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Original Research Article

Spinal Anaesthesia for Elective Cesarean Section with Bupivacaine Associated with Different Doses of Fentanyl

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Abstract

Introduction: Spinal anaesthesia is commonly used in cesarean section using bupivacaine for anaesthetic effect at low dosage which is given with fentanyl. This enhances the anesthetic effect, lengthen the duration of anesthesia, minimize the post-operative nausea and vomiting. Although there are conflicting findings about the effectiveness of fentanyl when used with local anaesthetics. The drawbacks of continuous spinal anaesthesia includes probable post-dural puncture headache, technical challenges, and neurologic problems. Microcatheters allowed to modify the dosage of fentanyl which is expected to have different pharma coeffect as fentanyl can modulate the effect of anaesthesia.

Aims and Objectives: To compare different dosage of fentanyl given with bupivacaine for spinal anaesthesia in caesarean sections.

Methods: This is a randomised, prospective research, conducted on 70 pregnant patients who were scheduled for caesarean section and received spinal anaesthsia using bupivacaine and fentanyl at 4 different dosages. There were several factors that were analyzed in each patient including anaesthetic block latency, sensory obstruction, motor block level, duration of block recovery, analgesic effect, etc.

Results: The study found that More individuals (14 (77.7%), 13 (72.2%), and 10 (55.5%), respectively) in the groups that are receiving a fentanyl-containing solution (Groups I, II, and III) rated analgesia as "Excellent". Four members of Group IV (or 25%) said they had excellent analgesia. Comparing the fentanyl-treated groups to the control group, there was a significant difference ($p = 0.0023$).

Conclusion: The study mainly found that bupivacaine with 15.1 µg fentanyl in 0.4 mL of solution is the most effective dosage combination which has maximum analgesic effect.

Keywords: Caeserean Section, Fentanyl, Bupivacaine, Spinal Anaesthesia.

Introduction

The most commonly used form of anaesthesia for both elective and urgent caesarean sections is spinal anaesthesia. When delivering the foetus should be accelerated because of a compromised foetus, the quickness of spinal onset is extremely helpful [1]. Rapid sequence

spinal has been documented to omit spinal opioids, increase hyperbaric bupivacaine 0.5% dosage (up to 3 ml), and limit the number of attempts [2,3]. Spinal anaesthesia delivered in a single shot has a number of benefits. Co-administering analgesic drugs, such as opioids, enables analgesia post-operatively, which enhances the mother's comfort during the recovery phase [4]. The advantage of spinal blocks being more economical than epidural anaesthesia is another benefit. The increased rate of complications with epidurals and the much longer overall time of operating room for epidural blocks, which take longer to establish, were blamed for the price discrepancy [5].

Due to its ease of use, affordability, and speedy implementation of anaesthesia, spinal anaesthesia with hyperbaric bupivacaine has become the most frequently used anaesthetic technique for elective caesarean sections as well as in urgent and emergency situations. It also offers sufficient analgesic effect and relaxation of muscles for the surgery [6,7]. It is recommended to use 12 to 15 mg doses of peritoneal traction alone to block sensory pathways for surgery and avoid visceral pain. As a result, the primary side effects will be circulation, such as foetal distress [8]. Low dosages of bupivacaine combined with the lipophilic opioid fentanyl have been suggested to enhance blockade quality, lengthen analgesia duration, and lessen the likelihood of intraoperative vomiting and nausea [9].

Increased postoperative opioid needs have been linked to intrathecal fentanyl use, possibly as a result of the quick development of tolerance to opioids or hyperalgesia induced by opiods [10]. Furthermore, a ceiling effect was seen with intrathecal dosages above 0.27 $g.kg^{-1}$, indicating that high intrathecal fentanyl doses worsen rather than improve the quality of analgesia. As a result, there are conflicting findings about the effectiveness of fentanyl when used with local anaesthetics, and a meaningful dose-effect connection has not yet been discovered [11,12].

An obvious disadvantage of spinal anaesthesia is that it cannot be adjusted if the initial block height is not sufficient or if the surgery takes longer than expected. Before beginning surgery, it is crucial to guarantee appropriate block because doing so could prevent patient suffering, the need for general anaesthesia, and potential medicolegal repercussions [13-15].

The drawbacks of continuous spinal anaesthesiaincludes probable post-dural puncture headache, technical challenges, and neurologic problems, led to a drop in its applications. Microcatheters were created due to the apparent increased risk of post-dural puncture headache, however, they were unfavourably prone to kinking and breaking [16,17]

The introduction of more recent spinal catheters with smaller gauges has boosted interest in this contentious regional method. With relatively tiny dosages of local anaesthetics, this approach offers the advantages of spinal anaesthesia well with the potential for block extension [18,19].

Materials and methods

Study Design

A prospective, double-blind, randomised trial was used in the current investigation on 70 participants. Participants who were full-term pregnancy and had signed informed permission underwent caesarean sections while receiving a spinal anaesthetic. A 10 mg (2 mL) dosage of 0.5% hyperbaric bupivacaine was administered to the four groups, along with various fentanyl doses. In order to make a total volume of 3 mL in all groups, a 0.9% NaCl solution was added. The same manufacturer's medications were utilised in all instances. The study has consider 4 groups. They are Group I, which received fentanyl (15.1 μg - 0.4 mL) and 0.9% sodium chloride solution (0.7 mL); Group

II, which received fentanyl (10.2 μg - 0.3 mL); Group III, which received fentanyl (7.5 μg - 0.15 mL) and 0.9% sodium chloride solution (0.8 mL); and Group IV, which received 0.9% sodium chloride solution (1.0 mL).

Participants did not receive any pre-anaesthetic medication and were fasting. For the blockage, Ringer's lactate solution was injected. A 16G Tuohy needle was used to make a first epidural puncture in the L2-L3 interspace while the patient was sitting, and the epidural catheter was then placed in the cranial direction. A Whitacre 27G or 25G Quincke needle was used to administer spinal anaesthesia, and the anaesthetic solution was delivered manually at a rate of 1 mL.15s-1 without the use of barbotage into the L3-L4 interspace.

The following factors were analyzed in each patient:

1) Sensory block latency, 2) The greatest degree of sensory obstruction, 3) The highest level of motor block, 4) Duration until complete motor block recovery, 5) the Total amount of analgesic time, 6) The effectiveness of intraoperative analgesia, 7) Maternal respiratory and hemodynamic parameters, 8) Results for newborns, 9) Adverse effects on mothers, 10) Operating room time.

Inclusion and exclusion criteria

Age of at least 18 years, ASA (American Society of Anesthesiologists) physical status II or III, a BMI of less than 40 kg/m2, a pregnancy lasting at least 37 weeks, and the presence of a live, single foetus were all required for inclusion.

A pregnant woman who is suffering from psychiatric disorders has a drug addiction history, has a diagnosis of chronic or acute foetal distress, is contraindicated from the regional anaesthesia, has a history of drug hypersensitivity, and has used other CNS depressants and/or opioids during the current hospital stay was excluded.

Statistical analysis

Intent to treat statistical analysis was carried out. The Kruskal-Wallis test was performed to examine patient characteristics, the length of analgesia, the recovery time from the motor block, and cardiorespiratory markers. The distribution of patients based on physical state (ASA), sensory block delay, analgesia efficacy, sensory block level, and motor block degree was determined using Fisher's exact test. The quality of analgesia (satisfying or unsatisfactory) for the need for vasopressors and adverse maternal events was compared between groups using the chi-square test. The significance level was 5% (p 0.05). Version 9.2 of the SAS System for Windows (Statistical Analysis System) was used for all studies.

Ethical approval

The study process was approved by the Ethical Committee of the hospital. Each patient was explained about the study process and written consent was obtained from each one of them.

Results

Weight, height, age, BMI, and physical status did not significantly differ between groups (ASA). The potential bias related to the surgical process was reduced because there was no discernible difference among both the groups' surgical time and fetus extraction times (table 1).

Table 2 displays signs of a spinal block. The degree of motor block, the maximum level of sensory block, and sensory delay duration did not significantly differ across the groups. There was no statistically significant difference among the four groups in the maximal degree of sensory block, which varied from T2 to T6, with level T4 predominating ($p = 0.496$). The range of the motor block's severity was 0 to 3, with degree 3 being the most prevalent across all groups. The duration of analgesia

and the time to complete recovery from motor block (BROMAGE = 0) for all participants receiving fentanyl-containing spinal anesthetic solution (Groups I, II, and III) were significantly longer (p 0.001) than for participants receiving only local anesthetic (Group IV).

Table 1: Demographic characteristics of patients

Characteristics	Group I	Group II	Group III	Group IV	*p*-value
Age (years)	32.12 ± 5.98	32.01 ± 6.13	30.03 ± 7.65	25.89 ± 7.08	0.24
Weight (kg)	88.12 ± 16.78	84.09 ± 13.78	85.83 ± 14.56	83.97 ± 14.98	0.70
Height (m)	1.76 ± 0.11	1.76 ± 0.12	1.74 ± 0.10	1.76 ±0.11	0.93
Body mass index (kg.m-2)	34.06 ± 5.67	31.75 ± 5.03	32.87 ± 4.97	31.70 ± 5.23	0.40
Duration of surgery (min)	84.0 ± 20.65	79.45 ± 20.76	70.42 ± 17.98	75.09 ± 19.76	0.126
Time to fetal extraction time (min)	23.12 ± 9.67	21.89 ± 7.29	29.05 ± 7.13	21.67 ± 8.34	0.937

Table 2: Spinal anesthesia variables

Variables	Group I	Group II	Group III	Group IV	*p*-value
Sensory block latency (min)	1.78 ± 0.81	1.78 ± 1.23	1.96 ± 1.12	2.19 ± 0.98	0.126
Level of sensory block	4.24 ± 1.12	4.03 ± 1.29	3.98 ±0.99	4.45 ± 1.16	0.50
Degree of motor block	3.09 ± 0.18	2.67 ± 0.65	2.67 ± 0.65	2.63 ± 0.76	0.950
Time to full motor function recovery (min)	136.67 ± 51.01	120.02 ± 36.23	116.23 ± 49.98	72.43 ± 37.78	<0.001
Duration of analgesia (min)	142.78 ± 68.90	116.89 ± 36.90	113.23 ± 48.78	67.09 ± 36.76	<0.001

Table 3 shows the findings of the quality of analgesic effect. More individuals (14 (77.7%), 13 (72.2%), and 10 (55.5%), respectively) in the groups that are receiving a fentanyl-containing solution (Groups I, II, and III) rated analgesia as "Excellent". Four members of Group IV (or 25%) said they had excellent analgesia. The study found that there is a significant difference between the groups (p = 0.0023). Hence, the study found that the group I had maximum significant anaesthetic effect as compared to other groups

Table 3: Quality analysis of the study

Quality Level	Group I	Group II	Group III	Group IV	Total	*p*-value
Excellent	14 (77.7%)	13 (72.2%)	10 (55.5%)	4 (25%)	41	0.0023
Good	2 (11.1%)	1 (5.5%)	2 (11.1%)	1 (6.5%)	6	
Fair	1 (5.55%)	2 (11.1%)	5 (27.7%)	5 (31.2%)	13	
Bad	1 (5.55%)	2 (11.1%)	1 (5.5)	6 (37.5%)	10	
Total	18	18	18	16	70	

Discussion

Finding alternatives to lidocaine spinal anesthetic has been motivated by recent worries about lidocaine neurotoxicity. Though it may not produce enough anesthetic, small-dose diluted bupivacaine spinal anesthesia has a comparatively quick

recovery profile. The ability to increase spinal anesthesia without delaying recovery may be achieved by taking advantage of the synergy among intrathecal opioids and local anesthetics. Spinal anesthetic with diluted small-dose bupivacaine and 10 microg fentanyl lengthens and prolongs the course of sensory blockade neither escalating motor blockade nor delaying recovery to street fitness or micturition [20,21]

The administration of neuraxial opioids has grown in popularity in recent years; by directly interacting with certain spinal receptors, they may enhance the analgesia brought on by the local anesthetic. Because of its late onset, the lipophobic opioid morphine may not be the best choice for intraoperative analgesia when administered intrathecally. Fentanyl is a lipophilic opioid that, when delivered intrathecally, has a rapid onset and several benefits that can be observed during surgery due to this feature. 75 healthy pregnant women who underwent spinal anesthesia for cesarean sections were evaluated in random order. 0.5% hyperbaric bupivacaine was the spinal anesthetic utilized. According to the study's findings, administering bupivacaine along with a dosage of fentanyl as small as 7.5 mg did not result in any noticeable clinical effects. The level of surgical analgesia improved and the duration of postoperative analgesia increased as the fentanyl dose was raised to 12.5 or 15 micrograms. At 12.5 micrograms, it appeared that the clinical effect might have peaked. The most frequent side effect, while moderate, was pruritus [22].

In obstetrics, intrathecal opioids are becoming more and more common because they help local anesthetic drugs generate more analgesia. The purpose of a current study is to ascertain how long analgesia lasts when fentanyl is added to bupivacaine during elective Caesarean surgery. a controlled trial comparing the effects of intrathecally administering 2.5 ml of 0.5% hyperbaric bupivacaine and 25 microg of fentanyl. According to the study's findings, 25 microg of fentanyl added to bupivacaine intrathecally during an elective Caesarean section lengthens the period of effective and complete analgesia, decreasing the requirement for immediate postoperative analgesic use [23].

It is known that adding intrathecal opiates can enhance the effects of intra-abdominal local anesthetics. In this study, we attempted to reduce the dose of bupivacaine by adding fentanyl, so minimizing the side effects brought on by the high dosage of intrathecal bupivacaine during cesarean delivery. A number of factors were taken into account, including visceral pain, intraoperative sedation, hemodynamic stability, transient shivering during and after surgery, and postoperative pain. The study found that strict dose estimations are required for spinal anesthesia among neuraxial blocks in pregnant patients because even with little dose adjustments, problems and side effects can occur. Here, the synergistic, potentiating effects of the opioid fentanyl are presented in the effects of morphine (an opioid) on bupivacaine (a local anesthetic used for cesarean sections). Fentanyl is possible to lower the dose of bupivacaine and, consequently, its adverse effects [24].

Bupivacaine's adverse effects during spinal anesthesia include hypotension, vomiting, respiratory depression, and shivering. Different methods have been tried to prevent spinal-induced difficulties because the side effects are dosage-dependent, including reducing the local anesthetic dose and combining it with supplements like Neuraxial opioids. [25] Recently, a study was carried out on patients who are undergoing elective cesarean surgery under spinal anesthesia, to assess the analgesic and hemodynamic effects of intrathecal fentanyl as an adjunct with lower and conventional dosages of bupivacaine. [26]

Conclusion

The study concludes that a lower bupivacaine dose is linked to a quicker recovery and a reduced risk of hypotension. In spinal anesthesia for cesarean sections, combining fentanyl with a lesser dose of bupivacaine may produce equivalent anesthesia with a reduced risk of hypotension and extended postoperative analgesia. The study mainly found that bupivacaine with 15.1 μgfentanylin 0.4 mL of solution is the most effective dosage combination which has maximum analgesic effect. This combination has also shown that minimum time taken to recover motor function and duration of analgesic effect are significantly higher in group I than other groups.

This study has been conducted in one centre and hence, there is a need to conduct similar studies in the future which may include patients with psychiatric disorders and other underlying conditions. However, this current study has brought forward an important finding which may contribute to the cesarean section in terms of effective analgesic management.

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