Effects of intrathecal fentanyl as an adjunct to hyperbaric bupivacaine in spinal anesthesia for elective caesarean section

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ABSTRACT

Hyperbaric bupivacaine is the most common drug used in spinal anesthesia for caesarean section. The aim of this study was to compare the effects of adding fentanyl to intrathecal bupivacaine on the onset and duration of spinal anesthesia and its effect on mother and neonate. Seventy healthy parturients with singleton pregnancy scheduled for elective cesarean section were randomly allocated to receive subarachnoid block with 0.5% bupivacaine heavy 2.4 ml (Group A) or fentanyl 20 microgram (0.4 ml) added to 0.5% bupivacaine heavy 2ml (Group B).Blood pressure, heart rate, respiratory rate, oxygen saturation, along with characteristics of spinal block were assessed throughout the surgery and in the postoperative ward until the patient requested for analgesia. It was found that duration of sensory block was prolonged in fentanyl group ($p<0.05$). Duration of complete analgesia (97 ± 8.23 minutes vs 153 ± 7 minutes; p value= 0.00) and effective analgesia (134 ± 5.6 minutes vs 164 ± 9; p value= 0.00) were also found to be prolonged in Group B. There was not much difference in the occurrence of side effects in both the groups. Addition of fentanyl to intrathecal bupivacaine for cesarean section increases the duration of postoperative analgesia without increasing maternal or neonatal side effects.

Key words: Bupivacaine, Cesarean delivery, Fentanyl, Spinal Anesthesia.

INTRODUCTION

Spinal anesthesia is the preferred means for cesarean section as it is simple to perform, has rapid onset, involves lesser drug doses, produces minimal neonatal depression, and has lesser incidence of aspiration pneumonitis. However, it also has disadvantages as it produces a fixed duration of anesthesia, causes hypotension and lesser control of block height.[1]

Bupivacaine, commonly used drug for subarachnoid block, has high potency, slow onset (5-8 min) and long duration of action (1.5-2 hours). For cesarean section intrathecal dose of hyperbaric bupivacaine is said to be 12 to 15 mg.[2]. Cesarean delivery requires traction of peritoneum and handling of intraperitoneal organs, resulting in intraoperative visceral pain. With higher doses of hyperbaric bupivacaine, incidence of intraoperative visceral pain is reduced,[3] but increasing the dose of bupivacaine increases the risk of high block.

Addition of opioids to local anesthetic for spinal anesthesia was first introduced into clinical practice in 1979.[4] Thereafter, opioids have gained popularity as it was found to improve the quality of intraoperative analgesia and prolong the duration of postoperative analgesia, without increasing the sympathetic block.[5]

Morphine, a hydrophilic agent, when given intrathecally, provides longer lasting analgesia than fentanyl,[6] but has a slow onset of action and also risk of delayed respiratory depression.

Fentanyl, a short acting lipophilic opioid, has extremely rapid onset of action as compared to morphine, following intrathecal administration. Analgesia has been reported to occur within 5 – 10 min.[7] It does not tend to migrate to the fourth ventricle in sufficient concentration when administered intrathecally, thereby augmenting the quality of subarachnoid block without increasing the risk of delayed respiratory depression. Therefore the addition of fentanyl in cesarean section has become more popular in these years.[8]

The principal objective of the present study was to evaluate the effects of intrathecal fentanyl (20 µgm) on the onset and duration of hyperbaric bupivacaine induced spinal block.

MATERIALS AND METHODS

The study was approved from Ethical committee and written informed consent was taken from patients who participated in the study. Seventy full term women, scheduled for elective cesarean section under spinal anesthesia were enrolled. Preanesthetic evaluation was done a day prior to surgery. Patients with complicated pregnancies or evidence of fetal compromise were

excluded. None of the patients had any contraindications for spinal anesthesia.

Participants were randomly allocated equally to either of Bupivacaine group (Group A) or fentanyl group (Group B) by lottery method. Group A received 0.5% bupivacaine heavy 2.4 ml and Group B received fentanyl 20 µgm (0.4 ml) with 0.5% bupivacaine heavy 2 ml. Neither the anesthesiologist nor the patients were aware of the group allocation. All the patients were fasted overnight and were premedicated with ranitidine 150 mg orally the night before surgery.

After arrival in the operating room, intravenous access was secured with 18 gauge cannula. All the parturients were preloaded with 20 ml/kg of Ringer lactate. Monitors were attached to record heart rate, noninvasive blood pressure, respiratory rate and SpO2. Fetal heart rate was also monitored. Spinal anesthesia was given with the patients in sitting position with 25 gauge whitacre needle via midline approach. Once free flow of CSF had been confirmed, the anesthetic solution prepared was injected slowly over 15 seconds. Immediately after the block, patient was asked to lie down with a 10 cm wedge placed under right hip. All the patients were given supplemental oxygen. Maternal heart rate, SpO2, respiratory rate and noninvasive blood pressure were recorded 2 minutes after block, then every 5 minutes till the end of the surgery. Maternal respiratory depression was defined as less than 10 breaths per minute. Hypotension was defined by a decrease in systolic blood pressure of more than 20% of baseline value and was treated with additional Ringer lactate and intravenous mephentermine. Maternal bradycardia was defined as heart rate less than 60 beats per minute and was treated with intravenous atropine 0.6 mg.

Assessments of sensory block were made by pinprick bilaterally at the midclavicular line every one minute until 15 minute after intrathecal injection and then every 15 minute until regression to T10 dermatome. The time required for the onset of sensory block was recorded. Surgical incision was allowed when the block level reached T6 dermatome. The highest level of sensory block achieved and the time taken from intrathecal injection to the highest level of sensory block was noted.

Motor block was assessed by using Bromage scale (BS).[9]

0= No paralysis

1= Inability to raise extended leg

2=Inability to flex the knee

3=Inability to flex the ankle (complete motor block)

Time required for the onset of grade 3 motor block was recorded.

Intraoperative assessment of pain intensity was done by a 10cm visual analogue scale (VAS). VAS was explained to patients as "0" no pain and "10" as intolerable pain. During operation, if patient complained of pain (VAS 3-4), intravenous fentanyl was given and the patients were excluded from the study. Any patient requiring sedation, conversion to general anesthesia was excluded from the study. Incidence of nausea, vomiting and dizziness were recorded.

Neonates were evaluated by Apgar scores at 1 and 5 minutes after birth by pediatricians unaware of the drugs used.

Total duration of surgery was recorded. After completion of surgery, patients were transferred to the postoperative ward where they remained for 24 hours during which time blood pressure, heart rate and respiratory rate were measured every half hourly for 2 hours and then 2 hourly for 24 hours. Time for sensory regression to T10 dermatome and motor recovery to BS 0 were noted. The duration of complete analgesia (time from subarachnoid injection to first reports of pain) and effective analgesia (time from subarachnoid injection to first dose of postoperative analgesic) were recorded.

Any episode of nausea, vomiting and dizziness in the postoperative ward were also recorded.

Statistical tests were performed using Statistical Package for the Social Sciences 16 for windows. Data were analyzed by using unpaired t test. Nominal variables were analyzed using Chi square test. P value <0.05 was considered statistically significant.

RESULTS

The two groups did not differ significantly with respect to age, weight, height and duration of surgery (Table 1).

Table 1: Demographic profile and duration of surgery.

	Group A	Group B	P value
Number of patients	35	35	
Age	24 ± 3.5	25 ± 3.4	0.08
Weight (kg)	62 ± 4.9	62 ± 5.3	0.94
Height (inch)	60 ± 2.5	60 ± 3.6	0.38
Duration of surgery	49 ± 3.6	49 ± 5.3	0.75

Values are in mean +- SD.

The characteristics of block in each group are summarized in Table 2. The onset of bupivacaine induced spinal block was not enhanced in fentanyl group. The maximal height of sensory block was T4 dermatome in both the groups and the time required to achieve this block height was similar in both the groups.

The time intervals for sensory level to regress to T 10 dermatome were prolonged in fentanyl group. Both the onset and duration of motor block were statistically insignificant in both the groups.

Table 2: Characteristics of spinal anesthesia.

	Group A	Group B	P value
Highest sensory level (dermatome)	T4	T4	
Onset of sensory block (min)	3 ± 0.66	3 ± 0.45	0.75
Time to achieve highest sensory level (min)	7 ± 2.3	6 ± 2.5	0.11
Time for sensory regression to T 10 (min)	115 ± 4.3	150 ± 2.3	0.00
Onset of motor block (grade III) (min)	4 ± 0.75	4 ± 0.55	0.24
Duration of Grade 0 motor block (min)	96 ±9.24	94 ± 6.9	0.27

Values are in mean +- SD.

Efficacy of spinal anesthesia is shown in table 3. Complete analgesia lasted longer in Group B compared with group A. The duration of effective analgesia (time from subarachnoid injection to postoperative analgesia) was also prolonged in group B as compared with group A.

Table 3: Efficacy of spinal anesthesia.

	Group A	Group B	P value
Complete analgesia	97 ± 8.23	153 ± 7	0.00
Effective analgesia	134 ± 5.6	164 ± 9	0.00

Values are in mean +- SD.

As shown in Table 4, there were no differences in the number of patients experiencing bradycardia or hypotension. None of the patients in both the group had episodes of respiratory depression or desaturation. Episodes of nausea or vomiting were statistically insignificant in both the groups.

Table 4: Comparison of side effects.

	Group A	Group B	P value
Hypotension	34% (12)	40% (14)	0.8
Bradycardia	5.7% (2)	2.8% (1)	1
Respiratory depression	0	0	
Nausea/Vomiting	14.2% (5)	11.4% (4)	0.5

There were no differences in neonatal Apgar scores among the groups as shown in Table 5.

Table 5: Apgar scores.

	Group A	Group B
1 min	8-9	7-9
5 min	9-10	9-10

DISCUSSION

General anesthesia has been found to be associated with higher mortality rate as compared to regional anesthesia,[10] which is one of the most important reasons for increased use of regional anesthesia in obstetric patients.

However, regional anesthesia is not without risk. There is always a chance of higher levels of block or toxicity of local anesthetics, the risk being higher in pregnant patients than in nonpregnant patients. In this study fentanyl was added to bupivacaine with the aim of providing adequate depth of anesthesia with lesser doses of bupivacaine, thereby reducing chances of high block.

Although improved intraoperative analgesia has been reported with intrathecal fentanyl when given in doses as low as 6.25 µgm,[11] longer postoperative analgesia has been found when the dose of fentanyl was increased to 15 µgm and 25 µgm.[12, 13]

In order to achieve maximal analgesic effect with minimal side effects, a dose of 20 µgm was chosen for this study.

In our study, it was found that there was no difference on the onset and maximum height of sensory block with the addition of fentanyl. Sergio D. Belzarena[14] found similar results despite using fentanyl in higher doses than in our study. However, fentanyl significantly increased the duration of both complete and effective analgesia as compared to the control group. Similar findings were reported in study done by Biswas et al.[4]

Because of high affinity of fentanyl with nonspecific binding sites on the lipid surface only a small proportion of the administered dose migrates to the cervical region,[15] which explains the lesser incidence of respiratory depression with fentanyl. Arai YC et al[16] tested the effect of addition of 20 µgm fentanyl added to hyperbaric bupivacaine on maternal spirometric performance in parturients undergoing cesarean section and found no deterioration in respiratory function when compared to parturients receiving intrathecal bupivacaine alone.

Intraoperative nausea and vomiting is said to occur in as many as 66% of caesarean deliveries, mainly related to peritoneal traction and exteriorization of the uterus performed with regional anaesthesia.[17] In studies done by Mauling et al[18] and Dahlgren et al,[19] fentanyl was found

to reduce the emetic episodes in patient undergoing caesarean section. In our study episodes of nausea and vomiting though lower in fentanyl group was statistically insignificant when the two groups were compared which may be because of the adequate level of anesthesia achieved in both the groups.

There were no differences in neonatal Apgar scores among the groups, which were similar with observations of Hunt et al and Shende et al study.[11, 12]

In our study incidence of bradycardia was 5.7% in Group A and 2.8% in Group B with no significant variation in the group which is similar to the finding of Singh et al.[20] The results of our study indicated that 20 µgm of fentanyl added to hyperbaric bupivacaine for spinal anesthesia increases the duration of postoperative analgesia, without any adverse effect on fetus and mother.

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