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ORIGINAL ARTICLE

Comparison of the Durations of Sensory Block Induced by Adding Different Doses of Intrathecal Fentanyl to Lidocaine 5% in Spinal Anesthesia

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ABSTRACT

Background: Fentanyl is used to improve the quality and duration of sensory block and analgesia in spinal anesthesia. However, there is still no data on the effects of different doses of this medication. The aim of this study was to compare the duration of sensory block and side effects of adding different doses of intrathecal fentanyl to lidocaine 5% in spinal anesthesia.

Materials and Methods: This double blind controlled clinical trial was conducted on 140 adult patients undergoing elective surgery under spinal anesthesia. The patients were randomly assigned into four groups, namely control (2 ml distilled water), second group (25 µg fentanyl), third group (50 µg fentanyl), and fourth group (100 µg fentanyl). The duration of sensory block and the respective complications were recorded.

Results: The duration of analgesia between the control group and the 3rd and 4th groups and between the second group and the 3rd and 4th groups were statistically different (P<0.001). The frequency of drowsiness and respiratory depression was significantly higher in the third and fourth groups, compared to those of the other groups (P<0.01). In addition, the frequency of itching in the control group was lower than those in the third and fourth groups (P<0.01). The frequency of nausea, vomiting, and shivering was higher in the control group than those in the other groups (P<0.01).

Conclusion: As the findings of the present study indicated, the addition of 50 µg of fentanyl to 100 mg intrathecal lidocaine could significantly increase the duration of analgesia. However, it was associated with the risk of respiratory depression.

Key Words: Fentanyl, Lidocaine, Spinal Anesthesia

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INTRODUCTION

Lidocaine is one of the most common drugs, which is widely used to induce spinal anesthesia in the surgeries performed on the lower abdomen and extremities. Although the onset of spinal anesthesia with lidocaine is fast, the duration of the anesthetic and analgesic effects of this medication is limited [1].

Many drugs have been tested as adjuvants for spinal anesthesia in order to reduce the pain and prolong the postoperative analgesia. One of the effective methods in increasing the duration of local anesthesia is the addition of an opioid to the local anesthetic solution [2].

One of the main advantages of this approach is includes the prolongation of postoperative analgesia, which has no significant effect on the prolongation of motor block and the time of first urination after surgery [3, 4]. However, be considered the use of these drugs is associated with some side effects, such as nausea, vomiting, pruritus, urinary retention, and respiratory depression [5, 6].

Fentanyl is a short-acting synthetic opioid analgesic with spinal effects and dose dependent side effects [7]. The impact of adding fentanyl to lidocaine in spinal anesthesia has been investigated in a few studies [2, 4, 8-11]. Nevertheless, in the majority of these studies, low doses of fentanyl were used, and the analgesic effect of this drug was short lasting [2, 4, 8].

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This study aimed to compare the duration of sensory block induced by adding different doses of intrathecal fentanyl to lidocaine 5% in spinal anesthesia.

MATERIALS AND METHODS

The population if this double blind controlled clinical trial were a group of 140 patients within the age range of 15-65 years of age with the American Society of Anesthesiologists status of I or II who were candidates for elective surgery of lower abdomen and extremities and required anesthesia level of T10.

To calculate the sample size, it was assumed that with the addition of fentanyl to lidocaine, the sensory block duration would approximately prolong to 12 min. Therefore, the number of the patients needed to show a significant difference in the duration of analgesia between the two groups (i.e., lidocaine alone and lidocaine with fentanyl) was estimated to be 34 cases in each group with a power of 80%. In order to compensate for the drop outs, one patient was added to each group.

The exclusion criteria included: 1) any contraindication to spinal anesthesia (e.g., unwillingness, infection at the injection site, anatomic problems that made the administration of anesthetic drugs difficult), 2) taking any analgesic medicines 24 h prior to the operation, 3) history of sensitivity to lidocaine and similar compounds or fentanyl, 4) history of drug abuse, medication abuse, and alcohol dependence, 5) history of neurological, neuromuscular, or psychiatric diseases (especially seizures or epilepsy), 6) history of chronic pain syndromes, 7) the need for general anesthesia for any reason (e.g., increased duration of surgery for longer than expected), and 8) injection of analgesics and opiates during spinal anesthesia.

The patients received no sedative drugs preoperatively. All patients received 500 ml Ringer's solution prior to the surgery. They were monitored with noninvasive blood pressure devices, pulse-oximetry, and electrocardiography. For spinal anesthesia, all patients received 100 mg intrathecal preservative-free lidocaine 5% (Lidocard, Orion Pharma, Finland). The patients were randomly divided into four groups based on the added drug. The subjects in the control group received lidocaine %5 in 2 ml of distilled water. On the other hand, in the second, third, fourth groups, the participants received lidocaine %5 plus 25, 50, and 100 µg fentanyl, respectively. All the injected solutions had the same volume and were administered using similar syringes. In addition, these solutions were prepared by an anesthetic technician.

All spinal anesthesias were performed by one anesthesiologist with the patient in sitting position in aseptic conditions. The anesthesiologist was unaware of the contents of the syringes. He used a 25-gauge Quincke spinal needle to enter the subarachnoid space. The free flow of cerebrospinal fluid confirmed that the needle was in subarachnoid space. The bevel of needle was directed cephalad and the study drugs were injected. Following the injection, the patients were placed in supine position, and the injection time was immediately recorded. The patients' heads were slightly lifted, and 100% nasal oxygen was administered.

Then dermatomes below T10 were examined by an alcohol cotton swab and a needle to determine the time of the onset of analgesia. The patients were observed and evaluated every 15-30 sec. In addition, the time of not sensing the pain or sharpness of needle was recorded.

The surgery began just after ensuring the appropriate level of sensory block and hemodynamic stability. No sedative, analgesic, or additional opioid was used during the study, and if the patient felt pain, he/she was excluded from the study after taking the appropriate measures. The commencement time of sensation and its difference from the beginning time of analgesia was considered as analgesic duration.

Until the achievement of recovery, the patients were questioned and evaluated about such symptoms as pruritus, nausea, vomiting, drowsiness, chills, and respiratory depression. Furthermore, in the postoperative period, the pain intensity was assessed with the Visual Analogue Scale (VAS). If the pain score was greater than 5, the patients received analgesics.

The statistical analysis was performed using One-way ANOVA, Kruskal-Wallis, Dunnett's T3, Chi-square, and Fisher's Exact tests through SPSS version 18. P-value less than 0.05 was considered statistically significant.

This trial was approved by the Deputy of Research and Medical Ethics Committee of Hamedan University, Hamedan, Iran. After informing the patients about the study objectives, their written informed consents were obtained.

RESULTS

The mean age of the patients was 36.5 years. Regarding the site of injection, 44.3%, 47.1%, and 8.6% of the injections were in L3-L4, L4-L5 space, and L5-S1 spaces, respectively.

No patient was excluded from the study. According to the results, 56.4%, 29.3%, and 14.4% of all surgeries were orthopedic, urologic, and cesarean section, respectively. In addition, 91 (65%) patients were males.

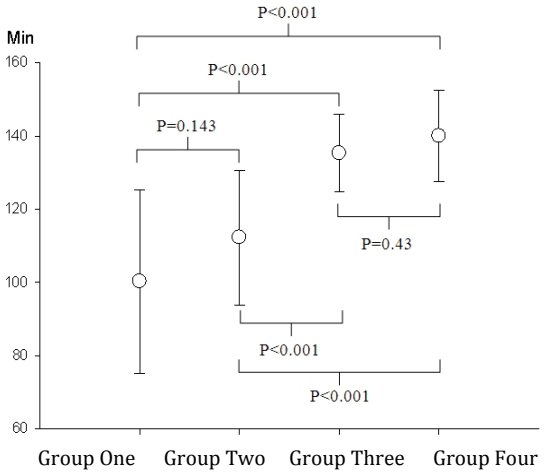

Figure 1. The mean duration of anesthesia at different times among the four groups

All patients received 500 cc Ringer's solution prior to the spinal injection. Then they underwent spinal injection in sitting position. The mean duration of analgesia was 100.28±25.05, 112.28±18.4, 135.28±10.63 and 140±12.42 minutes in control, second, third and forth groups, respectively. The duration of analgesia between the control group and 3rd and 4th group and between the second group and the 3rd and 4th group was statistically significant (P<0.001). The frequency of drowsiness and respiratory depression was significantly higher in third and fourth groups (P<0.01).

The frequency of itching in the control group was lower than those of third and fourth group (P<0.01). The frequency of nausea and vomiting and shivering in the control group was higher than other groups (P<0.01) (Figure 1 and Table 1).

According to table 1 nausea, vomiting, and chills were significantly different between the controls and other groups. Concerning pruritus, there was meaningful difference between control group and third and fourth groups and also between the second group and the fourth group.

Moreover, there was significant difference between all groups in drowsiness except between control group and the second group.

But, the difference of duration of analgesia between the control and second group and between the third and fourth groups were not statistically significant.

The duration of analgesia between third and fourth groups was not significantly different and respiratory depression in the 4th group was higher than other groups.

DISCUSSION

The results of this study showed that intrathecal injection of fentanyl at doses of 50 or 100 micrograms is effective in increasing the duration of anesthesia. Although adding 25 µg intrathecal fentanyl to lidocaine 5% increased the duration of analgesia, it was not statistically meaningful.

Also, there was no significant difference between 50 or 100 µg doses in duration of anesthesia but the respiratory depression in the 4th group was more frequent than other groups.

Previous studies have shown that patients, who had undergone cesarean section under spinal anesthesia, benefit from simultaneous administration of local anesthetics and opiates because of increased ease of surgery [12], significant increase in duration of spinal anesthesia [13], and lesser need for sedatives postoperatively [14].

The findings of the present study confirm the results of other studies. For example Shahriari *et al.* showed that adding 15 µg fentanyl to 80 mg lidocaine intrathecally increases the duration of anesthesia and quality of analgesia during spinal anesthesia in women who undergo cesarean section [2]. Also Palmer and colleagues found similar results in a comparable study [8].

Liu *et al.* also demonstrated that adding 20 µg fentanyl to intrathecal lidocaine prolonged the duration of sensory block [4]. Jacobson et al studied the effect of adding intrathecal fentanyl (25 µg) to 70 mg lidocaine and showed that this will increase the quality of analgesia and may cause euphoria in patients [9]. Similar results have been obtained in other studies [10, 11].

Also other studies have shown that adding 15 to 25 µg fentanyl provide longer postoperative analgesia [15, 16]. As mentioned above, in most studies, low doses of fentanyl (15 to 25 µg) were used but in the present study, higher doses of intrathecal fentanyl (25 to 100 µg) have been studied for the first time. Based on our results, regardless of the frequency of complications, it seems that adding 50 µg fentanyl is more effective, but adding intrathecal fentanyl is not

Table 1. The frequency of some complications in different study groups

Complication	Control (n=35)	2nd group (n=35)	3rd group (n=35)	4th group (n=35)	P-value*
Nausea and vomiting n(%)	26 (74.29%)	4 (11.43%)	0 (0.0%)	0 (0.0%)	<0.01
Pruritus n(%)	1 (2.86%)	4 (11.43%)	8 (22.86%)	12 (34.29%)	<0.01
Chills n(%)	30 (85.71%)	5 (14.29%)	0 (0.0%)	0 (0.0%)	<0.01
Drowsiness n(%)	2 (5.71%)	1 (2.86%)	16 (45.71%)	26 (74.29%)	<0.01
Respiratory depression n(%)	0 (0.0%)	0 (0.0%)	7 (20.0%)	19 (54.29%)	<0.01

* P-value less than 0.05 is statistically significant

possible without considering the complications. Respiratory depression is one of the potential complications of intrathecal injection of opiates [17-20].

The results of our study showed that the frequency of drowsiness and respiratory depression in the third and fourth groups was significantly higher than the control and the second groups. Therefore, it seems that increasing the dosage of intrathecal fentanyl to 50 and 100 µg is associated with increased risk of respiratory depression while 25 µg is not. Other studies have demonstrated that administration of 15 µg intrathecal fentanyl is not associated with respiratory depression [2, 13, 15].

Pruritus is another complication of intrathecal injection of opiates. The results of our study showed that the frequency of pruritus was significantly lower in control group in comparison with groups three and four. Also patients in group two experienced less pruritus than the fourth group. In previous studies, pruritus was reported in patients who received intrathecal fentanyl [4, 9].

The results of the present study showed that the frequency of nausea, vomiting, and chills in control group was significantly higher than the other groups. Palmer et al also showed that patients who receive fentanyl, experience less nausea and vomiting in comparison with the control group [8]. But no significant difference in the incidence of pruritus and chills was observed. There are studies that confirm this issue [2].

Finally, the results of this study indicate that adding 50 µg fentanyl to 100 mg intrathecal lidocaine significantly increases the duration of analgesia but is associated with increased risk of respiratory depression. Using this combination especially in patients who have contraindication to the use of epinephrine in spinal anesthesia could be useful. Nevertheless because of probability of respiratory depression, patients require more attention and in case of respiratory depression, necessary interventions should be performed. We recommend future studies to assess the time to first analgesic request and the total amount of opioid used post-operatively.

CONCLUSION

As the findings of the present study indicated, the addition of 50 µg of fentanyl to 100 mg intrathecal lidocaine could significantly increase the duration of analgesia. However, it was associated with the risk of respiratory depression.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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