

EFFICACY EVALUATION OF BUPIVACAINE ASSOCIATED WITH DIFFERENT DOSES OF FENTANYL AMONG PATIENTS UNDERGOING CAESAREAN SECTION AT A TERTIARY CARE HOSPITAL

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Abstract

Background: Bupivacaine, an amide local anesthetic discovered in 1957, is widely used in regional, epidural, spinal anesthesia, and local infiltration due to its potency and long duration of action. Fentanyl, a potent synthetic opioid, acts primarily as a Mu-selective opioid agonist while also activating delta and kappa receptors, leading to strong analgesic effects. Hence, we evaluated efficacy of bupivacaine associated with different doses of fentanyl among patients undergoing caesarean section at a tertiary care hospital. **Materials and Methods:** A total of 60 patients scheduled for elective cesarean sections were recruited for the study. Comprehensive demographic and clinical information were collected for each participant. The patients were divided into three study groups based on the administered dose of fentanyl: Group 1 received 15 µg, Group 2 received 10 µg, and Group 3 received 7.5 µg. Outcomes and complications were systematically assessed, and the hemodynamic responses among the different study groups were also evaluated. All data were analyzed using SPSS software. **Result:** Mean age of the patients of group 1, group 2 and group 3 was 31.2 years, 30.9 years and 31.5 years respectively. Mean BMI of the patients of group 1 and group 2 was 27.3 Kg/m², 28.2 Kg/m² and 27.1 Kg/m². Mean time to full motor recovery among patients of group 1, group 2 and group 3 was 143.3 minutes, 121.8 minutes and 112.2 minutes respectively. Mean duration of analgesia among patients of group 1, group 2 and group 3 was 149.2 minutes, 129.4 minutes and 115.3 minutes respectively. Significant better results were obtained among patients of group 1 in terms of spinal variables. However, hemodynamic response complication rate was similar among all the three study groups. **Conclusion:** Spinal anesthesia utilizing hyperbaric bupivacaine is the predominant anesthetic method employed for elective caesarean deliveries. The application of this technique, in conjunction with 15 µg of fentanyl, has been shown to deliver optimal analgesic outcomes.

INTRODUCTION

Bupivacaine, an amide local anesthetic discovered in 1957, is widely used in regional, epidural, spinal anesthesia, and local infiltration due to its potency and long duration of action.^[1,2] It works by blocking sodium (Na⁺) channels, inhibiting nerve impulse conduction and leading to anesthesia.^[3,4]

Fentanyl, a potent synthetic opioid, acts primarily as a Mu-selective opioid agonist while also activating delta and kappa receptors, leading to strong analgesic

effects. It increases dopamine levels in the brain's reward centers, contributing to its addictive potential. Metabolized in the liver via CYP3A4, fentanyl has a half-life of 3 to 7 hours and is excreted mainly in urine. It is administered intravenously (IV), intramuscularly (IM), transdermally (TD), intranasally (IN), intrathecally (IT), or as a buccal film, with dosages varying by indication. Common adverse effects include respiratory depression, nausea, confusion, muscle rigidity, addiction, and, in severe cases, coma or death. Risk increases when

combined with alcohol or other depressants. Contraindications include respiratory disorders, liver failure, hypersensitivity, and recent monoamine oxidase inhibitor use. The drug interacts with CYP3A4 inhibitors and inducers, requiring careful dose adjustments and monitoring of vitals, ECG, and renal function to prevent complications like opioid-induced respiratory depression. Close monitoring is essential when altering medications that affect fentanyl metabolism to ensure efficacy and patient safety.^[5-7]

The combination of low-dose bupivacaine with fentanyl has been proposed to enhance blockade quality, prolong analgesia, and reduce intraoperative nausea and vomiting. While 25 µg is the most commonly used dose for spinal anesthesia in cesarean sections, intrathecal fentanyl may increase postoperative opioid needs due to tolerance or hyperalgesia. A ceiling effect above 0.25 µg/kg limits its benefits while increasing side effects, and a clear dose-effect relationship remains uncertain.^[8,9] Hence; we evaluated efficacy of bupivacaine associated with different doses of fentanyl among patients undergoing caesarean section at a tertiary care hospital.

MATERIALS AND METHODS

The present study was conducted for comparing the efficacy of Bupivacaine associated with different doses of fentanyl: among patients undergoing c section. A total of 60 patients scheduled for elective cesarean sections were recruited for the study. Comprehensive demographic and clinical information were collected for each participant. The patients were divided into three study groups based on the administered dose of fentanyl: Group 1 received 15 µg, Group 2 received 10 µg, and Group 3 received 7.5 µg. Prior to the administration of spinal anesthesia, all patients had an epidural catheter inserted to facilitate potential epidural top-ups with local anesthetics, ensuring sufficient anesthesia during surgery for those experiencing intraoperative discomfort. Participants were required to fast and did

not receive any preanesthetic medications. In the operating room, continuous monitoring was conducted using ECG DII derivation tracing, a non-invasive blood pressure monitor, and a pulse oximeter. Each patient underwent a cesarean section according to their assigned study group. Outcomes and complications were systematically assessed, and the hemodynamic responses among the different study groups were also evaluated. All data were analyzed using SPSS software.

RESULTS

Mean age of the patients of group 1, group 2 and group 3 was 31.2 years, 30.9 years and 31.5 years respectively. Mean BMI of the patients of group 1 and group 2 was 27.3 Kg/m², 28.2 Kg/m² and 27.1 Kg/m². Mean time to full motor recovery among patients of group 1, group 2 and group 3 was 143.3 minutes, 121.8 minutes and 112.2 minutes respectively. Mean duration of analgesia among patients of group 1, group 2 and group 3 was 149.2 minutes, 129.4 minutes and 115.3 minutes respectively. significant better results were obtained among patients of group 1 in terms of spinal variables. However; hemodynamic response complication rate was similar among all the three study groups.

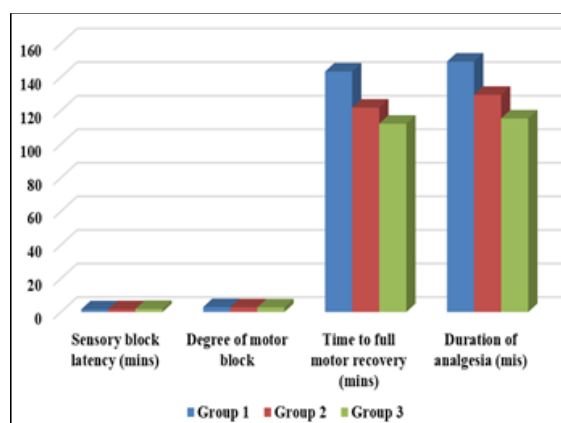


Figure 1: Spinal characteristics

Table 1: Demographic and anthropometric data.

Variable	Group 1	Group 2	Group 3
Mean age (years)	31.2	30.9	31.5
Rural residence	13	11	11
Urban residence	7	9	9
Mean BMI (Kg/m ²)	27.3	28.2	27.1

Table 2: Spinal characteristics

Variable	Group 1	Group 2	Group 3	p-value
Sensory block latency (mins)	1.63	1.68	1.83	0.25
Degree of motor block	2.96	2.84	2.79	0.13
Time to full motor recovery (mins)	143.3	121.8	112.2	0.00*
Duration of analgesia (mins)	149.2	129.4	115.3	0.00*

*: Significant

DISCUSSION

Caesarean section (C-section) is one of the most commonly performed surgical procedures worldwide, requiring effective anesthesia for optimal maternal and fetal outcomes. Regional anesthesia, particularly spinal anesthesia, is preferred due to its safety, rapid onset, and effectiveness in providing surgical analgesia. Among the various local anesthetics, bupivacaine is widely used for spinal anesthesia due to its long duration of action and reliable sensory blockade. However, it is often combined with opioid adjuvants, such as fentanyl, to enhance analgesia, reduce the required dose of local anesthetic, and minimize hemodynamic instability.^[10] Fentanyl, a potent lipophilic opioid, acts synergistically with bupivacaine to improve intraoperative anesthesia and provide postoperative pain relief. However, the optimal dose of fentanyl to be used in combination with bupivacaine remains a subject of debate. Higher doses may prolong analgesia but can also increase the risk of side effects such as respiratory depression, pruritus, nausea, and hemodynamic fluctuations. Conversely, lower doses may be insufficient for adequate pain control.^[11,12] Hence; we evaluated efficacy of bupivacaine associated with different doses of fentanyl among patients undergoing caesarean section at a tertiary care hospital.

Mean age of the patients of group 1, group 2 and group 3 was 31.2 years, 30.9 years and 31.5 years respectively. Mean BMI of the patients of group 1 and group 2 was 27.3 Kg/m², 28.2 Kg/m² and 27.1 Kg/m². Mean time to full motor recovery among patients of group 1, group 2 and group 3 was 143.3 minutes, 121.8 minutes and 112.2 minutes respectively. Mean duration of analgesia among patients of group 1, group 2 and group 3 was 149.2 minutes, 129.4 minutes and 115.3 minutes respectively. Significant better results were obtained among patients of group 1 in terms of spinal variables. However; hemodynamic response complication rate was similar among all the three study groups. Ferrarezi et al,^[13] assessed the efficacy of different fentanyl doses combined with bupivacaine in 124 pregnant women undergoing elective caesarean section under spinal anesthesia. Participants were randomly assigned to four groups receiving fentanyl (15 µg, 10 µg, 7.5 µg) or no fentanyl, all with 10 mg of 0.5% hyperbaric bupivacaine. Results showed significantly better analgesia, longer pain-free periods, and delayed motor block recovery in fentanyl groups compared to controls ($p < 0.001$). No negative maternal-fetal outcomes were observed. Nausea was more common in the 10 µg and 7.5 µg groups, while vomiting was highest in the 7.5 µg group ($p = 0.006$). Pruritus incidence increased with fentanyl use ($p = 0.012$). The 15 µg fentanyl dose provided optimal analgesia with minimal side effects, making it the most effective option for spinal anesthesia in caesarean

sections. Another study investigated whether adding fentanyl to bupivacaine for spinal anesthesia in caesarean delivery could reduce hypotension. Thirty-two women were divided into two groups: one received 10 mg of isobaric bupivacaine 0.5%, while the other received 5 mg of isobaric bupivacaine with 25 µg fentanyl. Both groups achieved surgical anesthesia, but the plain bupivacaine group had a higher peak sensory level (T3 vs. T4.5), more intense motor block, and significantly more hypotension (94% vs. 31%), requiring higher ephedrine doses (23.8 mg vs. 2.8 mg). Hypotensive episodes were more frequent (4.8 vs. 0.6 per patient), and nausea occurred more often (69% vs. 31%) in the plain bupivacaine group. The study concluded that spinal anesthesia with 5 mg bupivacaine plus 25 µg fentanyl resulted in lower hypotension rates, reduced vasopressor requirements, and less nausea compared to 10 mg bupivacaine alone.^[14]

Choi DH et al,^[15] evaluated whether adding fentanyl could reduce the required bupivacaine dose for spinal anesthesia in caesarean delivery. Two prospective, double-blinded studies were conducted on 120 patients. In the preliminary study, patients received 8, 10, or 12 mg of 0.5% hyperbaric bupivacaine intrathecally, while in the main study, they received the same doses combined with 10 µg fentanyl. Each group had 20 patients (B8, B10, B12, BF8, BF10, BF12). Sensory and motor block, intraoperative pain (assessed via VAS), muscle relaxation, and side effects were recorded, along with sensory and motor recovery and the onset of postoperative pain. Higher maximal block levels and increased incidence of high block ($\geq T1$) were observed in the 12 mg groups. Intraoperative pain occurred in 35% of B8 and 20% of B10 patients but was absent in the B12 and all fentanyl groups. Side effects were similar across groups. The addition of fentanyl significantly delayed sensory recovery and postoperative pain onset, but motor recovery remained unchanged. The study concluded that while 12 mg bupivacaine provided effective anesthesia, adding 10 µg fentanyl allowed for a reduced bupivacaine dose of 8 mg in spinal anesthesia for caesarean delivery.

CONCLUSION

Spinal anesthesia utilizing hyperbaric bupivacaine is the predominant anesthetic method employed for elective caesarean deliveries. The application of this technique, in conjunction with 15 µg of fentanyl, has been shown to deliver optimal analgesic outcomes.

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