A Comparative Study of Intrathecal Fentanyl and Dexmedetomidine as Adjuvants to Hyperbaric Levobupivacaine 0.5% and Hyperbaric Levobupivacaine 0.5% Alone in Infraumbilical Surgeries

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ABSTRACT

Introduction: Spinal anesthesia is the most common approach used for lower abdominal surgeries. Levobupivacaine 0.5% and racemic bupivacaine 0.5% are equally effective in spinal anesthesia. Dexmedetomidine (a highly selective alpha-2 adrenergic agonist) and fentanyl (short-acting synthetic opioid) are effective intrathecal adjuvants. The aim of our study was to evaluate onset and duration of sensory and motor block, duration of postoperative analgesia, and side effects on addition of dexmedetomidine and fentanyl as adjuvants to hyperbaric 0.5% levobupivacaine along with the control group.

Materials and methods: Ninety patients of American Society of Anesthesiologists (ASA) grade I/II undergoing infraumbilical surgery were studied in a prospective, double blind, controlled study. Levobupivacaine was made hyperbaric by adding 1 mL of 25% dextrose to 12.5 mg levobupivacaine. Patients were randomly allocated to receive either 12.5 mg hyperbaric levobupivacaine + normal saline (group A, n = 30) or 12.5 mg hyperbaric levobupivacaine + 25 μg fentanyl (group B, n = 30) or 12.5 mg hyperbaric levobupivacaine + 5 μg dexmedetomidine (group C, n = 30) intrathecally.

Results: Patients in the dexmedetomidine group had significantly longer sensory and motor block time than patients in the fentanyl and control groups. Mean time of sensory regression to S1 was 161.2 ± 14.3, 180.3 ± 6.2, and 472.5 ± 8.5 minutes in groups A to C respectively (p < 0.0001). Duration of analgesia was prolonged to 259.4 ± 12.8 minutes in group C as compared with 114.0 ± 14.3 and 161.8 ± 8.5 minutes in the control and fentanyl group respectively (p < 0.0001).

Conclusion: Intrathecal 5 μg dexmedetomidine seems to be an attractive alternative to 25 μg fentanyl as adjuvant to 0.5% hyperbaric levobupivacaine in spinal anesthesia. It is associated with prolonged motor and sensory block and provides good quality of intraoperative analgesia and extended duration of postoperative analgesia as compared with fentanyl.

Keywords: Dexmedetomidine, Fentanyl, Levobupivacaine, Spinal anesthesia.

INTRODUCTION

Pain is a dehumanizing experience that destroys the soul. Pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. Relief of pain during surgery is the main aim of anesthesia. Any expertise acquired in this field should be extended into the postoperative period. Severe postoperative pain is a well-known morbidity and is the most distressing complication of surgery. Many options are available for the treatment of postoperative pain, including systemic (i.e., opioid and nonopioid) analgesics and regional techniques.

Spinal anesthesia is a commonly used technique for lower abdominal surgeries. Nowadays, apart from lignocaine and bupivacaine, levobupivacaine and ropivacaine are commonly being used for neuraxial anesthesia. Levobupivacaine is the S-enantiomer of bupivacaine with similar onset of sensory and motor block. Duration of analgesia is prolonged with rapid recovery from motor block. It is better in safety profile, i.e., it has less central nervous system and cardiac toxicity, and there are lesser episodes of hypotension.

However, 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 midazolam, clonidine, and fentanyl, have been used to prolong the duration of spinal anesthesia. Fentanyl is a potent, short-acting, highly lipophilic, synthetic opioid analgesic. It has been commonly used as an adjuvant for postoperative analgesia. Dexmedetomidine, a selective α2-agonist, provides stable hemodynamic conditions and good quality of intraoperative and prolonged postoperative analgesia with minimal side effects.
Until now, there has been no study done evaluating the effect of adding fentanyl or dexmedetomidine to hyperbaric levobupivacaine and comparing with control group. Our study was designed to assess and compare the effect of intrathecal fentanyl and dexmedetomidine as adjuvants to hyperbaric levobupivacaine 0.5% and hyperbaric levobupivacaine 0.5% alone in patients undergoing infraumbilical surgeries.

**MATERIALS AND METHODS**

The study was conducted with due permission from the institutional ethical committee. Informed written consent from all the patients was obtained before participation. Expecting the minimum detectable difference in total analgesia time to be 82 minutes with residual standard deviation (SD) 101 minutes (as per seed article – Gupta et al\(^5\)), the sample size was calculated as 30 subjects for each group at alpha error 0.05 and power 80%.

Ninety patients of either sex, aged between 30 and 50 years, with American Society of Anesthesiologists (ASA) grade I/II presenting for infraumbilical surgery, such as appendicectomy, herniorraphy, abdominal hysterectomy (duration 60–90 minutes), were included in the study. The patients were randomized into one of the three groups (n = 30/group) using chit in box method.

The patients were preloaded with lactated Ringer’s solution 10 mL/kg. They were monitored with pulse oximetry, automated noninvasive blood pressure, and electrocardiogram. Hyperbaric solution of levobupivacaine was prepared by mixing 2.5 mL of 0.5% preservative-free isobaric levobupivacaine and 1 mL of 25% dextrose. This gave 3.5 mL of hyperbaric solution for injection. The groups were comparable with respect to age, weight, height, and ASA physical status (p > 0.05). There was no significant difference with respect to type and duration of surgery among the groups (Table 2).

The study was designed to assess and compare the effect of intrathecal fentanyl and dexmedetomidine as adjuvants to hyperbaric levobupivacaine 0.5% and hyperbaric levobupivacaine 0.5% alone in patients undergoing infraumbilical surgeries.

**RESULTS**

The groups were comparable with respect to age, weight, height, and ASA physical status (p > 0.05). There was no significant difference with respect to type and duration of surgery among the groups (Table 2).

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>No pain</td>
</tr>
<tr>
<td>1–3</td>
<td>Mild pain</td>
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<tr>
<td>4–6</td>
<td>Moderate pain</td>
</tr>
<tr>
<td>7–9</td>
<td>Severe pain</td>
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<tr>
<td>10</td>
<td>Worst imaginable pain</td>
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The groups were comparable with respect to age, weight, height, and ASA physical status (p > 0.05). There was no significant difference with respect to type and duration of surgery among the groups (Table 2).
Table 3 summarizes the sensory and motor block characteristics in the three groups. The time for onset of sensory block and motor block was similar in the three groups (p > 0.05). Block regression was significantly slower in group C as compared with the other two groups. Hence, time for two-segment regression and sensory regression to S1 was significantly prolonged in dexmedetomidine group as compared with fentanyl and control groups (p < 0.0001). Duration of analgesia was also significantly longer in dexmedetomidine group as compared with groups A and B (p < 0.0001). Addition of fentanyl did not show prolongation of motor block (p = 0.22), whereas dexmedetomidine caused significant prolongation of duration of motor block as compared with the control group (p < 0.0001).

Patients in all the three groups remained hemodynamically stable and the trends of blood pressure and pulse rate were comparable in the three groups (p > 0.05) (Graphs 1 and 2). The incidence of side effects was also similar in the three groups (Table 4).

**DISCUSSION**

It is well recognized that postoperative pain is most often being undertreated. The routine use of regional anesthesia for lower abdominal surgeries is associated with...
a short duration of analgesia postoperatively. Although many drugs (morphine, nalbuphine, clonidine vasoconstrictors like epinephrine and phenylephrine) have been used as an adjuvant to local anesthetics, the high incidence of side effects (respiratory depression, sedation, cardiovascular instability, nausea–vomiting, pruritus, and urinary retention) and relative ineffectiveness resulted in reluctance to administer these drugs.

Fentanyl is a short-acting, lipophilic, μ-receptor agonist opioid. It has been used intrathecally as an adjuvant for over two decades. In the spinal cord, μ-receptors are located with highest concentration in the substantia gelatinosa, and direct application of fentanyl to these receptors creates intense analgesia by inhibiting presynaptic release of substance P in primary sensory neurons. This is mediated by a decrease in intracellular cyclic adenosine monophosphate levels, associated with a G-protein-mediated increase in K+ influx and inhibition of Ca2+ influx, leading to reduced neurotransmitter release, hyperpolarization of neuronal membranes, and decreased synaptic transmission. Singh et al observed that the addition of 25 µg fentanyl to hyperbaric bupivacaine intrathecally results in significant prolongation of time for two-segment sensory regression and sensory regression to L1 dermatome. In our study, we also did not find any significant difference in the onset time of sensory and motor block. The prolongation of two-segment sensory regression, sensory regression to S1, and duration of motor block was statistically highly significant. Also, the duration of analgesia was prolonged to 259.4 ± 12.8 minutes as compared with 114.0 ± 14.3 and 161.8 ± 8.5 minutes in control and fentanyl groups respectively. Similar results were observed by Gupta et al and Al-Mustafa et al.

In our study, hypotension and bradycardia were more in the dexmedetomidine group as compared with the other two groups, but it was not statistically significant. No patient experienced pruritis and respiratory depression in any group. Dexmedetomidine also has antishivering properties as observed by Maroof et al. We too did not find any incidence of shivering in the three groups.

REFERENCES


