Original Research Article

A study of intrathecal low dose bupivacaine and fentanyl versus conventional dose of bupivacaine alone for elective caesarean section

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Abstract

Background: Spinal anesthesia is the most common method of the regional block in cesarean section, because it is easy to perform, economical produces rapid onset of anesthesia, and good muscle relaxation, and most importantly, it gives immense pleasure to the conscious mother. To improve the quality of subarachnoid block, intrathecal opioids are used as adjuvants to Bupivacaine. Fentanyl has a rapid onset of action as a lipophilic opioid following intrathecal administration. Because of high lipid solubility, it undergoes rapid uptake by the spinal cord, and hence the chances of delayed respiratory depression are less. **Methods:** We randomly selected 60 patients belonging to the American Society of Anesthesiologists (ASA) class I and II, who are scheduled for elective LSCS. These patients were divided randomly into two groups of 30 each. Group B received 10mg of 0.5% hyperbaric bupivacaine (2ml). Group BF received 7.5mg of 0.5% hyperbaric bupivacaine (1.5ml) with 25mcg of Fentanyl (0.5ml). Lumbar puncture was performed at the level of L3-L4 with 23 Guage Quincke Babcock's needle with the patient in the right lateral position. The sensory block was assessed with the loss of pin prick sensation, and the motor block was set using the Bromage scale technique. We also recorded the hemodynamic parameters like pulse rate, blood pressure, oxygen saturation. **Results:** No significant statistical difference was found in demographic data between the two groups. Group BF showed early onset of the sensory block with a P value of 0.001. Time taken to attain peak sensory level was early in the BF group with a P value of 0.001. The total duration of sensory block and duration of effective analgesia was longer in the BF group with a P value of 0.001. The onset of motor blockade was early in the bupivacaine only group with a P value of 0.02. **Conclusion**: The intrathecal fentanyl 25mcg reduces the dose of 7.5 mg of 0.5% hyperbaric Bupivacaine for spinal anesthesia in cesarean section, thus reducing the incidence of side effects associated with it. By its synergistic effect with 0.5% hyperbaric bupivacaine, it provides better excellent sensory blockade and postoperative analgesia, good hemodynamic stability, less incidence of complications like Nausea, vomiting, and shivering without compromising the safety of mother and fetus in comparison to intrathecal 10mg of 0.5% hyperbaric Bupivacaine alone.

Keywords: Bupivacaine, Fentanyl, Elective Caesarean Section, Sensory and motor block, side effects.

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All over the world, regional anesthesia is commonly used for cesarean section. The Anesthesia choice is determined by the clinical condition of the patient, the facilities available, and exposure of an anesthesiologist. The role of the anesthesiologist is to ensure the comfort and safety of the mother at all times[1].Spinal anesthesia was introduced into clinical practice by Karl August Bier in 1898[2].More than a century passed. Even today, it is one of the most popular techniques for both elective and emergency procedures, particularly cesarean sections, lower

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abdominal surgeries, orthopedic and urological surgeries, to name a few[3].Spinal anesthesia allows the mother to be awake and facilitates effective postoperative pain relief [2; 4]. It offers many benefits to the mother and baby over general anesthesia. The majority of the women welcome the choice to be awake during the birth of their baby. If regional anesthesia is performed with great care and attention to maternal physiology, then it is probably fundamentally safer than general anesthesia for cesarean section.[3] The hazards of difficult airway associated with weight gain and edema in the mother an be avoided, along with problems of regurgitation because of physiological weakening of the gastroesophageal sphincter and an increase in gastric volume and acid production[5]. A thriving regional anesthetic effectively suppresses many of the pain-mediated stress responses to surgery, such as a rise in blood pressure, heart rate, and increase in plasma concentrations of catecholamines, cortisol, and glucose. The net advantage is that placental perfusion is maintained. It is cost-effective, as a lesser number of drugs are required, thus making it relatively inexpensive. A spinal block is also associated with a lesser amount of surgical bleeding[6]. The significant adverse effect of spinal anesthesia for the mother is Hypotension during cesarean section[7,8]. Maternal Hypotension results in uteroplacental hypoperfusion and can provoke an acute fall in intervillous blood flow with the potential for fetal acidemia[9,10]. Furthermore, bradycardia, Nausea, vomiting, and cardiac arrest may occur but at lower incidence. Many anatomical and physiological changes during pregnancy affect spinal anesthesia. The hormonal and mechanical factors make pregnant women require less local anesthetic than non-pregnant women to attain the same level of anaesthesia[11]. Studies on hemodynamic alterations in spinal anesthesia show that hypotension after spinal anesthesia is caused due to enhanced sympathetic segmental block due to higher a dose of local anaesthetic[12]. The opioids act on opioid receptors present in the substantia gelatinosa of the dorsal horn of the spinal cord. They are commonly used as an adjuvant with local anesthetics for potentiating their effects, thus offering hemodynamic stability by reducing the dose and side effects of local anaesthetics[13].Thus, the combination of Bupivacaine and a low dose of Fentanyl provide excellent surgical anesthesia and also prolong the duration of postoperative analgesia. Among the synthetic opioids, Fentanyl is favorable because of its greater potency, rapid onset of action and fast redistribution with an associated decrease in the plasma concentration of the drug[14]. Fentanyl, a lipophilic opioid, has a rapid onset of action following intrathecal administration. It does not migrate to the fourth ventricle in sufficient concentration to cause delayed respiratory depression when administered intrathecally[15]. Fentanyl exerts analgesic effects through micro receptors in the central nervous system. Receptor activation will lead to G protein-mediated potassium channel opening (μ and Δ) and calcium channel closure (kappa). It reduces the release of an excitatory neurotransmitter (Glutamate and Substance P) from presynaptic C-fibres but not from A-fibre terminals with the consequent reduction in nociceptive transmitters[16]. So, in this study aim is to evaluate the efficacy of intrathecal Fentanyl as an adjuvant to Bupivacaine in cesarean section.

Aim and Objectives:

The present study aimed to compare and determine the efficacy of intrathecal fentanyl as an adjuvant to a low dose of Bupivacaine in elective cesarean section with regard to The onset of the desired sensory and motor block, Duration of sensory and motor block, Duration of postoperative analgesia, Hemodynamic changes during the procedure, APGAR Score and Complications.

METHODOLOGY

After approval from the Institutional Ethics Committee and taking written, informed consent, 60 patients were enrolled in the study. This controlled randomized prospective study was conducted in 60 ASA1 and ASA2 patients posted for elective cesarean section under spinal anesthesia in NRI MEDICAL COLLEGE AND GENERAL HOSPITAL. Group-B received 10mg of 0.5% Heavy Bupivacaine(2ml). Group-BF received 7.5mg of 0.5% Heavy Bupivacaine(1.5ml) with 25mcg Fentanyl(0.5ml)

Inclusion Criteria: The age group of 18-35yrs, ASA-1 and ASA-2 patients, Patients undergoing elective cesarean section.

Exclusion Criteria: ASA grade 3 and grade 4, Those posted for Emergency cesarean section, Allergic to study drugs, Having contraindications to regional Anaesthesia. The pre-anesthetic check-up was carried out preoperatively, which included a detailed history, general physical examination. Airway assessment and spinal cord examination were carried out. All the parturients were kept fasting for 6 hours before surgery. Premedication was given with T. Ranitidine 150mg and T.Metoclopramide 10mg on a preoperative night before surgery. Procedure: Patients are randomly allocated into two groups of 30 patients, each using a computer-generated randomization technique. Group-B received 10mg of 0.5% Heavy Bupivacaine(2ml) and Group-BF received 7.5mg of 0.5% Heavy Bupivacaine(1.5ml) with 25mcg Fentanyl(0.5ml). Intravenous access was secured with an 18G cannula, and Ringer lactate infusion was started at a rate of 10ml/kg. Preoperative monitors used were blood pressure monitor, pulse oximeter, and ECG. Baseline vital signs were recorded. Under strict aseptic conditions, a spinal block with the patient in a lateral position is performed with a 23G Quincke Babcock's needle in the L3- L4 space. After

the free CSF flow was confirmed, the study drugs were injected slowly into Subarachnoid space. After administering spinal anesthesia, patients were placed in the supine position, and a wedge was placed under the right buttock to facilitate left uterine displacement. Oxygen was supplemented with a face mask at 5lit/min. Following parameters were observed and recorded. Assessment of sensory level – The onset of sensory blockade, the time taken for the sensory blockade to reach up to T6, was noted from the time of drug administration to loss of pinprick sensation to T6. This was checked every 30 seconds. Time taken for achieving the maximum level of analgesia was recorded. Duration of effective analgesia was taken from intrathecal injection to VAS>4; at this point, patients received rescue analgesia. Assessment of motor blockade – The quality of the motor block was assessed according to the Bromage scale[17]. Bromage 0 – full flexion of knees and feet, Bromage 1- just able to move knees, Bromage 2 – able to move feet only, Bromage 3- unable to move feet or knees. The onset of motor blockade time taken was noted. The time to reach Bromage 0 was also recorded. All durations were calculated considering time of intrathecal injection as time zero. Patients were discharged after motor regression to Bromage 0, Aldrete score of 9 was achieved. Vital parameters –Systolic blood pressure, diastolic blood pressure, mean arterial blood pressure, Heart rate, oxygen saturation recorded immediately after Subarachnoid block, 2min,5min,10 min,20 min,40min,60 min, and every 30 minutes after that till next hour. Hypotension was defined as a reduction of SBP more than 30% below the baseline value or SBP recording <90mm Hg, and it was treated with an increased rate of IV fluids and, if needed, with vasopressors. Bradycardia was defined as H.R. <60beats per minute and was treated with 0.6mg of IV atropine. Side effects such as Nausea, Vomiting, Hypotension, Pruritis, and Shivering, if any were noted, Apgar score at 1 minute and 5 minutes were observed and noted. Postoperative pain was assessed by using the VAS scale. VAS (0-10cm where 0=No pain;10=worst pain). The time of request rescue analgesia was recorded, and thereby the duration of effective analgesia was calculated.

Statistical Analysis: In the present study, results are given as mean ± standard deviation. Students' t' test was used for the two groups, categorical data are expressed as numbers and percentages, and the difference between the groups was compared by chi-square test, Fischer Exact test. P-value of 0.05 or less was considered as statistically significant.

RESULTS

In this study, 60 patients belonging to ASA grade 1 and 2 scheduled for elective Cesarean sections were selected and randomly divided into two groups of 30 each. Then the mean age of patients in group B.F. is 23±2.09 years, and that of patients in group B is 23±2.08 years. The p-value was 0.85 for mean age which is not statistically significant. Then the mean Height of patients in group B.F. is 153.5±1.11cm, and that of patients in group B is 153.7±1.33cm. The p-value was 0.402 for mean height which is not statistically significant. Then the mean Weight of patients in group B.F. is 56.03±3.49kg, and that of patients in group B is 56.03±3.49kg. The p-value was 1.00 for mean weight which is not statistically significant.

Table 1: Comparison of Sensory block statistics between two groups

Variable	Group-BF		Group-B		P-value
	Mean	SD	Mean	SD	
Sensory block onset (Sec)	65.57	1.79	70.43	2.19	**<0.001**
Sensory block time to achieve peak sensory level (min)	5.75	0.2	7.5	0.5	**<0.001**
Sensory block time for complete sensory recovery (min)	145.76	2.88	120.05	1.81	**<0.001**
Sensory block duration of effective analgesia (min)	220.33	5.07	123.87	4.17	**<0.001**

From table-1: The time taken for sensory block onset to T6 level is 67.57±1.79 sec in group BF and is 70.43±2.19 sec in group B with a P-value of 0.001 which is Statistically significant. The mean time taken to attain peak sensory level is 5.75±0.20 min in group B.F. and is 7.50±0.50 min in group B with a P-value 0.001, which is significant statistically. The mean sensory block time for complete sensory recovery is 145.7±2.88 min in group B.F. and is 120.05±1.81 min in group B with a P-value 0.001, which is significant statistically (P<0.01) The mean duration of effective analgesia is 220.33±5.07 min in group B.F. and is 123.87±4.17 min in group B with a P-value 0.001, which is significant statistically (P<0.01) The mean motor block time for complete motor recovery is 95.52±3.28 min in group B.F. and is118.86±3.12 min in group B with a P-value 0.001, which is significant statistically (P<0.01) There was no significant variation in the APGAR score between the two groups at 1min and at 5mn

There was no statistically significant decrease in pulse rate immediately after Subarachnoid block, at 2 min, 5 min, 10 min,20 min, 30min in both group B.F. and group B but there is statistically significant decrease in pulse rate at 40 min in group B There was a significant decrease in mean Systolic blood pressure at 5min and at 30 min in Bupivacaine group.

There was no significant decrease statistically in Mean Diastolic Blood pressure immediately after Subarachnoid block, at 2 min, 5 min, 10 min,20 min, 30min and 40min in both group B.F. and group B. There was no statistical significance in SpO2 levels in both groups

Table 2: Perioperative Complications

Side effects	Group-BF		Group-B		P-value
	Count	%	Count	%	
Nausea	1	3.30%	2	6.70%	1
Vomiting	0	0.00%	1	3.30%	1
Hypotension	2	6.70%	8	26.70%	0.08
Pruritis	4	13.30%	0	0.00%	0.11
Shivering	0	0.00%	4	13.30%	0.11

From table-2: Out of 30 patients, 1(3.3%) developed Nausea, 2(6.7%) developed Hypotension, 4(13.3 %) developed pruritis in B.F. Group In Bupvacaine group, 2(6.7%) developed Nausea, 1(3.3%) developed vomiting, 8(26.7%) developed Hypotension, 4(13.3%) developed shivering. There was no significant difference.

DISCUSSION

Both groups were similar in distribution with respect to age, height, and weight, and duration of surgery, as evidenced by statistical analysis. The age (24±2.3) distribution was comparable to that of the studies by Biswas BN *et al.* (age 25 ± 4.1) and Archana L.R. *et al.* (age 28 ± 2.2).[18,19] In this study, the mean duration of surgery was (57.17±2.16 min) in Bupivacaine with fentanyl group, whereas in Bupivacaine, the only group it was (57.98±1.16 min). This was statistically not significant. This closely correlates with the studies by Biswas BN *et al.* (mean duration of surgery 45 minutes and 46 minutes, respectively). Srivastava U *et al.* (mean duration of surgery 56 min and 59 minutes, respectively) all of whom found that the duration of surgery was similar in both the groups.[18,20] The time of onset of sensory block was studied by recording the time from administration of the drug to loss of pinprick sensation at the T6 dermatome. In the present study, the meantime for the onset of sensory block (T6 level) in Bupivacaine with Fentanyl group was (67.57±1.79sec), and bupivacaine group was (70.43±2.1sec), which was statistically significant (P<0.05). These results are similar to other studies like in K Hemanth *et al.*, Bogra J *et al.* and Ngiam SKK *et al.*(who showed that the onset of sensory blockade occurred in the Bupivacaine + Fentanyl group at a mean of 151.6 seconds and a mean of 183.6 seconds in the Bupivacaine only group) significant difference between the two Groups[21,22,23] In the present study, the mean time taken to attain peak sensory level in Bupivacaine with fentanyl group was (5.75±0.2 min), and the Bupivacaine group was (7.50±0.5 min). The mean time required to achieve peak sensory level was earlier in group B.F. than group B, and the result was statistically significant. The mean time taken to reach complete sensory recovery was (145.76±2.88 min) in group B.F. and (120.05±1.81 min) in group B. The total sensory recovery was prolonged in group B.F. than in group B, and the result was statistically significant.

In the present study, the meantime for the onset of motor blockade was earlier in group B (79.64±2.64 sec) than group B.F. (81.08±2.05 sec), which was statistically significant. These results are similar to K Hemanth Babu *et al.* (the mean onset of motor blockade was delayed in group B.F. 1.78±3.7 min vs. in group B 1.26±4.2 min). In the present study, the mean duration of motor recovery was shorter in group B.F. (95.52±3.28 min) than group B (118.86±3.12 min), which was statistically significant.[21] The time request for rescue analgesia was noted, and thereby, the duration of effective analgesia was observed in both the groups. In the present study, the mean duration of effective analgesia in the bupivacaine only group was 123.87±4.17 min, whereas, in the bupivacaine + fentanyl group, it was 220.33±5.07 min. This was statistically highly significant (P<0.01), which means that postoperative analgesia duration was significantly more in group B.F. The results correlate with that of Biswas BN *et al.* (who showed that the mean duration of effective analgesia was 150 min in group B, whereas, in group B.F., it was 248 min). Ngiam S K.K. *et al.* (who showed that the mean duration of effective analgesia was 150.9 minutes in the Bupivacaine only group, whereas in the bupivacaine + fentanyl group, it was 385.8 minutes) and Dahlgren G *et al.* (who showed that the mean duration of effective analgesia was 120.9 minutes in the Bupivacaine only group, whereas in the bupivacaine + fentanyl group, it was 181.1 min.[18,23,24] The effects on the fetus were observed by noting APGAR scores at 1 and 5 minutes, respectively. The 1 minute Apgar in the Bupivacaine only group was 8 (mean), while the bupivacaine + fentanyl group was 8 (mean). None of the newborns had a 5 minutes Apgar score below 8. The 5 minutes Apgar in the Bupivacaine only group was 9 (mean), while in the bupivacaine + fentanyl group, it was 9 (mean). Both of these were non-significant. No adverse effects on the fetus were noted in this study. All these findings correlate with the observations of Bogra J *et al.*, Biswas BN5 *et al.*, indicating that at the doses used,

Fentanyl may not have significant effects on the vital parameters of the newborn.[18,22] In the present study, no patient in the bupivacaine only group had pruritus while four patients in the Bupivacaine + fentanyl group had this symptom. This was statistically insignificant. This correlates with the studies by Bogra J *et al.* and Hunt CO *et al.*, who found no significant differences in this side effect incidence.[22] In the present study, Nausea was observed in 2 patients in the Bupivacaine only group, while one patient had these symptoms in the bupivacaine + fentanyl group. There was no significant difference between the two groups. However, Biswas BN *et al.*, Dahlgren G *et al.* found that Nausea and vomiting incidence was less in the combination (Bupivacaine + Fentanyl).[18,24]

CONCLUSION

The present study showed that the intrathecal fentanyl 25mcg reduces the dose of 7.5 mg of 0.5% hyperbaric Bupivacaine for spinal anesthesia in cesarean section, thus reducing the incidence of side effects associated with it. By its synergistic effect with 0.5% hyperbaric bupivacaine, it provides better excellent sensory blockade and postoperative analgesia, good hemodynamic stability, less incidence of complications like Nausea, vomiting, and shivering without compromising the safety of mother and fetus in comparison to intrathecal 10mg of 0.5% hyperbaric Bupivacaine alone.

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