

Comparative Evaluation of Intrathecal Dexmedetomidine and Fentanyl as Adjuvant to Bupivacaine for Lower Abdominal Surgery

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Abstract

Objectives: The study is aimed to compare intrathecal dexmedetomidine and fentanyl as adjuvant to hyperbaric bupivacaine in terms of: (a) Evaluation of sensory and motor blocks in regards to, onset, duration, and quality of spinal anesthesia. (b) Duration of post-operative analgesia and requirement of rescue analgesics within 24 h after surgery. (c) Perioperative hemodynamic stability. (d) Side effects and complication.

Materials and Methods: All selected patients will be randomly divided into three groups as follows: Group A: Patients will be given only hyperbaric bupivacaine 12.5 mg (2.5 ml) and will serve as control group. Group B: Patients will be given hyperbaric bupivacaine 12.5 mg (2.5 ml) with 5 µg dexmedetomidine. Group C: Patients will be given hyperbaric bupivacaine 12.5 mg (2.5 ml) and 25 µg (0.5 ml) fentanyl to make final volume 3 ml. We will use 50 µg/ml concentration of fentanyl. Groups C and B will comprise the study group.

Results: Onset time for dexmedetomidine or fentanyl with bupivacaine was shorter than bupivacaine alone. The overall duration of analgesia was significantly longer in dexmedetomidine group than fentanyl group showing significant difference between the two groups ($P < 0.001$). The mean effective analgesia as assessed by visual analog scale ≥ 4 was: (i) 193.24 min with bupivacaine and normal saline. (ii) 373.24 min with bupivacaine and dexmedetomidine. (iii) 302.56 min with bupivacaine and fentanyl.

Side effects: No significant difference was observed among different groups for any of the side effects. Hypotension, bradycardia more in study Group B followed by study Group C and then control group. Sedation was more in study Group B than study Group C, respiratory depression more in study Group C followed by control group. There was no respiratory depression in study Group B. Nausea and vomiting were observed in three patients in control group, in four patients in study Group B and in six patients in study Group C.

Conclusion: The duration of sensory and motor block were more prolonged with dexmedetomidine than fentanyl. Duration and effectiveness of analgesia was significantly better in dexmedetomidine group than fentanyl group.

Key words: Analgesia, Intrathecal bupivacaine, Lower abdominal surgery

INTRODUCTION

Spinal anesthesia is a type of regional anesthesia technique and has got many advantages such as rapid in onset,

easy to perform, and without risk of local anesthetic toxicity. Bupivacaine is the most commonly used drug in spinal anesthesia. Various additive drugs have been tried with bupivacaine to look for the improvement in the quality and extending the duration of blockade such as opioid analogs, neostigmine, benzodiazepines, ketamine, and α_2 -agonist. Fentanyl is a partial agonist on μ -opioid receptors and dexmedetomidine is an α_2 -agonist. Intrathecal dexmedetomidine when combined with spinal bupivacaine prolongs the sensory block by depressing the release of C-fibers transmitters and by hyperpolarization of postsynaptic dorsal horn neurons. Intrathecal fentanyl

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when combined with bupivacaine prolonged the duration of bupivacaine-induced sensory block and reduced the analgesic requirement in the early post-operative period following bupivacaine spinal block.

Aims and Objectives

It is aimed to compare effects of adding dexmedetomidine and fentanyl with bupivacaine in spinal anesthesia by evaluating onset of sensory and motor blockade, duration of block, post-operative analgesia, and side effects in lower abdominal surgeries.

MATERIALS AND METHODS

The study was conducted in the Department of Anaesthesiology, M.L.B. Medical College, Jhansi, following approval of hospital ethical committee. Our study included 150 healthy cases, between the age group of 18-50 years, of either sex (M/F) and belonging to ASA Grade I and II, admitted for lower abdominal surgery.

- Group A: 12.5 mg (2.5 ml) hyperbaric bupivacaine + 0.5 ml normal saline. This served as control group.
- Group B: 12.5 mg (2.5 ml) hyperbaric bupivacaine + 5 mcg (0.5 ml) dexmedetomidine.
- Group C: 12.5 mg (2.5 ml) hyperbaric bupivacaine + 25 mcg (0.5 ml) fentanyl. Total volume injected intrathecally was 3.0 ml.

After taking detailed history and thorough systemic examination and necessary laboratory investigation, the patients were excluded from the study on the basis of below mentioned criteria:

1. Uncontrolled diabetes mellitus
2. Cardiac disease
3. Uncontrolled hypertension
4. Chronic obstructive respiratory disease
5. Coagulation abnormalities
6. Spinal deformities
7. Patient on beta blocker therapy
8. High degree of heart block.

RESULTS

The sensory onset (T10) was faster in Group B (3.72 ± 0.50 min) followed by Group C (3.80 ± 0.53 min) and Group A (6.14 ± 0.61 min), the difference between dexmedetomidine and fentanyl groups was not significant; both of these are equally effective in reducing the time of onset of sensory block when compared to bupivacaine alone.

While onset of motor block (Grade III) in Group B was 5.76 ± 0.43 min followed by Group C 5.80 ± 0.40 min and Group A 9.0 ± 0.00 min. The difference was statistically

significant in the case of comparison of Groups A and B and Groups A and C, but not in Groups B and C. Duration of sensory block was maximum in Group B (306 ± 13.32 min) then Group C (206 ± 16.69) and least in Group A (187.94 ± 8.32 min).

Duration of sensory regression to S1 level was 187 ± 8.32 , 306.0 ± 13.32 , 206.14 ± 16.69 min in control Group A and study Groups B and C, respectively. Duration of motor blockade was also maximum in Group B (257 ± 14.61) followed by Group C (178.54 ± 14.23 min) and Group A (160.18 ± 7.44 min). The sensory and motor block were more prolonged in dexmedetomidine group than fentanyl group showing significant difference among the two groups (*P* value).

The mean effective analgesia as assessed by visual analog scale (VAS) ≥ 4 was 193.24 min in Group A, 373.24 min with Group B, and 302.56 min with Group C.

In relation to hemodynamic instability, in control Group A, the mean arterial pressure (MAP) ranged from 76.32 ± 6.08 (at 45 min) to 102.76 ± 43.89 mmHg just after spinal anesthesia, whereas in study Group B, it ranged from 73.80 ± 6.53 (45 min) to 95.56 ± 8.66 mmHg (baseline) and in study Group C the mean value ranged from 73.0 ± 5.36 (45 min) to 98.80 ± 7.21 mmHg (baseline).

None of the subjects in any group had pruritus, hypotension, and sedation were the most common side effect. Bradycardia and respiratory depression were less commonly reported side effects. For all the complications, the proportion of control Group B subjects was minimum while that of study Group F subjects was maximum. Statistically, no significant intergroup difference was observed for any of the complications (*P* > 0.05) (Figure 1).

DISCUSSION

In this study, we compared dexmedetomidine and fentanyl with bupivacaine in spinal anesthesia for lower

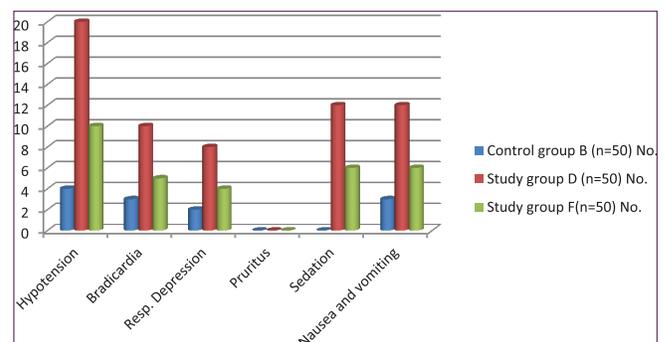


Figure 1: Side effects

abdomen surgeries through randomized control trial and findings.

Onset of Sensory Block

The mean time to achieve sensory block up to T10 level was 6.14 ± 0.61 min in control Group A, 3.72 ± 0.50 min in study Group B and 3.80 ± 0.53 min in study Group C, showing statistically significant intergroup difference ($P < 0.001$), but no significant difference between study Group B and C ($P = 0.440$).

We have seen that onset time for dexmedetomidine or fentanyl with bupivacaine was shorter than bupivacaine alone.

Onset of Motor Block

The mean time to achieve Grade III motor block was 9.0 ± 0.00 min in control Group A, 5.76 ± 0.43 min in study Group B, and 5.80 ± 0.40 min in study Group C.

The mean time to achieve Grade III motor blockade was minimum in study Group B, and maximum in control Group A showing a significant intergroup difference ($P < 0.001$). There was no significant difference in the meantime to achieve Grade III motor blockade between the study Group B and study Group C ($P > 0.05$).

Duration of sensory block

Duration of sensory block was assessed by period for sensory regression to S1 level after intrathecal injection of drug.

The period for sensory regression to S1 level was 187.94 ± 8.32 , 306.0 ± 13.32 and 206.14 ± 16.69 min in control Group A, study Groups B and C, respectively.

Duration of motor block

Duration of motor block was assessed by period of regression to Bromage - 0 after intrathecal injection of drug.

The period for regression to Bromage - 0 were 160.18 ± 7.44 , 257.70 ± 14.61 and 178.54 ± 14.23 min in control Group A, study Groups B and C, respectively.

Duration of Analgesia

Complete analgesia

It refers to the time from intrathecal injection to the first complaint of pain by the patient.

Effective analgesia

It refers to the time from intrathecal injection to the administration of analgesic supplement, i.e., IM tramadol (VAS ≥ 4).

The mean time for both complete and effective analgesia was found to be maximum in study Group D and minimum in Group D showing a statistically significant intergroup difference ($P < 0.001$).

Control Group B had significantly shorter duration of complete as well as effective analgesia as compared to study Groups D and F ($P < 0.001$).

However, a significant difference was observed between study Groups D and F for effective analgesia time ($P < 0.001$) with study Group D showing significantly longer duration as compared to study Group F.

The mean complete analgesia was found to be 156.74 ± 10.19 , 324.60 ± 16.81 , and 256.80 ± 20.65 min in the control group, study Group D and F, respectively.

The mean effective analgesia was found to be 193.56 ± 12.43 , 373.0 ± 16.26 , and 302.40 ± 16.01 min in the control group, study Group D and F, respectively.

It means that the longest duration of both complete and effective analgesia was experienced by the patients receiving dexmedetomidine, followed by the patients receiving fentanyl.

Singh *et al.*¹ used intrathecal fentanyl with bupivacaine to prolong sensory blockade and they concluded that fentanyl prolonged the duration of bupivacaine-induced sensory block and reduced the analgesic requirement in the early post-operative period following bupivacaine spinal block.

Shende *et al.*² studied the influence of intrathecal fentanyl on subarachnoid block for cesarean section, and they concluded that adding fentanyl to hyperbaric bupivacaine for spinal anesthesia markedly improves intraoperative anesthesia for cesarean section.

Various studies have shown the time for onset of sensory block to be governed by the type of local anesthetic solutions and its concentration and its site of administration. Increasing the concentration of local anesthetic shortens the time required for the onset of effect. Lignocaine by its nature has a faster onset of action than bupivacaine, but due to known toxicity and shorter duration of action of lignocaine, we used bupivacaine. Bogra *et al.*³ studied the synergistic effect of intrathecal fentanyl and bupivacaine in spinal anesthesia for cesarean section and they concluded that fentanyl potentiate and reduce the dose of bupivacaine.

Biswas *et al.*⁴ compared the effects of adding 12.5 mcg fentanyl to 2.0 ml bupivacaine and concluded that duration

of effective analgesia was prolonged to 248 min in comparison to 150 min when bupivacaine was used alone.

CONCLUSION

From this study, it can be concluded that the onset of sensory and motor blockade in both dexmedetomidine and fentanyl group were comparable. The duration of sensory and motor block were more prolonged with dexmedetomidine than fentanyl showing significant difference among the two groups ($P < 0.001$). Overall duration and effectiveness of analgesia were significantly better in dexmedetomidine group than fentanyl group showing significant difference between the two groups ($P < 0.001$). Fall in systolic blood pressure, diastolic blood pressure, and MAP were more in fentanyl group which was easily controlled with small bolus dose of ephedrine.

Adding dexmedetomidine 5 mcg to single shot spinal blockade with bupivacaine 12.5 mg not only provide

rapid onset, profound analgesia with good relaxation for surgery but also prolongs the duration of sensory and motor blockade and extends the duration of post-operative analgesia without significant side effect. The overall effect and duration are superior to addition of 25 mcg of fentanyl.

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