluation as a neuraxial adjuvant as it provides stable hemodynamic conditions, good quality of intraoperative and prolonged postoperative analgesia with minimal side effects.[5] Dexmedetomidine has been approved by 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 postoperative analgesic effect with hyperbaric bupivacaine in spinal anaesthesia with minimal side effects.[5]So we decided to conduct a study forcomparative effect of the addition of dexmedetomidine to hyperbaric bupivacaine with fentanyl to hyperbaric bupivacaine.

Materials and Methods

The study was conducted at tertiary care institute in southern Rajasthan, after approval of ethical committee. Written informed consent was obtained from all patients. Inclusion criteria were either sex, age 18–50 years, presenting for lower abdominal surgeries. Exclusion criteria were patient allergic to drug, refusal by patient, infection at the site of spinal anaesthesia, thrombocytopenia, heart block/dysrhythmia, or on therapy with adrenergic receptor antagonist, calcium channel blocker, and/or ACE inhibitor.

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All patients received Alprazolam 0.25 mg orally, the night before surgery. The patients were preloaded with Lactated Ringer's solution 15 mL/kg. They were monitored with automated noninvasive blood pressure, pulse oximetry, and electrocardiogram. 25G Pencil point spinal needles were introduced through L3–L4 interspaces in sitting position using aseptic precautions. Patients were randomly divided into the following groups: Group D—to receive 2.5 mL of 0.5% hyperbaric bupivacaine and 5 μg dexmedetomidine in 0.5 mL of normal saline intrathecal [dexmedetomidine (100 μg/mL) was diluted in preservative-free normal saline] and Group F—to receive 2.5 mLof 0.5% hyperbaric bupivacaine with 25 μg fentanyl intrathecally. Intrathecal injection was given over approximately 10–15 s. Immediately after completion of the injection patients were made to lie supine.

Oxygen (2 L/min) was administered via a mask if the pulse oximeter reading decreased below 90%. Hypotension, defined as a decrease of systolic blood pressure by more than 30% from baseline or a fall below 90 mmHg, was treated with incremental IV doses of ephedrine 5 mg and IV fluid as required. Bradycardia, defined as heart rate < 50 bpm, was treated with IV atropine 0.3–0.6 mg. The incidence of adverse effects, such as nausea, vomiting, shivering, pruritus, respiratory depression, sedation, and hypotension were recorded. Sensory testing was assessed by loss of pinprick sensation to 23G hypodermic needle and dermatomes levels were tested every 2 min until the highest level had stabilized by consecutive tests. On achieving T7 sensory blockade level, surgery was allowed. Testing was then conducted every 10 min until the point of two segment regression of the block was observed. Further testing was performed at 20-min intervals until the recovery of S2 dermatome. The surgeon, patient, and the observing anesthesiologist were blinded to the patient group. Data regarding the highest dermatome level of sensory blockade, the time to reach this level from the time of injection, time to S1 level sensory regression, time to urination, and incidence of side effects were recorded. Sedation was assessed by a modified Ramsay sedation scale.

Modified Ramsay sedation scale:

1. Anxious, agitated, restless.
2. Cooperative, oriented, tranquil.
3. Responds to commands only.
4. Brisk response to light glabellar tap or loud noise.
5. Sluggish response to light glabellar tap or loud noise.
6. No response.

Postoperatively, the pain score was recorded by using visual analog 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 next 8 h and then after every 4 h till 24 h. Diclofenac was given intramuscularly as rescue analgesia when VAS was >4.

Statistical analysis was done using the Statistical Package for Social Science (SPSS 25.0 Evaluation version). To calculate the sample size, a power analysis of α=0.05 and α=0.90, showed that 30 patients per study group were needed. Data are expressed as either mean and standard deviation or numbers and percentages. Students T test & Chi Square tests were applied where deemed appropriate. P<0.05 was considered statistically significant.

Results

Table 1: Demographic Characteristics - Age, Height and Weight2

Study parameter	Group D	Group F	P value
Age (yrs)	33.6±9.74	31.7±9.01	0.436
Weight (kg)	64.4±6.25	63.77±6.58	0.617
Height (cm)	161.5±6.42	159.73±6.34	0.288

Table 2: Demographic Characteristics – Gender

Study parameter	Group D	Group F	P value
Male	24	21	0.371
Female	6	9	
Total	30	30	

Table 3: Sensory-motor blockade, Analgesia Characteristics & Surgery Duration

Study parameter	Group D	Group F	P Value
Onset of sensory block(sec)	462±61.33	369.33±41.27	0
Time to cephalic spread T7(min)	10.65±1.73	7.92±0.64	0
Two segmentregression(min)	138.83±11.5	115.5±9.94	0
Onset of motor Block(sec)	540±66.85	472±49.16	0
Duration of motor block(min)	301.67±19.45	267.50±11.2	0
Duration of surgery (min)	101.17±11.72)	98.33±13.41	0.387
Post operative Analgesia(min)	344.67±25.43	240.83±24	0

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Table 4: Overall Incidence of Side Effects and Complications

Complication	Group D	Group F	Total
Nausea & Vomiting	1 (3.3%)	2 (6.7%)	3 (5%)
Hypotension	3 (10%)	2 (6.7%)	5 (8.3%)
Bradycardia	4 (13.3%)	1 (3.3%)	5 (8.3%)
Shivering	0 (0.0%)	2 (6.7%)	2 (3.3%)
Pruritus	0 (0.0%)	2 (6.7%)	2 (3.3%)
No Complication	22 (73.3%)	21 (70%)	43 (71.7%)
Total	30 (100%)	30 (100%)	60 (100%)

Discussion

The sole essence of anaesthesia is pain relief in perioperative period for which spinal anaesthesia is the most commonly used technique. However, for postoperative pain control, spinal anaesthesia using only local anaesthetics is associated with relatively short duration of action, and thus early analgesic intervention is needed. The quality of the spinal anaesthesia is improved by the addition of opioids (such as Morphine, Fentanyl and Sufentanil) and other drugs such as Dexmedetomidine, Clonidine, Magnesium sulphate, Neostigmine, Ketamine and Midazolam, but no drug to inhibit nociception is without associated adverse effects.(1) Fentanyl is a lipophilic mu receptor agonist opioid. Intrathecally, Fentanyl exerts its effect by combining with opioid receptors in the dorsal horn of the spinal cord and may have a supraspinal spread and can exhibit various adverse actions. Sullivan et al have studied the ED50 of 2.5 μg Dexmedetomidine for inhibition of C fibre responses of dorsal horn neurons and Aβ-evoked responses were inhibited to a lesser degree with a maximum inhibition seen above 10 μg dose.[6]The α2adrenoreceptor agonists act by binding to the presynaptic C-fibers and postsynaptic dorsal horn neurons. They produce analgesia by depressing the release of C-fiber transmitters and by hyperpolarization of post synaptic dorsal horn neurons. The complementary action of local anaesthetics and α2 adrenoreceptor agonists account for their profound analgesic properties. The prolongation of the motor block of spinal anaesthetics may be the result of binding of α2 adrenoreceptor agonists to the motor neurons in the dorsal horn. Dexmedetomidine is eight times more specific and highly selective α2 adrenoreceptor agonists compared to Clonidine, thereby making it a useful and safe adjunct in diverse clinical applications.[7]In a few dose finding studies, investigators have used 3, 5, and 10 mcg of intrathecal Dexmedetomidine in rats with favorable results[8] along with preserved hemodynamic stability and lack of sedation.

In our study, the distribution of patients according to age, gender, height and weight was comparable and statistically insignificant (p>0.05). (Table no. 1, 2) Onset of sensory block was significantly longer in Dexmedetomidine group. Dexmedetomidine may have an additive or synergistic effect with local anaesthetic in increasing the time of two segment regression and total duration of complete analgesia. The potentiation of motor block by Dexmedetomidine may be an additive or synergistic effect to the local anaesthetics or related to the interference with neuromuscular activity or binding of α2-agonists to motor neurons in the dorsal horn.[9]Dexmedetomidine produce sedative effect by acting on α2-adrenergic receptors in locus ceruleus.

In our study the mean sedation scores were found to be comparable and statistically insignificant (p>0.05) preoperatively and intraoperatively among the two groups. Preoperatively and intraoperatively the difference between mean PR, SBP, DBP, MAP, RR, SpO2 were insignificant (p value > 0.005).

Intrathecal narcotics, enhance the sensory blockade and prolong postoperative analgesia. They are associated with increased risk of nausea, vomiting, itching and respiratory depression. Opioids are known to depress all phases of respiration by their action on the opioids receptors in the ventral medulla, irrespective of route of administration. Fentanyl is a μ receptor agonist which can be administered safely intrathecally. It is highly lipophillic which prevents its rostral spread. But, systemic absorption of the drug could contribute to the lower respiratory rates by direct depressant action on μ receptors in brainstem. Although the incidence of intraoperative and postoperative complications was not statistically significant among the two groups. (Table no.4)

Conclusion

Patients in group F had faster onset of motor and sensory block than group D (P = 0.000). Patients in group D had significantly longer duration of motor and sensory blockade as compared to those in group F (P = 0.000). Postoperative analgesia was significantly longer in group D than group F (P =0.000). Incidence of side effects among the two groups was not statistically significant. Fentanyl has faster onset compared with Dexmedetomidine but prolonged duration of sensory and motor blockade with postoperative analgesia was seen with Dexmedetomidine without significant side effects.

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Source of Support
Nil

Conflict of Interest
No

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