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Research Article

Comparison of Effect of Intrathecal Fentanyl 25µg with 0.5% Hyperbaric Bupivacaine and Only 0.5% Hyperbaric Bupivacaine

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Abstract

Background: To enhance the duration of sensory anaesthesia and to prolong the duration of post-operative pain relief during spinal anaesthesia, various adjuvants have been tried along with local anaesthetic agent. The present study was undertaken to evaluate and compare the onset and duration of sensory block, motor block and duration of post-operative pain relief by using intrathecal 0.5% Hyperbaric bupivacaine with fentanyl 25µg versus only 0.5% Hyperbaric bupivacaine selected groups.

Methods: We enrolled 70 ASA I & II patients undergoing surgeries below umbilicus level for our Prospective Randomized trial. Those who met our inclusion criteria were randomized using simple random sampling technique, after obtaining informed consent. Patients in Group A received fentanyl 25µg with 0.5% Hyperbaric Bupivacaine and patients in Group B received only 0.5% Hyperbaric Bupivacaine intrathecally. Parameters like onset and duration of sensory and motor block and postoperative pain relief were observed. In postoperative period, VAS score was monitored & time for rescue analgesia was noted, when VAS exceeded 5 or above.

Results: It was found that Patients in Group A had significantly prolonged duration of postoperative analgesia as compared to Group B (Z value 17.35). Results of Onset & Duration of sensory and motor block were suggesting insignificant result. Post-operative complication was insignificant in our study.

Conclusion: Addition of Fentanyl 25µg with 0.5% Hyperbaric Bupivacaine in Spinal anaesthesia have insignificant effect on duration of sensory and motor blockade and prolongs postoperative pain relief.

More Information

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Keywords: Spinal anaesthesia; Intrathecal fentanyl; Hyperbaric bupivacaine; Analgesia; Pain relief; VAS score

Introduction

Neuraxial blockade is the preferred method of anaesthesia for surgeries on lower abdomen and lower limb. It is remarkable for its ability to produce intense and extensive analgesia from a tiny dose of local anaesthesia. It is easy to perform, guided by a definite end point and enjoys a high success rate in producing rapid onset of action. It provides effective pain relief for a short duration in post-operative period and thus early analgesic intervention is needed in postoperative period due to which various adjuvants have been studied.

Advantages include simplicity, rapidity and reliability. Disadvantages include higher incidence of hypotension, limited control of level and duration of anaesthesia and possibility of post dural puncture headache.

Local anaesthetic like Bupivacaine is commonly used in spinal anaesthesia but its duration of spinal anaesthesia may be short and limited.

Various medications were used in combination with local anesthesia, as postoperative anesthesia is not only desirable, but also very necessary for all surgical procedures, to increase the duration of sensory anesthesia and to prolong the duration of postoperative pain relief. Now a days drugs like Benzodiazepines [1], Epinephrine [2], Morphine [3], Buprenorphine [4], Fentanyl [5], Neostigmine [6,7], Dexmedetomidine [8], Clonidine [6] have been tried by various authors to potentiate the effect of local anaesthesia drug in spinal anaesthesia.

Fentanyl citrate is safer and commonly used drug among opioids. It is a lipophilic opioid having fast onset of action

and short duration of action. When it is added to intrathecal hyperbaric bupivacaine, it prolongs duration of post-operative analgesia.

Fentanyl acts at the µ(mu)-opioid receptor and some studies suggest that when Fentanyl is added to hyperbaric bupivacaine enhance the quality of intrathecal block.

But it also has adverse effects, like pruritus and respiratory depression.

The present study was attempted to compare onset and duration of sensory and motor block and duration of post-operative pain relief by using intrathecal 0.5% Hyperbaric bupivacaine + fentanyl 25µg versus only 0.5% Hyperbaric bupivacaine in respective groups.

Material and methodology

Once we got Institutional Ethical Committee approval and written consent from all patients, the study was undertaken on 70 patients of ASA grade I & II planned for surgeries below umbilicus level under spinal anaesthesia. This study was Prospective, Randomized, double blinded study which was done during October 2022 to March 2024 at our Institute.

Inclusion & exclusion criteria

Patients undergoing surgeries below umbilicus level, of age between 20-60 years, whose weight in range of 42-86 kg, and height was between 145-180 cm, belonging to ASA I and II were included in study.

Patient refusal, ASA III and IV, Contraindications to spinal anaesthesia like bleeding diathesis, hypovolemia, infection at the site of intrathecal injection, allergy to bupivacaine and fentanyl, Patients undergoing obstetric procedures were not included in our study.

Sample size

$$n = \left[\frac{Z_{\frac{\alpha}{2}}.\sigma}{E}\right]^2$$

Where n = Sample Size

Z = Standard Normal Variate α = Level of significance

σ = Standard Deviation of Population

(from literature review/past studies the rough estimate is 15) E = Error level= 5%

At 5% level of significance Z α/2 = 1.96

Hence the estimated sample size is 34.57 which is approximately 35.

For the study two groups each of size 35 are investigated.

Statistical analysis

Data analysis was done using SPSS (statistical package for the social science) Version 20 for windows.

All quantitative data (continuous variable like Sensory block time, Motor block time, Post-operative VAS score) presented in mean ± SD at decimal point.

The data thus obtained was statistically analyzed using Z test (for quantitative data (as n > 30) & Chi square test (for qualitative data).

A p - value of <0.05 and Z-test of > 2 considered statistically significant.

Pre anaesthetic assessment

One day prior to surgery for all selected patients including detailed history, investigations, drug therapy and drug allergy was taken. A clinical examination of the patient was performed including general and systemic examination. All patients were kept fasting for 6 hours prior to surgery.

Visual Analogue Score (VAS) was explained to patients preoperatively.

All patients were allocated by randomization using closed opaque envelope technique in 2 groups as mentioned below,

GROUP A: (case group n = 35) received 3.5 ml of 0.5% Hyperbaric Bupivacaine + 0.5 ml (25µg) Fentanyl in subarachnoid space.

GROUP B: (control group n = 35) received 3.5 ml of 0.5% Hyperbaric Bupivacaine + 0.5 ml of Normal Saline in subarachnoid space.

Intravenous access was secured in preoperative area and intravenous infusion was commenced.

All baseline vital parameters like heart rate, MAP, SpO_2 were noted and documented.

The patients were premedicated with Ondansetron 8mg& Ranitidine 50 mg intravenously and then patients were shifted to operation theatre (OT).

In OT, patients were connected to monitors and vital data were recorded. Then patients were prepared for spinal anaesthesia.

Before the beginning of anaesthetic procedure, the patient was subjected to Group A or Group B by opening of the envelopes. The randomization was kept blind to the observer who monitored the patient in intraoperative and postoperative period. The person who has observed and recorded data for assessment has no knowledge of the regime of Group A or Group B that the particular patient receive.

Spinal anaesthesia was performed in sitting position with proper aseptic precautions. Local skin wheal was raised with 2 ml of 0.5% lignocaine at the site of lumbar puncture. Then lumbar puncture was performed with 23 Gauge Quincke's spinal needle in L3-L4 space. After successful subarachnoid puncture, drug solution was injected slowly according to randomization, without the knowledge of observer who was supposed to document the observations. The time of intrathecal injection was noted.

The patient's Heart rate, ECG, Mean Arterial Pressure (MAP), SpO_2 were monitored closely at various time intervals till the end of surgery.

Sensory block was evaluated by loss of sensation using pin prick technique bilaterally at lateral part of foot (S1). Time of onset of analgesia was recorded.

Modified Bromage Scale as given below utilized to decide the grade of motor block. The grading was done every 2 mins from the time of subarachnoid injection of local anaesthetic. The grading continued for a total 10 mins. Grade 3 was considered as complete motor block.

Any intraoperative complication was noted.

Duration of surgery was considered from the time of spinal anaesthesia till the time of dressing was done.

After 4 hours of commencement of spinal anaesthesia, the patient was questioned about pain perceived. Subsequently patient was asked the same question about feeling of pain every hour for the next 8 hours and then 2nd hourly. At any stage when patient confirmed the feeling of pain, he/she was asked to give VAS score for documenting the severity of pain. The total duration from the time of giving subarachnoid block, to the instance when patient complained of pain was calculated.

At the same time interval like assessment of pain the patient was also assessed for regression of motor tone. The pulse rate, MAP, SpO2 were recorded concurrently.

Whenever VAS was 5 or above, systemic analgesic was administered to patient. In our study, we used Inj. Diclofenac Sodium (75 mg) intramuscularly. The duration of first analgesic need from the time of administration of spinal anaesthesia was documented.

Any postoperative adverse effects or complications were looked for before discharge.

Result and analysis

The charts and tables are designed from the data obtained from every patient and compiled from master chart. Data is expressed as Mean ± SD (Tables 1,2).

Regarding comparison of onset of motor block, the calculated *Z* value of -1.35, suggesting the observed difference has no significance at 95% confidence limit (Table 3).

Table 1: Demographic characteristic of our study.

Sr. No.	Characteristic	Group A	Group B
1	Age in years	42.7 ± 13.7	43.5 ± 10.7
2	Height in cm	158.3 ± 6	159.6 ± 7.03
3	Weight in kg	55.4 ± 6.8	58.4 ± 8.08
4	Sex of patients(M:F)	17:18	18:17
5	ASA grade (I : II)	17:18	20:15
6	Duration of surgery	119 ± 25	105 ± 19.7

Table 2: Comparison of onset of sensory block & motor block

	Group A	Group B	Z	
Onset of sensory Block(min) Mean ± SD	3.3 ± 0.8	3 ± 0.7	1.67	Insignificant
Onset of motor Block (min) Mean ± SD	4.7 ± 1.04	5 ± 0.8	-1.352	Insignificant
Comparison of onset of sensory block on statistical analysis the difference was not significant (Z value 1.67).				

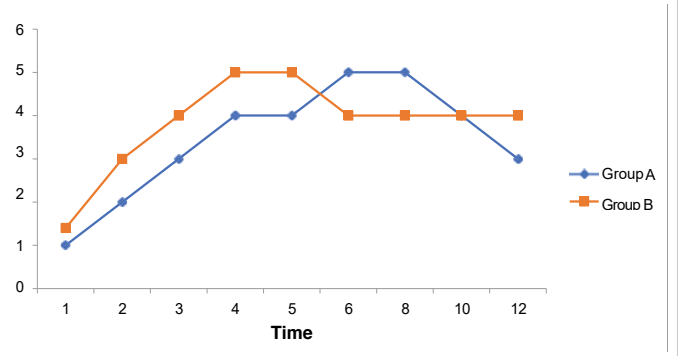

Chart 1: Mean VAS.

Assessment of pain

The subjective measurement of pain was documented in form of VAS - Visual Analogue Scale in each group (Table 4).

The Chart 1 depicts the line diagram of mean VAS in both the groups. As it is clearly evident that the line curve in Group A which received Fentanyl is shifted to the right. This suggests that the equivalent VAS for pain was observed at a longer duration in Group A as compared to Group B. However, the peak mean VAS score was same around 5 in both the groups although at different time intervals.

Table 5 suggested the duration of analgesia was statistically significant and longer in Group A as compared to Group B. The calculated *Z* value of 17.35, suggests that the observed difference is highly significant at 95% confidence limit (p value < 0.05).

Table 6 suggests that the observed difference has no significance at 95% confidence limit.

Comparison of complications in both the groups

Incidence of pruritus was slightly observed (14.285 %) in Group A compared to Group B.

Rest of other complications were not statistically significant in both the groups.

Table 3: Comparison of heart rate & mean arterial pressure in 1st hour (at different time interval in minutes).

Measured at time interval from the start of intrathecal block		5 min	10 min	20 min	30 min	45 min	1 hour
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Heart Rate	Group A	77 ± 10.1	74 ± 12.3	73 ± 11.4	75 ± 10.2	75 ± 9.4	76 ± 8.7
	Group B	89 ± 8.6	83 ± 8.8	79 ± 9	78 ± 7.4	78 ± 8.1	79 ± 7.4
Z value		-5.35	-3.52	-2.44	-1.4	-1.43	-1.56
Mean Arterial Pressure	Group A	87 ± 11.2	83 ± 8.4	82 ± 9.3	81 ± 9.4	83 ± 8.8	83 ± 8.3
	Group B	92 ± 5.9	79 ± 4.9	78 ± 4.4	78 ± 4.8	79 ± 4.6	79 ± 4.9
Z value		-2.34	2.43	1.19	1.68	2.38	2.46

Z value > 2 suggestive of significance

Table 4: Comparison of vas score in both groups at various time interval in hour

Time (hour) after sensory block	Mean VAS		SD			
	A	B	A	B	*p* value	
4	4	5	1.06	0.6	< 0.05	Significant
5	4	5	0.9	0.7	< 0.05	Significant
6	5	4	0.65	0.7	< 0.05	Significant
8	5	4	0.7	0.8	< 0.05	Significant
10	4	4	1.06	0.7	> 0.05	Insignificant
12	3	4	0.7	0.9	< 0.05	Significant

Table 5: Comparison of duration of analgesia.

	Group A	Group B
Duration of Analgesia (min) Mean ± SD	576 ± 93.3	280 ± 38.48
Z	17.35	
	Highly Significant	

Table 6: Comparison of duration of sensory & motor block.

	Group A	Group B	Z	
Duration of Sensory Block (min) Mean ± SD	190 ± 30.94	200 ± 19.57	-1.61	Insignificant
Duration of Motor Block (min) Mean ± SD	217 ± 33.98	220 ± 24.91	-0.41	Insignificant

Table 7: Demographic characteristic of Bajwa, et al. (2017).

Characteristics	BF group (*n* = 50) (mean ± SD)	BC group (*n* = 50) (mean ± SD)
Age (year)	42.53 ± 15.43	44.76 ± 14.20
Height (cm)	154.75 ± 9.54	153.25 ± 8.59
Weight (kg)	64.54 ± 12.50	61.80 ± 8.38
Sex of patients (Male : Female)	16:18	18:16
ASA grade	1-2	1-2
Duration of Surgery (minutes)	120.47 ± 54.63	128.65 ± 7.10

Table 8: Comparison of Sensory and Motor blockade and Analgesic duration.

Parameters	Groups				Z
	A		B		
	Mean	SD	Mean	SD	
Onset of sensory blockade	3.3	0.8	3	0.7	1.67
Onset of motor blockade	4.7	1.04	5	0.8	-1.3
Duration of sensory blockade	190	30.94	200	19.57	-1.61
Duration of motor blockade	217	33.98	220	24.91	-0.41
Duration of analgesia	576	93.3	280	38.48	17.35

Z > 2, *p* < 0.05 suggestive of statistical significance.

Discussion

Addition of fentanyl as an adjuvant prolonged the bupivacaine spinal block. Fentanyl when used in lower dose is safe and prolongs the postoperative pain relief of intrathecal bupivacaine. There is scarcity of studies comparing safety and effectiveness of fentanyl with bupivacaine. With this background, in our study, we have studied intrathecal fentanyl (25µg) as adjuvant with 0.5% Hyperbaric bupivacaine in terms of safety, efficacy and post-operative pain relief in patients undergoing surgeries at below umbilicus level.

Demographic data (Table 1)

The mean age of participants was 43.1 ± 12.2 (between 20-60years). There was no significant difference in view of age, height and weight, gender distribution, ASA grade between both groups.

There was significant difference in mean surgical operating time.

Bajwa, et al. [9] also observed that demographic parameters (age, height, sex, ASA grade and duration of surgery) (Tables 7,8) were comparable.

In our study, both the groups were comparable in terms of onset and duration of sensory and motor blockade; whereas analgesic duration was prolonged in Group A as compared to Group B. The time for requirement of rescue analgesia was longer in Group A than Group B ($p < 0.0001$).

Our findings were correlated with below mentioned studies

Jayshri Bogra, Namita arora, et al. [10] studied synergistic effect of intrathecal fentanyl and bupivacaine in spinal anaesthesia in 120 parturients who underwent elective caesarean. They divided patients into six groups, identified as B8, B10 and B12.5; received 8, 10 and 12.5mg of bupivacaine and FB8, FB10 and FB12.5 received combination of 12.5 µg fentanyl respectively. They concluded bupivacaine-fentanyl combination leads to abolishment of the visceral pain, increased hemodynamic stability and increased duration of post-operative analgesia.

Shashikala, Shrinivas, et al. [11] conducted study in 90

healthy parturients undergoing elective caesarean, divided them in two groups in which one received 0.5%Hyperbaric bupivacaine alone and the other received 0.5%Hyperbaric bupivacaine with 12.5µg fentanyl citrate intrathecally. They observed statistically highly significant difference in duration of analgesia 165 ± 29.8 minutes in hyperbaric bupivacaine alone and 259.4 ± 35.5 minutes in fentanyl group.

Amir Sabertanha, Gholam Reza Makhmalbaf, et al. [12] conducted study on 40 patients undergoing lower limb surgery, divided them in two groups in which one received bupivacaine alone and the other group received bupivacaine plus dextrose 5% and fentanyl 25µg intrathecally. They concluded that the mean time of anaesthesia onset and analgesia duration were significantly longer in bupivacaine plus fentanyl group than bupivacaine alone.

Hemodynamic parameters

Heart rate: In our study, heart rate were comparable in both groups and statistically insignificant (Z >2).

Mean arterial pressure: In our study, the fall in Mean Arterial Pressure (MAP) in was significant at 10 minutes, 45 minutes and 60 minutes (Z < 2). Rest at all time period, MAP in both groups were comparable and was statistically insignificant (Z > 2).

Bajwa, et al. [5] showed that there was no statistically significant difference in hemodynamic parameters (blood pressure and heart rate) is observed in both the groups.

Adverse effects or complications

The dose of Fentanyl selected in this study did not produce excessive sedation, as at no time sedation score exceeded 2 and no patient developed respiratory depression or fall in SpO2. In fact, the sedation produced by Fentanyl was found to be desirable as all the patients remained calm and quite in intraoperative and postoperative period. There was no statistically significant difference in sedation score between two groups. Our study is comparable with Nasr, et al. [13] and Elzayyat, et al. [14] with respect to sedation score.

No any patient developed shivering during intraoperative or post-operative period.

The incidence of nausea and vomiting was not significant in both groups. It should be noted that in this study Inj Ondansetron IV 8 mg was administered in all cases as part of premedication. Our study is comparable with Nasr, et al. [13], Bansal, et al. [15], Elzayyat, et al. [14] and Chatrath, et al. [16] with respect to these adverse effects.

Limitations

Patients with high risk factors were excluded from study. The generalization of the findings is the limitation in the study.

Being a teaching institute, the spinal anaesthesia is given by doctors of the different seniority. Whether this has any effect is not clear.

Recommendations

Further studies based on comparison between different doses can be considered.

Further studies based on comparison between normal risk patients and high risk patients can be considered.

Conclusion

Following conclusions were drawn from this study:

- The duration of requirement of rescue analgesia was significantly prolonged, which delayed the use of systemic analgesics.
- Fentanyl does not extend the duration of sensory & motor block.
- No significant adverse effects were observed.

Thus, we conclude that intrathecal fentanyl as an adjuvant to hyperbaric bupivacaine is an efficient safeguard for prolongation of post-operative pain relief with reasonably controlled hemodynamics without significant adverse effects.

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