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Original Research Article

Low dose bupivacaine along with fentanyl in spinal anesthesia with conventional dose of bupivacaine: Hemodynamic changes

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Abstract

The onset of action of bupivacaine is between 4 and 6 minutes, and maximum anaesthesia is obtained between 15 to 20 minutes. The duration of anaesthesia varies according to the block; the average duration of peridural block is about 3.5 to 5 hours and for nerve blocks, it is about 5 to 6 hours. The short duration of action of fentanyl is associated with decrease in the concentration of the drug due to its rapid redistribution to inactive sites such as fat and skeletal muscles. 86% is protein bound. High volume of distribution of 3 to 6 L/Kg. Context sensitivity half time is 260 minutes after a 4 hour infusion. 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. The minute to minute variation of averages of SBP was more pronounced in Group A, whereas the average SBP was more consistent in Group B. The minute to minute variation of averages of HR was very much higher in Group A, than in Group B.

Keywords: Conventional dose of bupivacaine, low dose bupivacaine along with fentanyl, hemodynamic changes

Introduction

Bupivacaine is an amide type local anaesthetic agent. A.F. Ekanstam and his colleagues synthesized Bupivacaine in 1957 at A B Bofors, Sweden.

The bupivacaine base is sparingly soluble in water highly soluble in lipid, but the hydrochloride is readily soluble in water. Bupivacaine is highly stable and can withstand repeated autoclaving [1].

The onset of action of the drug is intermediate. The bupivacaine can be detected in the blood within 5 minutes of infiltration or following epidural or intercostal blocks. The pKa of bupivacaine is 8.1 which determines the onset of action. The plasma levels are related to the total dose administered, peak levels of 0.14 to 1.18µg mL^{-1} were found within 5 minutes to 2 hours after the administration of anaesthesia, and they gradually decline to 0.1 to 0.34µg ml^{-1} by four hours. The tissue blood partition coefficient of bupivacaine 1:28, and has a clearance of 0.47L min^{-1}. The elimination half-life of bupivacaine is 3.5 hours in adults and 8.1 to 14 hours in neonates [2].

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obtained between 15 to 20 minutes. The duration of anaesthesia varies according to the block; the average duration of peridural block is about 3.5 to 5 hours and for nerve blocks, it is about 5 to 6 hours.

In subarachnoid block, the onset of action is about 3 to 4 minutes, and complete anesthesia occurs in 5 minutes and lasts for 3.5 to 4 hours. The motor blockade is definitely inferior to tetracaine.

At plasma concentrations of 1.0 to 2.0μg mL^{-1}, the heart rate increases significantly. The mean arterial pressure increased from 87 to 100 mmHg, while cardiac output is decreased about 20%. The blood concentration of glucose, lactose, plasma cortisol, and fatty acids do not change significantly. In addition, intravenous bupivacaine has been shown to inhibit cardiac sympathetic nerve activity. The lung is capable of extracting bupivacaine. The pulmonary extraction limits the concentration of drug which reaches the systemic circulation [3].

Fentanyl is a synthetic opioid, 75 to 125 times more potent than morphine. Chemically, it is a phenyl piperidine derivative, with empirical formula of $C_2$2.H28.N2o.C6.H_8.O_7, identified as N-(l-phenylethyl-4-piperidyl) propionanilide citrate, its structure being similar to pethidine [4].

Fentanyl, given I.V. has an onset of action in 7 to 8 minutes and action lasts for 30 to 60 minutes, while intramuscularly, it has onset within 4 to 6 minutes and lasts for 1 to 2 hours [5].

75% of fentanyl undergoes first pass uptake by lungs. It has a rapid distribution half-life of 1 to 2 minutes and second distribution phase of 10 to 30 minutes. The short duration of action of fentanyl is associated with decrease in the concentration of the drug due to its rapid redistribution to inactive sites such as fat and skeletal muscles. 86% is protein bound. High volume of distribution of 3 to 6 L/Kg. Context sensitivity half time is 260 minutes after a 4 hour infusion [6].

Fentanyl undergoes high hepatic extraction with extraction ratio of 8-1 and is metabolized by N-dealkylation and hydroxylation to Norfentanyl and Despropionylfentanyl, which are excreted in the urine and bile. Metabolites have minimal activity. Elimination half-life is prolonged which is about 185-219 minutes.

Methodology

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 envelope 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 7.5mg bupivacaine 0.5% (H) + 25mcg 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.

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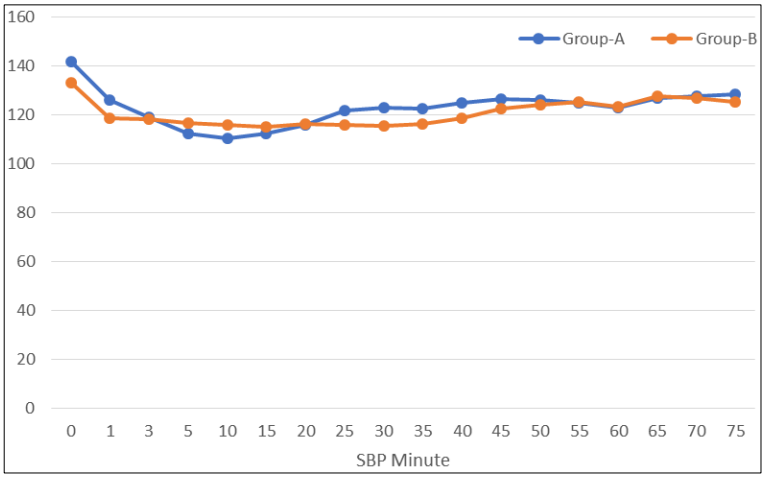
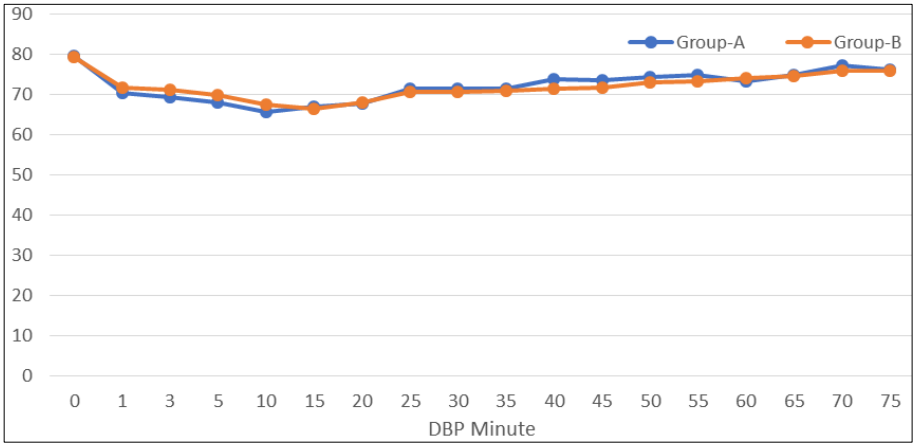
Results



Graph 1: Line graph of averages of SBP Corresponding to Groups

The minute to minute variation of averages of SBP was more pronounced in Group A, whereas the average SBP was more consistent in Group B.



Graph 2: Line graph of averages of DBP Corresponding to Groups.

There was no much variation seen in the averages of DBP in both the groups.

Table 1: Analysis of mean of MAP

MAP Time	Group-A		Group-B		P-value
	Mean	SD	Mean	SD	
0	100.34	12.07	97.2	9.68	0.2708
1	88.79	10.64	87.34	8.98	0.9124
3	85.82	9.73	86.66	7.86	0.7139
5	82.82	9.97	85.5	7.94	0.2556
10	80.54	10.34	83.54	7.63	0.2065
15	81.99	10.45	82.62	8.72	0.8003
20	83.91	9.81	84.04	7.38	0.9528
25	88.1	9.67	85.65	7.42	0.2749
30	88.49	9.03	85.54	7	0.1639
35	88.39	9.57	86.07	7.67	0.3047
40	90.72	8.11	87.17	6.7	0.0705
45	91.08	8.02	88.57	6.88	0.1992
50	91.62	7.43	89.97	7.02	0.3821
55	91.45	8.05	90.45	6.14	0.591

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60	89.72	8.46	90.31	6.33	0.7633
65	92.14	7.3	92.27	6.5	0.9456
70	93.92	6.49	92.72	7.59	0.5133
75	93.46	6.31	92.19	7.31	0.7747

The minute to minute variation of averages of MAP was slightly more in Group A, than in Group B.

Table 2: Analysis of mean of HR

HR Time	Group-A		Group-B		P-value
	Mean	SD	Mean	SD	
0	79.5	7.56	81.7	8.35	0.2895
1	83.6	7.79	81.53	7.37	0.2957
3	87.4	10.36	84	9.05	0.1813
5	90.23	12.96	84.9	10.76	0.0886
10	91.03	13.59	85.27	10.74	0.0738
15	89.17	12.04	84.33	9.31	0.0876
20	87.47	10.91	82.87	8.08	0.0689
25	85.4	10.09	83.27	7.98	0.3681
30	83.17	9.28	83.53	7.27	0.8654
35	84.33	9.51	83.23	7.72	0.6248
40	84.7	9.63	82.27	7.51	0.4499
45	82.47	8.01	82.63	7.19	0.7112
50	82.67	7.28	81.97	7.29	0.7112
55	81.5	7.66	82	7.8	0.8032
60	81.6	6.53	83.13	7.72	0.4097
65	81.33	6.53	82.8	8.13	0.3858
70	82.13	7.33	82.76	7.79	0.4861
75	82.23	6.37	82.67	7.73	0.8136

The minute to minute variation of averages of HR was very much higher in Group A, than in Group B.

Discussion

The incidence of hypotension was 50% in group A whereas, it was only 10% in group B after spinal anaesthesia which was clinically and statistically significant.

Ben-David *et al*. [7], Stamenic *et al*. [8], Desai *et al*. [9], Sheila *et al*. [10] and Sumit Kumar *et al*. [11] compared bupivacaine alone and various doses of bupivacaine and fentanyl for spinal anaesthesia and concluded that combination of bupivacaine and fentanyl provided a better hemodynamic stability with lower incidence of hypotension than higher doses of bupivacaine alone.

In our study we also found that variation in the mean of SBP and MAP was found more in Group A than in Group B while there was no significant variation in DBP. All these variations were statistically insignificant**.**

Kristiina *et al*. [12] and Sumit Kumar *et al*. [11] observed no significant changes in HR. However, the variation in the averages of HR was clinically more significant in group A than in group B with no statistical significance.

Respiratory depression is one of the major side effect of intrathecal opioid. None of our patients experienced respiratory depression.

Varassi G, *et al*. [13] in 1992 studied the ventilatory effects of different dosage of intrathecal Fentanyl on elderly patients and concluded that the patients who received 50µg Fentanyl had respiratory depression and recommended 25µg as only dose without respiratory depression.

In our study we did not find any respiratory depression associated with 25µg intrathecal

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fentanyl which correlates with the above study.

Pruritus is a frequent complication (49-100%) of intrathecal Fentanyl. The mechanism by which the combination of local anesthetic with opioid may result in a reduced incidence of pruritus may be either due to neuronal blockade or direct modulation of opioid receptors, probably inhibiting receptor action and increasing opioid binding to delta and kappa receptors [14].

Kristiina *et al*. [12] and Stamenic *et al*. [8] in their study observed that there was higher incidence of pruritis in patients receiving fentanyl, it was mild and well tolerated. However, no such observation was made in our study.

Conclusion

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

- Reduces the incidence of hypotension.
- With no observed adverse effects.

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