

A comparative clinical study of intrathecal hyperbaric bupivacaine with and without fentanyl for hysterectomy



Hari Poudel¹, Surinder Nath Bawa², Surendra Mohan Sharma²

¹Lecturer, Department of Anaesthesiology, Manipal Teaching Hospital, Phulbari, Pokhara, Nepal, ²Professor, Department of Anaesthesiology, Manipal Teaching Hospital, Phulbari, Pokhara, Nepal.

Submitted: 04-12-2019

Revised: 22-01-2020

Published: 01-03-2020

ABSTRACT

Background: Spinal anaesthesia has been widely used for lower abdominal surgeries like hysterectomy. Hyperbaric bupivacaine is the most extensively used local anesthetic. Addition of fentanyl can allow the reduction in the dose of bupivacaine, increase the height and duration of sensory blockade, and reduces complications of spinal anesthesia.

Aims and Objective: The aim of the study was to examine whether adding fentanyl to hyperbaric bupivacaine would increase the height of sensory blockade, accelerate the onset of sensory blockade and increase the duration of the sensory blockade. **Materials and Methods:** This study was done in Manipal Teaching Hospital, Pokhara, Nepal that included hundred patients who underwent total abdominal hysterectomy. The patients were randomly allocated in two groups; **Group I:** received 0.5% hyperbaric bupivacaine 2.5 ml (12.5 mg) plus normal saline 0.5 ml. **Group II:** received 0.5% hyperbaric bupivacaine 2.5 ml (12.5 mg) plus 0.5 ml fentanyl (25 µg). Hemodynamic variables, onset of motor and sensory blockade, duration of sensory and motor blockade and any side effects were observed and recorded. **Results:** The highest and lowest sensory block in Group I was T-7 and T-9 whereas in Group II was T-5 and T-9 respectively. In group I, the mean onset till maximum height of sensory blockade was 7.04 min whereas in group II it was 5.96 min ($P < 0.00$). There was no significant statistical difference in the incidence of side effects in both the groups. **Conclusion:** Intrathecal fentanyl with hyperbaric bupivacaine for spinal anesthesia significantly accelerated the onset of sensory blockade and increased its maximum height and duration.

Key words: Bupivacaine; Fentanyl; Spinal anesthesia

Access this article online

Website:

<http://nepjol.info/index.php/AJMS>

DOI: 10.3126/ajms.v11i12.26548

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

Spinal anaesthesia is the major regional anaesthesia technique with a long history of effective use for a variety of surgical procedures and pain relief. It produces sympathetic block, sensory analgesia and motor block, depending on dose, concentration, or volume of local anaesthetic.¹ Nevertheless, precipitous hypotension, operations outlasting the spinal anesthesia and risk of failure are major disadvantages of spinal block.²

Opioids and local anesthetics administered together intrathecally have a potent synergistic analgesic effect.^{3,4} Intrathecal fentanyl causes neither by itself nor

in combination with bupivacaine any further depression of efferent sympathetic activity, it is possible to enhance the sensory blockade without altering the degree of sympathetic blockade.⁵

Lipophilic opioids (fentanyl and sufentanil) are increasingly being administered intrathecally as adjuvants to local anaesthetics. They enhance spinal anaesthesia without prolonging motor recovery and discharge time.^{6,7}

MATERIAL AND METHOD

After receiving approval from Institutional Review Committee (IRC), this single centered hospital based

Address for Correspondence:

Dr. Hari Poudel, Lecturer, Department of Anaesthesiology, Manipal College of Medical Sciences/Manipal Teaching Hospital, Phulbari, Pokhara, Nepal. **Mobile No:** +977-9856002255. **E-mail:** haripoudel702@gmail.com

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observational analytical study was carried out in Department of Anaesthesiology at Manipal Teaching hospital, Pokhara, Nepal. The study included 100 patients fulfilling the inclusion criteria which are consenting patients of ASA physical status I and II, Age between 20 and 70 years and Patient undergoing Total Abdominal Hysterectomy under spinal anaesthesia. Exclusion criteria were also defined which are Unwilling patients, ASA physical status > III, Patients having the level of sensory block below T₁₀ after 15 minutes, Contraindications to Subarachnoid block, Coagulation disorder or taking any anticoagulant and anti-platelet medicines, Pre-existing neurological or spinal diseases and History of allergy to local anaesthetics and/or opioids. Routine pre-anaesthetic checkup was done one day prior to surgery. Informed and written consent was taken and data collection was done in the preformed collection sheet. All patients were premedicated with diazepam 5 mg per oral at 10 PM the Previous night and fasting from midnight.

On the day of surgery patients were transferred to Pre-anaesthesia preparation room and baselines BP, HR, SPO₂ were recorded. IV cannulation was done with 18 G IV cannula and IV fluid Ringer's Lactate infusion was started. The patients were randomly allocated in to groups: Group I: (n=50) received 0.5% hyperbaric bupivacaine 2.5 ml (12.5 mg) plus normal saline 0.5 ml and Group II: (n=50) received 0.5% hyperbaric bupivacaine 2.5 ml (12.5 mg) plus 0.5 ml fentanyl (25 µg). Study drug was administered intrathecally at L3-L4 intervertebral space with 25 G quincke needle at the rate of 0.2ml/second after free flow of CSF. Patients were kept in supine position with pillow under head and neck immediately after spinal anaesthesia. BP, HR, ECG, SPO₂ was monitored continuously every five minutes. Level of sensory block was defined as the loss of sharp sensation to a pinprick test, and was recorded bilaterally at the midclavicular line. Level of Sensory block assessment was done every minute for 10 minutes after the study drug was given, then at 20 min and at the end of operation. Onset till the maximum height of sensory block was noted. Surgical procedure was allowed only after the level of sensory block reached T₁₀ dermatomal level. Intraoperative visual analog scale (VAS) pain score was recorded from the time of surgical incision at 10 minutes interval till the end of surgery. At the end of surgical procedure, the patients were shifted to recovery room and monitored.

Bradycardia was defined as HR < 50 beats/min. Hypotension was defined as 20% decrease in systolic BP from baseline or SBP < 90 mmHg. The following side effects were recorded and rescue treatment was given as mentioned below; Respiratory Depression: Defined as respiratory rate < 10 breaths/min and classified as Mild:

[SPO₂ 90-94%] on room air, Moderate: [SPO₂ (85-89%)] on room air- treated with O₂ via bag and mask and i.v Naloxone (as required), monitored for 100 minutes after initiation of spinal anaesthesia. Pruritus was recorded at the time of complain of symptom and classified as Grade 0: no itching, Grade 1: mild not requiring treatment, Grade 2: moderate requiring first line treatment, Grade 3: severe requiring second line treatment. Treatment of Pruritus was done as follows if grade > 2; First line treatment: IV Promethazine 12.5 mg, if not improved by 5 min then, second line treatment: IV Naloxone (0.01ml/kg). The time to first request for therapy for pruritus and the total amount of rescue drug administered were recorded. Nausea and vomiting was recorded at the time of complain of symptom and classified as Grade 0: no nausea, Grade 1: mild nausea not requesting treatment, Grade 2: severe nausea requesting treatment, Grade 3: vomiting. Treatment of nausea and vomiting was done if grade > 2; Treatment was done with IV Metoclopramide 10 mg, If not controlled, repeated after 15 min, The time to first request for antiemetic therapy and the total amount of supplemental antiemetic administered were recorded. All other complaints were noted and recorded. For post-operative pain, oral NSAIDS were given as needed, the interval from the injection of spinal anaesthesia to the request of first dose of analgesic was recorded. Data was entered in Excel Master sheet with coding of the variables. SPSS software version 20.0 was used. Frequencies, percentages, means with standard deviation were calculated. Paired sample t-test was used to compare the means between the two groups. P-value was taken as significant if less than 0.05.

RESULTS

Hundred ASA I and II female patients aged between 20 to 70 years posted for abdominal hysterectomy under spinal anaesthesia were selected for the study. The study was undertaken to evaluate the efficacy of fentanyl (25 µg) as adjuvant to hyperbaric bupivacaine (0.5%) in comparison with hyperbaric bupivacaine (0.5%) with NS (0.5 ml.) for spinal anaesthesia. The demographic parameters were comparable between the groups (Table 1).

Table 1: Demographic characteristics of the study population

Parameter	Group I	Group II	p-value
Age (yrs)	48.42±9.86	51.04±10.23	0.196
Weight (Kg)	50.02±5.71	48.78±7.69	0.362
Height (cm)	150.66±4.08	151.20±4.87	0.550
ASA n (%)			
ASA I	24 (48.0)	22 (44.0)	0.688
ASA II	26 (52.0)	28 (56.0)	

Values are in Mean±SD or n (%)

Table 2: Height of sensory blockade, onset till maximum height of sensory blockade, request for first analgesia and VAS score at the time for request of analgesia

Parameter	Group I	Group II	p-value
Maximum height of sensory blockade	T7-T9	T5-T9	
Mean height of sensory blockade of Thoracic Segment	8.26±0.096	6.74±0.751	<0.001
Onset till max height (min)	7.04±0.83	5.96±0.60	<0.001
Time for first analgesia (min)	230.32±8.58	270.54±25.08	<0.001
VAS score at first analgesia	5.48±0.64	5.64±0.69	0.235

Values are in mean±SD

The highest and lowest sensory block in Group I was T-7 and T-9 whereas in Group II was T-5 and T-9 respectively. The mean height of sensory blockade in group I and group II were T-8 and T-7 respectively. (p-value < 0.001) (Table 2).

Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and oxygen saturations were comparable between groups and did not change significantly in the intraoperative or postoperative period. No adverse events were encountered in either group of patients. Few complications occurred and were treated (Table 3).

DISCUSSION

Opioids and local anesthetics administered together intrathecally have been shown to have a synergistic analgesic effect.^{8,9,10} Lipophilic opioids (e.g. fentanyl and sufentanil) are increasingly being administered intrathecally as adjuncts to local anaesthetics. The synergism is characterized by enhanced somatic analgesia without effect on the degree of the local anaesthetic induced sympathetic or motor blockade.¹¹⁻¹⁴ The explanation of this synergism is likely due to the drugs separate mechanisms of action, where in inhibition of nociceptive transmission occurs at sequential stage of that signal transmission. Intrathecal opioids inhibit nociceptive afferent synaptic transmission via A delta and C fiber by opening presynaptic potassium channels to inhibit transmitter release and thus reduce calcium influx. There is also a direct postsynaptic effect with hyperpolarization and reduce neuronal activity along with inhibition of substance P release in dorsal horn of spinal cord.¹⁵

Local anaesthetics work primarily by causing blockade of voltage-gated sodium channels in the axonal membrane and possibly, a further effect on pre-synaptic inhibition of calcium channel. This leads to a decrease in electrical depolarization, failure to achieve threshold, and a failure to propagate an action potential that culminates in conduction blockade.¹⁶

In This study, Fentanyl was added to bupivacaine to determine its effect on maximum height of sensory

Table 3: Complications

Parameter	Group I	Group II
Bradycardia	3/50	1/50
Treated for Bradycardia	1/3	Nil
Hypotension	8/50	3/50
Treated for Hypotension	6/8	1/3
Nausea/vomiting	3/50	3/50
Treated for Nausea/vomiting	Nil	Nil
Pruritus	Nil	3/50
Treated for Pruritus	Nil	Nil
Respiratory Depression	Nil	Nil
Treated for Respiratory Depression	Nil	Nil

blockade, onset till maximum height, duration of sensory blockade and complications if any. The results suggest that the addition of 25 µg of fentanyl to 12.5 mg of bupivacaine (Group II) increased the maximum height of sensory blockade, hastened the onset till the maximum height of sensory blockade, prolonged the total duration of sensory analgesia and cause lesser frequencies of hypotension which was statistically significant.

Study made by Techanivate A et al.¹⁷ showed that addition of 20 mcg of Fentanyl in 20mg of bupivacaine prolonged the duration of sensory blockade with no difference in maximum height of sensory blockade and frequencies of complications like hypotension and respiratory depressions. In aspects of hypotension and maximum height of sensory blockade the result differs from the present study. In present study there is lesser frequency of hypotension and the level of the sensory blockade is higher with the addition of fentanyl to bupivacaine. The results of prolonging duration of the sensory blockade and no respiratory depression are similar to this study.

The study showed that there is prolongation of the sensory blockade and no significant increase in hypotension similar to the results shown by the study made by Singh H et al.¹⁸ in lower extremities and genitourinary surgeries, whereas it differs that the onset of sensory blockade till the maximum height is unaltered in study made by Singh H et al.

In the study done by Kumar PN et al,¹⁹ 25 mcg of fentanyl added to 12.5 mg 0.5% bupivacaine in spinal anaesthesia had advantages over conventional dose hyperbaric

bupivacaine, including faster onset of sensory blockade and longer duration of analgesia which is similar to the results shown by my study.

Likewise, in a study done by Rajnish *et al.*,²⁰ the duration of sensory blockade was prolonged in the group who received intrathecal bupivacaine along with fentanyl and the hypotension noted was also significant which is similar as the results in my study.

The study made by Parlow *et al.*,²¹ in which showed addition of fentanyl in bupivacaine reduced the density of intrathecal drug injected than the bupivacaine alone. This resulted in higher level of sensory blockade in fentanyl added group which resembles my study result.

Regarding the other side effects, same number of patient from each group had nausea or vomiting not requiring treatment with I.V. ondansetron. This finding was not statistically significant. Similarly, there was no statistical difference in the incidence of bradycardia and pruritus among the groups. Liu *et al.*,²² studied the effect of addition of fentanyl in the quality and duration of lidocaine spinal anesthesia. Pruritus occurred in only subjects receiving fentanyl but was treated easily and was well tolerated.

The administration of intrathecal opioids may provide benefits in augmenting intraoperative anesthesia, but carries a risk of respiratory depression.^{23,24} But we found no clinical manifestations of respiratory depression. The similar result was found in a study made by Techanivate *et al.*¹⁷ which showed that administration of 20 µg of fentanyl during spinal anaesthesia did not lead to respiratory depression. Fentanyl is much more lipid-soluble than morphine and hence dose not tend to migrate intrathecally to the fourth ventricle in sufficient concentrations to cause respiratory depression.

CONCLUSION

The addition of 25 µg of fentanyl to 12.5 mg of bupivacaine increases the maximum height of sensory blockade, hastens the onset till the maximum height of sensory blockade, prolongs the total duration of sensory analgesia, causes no significant complications like bradycardia respiratory depression, pruritus or nausea and vomiting.

ACKNOWLEDGEMENT

None.

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Authors Contribution:

HP- Concept and design, review of literature, statistically analysis and interpretation, manuscript preparation and revision; **SNB**- literature search and review; **SMS**- Manuscript revision and literature review.

Work attributed to:

Department of Anaesthesiology, Manipal Teaching Hospital, Phulbari, Pokhara, Nepal.

Orcid ID:

Dr. HariPoudel -  <https://orcid.org/0000-0002-9168-6620>

Source of Support: Nil, **Conflict of Interest:** None declared.