International Journal of Research and Review
www.ijrrjournal.com E-ISSN: 2349-9788; P-ISSN: 2454-2237

Original Research Article

A Comparative Study of Intrathecal Fentanyl Along with Bupivacaine and Bupivacaine Alone in Lower Segment Caesarean Section and Postoperative Analgesia

Dr. Ratnam Raoji

Associate Professor, Department of Anaesthesiology, Prathima Institute of Medical Sciences, Karimnagar, Telangana, India

ABSTRACT

Background: The addition of opioids like the lipophilic opioid fentanyl to local anaesthetics enhances surgical anaesthesia and prolongs the duration of anaesthesia in the postoperative period.
Aims and Objectives: To compare the efficacy of Intrathecal Fentanyl along with bupivacaine and bupivacaine alone and their effect on prolonging the duration of postoperative analgesia in lower segment caesarean section without any adverse effects on the foetus, determined clinically by the APGAR scoring.
Materials and Methods: The subjects included 50 patients belonging to ASA physical status I scheduled for lower segment caesarean section. Patients were randomly categorized in to two groups, group FB and group B consisting of 25 each. Patients in the group FB were given 8.5 mg of Bupivacaine plus 25 µg (0.5cc) fentanyl. Group B received 8.5 mg of Bupivacaine plus 0.5cc normal saline to adjust the final volume to 2.20 cc. Level of sensory block, duration of postoperative analgesia and any complications were noted.
Results: There was not much difference in the onset of analgesia in both the groups. Majority of the patients in both the groups had a higher level of sensory block at T4. The time to reach highest sensory level did not show any significant difference among the groups. Postoperative analgesia lasted for a longer time in Group FB than Group B, the difference being statistically significant. Among various complications observed, pruritus (20%) was the commonest followed by nausea, bradycardia and hypotension. In Group B, only 6 (24%) patients had adverse effects, out of which 3 had shivering, 2 had hypotension and one had bradycardia.
Conclusion: Fentanyl 25 µg does not enhance the onset and duration of sensory block produced by 8.5mg intrathecal hyperbaric bupivacaine. Fentanyl however prolongs postoperative analgesia and lowers the incidence of shivering.

Key Words: Bupivacaine, Caesarian section, Fentanyl, Opioid, Spinal anaesthesia.

INTRODUCTION

Spinal anaesthesia is the regional anaesthesia obtained by blocking the spinal nerves in the subarachnoid space. The anesthetic agents are deposited in the subarachnoid space and act on the spinal nerves. The addition of opioids like the lipophilic opioid fentanyl to local anaesthetics produces many of its clinical effects very early after intrathecal administration. In the intraoperative period it enhances surgical anaesthesia and prolongs the duration of anaesthesia in the postoperative period. Spinal anaesthesia was initially produced inadvertently by Corning in 1885, and was first used deliberately by Bier in 1898. [1-3]

The spinal column which surrounds the spinal cord is formed by series of bony vertebrae separated by cartilaginous

intervertebral discs and united by a series of ligaments. The vertebral column is composed of 33 vertebrae, 7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 4 fused coccygeal. [3,4]

MATERIALS AND METHODS

The study protocol was approved by the ethical committee of Prathima Institute of Medical Sciences, Dr NTR University of Health Sciences. A written informed consent was obtained from all the patients. The subjects included 50 patients belonging to ASA physical status I scheduled for lower segment caesarean section.

A clinical study was undertaken using spinal analgesia as an anaesthetic technique, to study the clinical effects of intrathecally administered preservative free fentanyl along with hyperbaric bupivacaine.

Exclusion Criteria:

1. Patients with deformities of spinal column,
2. Patients with mental disturbances,
3. Patients with neurological diseases.

Visual Analog Scale (VAS) constituting of 100 mm line, with 0=no pain, 100=severe possible pain was explained to all the patients during the preoperative check up. Detailed history and preoperative examination was made. All the patients were subjected to routine investigations like urine analysis, complete blood picture, blood sugar, blood urea, and blood grouping.

Patients were randomly categorized in to two groups, group FB and group B consisting of 25 each. Patients in the group FB were given 8.5 mg of Bupivacaine plus 25 µg (0.5cc) fentanyl. Group B received 8.5 mg of Bupivacaine plus 0.5cc normal saline to adjust the final volume to 2.20 cc. The demographic and preanesthetic hemodynamic data were comparable in both the groups.

Premedication, especially with analgesics was avoided as this might influence and modify the hemodynamic changes produced. Preoperatively, heart rate and blood pressure of the patients were recorded and an intravenous line established with a large bore intravenous cannula in a large peripheral vein. Preloading with intravenous fluids with a dose of 15ml/kg of crystalloid solution (Ringer lactate) infused over 20-30 minutes.

Intraoperatively heart rate, respiratory rate, blood pressure and oxygen saturation levels were monitored at frequent intervals of all the patients. After thorough scrubbing, a sterile gown and gloves were worn. The necessary equipment like towels, cotton swabs, swab holding forceps, a gallipot for skin, cleaning solutions and glass syringes, that were sterile packed were used. The patients back was cleaned using surgical spirit and draped with sterile towels. The operating table was adjusted to a horizontal position. The patient was placed in the lateral decubitus position, with the shoulders and anterior superior iliac spine in straight line. With back parallel to the edge of the operating table nearest to the anaesthesiologist, with thighs flexed on the abdomen and neck flexed.

Lumbar puncture was done using midline approach at L3-L4 using a 23 gauge disposable quincke needle which tends to split the dural fibers rather than cut them, when introduced with the bevel parallel to the dural fibers. This was done to decrease the incidence of post spinal headache due to cerebrospinal fluid leak. After Lumbar puncture was performed and subarachnoid space entered, a free flow of cerebrospinal fluid was obtained, and the drug either 8.5 mg of Bupivacaine plus 25 µg (0.5cc) fentanyl or 8.5 mg of Bupivacaine plus 0.5cc normal saline was instilled and the time recorded. The patient was immediately turned in to supine position for the rest of the study. Then crystalloid solution (Ringer lactate) was infused 8 ml/Kg for 30 minutes. Later fluids were administered based on the arterial pressure changes. All the patients received 100% oxygen and face mask till the baby is delivered.

Parameters Recorded:

For the first 45 minutes during and after the spinal injection, systolic and

diastolic arterial pressure, heart rate, SPO2, and respiratory rate were recorded every 5 minutes. Level of sensory block defined as loss of sharp sensation to pin prick, was recorded bilaterally at the mid clavicular line for every 30 seconds, until sensory analgesia established at T10 level, then every one minute until maximum level had established for 3 consecutive tests, then testing was conducted every 15 minutes until 2 segmental regression occurred.

Duration of 2 segment regression

Duration of postoperative analgesia was measured as the time between the administration of local anaesthetic and opiod intrathecally and first request for supplemental analgesic. A score of 40 on the VAS scale was taken as an end point of analgesia provided by the intrathecal administration of local anaesthetic and opiod.

Any complications were noted. A decrease of systolic arterial pressure of more than 30% or more below preoperative levels as well as decrease in heart rate of more than 20 % were considered significant and treated with 3 mg ephedrine 0.6 mg atropine sulphate respectively. A respiratory rate less than 10 per minute and SPO2 less than 90 % were considered respiratory depression and were noted.

The patients were followed throughout their hospital stay and complications were recorded.

Statistical Analysis:

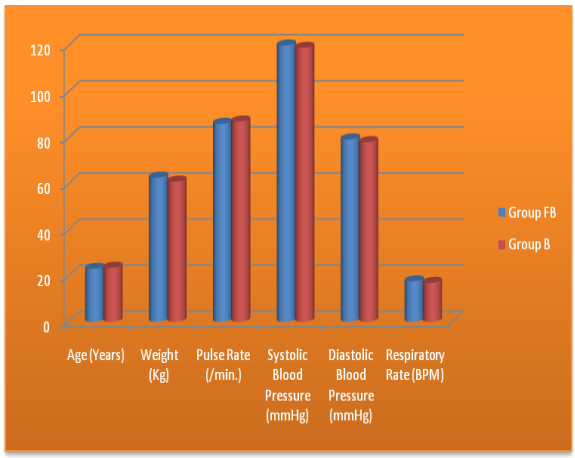
Data were expressed as mean±SD and analyzed by software SPSS Version 20 (IBM SPSS Statistics for Windows, IBM Corp., Armonk, NY: USA). Chi-square test and independent two sample 't'-test for unpaired samples were used. A P value < 0.05 was considered as significant.

RESULTS

Table 1 and Graph 1 shows the demographic and preoperative hemodynamics and respiratory rates were comparable in the 2 groups.

Table 1: Patients Characteristics and preoperative Hemodynamic Variables

Patients Characteristics	Group FB	Group B
Age (Years)	23±3.65	23.5±3.61
Weight (Kg)	62.6±7.43	60.9±5.58
Pulse Rate (/min.)	86±7.32	87±8.60
Systolic Blood Pressure (mmHg)	120±9.35	119±10.9
Diastolic Blood Pressure (mmHg)	79.2±6.40	78±8.16
Respiratory Rate (BPM)	17.6±2.02	16.9±2.14

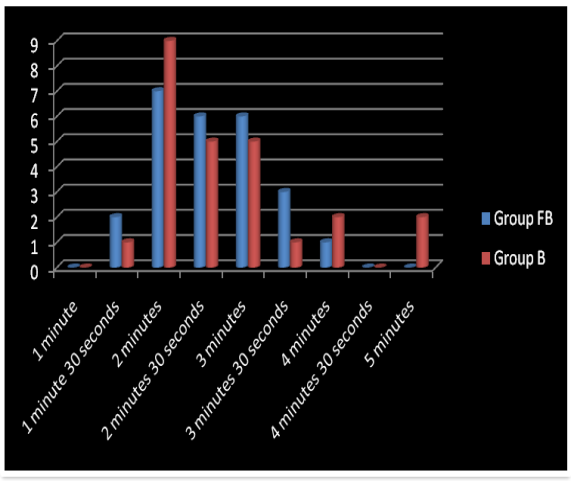


Graph 1: Patients Characteristics and preoperative Hemodynamic Variables

There was not much difference in the onset of analgesia in both the groups, the difference being statistically insignificant (P>0.05) (Table 2 and Graph2).

Table 2: Onset of Sensory Blockade

TIME	Group FB	Group B
1 minute	0	0
1 minute 30 seconds	2	1
2 minutes	7	9
2 minutes 30 seconds	6	5
3 minutes	6	5
3 minutes 30 seconds	3	1
4 minutes	1	2
4 minutes 30 seconds	0	0
5 minutes	0	2

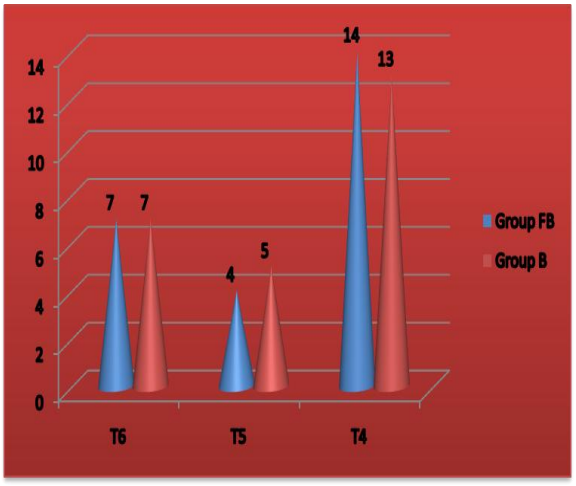


Graph 2: Onset of Sensory Blockade

Majority of the patients in both the groups had a higher level of sensory block at T4 (Table 3 and Graph 3).

Table 3: Highest level of Sensory Block

Level of Sensory block	Group FB		Group B	
	Number	Percentage	Number	Percentage
T6	7	28	7	28
T5	4	16	5	20
T4	14	56	13	52



Graph 3: Highest level of Sensory Block

The time to reach highest sensory level did not show any significant difference among the groups (Table 4).

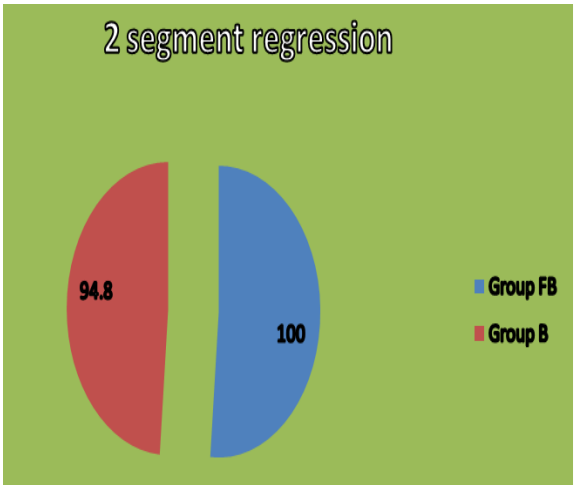
Table 4: Time taken to reach the Highest level of Sensory Block

TIME	Group FB	Group B
4 minute	2	1
4 minute 30 seconds	0	0
5 minutes	5	3
5 minutes 30 seconds	0	2
6 minutes	7	9
6 minutes 30 seconds	2	4
7 minutes	5	4
7 minutes 30 seconds	1	0
8 minutes	1	1
8 minutes 30 seconds	0	0
9 minutes	2	1

Regarding 2 segment regression, there was no significant difference between the 2 groups (Table 5 and Graph 4).

Table 5: Time required for 2 segment regression

TIME	Group FB	Group B
2 segment regression	100±8.75	94.8±10.6



Graph 4: Time required for 2 segment regression

Postoperative analgesia lasted for a longer time in Group FB than Group B, the difference being statistically significant (Table 6).

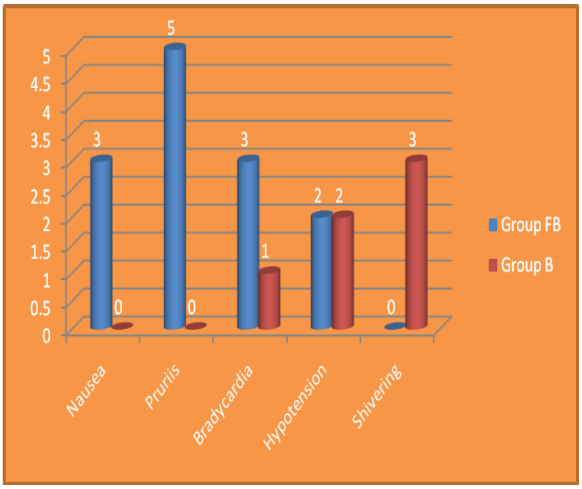
Table 6: Duration of Postoperative analgesia

TIME	Group FB	Group B
2 hours	0	1
2 hours 15 minutes	0	1
2 hours 30 minutes	0	3
2 hours 45 minutes	0	3
3 hours	0	9
3 hours 15 minutes	2	5
3 hours 30 minutes	6	0
3 hours 45 minutes	5	0
4 hours	5	3
4 hours 15 minutes	2	0
4 hours 30 minutes	5	0
4 hours 45 minutes	0	0
5 hours	0	0

Among various complications observed, pruritus (20%) was the commonest followed by nausea, bradycardia and hypotension. Group FB none of the patients had vomiting, shivering and respiratory depression. In Group B, only 6 (24%) patients had adverse effects, out of which 3 had shivering, 2 had hypotension and one had bradycardia (Table 7 and Graph 5).

Table 7:Incidence of complications in both the groups

Adverse effects	Group FB		Group B	
	Number	Percentage	Number	Percentage
Nausea	3	12	0	0
Vomiting	0	0	0	0
Pruriis	5	20	0	0
Bradycardia	3	12	1	4
Hypotension	2	8	2	8
Shivering	0	0	3	12
Respiratory Depression	0	0	0	0



Graph 5: Incidence of complications in both the groups

DISCUSSION

In recent years, neuraxial opioids have been increasingly used to augment the analgesia produced by local anesthetics. Subarachnoid morphine has been widely used for this purpose to provide effective postoperative analgesia. Fentanyl may be advantageous over morphine because of its rapid onset of action, superior intraoperative conditions and lack of delayed respiratory depression. [1, 2]

This study suggests that addition of 25 µg of fentanyl to 8.5 mg bupivacaine has no effect on the onset of analgesia to pin prick, height of the sensory block achieved and time to achieve maximum level. Fentanyl does not prolong the bupivacaine sensory block. But there is a significant prolongation of postoperative analgesia with the addition of fentanyl. Wang et al found that there was a potential synergism between intrathecal fentanyl and bupivacaine. Our results are consistent with experimental effect of intrathecal opioids which shows that combination of opioids and local anesthetics are synergistic for somatic analgesia. Intrathecal opioids can markedly enhance analgesia from subtherapeutic doses of spinal bupivacaine. Intrathecal opioids appear to produce analgesia by inhibition of synaptic transmission in nociceptive afferent pathways (Aδ and C fibers) and yet, they didn't inhibit conduction in sympathetic pathways or somatosensory evoked potentials. Thus, synergestic blockade of Aδ and C afferents allowed subtherapeutic concentration of hyperbaric bupivacaine to maintain surgical anaesthesia during regression of spinal anaesthesia. Thus our study results are consistent with an enhanced block of nociceptive afferents as a mechanism of improved analgesia with addition of fentanyl to spinal bupivacaine. [5]

In both the groups, the mean onset of sensory block occurred between 2 and 3 minutes in most of the patients (76%) and maximum level of sensory blockade at T4 is achieved in 5 to 7 minutes. This observation shows that addition of fentanyl to bupivacaine does not influence bupivacaine sensory block. According to Hunt et al, the synergism between fentanyl and bupivacaine doesn't affect the onset of sensory block and the duration of motor block, but it facilitates an effective postoperative analgesia. In our study the mean duration of 2 segment regression in group FB was 100 minutes and in group B was 94.8 minutes. So there was no difference in the duration of 2 segment regression in both the groups. [2]

All the previous studies have shown that there is a significant increase in the duration of postoperative analgesia with the addition of fentanyl to bupivacaine. Our data shows that postoperative analgesia is better and longer lasting with addition of 25 µg fentanyl to bupivacaine. The mean duration of postoperative analgesia in group FB was 3 hours, 58 minutes and group B was 3 hours. This is very significant finding. This finding is in accordance with all other previous studies. [4-6]

Norris et al reported that pruritus would be frequently encountered after intrathecal opioid administration. According to our results, the rate of pruritus has exceeded by 20% with intrathecal fentanyl to bupivacaine combination, when compared to the control group. But it was well tolerated, none of the patients needed treatment. [7]

The administration of intrathecal opioids carried the risk of respiratory depression. Fentanyl is much more lipid soluble than morphine and does not migrate intrathecally to the fourth ventricle to cause respiratory depression. Liu et al postulated that they did not observe any respiratory depression. [8] Hunt et al did not report respiratory depression with intrathecal administration of bupivacaine and 12.5 µg fentanyl. In this study we also did not observe any respiratory depression. [6] Our results are comparable with those of Liu et al and Hunt et al. [6,8] According to Chu et al, [9] shivering subsided significantly with 12.5 µg fentanyl and bupivacaine combination intrathecally. In our study shivering was not seen in fentanyl group, but 12% patients had shivering in bupivacaine group. Other complications in FB group were bradycardia (12%) and nausea (12%), but none had vomiting, 2 patients had hypotension.

Recent trends in obstetric anaesthesia show increased popularity of regional anaesthesia among obstetric anaesthetists. Deaths in regional anaesthesia are primarily related to excessive high regional blocks and toxicity of local anaesthetics. With minimum dose changes, the chances of complications and side effects are enhanced. These days 0.5% heavy bupivacaine is used commonly for spinal and epidural anaesthesia. It was decided to combine it with intrathecal fentanyl to provide adequate depth of anaesthesia with lesser doses of bupivacaine. Our results of onset time of sensory block to T6 corroborate with that of Randalls et al (1991). [10] Complete motor block was achieved in 90-100 % of patients in our study, this is in accordance with Pederson et al (1989) [11] and Choi et al (2000). [1] It is evident from the results that the depth of anaesthesia in FB group is equivalent to B 12.5 group. This proves that by adding fentanyl adequate depth of spinal anaesthesia can be achieved at much lower doses of bupivacaine.

Incidence of hypotension as well as fall in systolic BP increases with the dose of bupivacaine. However no significant difference was noticed in the fentanyl added group when compared to fentanyl added group when compared with the non added counterpart. Bradycardia results from the blockade of sympathetic cardio accelerator fibers and decreased venous return to the heart. In our study bradycardia occurrence was overall 7% with no significant intergroup variation. This is in accordance with Singh et al (1995). [12] About 75-90% of the patients become drowsy but arousable with the intrathecal fentanyl addition as compared to those without fentanyl addition.

We found significant reduction in the incidence of nausea by addition of fentanyl to bupivacaine, similar to the findings of Randalls et al (1991). [10] Further negligible amount of pruritus, shivering and respiratory depression was observed. Also, the APGAR scores of the babies remained same in both the groups. There was longer duration of postoperative analgesia in fentanyl- bupivacaine groups. This also increases with the increasing dose of bupivacaine. However, motor recovery was not affected by addition of fentanyl.

In our study, we were interested to assess the efficacy of the combination of low-dose (7.5 mg) of 0.5% hyperbaric bupivacaine and 25 µg of fentanyl in spinal anaesthesia. Patients scheduled for elective caesarean section were chosen for the study as it is well known that they show visceral discomfort and pain under spinal anaesthesia. The aim of our study was to assess hemodynamics, duration of effective analgesia. We observed that the systolic and diastolic BP were decreased significantly ($P<0.001$) after 3 and 5 minutes of spinal anaesthesia in the control group when compared to the study group, mostly due to more sympathetic blockade by the higher doses of bupivacaine in the control group. Similar findings were observed by Bogra et al and also by Seyedhejazi et al. [13,14]

In our study we observed that the time required for the onset of sensory blockade up to T6 was faster in control group than study group and is statistically significant (P<0.001) which corroborate with the study of Singh et al. [12] The quality of analgesia which was assessed by VAS scale was excellent in the study group. Similar observations were observed by Choi et al. [1] The duration of effective analgesia was prolonged with P<0.001 in the study group, which also correlates with the study of Ngiam and Chong. [15] The time of the first request of analgesics was significantly delayed, which strongly suggests a synergism of action between intrathecal fentanyl and local anaesthetics. The duration of 2 segment regression of sensory blockade was prolonged in the study group than in the control group, which was statistically significant (P<0.001) and concurs with the study of Idowu et al. [16]

No patients complaining of nausea and vomiting may be due to the reduction of dosage of bupivacaine from 10 mg to 7.5 mg causing less hypotension in the study group. Negligible incidences of shivering and respiratory depression were observed in both the groups. None of the new born babies had 5 minute APGAR score<7. Similar observations were made by Belzarena et al, indicating that the dose of fentanyl used may not have a significant effect on new born. [17]

Intrathecal fentanyl has a very selective site of action on spinal cord; it acts synergestically with the bupivacaine to enhance the effect on the efferent pathways but without an effect on the sympathetic pathways, thus not producing hypotension. Most patients in the BF group required ephedrine. Maintenance of normal maternal BP during spinal caesarean section is key factor for adequate neonatal outcome. The mature placenta is a high capacitance organ with no autoregulatory ability, so uteroplacental perfusion pressure is dependent on systolic BP. Spinal anaesthesia with adequate BP results in better neonatal blood gas and acid-base measurements in caesarean delivery. The increased emetic effects in Bupivacaine group may be secondary to the increased incidence of hypotension, because effects were relieved when the BP was increased after administration of ephedrine. Spinal anesthesia has been reported to have sedative effects irrespective to the presence or absence of fentanyl addition, exact mechanism is unclear. One theory is that local anesthetics acts on the posterior horn of the spinal cord. They decrease stimulation to the reticular activating system which causes antianxiety effects. Another theory is that an increase in local anesthetics concentration in the central nervous system produces sedative effects. In this study, none of the subjects showed maternal respiratory depression. Hunt et al increased the dosage of fentanyl stepwise to 50µg in spinal anaesthesia for caesarean delivery, but did not observe respiratory depression. Similar results were obtained in the present study indicating negligible influence of fentanyl at a dose ≤20 µg. [1,6,10]

CONCLUSION

It was found that fentanyl 25 µg does not enhance the onset and duration of sensory block produced by 8.5mg intrathecal hyperbaric bupivacaine. Fentanyl however prolongs postoperative analgesia and lowers the incidence of shivering. The incidence of pruritus is high, but it is usually mild. Fentanyl 25 µg along with 8.5mg bupivacaine is very much safer than opioids like morphine which has more postoperative complications like intense intermittent respiratory depression.

REFERENCES

1. Choi DH, Ahn HJ, Kim MH. Bupivacaine sparing effect of fentanyl in spinal anesthesia for cesarean delivery. Regional Anesthesia Pain medicine. 2000;25:240–245.
2. Kaur M, Katyal S, Kathuria S, Singh P. A comparative evaluation of intrathecal bupivacaine alone, sufentanil or butorphanol in combination with bupivacaine for endoscopic urological surgery. Saudi J

Anaesth. 2011;5:202–7.
3. De Simone CA, Leighton BL, Norris MC. Spinal anesthesia for cesarean delivery. A comparison of two doses of hyperbaric bupivacaine. Regional Anesthesia. 1995;20: 90–94.
4. Abouleish E, Rawal N, Fallon K, Harnandez D. Combined intrathecal morphine and bupivacaine for cesarean section. Anesthesia & Analgesia. 1988;67:370–374.
5. Wang C, Chakrabarti MK, Whitwam JG. Specific enhancement by fentanyl of the effects of intrathecal bupivacaine on nociceptive afferent but not on sympathetic efferent pathways in dogs. Anesthesiology 1993; 79; 766-73.
6. Hunt CO, Naulty JS, Bader AM et al. Perioperative analgesia with subarachoid fentanyl bupivacaine for Caesarean delivery. Anesthesiology 1989; 71; 535-40.
7. Norris M, Honest J et al. A comparison of meperidine and lidocaine for spinal anesthesia for postpartum tubal ligation. Regn Anesth 1996; 21: 84-88.
8. Liu S, Chiu A, Carpenter RL, Mulroy MF, Allen HW, Neal JM, Pollock JE. Fentanyl prolongs lidocaine spinal anaesthesia without prolonged recovery. Anaesth Anlag., 1995; 80: 730-734.
9. Chu CC, Shu SS, Liu SM. The effect of intrathecal Bupivacaine with combined Fentanyl in caesarean section. Acta Anaesthesiol., 1995; 33: 149-154.
10. Randalls B, Broadway JW, Browne DA, Morgan BM. Comparison of four subarachnoid solutions in a needle-through needle technique for elective cesarean section. Br J Anaesth. 1991;66:314–318.
11. Pedersen H, Santos AC, Steinberg ES, Schapiro HM, Harmon TW, Finster M. Incidence of visceral pain during cesarean section: The effect of varying doses of spinal bupivacaine. Anesthesia & Analgesia. 1989;69:46–49.
12. Singh H, Yang J, Thornton K, Giesecke AH. Intrathecal fentanyl prolongs sensory bupivacaine spinal block. Can J Anesth. 1995;42:987–91.
13. Bogra J, Arora N, Srivastava P. Synergistic effect of intrathecal fentanyl and bupivacaine in spinal anesthesia for cesarean section. BMC Anesthesiol. 2005; 5:5.
14. Seyedhejazi M, Madarek E. Effect of small dose bupivaciane-fentanyl in spinal anesthesia on hemodynamic nausea and vomiting in caesarean section. Pak J Med Sci. 2007;23:747–50.
15. Ngiam SK, Chong JL. The addition of intrathecal sufentanil and fentanyl to bupivacaine for caesarean section. Singapore Med J. 1998;39:290–4. [PubMed]
16. Idowu OA, Sanusi AA, Eyelade OR. Effects of intrathecally administered fentanyl on duration of analgesia in patients undergoing spinal anesthesia for elective caesarean section. Afr J Med Med Sci. 2011;40:213–9.
17. Belzarena SD. Clinical effects of intrathecally administered fentanyl in patients undergoing cesarean section. Anesth Analg. 1992;74:653–7.

How to cite this article: Raoji R. A comparative study of intrathecal fentanyl along with bupivacaine and bupivacaine alone in lower segment caesarean section and postoperative analgesia. International Journal of Research and Review. 2018; 5(12):148-155.

******