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Original Research Article

Comparison of low dose bupivacaine along with fentanyl in spinal anesthesia with conventional dose of bupivacaine in patients undergoing surgical repair of traumatic hip fracture

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Abstract

Sub arachnoid blockade is the common form of centrineuraxial blockade performed for lower limb orthopaedic surgeries. The resulting nerve block using a local anesthetic agent ensures the patient well-being, while motor block facilitates the surgeon's work. 0.5% hyperbaric bupivacaine is the most frequently used drug for SAB. After randomization patients were split into groups of 30 each by computer-generated random numbers, sealed in an envelop as slips folded in the OT complex. An independent observer picked up these slips and performed spinal or epidural anesthesia. Electrocardiogram (ECG), and a baseline reading of SpO2, heart rate (HR) and blood pressures, systolic (SBP) and diastolic (DBP) were recorded. This was an investigator and participant blinded study. The drugs that was given to the two different groups are as follows.

Group A: Patients were administered with 15 mg bupivacaine 0.5% (H).

Group B: Patients were administered with 7.5 mg bupivacaine 0.5% (H) + 25mcg fentanyl.

Mean of Time for Sensory Regression to S1 is lesser in group B patients as compared to Group A and is statistically significant with p value of 0.0002. Mean of Time for Motor regression to Bromage 0 is lesser in group B patients as compared to Group A and is statistically significant with p value of < 0.001.

Keywords: Bupivacaine, fentanyl, spinal anesthesia

Introduction

Regional anesthesia for orthopedic lower limb surgery is held generally to be safer than general anaesthesia. It avoids general anesthesia related problems such as poly- pharmacy, airway manipulation, misplacement of endotracheal tube, hypo or hyper ventilation, vomiting, pulmonary aspiration. It reduces surgical stress and attenuates increase in plasma catecholamine and other hormones. Regional anaesthesia gives intra and postoperative pain relief with full preservation of mental status and normal reflexes.

Sub arachnoid blockade is the common form of centrineuraxial blockade performed for lower limb orthopaedic surgeries. The resulting nerve block using a local anesthetic agent ensures the patient well-being, while motor block facilitates the surgeon's work. 0.5% hyperbaric bupivacaine is the most frequently used drug for SAB. It produces longer duration of anaesthesia with good muscle relaxation. But, spinal anaesthesia is associated with rapid and extensive sympathetic block and can lead to severe hypotension and compromise perfusion of various vital organs.

These hemodynamic changes are more pronounced, and could be deleterious in older patients

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who are susceptible for traumatic hip fracture. Age related changes in spinal anatomy, nerve physiology and cardiovascular reflexes has made it necessary to limit the distribution of spinal block.

The various physiological alterations in elderly patients may cause significant increase in maximum spread, rate of onset of motor block and cardiovascular instability. This lead to the use of small doses of LA combined with lipophilic opioids administered intrathecally, to produce enhancement of spinal anesthesia without prolonging motor recovery and reduce adverse cardiovascular and pulmonary effects in such patients [1].

With the discovery of specific opioid receptors by Pert and Snyder [2] in 1973 and subsequent identification of these receptors in the substantia gelatinosa of spinal cord, a new enthusiasm was created for clinical application of opioids to the subarachnoid and epidural space. In 1976 Yaksh and Rudy [3] first demonstrated the effectiveness of intrathecal opioids in abolishing experimental pain in animals.

In a study on dogs, Chen Wang *et al*. [4] derived that bupivacaine administered intrathecally depressed nociceptive reflexes in a dose dependent manner. There was no selectivity on the nociceptive afferent and sympathetic efferent pathways. Addition of fentanyl to bupivacaine for intrathecal injection has a synergistic effect and enhances spinal analgesia without further sympathetic blockade.

The aim of using neuraxial opioids is to achieve as good analgesia as with systemic administration and to do it with smaller doses and systemic concentration and with less risk of systemic side effects. This lead to the use of intrathecal Morphine but, was associated with side effects like respiratory depression, nausea, vomiting due to slower uptake and longer duration of action with higher CSF concentration with rostral spread of the narcotic.

These considerations lead to the use of more lipophilic drugs such as Fentanyl, Sufentanil. Which are more potent and are have advantages over morphine such as rapid uptake with short duration of action, low CSF concentration, limited rostral spread of narcotic and less respiratory depression and early motor recovery compared to Morphine [5].

Methodology

Type of study

Prospective Randomized Double Blinded Interventional Comparative Study.

Sample size: 60

By considering the time for complete sensory recovery, group sizes of 30 each were determined by power analysis based on standard deviation data from a previously published report, $p \leq 0.05$, and the assumption of a 90% power to detect a 30-min difference in mean time to complete sensory recovery. Group sizes of 30 provided an 80% power to detect a difference of 24 min between groups and a 90% power to detect a difference of 28 min.

Group A (n=30)	Group B (n=30)
15 mg of 0.5% bupivacaine (H) given as spinal anesthesia	7.5 mg of 0.5% bupivacaine (H) along with 25mcg of fentanyl given as spinal anesthesia

Inclusion criteria

- Patients undergoing elective surgical repair for traumatic hip fracture
- Age > 50 yrs.
- All patients of ASA grade 1 and 2.
- Patients giving consent and ready to undergo the study.

Exclusion criteria

- Patients with known allergy to local anaesthetic agents.

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- Patients with severe cardiac-vascular or respiratory disease
- ASA 3 and above

Investigations

- Anthropometric: Height, Weight, BMI
- Biochemistry: Random blood sugars, Urea, Creatinine, Serum electrolytes.
- Pathology: Complete Blood Count, Urine Routine and microscopic examination.
- Radiological: Chest X-Ray
- Other: ECG, Blood born virus screen, Mallampatti grading of airway, ASA grading of patients.

Material

- Weighing machine.
- Height measuring scale
- Multipara monitor (to measure BP,MAP,SpO2 and ECG)
- 25 G quincke spinal needle
- Epidural catheter
- Anesthesia workstation.
- Intraoperative and post-operative monitoring chart
- VAS scale.

Study technique

Patients were prospectively randomized in to two groups with 30 patients in each group.
All Patients were kept nil by mouth for overnight before surgery. To ensure that all the patients received the same medications before and during the surgery, a standardized anesthetic protocol and technique were used.
In the operating room standard anesthesia monitors were attached to the patient to monitor: Heart rate, ECG, peripheral oxygen saturation, blood pressure. Intravenous access was obtained using a 20G/18G IV cannula.
After randomization patients were split into groups of 30 each by computer-generated random numbers, sealed in an envelop as slips folded in the OT complex. An independent observer picked up these slips and performed spinal or epidural anesthesia. Electrocardiogram (ECG), and a baseline reading of SpO2, heart rate (HR) and blood pressures, systolic (SBP) and diastolic (DBP) were recorded. This was a investigator and participant blinded study. The drugs that was given to the two different groups are as follows

Group A: Patients were administered with 15mg bupivacaine 0.5% (H).
Group B: Patients were administered with 7.5 mg bupivacaine 0.5% (H) + 25 mcg fentanyl.

After starting maintenance fluid (ringer lactate) patients were given sitting position. Under all aseptic precautions epidural catheter was inserted at the level of L2-L3 space as a rescue anaesthetic technique and spinal anaesthesia was given at L3-L4 space and drug was injected as per the group allotted.
After giving spinal anaesthesia the patient is given supine position. A drop in more than 20% of baseline systolic blood pressure was considered as hypotension.

Results

Table 1: Frequency Distribution table of gender

Gender	Group A	%	Group B	%	P-value
Male	15	50%	17	57%	0.7958
Female	15	50%	13	43%	

By chi-square no significant difference in gender was found in both the groups.

Table 2: Frequency Distribution table for ASA grading

ASA Grade	Group-A	Group-B	P-value
I	6	7	1.000
II	24	23	

By chi-square test no significant difference in ASA grade was found in both the groups.

Group A had 80% of patients in ASA II and 20% of patients in ASA I. While, Group B had 77% patients in ASA II and 23% patients in ASA I.

Table 3: Mean Duration of surgery in both groups.

Group	Mean Duration (SD)	P-value
A	78.17 (5.33)	0.8215
B	78.5 (6.03)	

There is no significant difference in the mean duration of surgery.

Table 4: Frequency Distribution table of Time for Highest Sensory Level

Time for Highest Sensory Level (min.)	Group A		Group B	
	Frequency	%	Frequency	%
5	4	13%	8	27%
7	8	27%	18	60%
9	10	33%	3	10%
12	8	27%	1	3%

60% of Patients in Group B achieved highest sensory level in 7mins whereas maximum number of patients in Group A took 9 mins to achecive highest sensory blockade which means that onset of sensory blockade is faster in Group B.

Table 5: Distribution of Hypotension in Patients of both Groups

Group	Frequency	Proportion
Group A	15	50%
Group B	3	10%

50% of the patients in group A had hypotensive episodes whereas, only 3% of the patients in group B had hypotension after spinal anaesthesia with a P value of 0.0007 which is statistically significant.

In Group A 47% of patients had a highest sensory blockade of T8 and 43% have a sensory blockade of T6. Whereas, In Group B 67% had the highest sensory blockade limited to T10.

Table 6: Comparison of sensory and motor blockade

Sr. No.	Variable	Group-A	Group-B	P-value
		Mean ± SD	Mean ± SD	
1	ONSET BROMAGE 3	7.93 ± 2.38	6.03 ± 1.39	0.0013
2	Time for Highest Sensory Level	8.73 ± 2.39	6.83 ± 1.53	0.001
3	2 Segment Regression	64.73 ± 5.4	93.73 ± 8.59	< 0.001
4	Time for Sensory Regression to S1	120.73 ± 7.22	111.17 ± 11.09	0.0002
5	Time for Motor Regression to Bromage 0	158.00 ± 5.06	119.93 ± 12.29	< 0.001
6	Time Taken for VAS 4	182.73 ± 8.75	178.17 ± 10.65	0.075

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From the above table, we conclude that

- Mean of time taken for motor blockade (ONSET BROMAGE 3) and mean of time taken for highest sensory level is lesser in group B than patients in group A. which is statistically significant with p value of 0.0013 and 0.001 respectively.
- Mean of time taken for 2 Segment Regression is higher in Group B when compared to Group A with a significant p value of < 0.001
- Mean of Time for Sensory Regression to S1 is lesser in group B patients as compared to Group A and is statistically significant with p value of 0.0002
- Mean of Time for Motor regression to Bromage 0 is lesser in group B patients as compared to Group A and is statistically significant with p value of < 0.001
- Mean of time taken for VAS 4 is lesser in group B patients as compared to Group A but is not statistically significant.

Discussion

In our study the mean time to attain highest sensory level in Group A was8.73 min and in Group B was 6.83 min which was significant statistically. This suggests the earlier onset of action with fentanyl and bupivacaine. This variation in onset of action is also clinically significant.

Desai *et al*. [6] conducted a study in 2019 and observed that the mean time for onset of sensory block and time to achieve highest sensory level was early, in patients receiving 7.5mg bupivacaine (H) + 25 µg fentanyl than in those receiving 12.5mg bupivacaine (H) for SAB

Most of the patients in Group A achieved upper limit of sensory blockade at level of T_6 and T_8, while it was T_{1o} in group B which was adequate to perform the surgery.

Kristiina *et al*. [7] evaluated effects of 25µg of Fentanyl with Bupivacaine 5mg and achieved the sensory level up to T_7. In their study, the final volume of intrathecal injection was adjusted to 2.5ml with sterile distilled water.

This difference in volume is probably responsible for high level of sensory blockade in their study.

We found that the mean time for two segmental regression was prolonged in Group B 93.73minutes when compared to 64.73minutes in Group A. This indicates that Fentanyl increases intensity of sensory blockade and also prolongs its duration. This is significant both clinically and statistically.

Desai *et al*. [6] and Ben David *et al*. [8] in their study concluded that addition of 25 µg of Fentanyl to Bupivacaine provided an enhancement and increased duration of sensory analgesia without intensifying motor blockade.

Sheila *et al*. [9] in their study found that the incidence of inadequate sensory block was higher in group receiving 4mg bupivacaine + 20µg fentanyl than in the group receiving 10-14mg bupivacaine + 10-20µg fentanyl for SAB.

In our study we found that 2 out of 30 patients in group B required an epidural supplement towards the end of the surgery as they experienced pain and discomfort. This finding was consistent with the above study.

Manpreet Kaur *et al*. [10] found that intrathecal addition of sufentanil/butorphanol prolonged the duration of sensory block (DOSB) compared with bupivacaine alone without altering the duration of motor blockade in patients undergoing endoscopic urological procedures.

Mean duration of motor blockade (bromage 0) in Group A was 158.00 min and in Group B 119.93min. This is statistically significant. This implies that patients in Group B receiving fentanyl and bupivacaine had recovered earlier from motor block.

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Conclusion

Addition of 25 µg Fentanyl to low dose Bupivacaine heavy for spinal anaesthesia

- Hastens the onset of sensory and motor block.
- Produces better quality of sensory block.
- Reduces the duration of motor blockade.

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