Comparative Study of Intrathecal Hyperbaric Bupivacaine and Hyperbaric Bupivacaine with Fentanyl for Quality of Anaesthesia and Duration of Post Operative Pain Relief

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Abstract :

The 'patient' has always been the center of concern, around which all the discoveries and researches in medical science have been revolving. Betterment, ease, decreased morbidity of the 'patient' is still the criteria for any medical science developments. The presented study was done with the same intent. Intrathecal Bupivacaine is an established anesthetic in cases of both elective and emergency caesarean sections. A loophole appearing is the high dose of the drug which is associated with its own side effects. In this study, the effects of addition of Fentanyl - a synthetic μ opioid receptor agonist; to intrathecal bupivacaine were identified & interpreted, in 120 female subjects. The subjects were selected based on their ASA grade (I & II) and their posting for lower section caesarean section. Case and control arms were defined. Pre-operative baseline assessment, intra-operative vitals assessment & parameters for post-operative recovery from the anesthetic were done and noted. Presence, onset, duration of side effects were checked for and all the data were analysed. The study concluded, that addition of low dose Fentanyl to intrathecal bupivacaine resulted in better intra-operative & prolonged post-operative analgesia, along with better hemodynamic stability & lesser complications. Hence, this synergistic effect may well be taken advantage of in cases where associated benefits are a requirement.

Key Words : Bupivacaine, Caesarean section, Fentanyl.

Introduction :

Caesarean section is one of the most common operations in the child bearing age of a woman. [1] Subarachnoid block for caesarean section is advantageous because of less neonatal exposure to depressant drugs, decreased risk of maternal pulmonary aspiration and an awaken mother at the time of birth of her child. [2] The choice of anesthesia for caesarean section depends on the reason for the operation, degree of urgency, the desires of the patient and the judgment of anesthesiologists. [3] Spinal anesthesia is simpler to perform and the presence of cerebrospinal fluid provides a more certain end point, and consequently has higher degree of success than epidural anesthesia. [4]

Hyperbaric Bupivacaine is most commonly used in subarachnoid block but effective calculated dose may be associated with high block and haemodynamic instability. Adding adjunct (opioid or non opioid) allows reduction in dose of Bupivacaine and provides cardiovascular stability.[5] Opioid added to local anaesthetic for spinal anaesthesia was first introduced into clinical practice in 1979 with intrathecal morphine as a forerunner. [6]

Fentanyl, a phenylpiperidine derivative, is a synthetic μ opioid receptor agonist. It is preferred as an adjuvant in spinal anaesthesia because of its rapid onset and short duration of action with lesser incidence of respiratory depression. [7]Hence, the Aim of this study was to compare and determine the efficacy of spinal anesthesia with Bupivacaine alone and low dose bupivacaine with additive fentanyl.

Material & Methods :

After approval by the institutional ethics committee, written informed consent was taken from all patients.120 women of ASA grade I and II posted for lower section Caesarean section were taken. Patients having complicated pregnancies such as multiple pregnancies, severe anaemia, pregnancy induced hypertension, placenta praevia and fetal distress and those patients having respiratory, cardio vascular, neurological, endocrinal disorders, musculoskeletal deformity, infection at back, receiving anticoagulants aspirin or any other medication, extremes of height or weight were excluded from the study.

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Group I 0.5% heavy bupivacaine 1.5 cc + normal saline 0.5 cc. **(Group B)**

Group II 0.5% heavy bupivacaine 1.5 cc + fentanyl 0.5 cc (25µ). **(Group BF)**

Total volume of intrathecal drug was 2.0 cc in both the groups.

Pre-anesthetic examination was carried out in detail which included general examination, systemic examination, airway assessment, spine examination. All baseline investigations were done including hemoglobin, complete blood count, blood sugar, serum urea, creatinine and urine albumin.

The equipments of the study

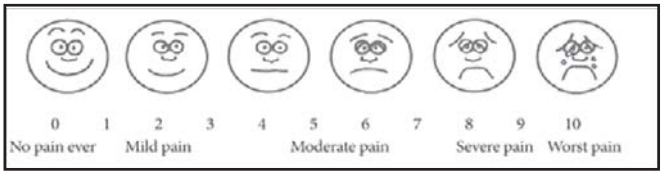
1.	Inj. Bupivacaine 0.5% heavy preservative free
2.	Preservative free Inj. Fentanyl 50µ g/mL – 2mL ampoule
3.	Autoclaved spinal tray
4.	23 G spinal needle
5.	5 CC syringe
6.	Emergency drug and equipments of resuscitation

After shifting the patient on the operating table, monitors like pulse oximeter, non-invasive blood pressure monitor and cardiac monitor were applied. Baseline pulse rate, ECG, blood pressure (systolic and diastolic) and oxygen saturation were recorded. Intravenous access was secured with 18G venous cannula. IV preloading was done with RL 10ml/kg body weight. Injection Ondansetron 8mg and Inj. Ranitidine 50mg i.v. was given before giving spinal anaesthesia as premedication. Patients were given left lateral position. Under all aseptic precautions, parts were cleaned and drapped. 23G spinal needle was inserted in space L3-L4. After clear free fluid of CSF, intrathecal drug was given. Patients were turned supine immediately and were given supplemental oxygen by transparent face mask at flow rate of 5L/min. Intra operatively pulse rate, respiratory rate, blood pressure and oxygen saturation monitoring was done at 1, 3, 5, 15, 30, 60 minutes; and till the operation finished. The onset and duration of sensory block was assessed by pin prick method and the time taken from intrathecal injection to the highest level of sensory block. The onset and duration of motor block was noted. Grading of motor block was done as per Bromage Scale.

Grade	Bromage Scale.
0	No Motor block
I	Inability to raise the extended leg
II	Inability to flex the knee, able to flex the ankle
III	Inability to flex the ankle (complete motor block)

Duration of motor blockade was calculated from the 0 time to the recovery of motor blockade

Pain was evaluated using a standard 10 cm linear visual analogue scale with 0 corresponding to no pain and 10 to the worst pain possible.



The duration of **complete analgesia** (time from subarachnoid injection to first reports of pain) (pain score greater than 0) and **effective analgesia** (time from subarachnoid injection to first dose of rescue analgesic) were recorded.

Result :

Table 1 shows that there was no statistical difference among groups as far as age, height, weight and duration of surgery were concerned.

Table 1: Demographic profile among two groups

Parameters	Group-B	Group-BF
Age in years	25 ± 4	25 ± 3
Weight in kgs	53 ± 5	51 ± 6
Height in cms	152 ± 7	153 ± 8
Duration of operation(mins)	45 ± 3	45 ± 4

Table 2 shows the mean time required to reach peak sensory level was earlier in Group BF than Group B and this was statistically significant ($P<0.05$).Time to onset of sensory blockade (sec), Peak level of sensory analgesia (T), Degree of analgesia (grade), Onset of motor blockade(sec) were comparable in both the groups.($p>0.05$).

Table 2 : Comparison of sensory and motor blockade between two groups

Parameter	Mean + 2SD		P value
	Group B	Group BF	
Time to onset of sensory blockade (sec)	80.91 ± 5.70	75.18 ± 5.91	>0.05
Peak level of sensory analgesia (T)	6.0 ± 1.73	6.15 ± 1.24	>0.05
Time to reach peak sensory level (min)	5.27 ± 0.57	2.80 ± 0.78	<0.05
Degree of analgesia (grade)	3.35 ± 0.73	3.61 ± 0.55	>0.05
Onset of motor blockade(sec)	83.51 ± 4.21	90.88 ± 3.5	>0.05

Figure 1: Duration of complete and effective analgesia among two study groups

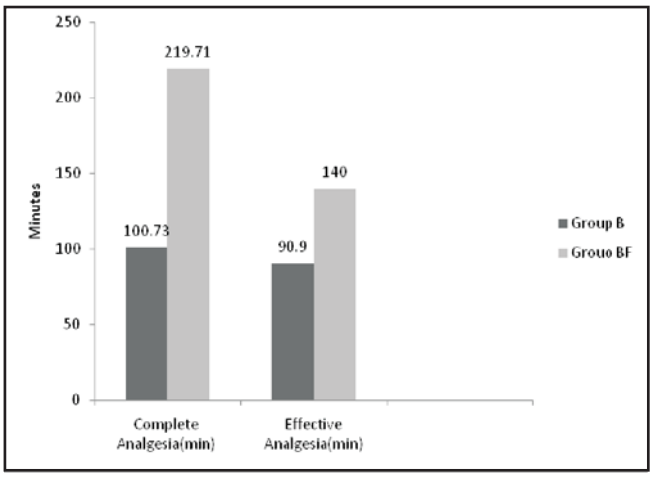


Figure 1 suggests that Duration of complete and effective analgesia was higher in group BF and it is statistically significant. (p<0.05)

Figure 2 : Incidence of side effects among two study groups

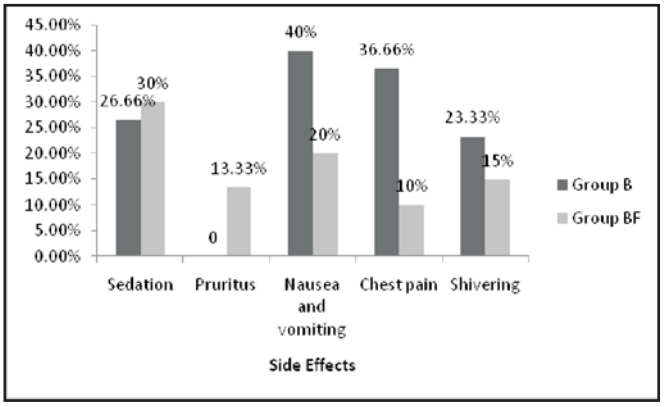


Figure 2 shows that mild pruritus was noted in 8(13.33%) of patients of group BF which did not require any treatment .Incidence of nausea, vomiting, chest pain and shivering were higher in group B than BF. Other side effects like bradycardia, respiratory depression or neurotoxicity were not seen in either of the groups.

Table 3 : Comparison of hemodynamic variables in both study groups

Parameters	Mean +/- SD values		P value
	Group B	Group BF	
Mean Pulse Rate (min)	78.15 ± 4.53	84 ± 3.69	>0.05
Mean Systolic blood pressure (mm of hg)	105.95 ± 6.33	114.9 ± 5.32	<0.05
Mean diastolic blood pressure (mm of hg)	83.01 ± 5.2	87.56 ± 6.5	>0.05
Mean arterial blood pressure(mm of hg)	90.7 ± 3.87	96.7 ± 4.22	>0.05
Mean respiratory rate (breaths/min)	16.7 ± 2.48	16.3 ± 2.29	>0.05
Mean oxygen saturation (%)	97.68 ± 1.39	97.85 ± 1.51	>0.05

P>0.05 non significant, p<0.05 significant, p<0.001 highly significant

Table 3 shows that Mean pulse rate in group B was 78.15± 4.53, lower than group BF (84 ± 3.69) but was statistically not significant.(p>0.05). Though, decrease in mean systolic blood pressure in group B(105.95 ± 6.33) was significantly more than group BF (114.9 ± 5.32)(P value<0.05) and the difference in mean arterial blood pressure among two groups was not clinically significant. Mean arterial blood pressure of group B was 90.7 ± 3.87 and in group BF it was 96.7 ± 4.22. (p>0.05) .Difference in diastolic blood pressure, oxygen saturation and respiratory rate were not significant in both groups.

Discussion :

The concept of using a low dose local anesthetic with opioid, over traditional higher-dose local anesthetic spinal anesthesia, has increased in recent years, producing clear benefits such as less hypotension and better peripoperative analgesia. [8,9] Administration of Fentanyl intrathecally is an established method for intraoperative anaesthesia and to supplement postoperative analgesia[8,9,10] The spread of Fentanyl after administration into cerebrospinal fluid includes, movement from the cerebrospinal fluid into the opioid receptors or other non-specific binding sites in the spinal cord and rostral migration via the cerebrospinal fluid to supraspinal sites. Because of the 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. [11] Jaishri bogra et al [12]found that mean time of onset of sensory blockade and peak level of analgesia were similar in both the groups and addition of Fentanyl to Bupivacaine did not alter the onset. Though there was no incidence of bradycardia in group receiving bupivacaine with Fentanyl but there was better analgesia . Bupivacaine-fentanyl combination was effective in abolishing visceral pain than Bupivacaine alone which was comparable to our study where mean onset of sensory blockade was 75.18+/-5.91 in group BF as compared to group B which was 80.91+/-5.70 and this difference was not clinically significant.(p>0.05).

Dahlgren G et al [13]concluded that time to reach peak sensory level was earlier with group BF than group Bupivacaine alone. Onset and degree of motor blockade was comparable in both study groups. All patients had grade III motor blockade. No significant bradycardia was seen in group B which was comparable to our study where time to reach peak sensory level was 2.80+/-0.78(sec) in group BF as compared to group B 5.27+/-0.57(sec). This difference was clinically significant. (p<0.05). Ben-David et al [14] observed that patients with plain bupivacaine were more likely to require treatment for hypotension than patients with bupivacine - fentanyl. This is because of less dose of bupivacaine used in group BF as compared to group B. Our study also found similar result.Shende D et al [15]assessed intra operative comfort score using Visual Analogue Scale. The quality of intra operative surgical anaesthesia improved significantly in fentanyl group compared with control group which can be explained due to efficacy of fentanyl in abolishing visceral pain, the better quality of surgical analgesia, good hemodynamic stability and fewer complications like nausea, vomiting and shivering. Study also found less analgesic requirement in the post operative period. All these results were consistent with our study. Seyedhejazi. M [16]found that there were significantly less number of patients who experienced nausea and vomiting in group BF, which is explained presumably due to their interaction with opioid receptors of the chemoreceptor trigger zone on the floor of the fourth ventricle. Low dose of highly lipophilic opioids (25□g Fentanyl) do not remain free in the cerebrospinal fluid long enough when administered in the subarachnoid space at the lumbar level to reach the chemoreceptor trigger zone in concentration sufficient enough to directly induce nausea. The same low dose may, however, sufficiently augment local anesthesia mediated block to decrease nociceptive stimulation which occurs during maneuvers like peritoneal traction & uterine exteriorization despite apparently adequate dermatomal sensory blockade and thus reduces nausea &vomiting. In our study, 12 patients (20%) of group BF experienced nausea and vomiting as compared to 24 patients (40%) of group B.

Anchalee T et al [17]concluded that there was reduction in shivering which was due to addition of Fentanyl intrathecally which affected afferent thermal inputs at the spinal cord. Our study also found low incidence of shivering in group BF (9 patients) as compared to group B (14 patients). Sergio DB [18] stated that pruritis and sedation were main side effects of intrathecal opioids. Our study also found similar cases of pruritis in 8

patients of group BF. Pruritis was of short duration and low to mild intensity and no treatment was needed for it. It likely results from activation of μ opioid receptors located both supraspinally and in the dorsal horn of spinal cord.

Conclusion :

Thus, low dose Fentanyl (25μg) used as an adjuvant to intrathecal 0.5% hyperbaric Bupivacaine provides various advantages; i.e. better intra operative analgesia, good hemodynamic stability, less complications like nausea, vomiting and shivering and prolonged effective analgesia in post operative period. As it has synergistic action with bupivacaine, it helps in reduction of the dose of bupivacaine for spinal anesthesia; this reduces the incidence of side effects associated with it and assures better quality of anaesthesia

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