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Original Research Article

Comparison of nalbuphine and fentanyl as adjuvants to bupivacaine in unilateral spinal anaesthesia in patients undergoing lower limb orthopaedic surgeries

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ABSTRACT

Aims: Unilateral spinal anaesthesia is a technique used to avoid hemodynamic changes and early recovery. Adjuvants are added to prolong post operative analgesia, this study was done to compare nalbuphine (0.8mg) and fentanyl (20μg) as adjuvants to 0.5% bupivacaine Heavy in unilateral spinal anaesthesia for patients undergoing lower limb orthopaedic surgeries.

Settings and Design: Randomized double blind study in patients posted for lower limb orthopaedic surgery in a teritiary care center.

Materials and Methods: Unilateral spinal anaesthesia was given to 68 eligible patients undergoing lower limb orthopaedic surgery with nalbuphine (0.8mg) and fentanyl (20μg) as adjuvants to 0.5% bupivacaine Heavy. Block characterstics, unilaterality, hemodynamic changes and recovery were noted.

Statistical Analysis used: Independent sample t-test was used to compare continuous variables with normal distribution and chi square test for categorical variables

Results: Unilateral block was seen in 60 of 68 patients enrolled. Time to achieve T 10 level was comparable between both the groups in nalbuphine and fentanyl group (4.33±0.99 and 4.77 ± 0.89 respectively). Duration of sensory block was significantly lesser in nalbuphine group as compared to fentanyl group (170.67±15.34 and 178.83±15.04 respectively). However, there was no significant difference in duration of analgesia, 265.17 ± 17.73 in nalbuphine group and 260.23 ±31.03 in fentanyl group (p=0.45).

Conclusions: Nalbuphine due to its easy availability can be used as effective alternative to fentanyl as adjuvant in unilateral spinal anaesthesia.

1. Introduction

Unilateral spinal anaesthesia is a technique of spinal anaesthesia wherein the nerve fibres supplying the operative side is preferentially blocked by local anaesthetic injected into intrathecal space.[1] Unilateral block of only operative side offers advantage of lesser degree of hypotension as compared to bilateral block as motor, sensory and sympathetic fibres of dependent side is aimed to be blocked.[2] This is more suitable for patients with cardiovascular risk factors such as coronary artery disease or valvular stenosis. Also, with increase in number of surgeries on day care basis, early recovery from anaesthesia is desired. Unilateral anaesthesia provides advantage of early recovery and hence early discharge.[2]

Adjuvants or additives are added to local anaesthetic administered in intrathecal space to prolong sensor-motor block, to increase duration of analgesia and to limit the side effects of increased dose of local anaesthetics on hemodynamics.[3] Opioids are the most commonly used adjuvants, of which fentanyl, an lipophilic opioid is the most widely used adjuvant.[3] However, availability of opioids is

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not uniform and is strictly under control of Narcotics act. Nalbuphine, an opioid agonist antagonist, when used as adjuvant has shown improved perioperative analgesia with few side effects.[4]

As per our literature search, there were no studies comparing nalbuphine with fentanyl as adjuvant in unilateral spinal anaesthesia. Hence, in this study we aimed to compare nalbuphine 0.8 mg and fentanyl 20 μg when used as adjuvant to 0.5% bupivacaine heavy in unilateral spinal anaesthesia for their effect on sensory block, motor block and post operative analgesia.

2. Materials and Methods

This prospective randomized double-blind comparative study was conducted in our tertiary care centre from November 2019 to December 2020 after obtaining Institution Ethical Committee approval. The study included 68 patients posted for lower limb, knee or below knee orthopaedic surgeries of American Society of Anaesthesiologist (ASA) status I and II of both genders, aged 25-65 years. Patients with significant co-exisisting conditions such as hepatic, renal, cardiovascular or CNS diseases, patients with contraindication to spinal anaesthesia, patients with history of allergy to study drugs, patients with anticipated or actual duration of surgery >120 minutes were excluded.

After obtaining written informed consent eligible patients were randomly allocated into either nalbuphine (I) or Fentanyl group (II) based on the computer generated random number. The study participants were enrolled and randomised into different group by an anaesthesiologist who was not involved in data collection.

On the day of surgery, patients were kept fasting for 6 hours prior to surgery and were administered antibiotic Inj Ceftriaxone 1 gm i.v and Inj pantoprazole 40 mg i.v. in preoperative ward before shifting to operation theatre. On the operating table, standard monitors, Non Invasive Blood Pressure, Electrocardiogram and pulse-oximetry were applied and baseline reading was taken in supine position. Patients were started on IV Ringer lactate at 5ml/kg/hr.

Spinal anaesthesia technique employed was similar in all patients. After baseline reading patients were put in lateral position, with limb to be operated on the lower side. After proper preparation and draping, a 25 G quincke BD spinal was used to inject drug at L3-L4 interspace with bevel of the needle facing dependent side. The drug was injected over 2 to 3 minutes at a rate slower than the usual of 0.02ml/sec. The total volume administered was 1.8 ml in both groups, group I received 1.4 ml of 0.5% bupivacaine heavy + 0.4 ml of nalbuphine (0.8 mg) and group II received same volume of bupivacaine with 20μg of fentanyl. The drug was prepared by nurse and the anaesthesiologist administering the drug was blinded to group allocation After administration of drug patient was kept in lateral position for 20 minutes with both limbs in extension.

The level of sensory block and motor block was assessed on both dependent and nondependent limb. Assessments were done every minute for sensory level till 20 minutes. Sensory testing was done by pin prick method from caudad to cephalic. Time taken to attain T12 level was considered as the time of onset of sensory block and time taken to achieve maximum level was noted. Motor blockade was assessed every 2 minutes according to modified bromage scale (0-no block, 1-hip blocked, 2-hip and knee blocked, 3- hip, knee and ankle blocked) till 20 minutes and thereafter every 5 minutes till maximum grade of block was achieved.

After 20 minutes, patients were put in supine position and the degree of sensory and motor block in non dependent or non operative limb was assessed. Block was considered as unilateral if sensory block in operative limb is at least T12 and bromage score of III with sensory level less than L2 and no motor block in non operative limb. Time taken for regression of block to L2 was noted along with duration of motor block defined as time in grade III block.

Hemodynamic parameters were recorded immediately after spinal and every 5 minutes till the end of surgery and till 4 hours in the post operative period. Hypotension was defined as blood pressure fall of more than 20% of baseline and was treated with Injection mephentramine 6mg IV bolus and IV fluids. Bradycardia was defined as 20% fall from baseline and was treated with injection atropine 0.6mg IV bolus.

In the postoperative period, visual analogue scale was used to assess pain every 30 minutes till 4 hours and time taken to administer rescue analgesia was noted. Patients were observed for side effects such as nausea, vomiting, pruritus, hypotension or bradycardia and were treated accordingly.

The sample size was calculated using standard program which computed 30 patients to be included in each group to detect clinically significant difference of 30 minutes in post operative analgesia between the groups and type 1 error of 0.05 and power of 80%. The duration of 30 minutes was considered significant based on previous studies comparing nalbuphine and fentanyl as adjuvants in spinal anaesthesia.[5,6] Considering, 80 to 85% efficiency in achieving unilateral block based on previous studies on unilateral spinal anaesthesia, 34 subjects were included in each group making total sample size of 68.[7–11] Statistical analysis was conducted using SPSS v19.0 for windows. Patients who achieved unilateral block were included for final analysis. Independent sample t-test was used to compare continuous variables with normal distribution and chi square test for categorical variables. Continuous data are presented as mean ± SD and categorical or ordinal variables as percentage. A p – value of <0.05 is considered significant.

3. Results

Of the 68 patients that participated in the study, 60 patients achieved unilateral block, 30 in each group. The two groups were comparable with respect to demographic variables such as age and gender. There was no statistical difference in the duration of surgery. Most surgeries in both groups were completed before 120 minutes after administration of spinal anaesthesia. (Table 1)

Sensory and motor block was significantly different between operative and non operative limb at 20 minutes, with p-value of 0.00 for both parameters. Maximum sensory level achieved in operative limb was T8, however majority of patients had T10 as maximum level on dependent side. The onset of sensory block and time to achieve T10 level were comparable between the groups (p=0.37 and 0.08 respectively). The time taken to achieve grade III motor block in operative limb was similar in both groups (P=0.32). Time taken to regress to L2 was significantly more in fentanyl group as compared to nalbuphine group (P=0.04). The time of first analgesic request was not significantly different between both groups with average duration of analgesia around 4 hours from the time of administration of spinal anaesthesia (P = 0.45). The peak sensory level achieved in non-operative limb was comparable between groups (p=0.89) and motor grade achieved was also not different (P=0.57). (Table 2)

There was no significant difference in heart rate, systolic blood pressure, diastolic blood pressure or mean arterial blood pressure between groups during intra-operative or postoperative period of observation. (Figures 1 and 2)

None of the patients in both groups developed hypotension or bradycardia during observation period. The incidence of pruritus was more in fentanyl group however it was not statistically significant (p=0.23).

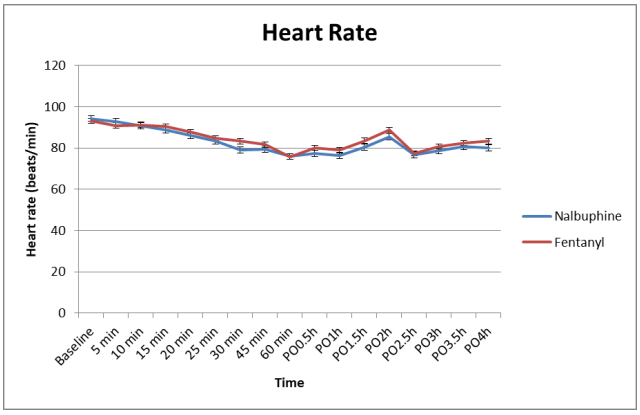

Fig. 1: Heart rate at different time points of observation. (PO – Post operative, h - hour)

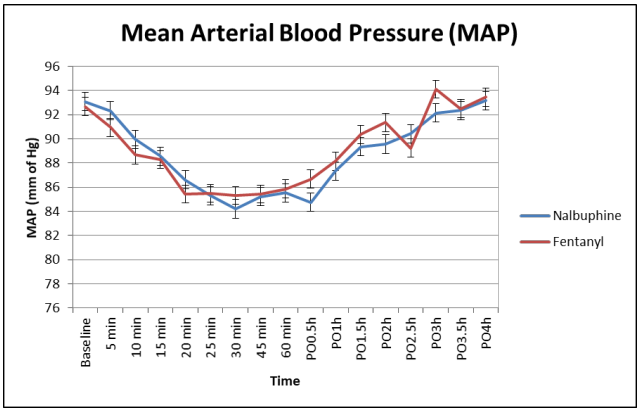

Fig. 2: Mean arterial blood pressureat different time points of observation. (PO – Post operative, h - hour)

4. Discussion

The results of this study demonstrated that when 0.8 mg of nalbuphine added to 0.5% bupivacaine heavy during unilateral spinal anaesthesia is comparable to 20 μg of fentanyl as adjuvant in all block parameters assessed except for duration of sensory block which was significantly longer in fentanyl group. The volume of drug and the technique used, produced a block restricted to operative limb in 85% of patients in both group similar to previous studies.[7–9] The volume of drug administered, rate of administration, bevel direction, maintenance of lateral position and use of hyperbaric drug probably ensures selective blockade of dependent nerve roots.[2,11] Addition of adjuvant is known to affect duration of sensory block, motor block and duration of analgesia without much compromise on hemodynamic, which is one of the chief objectives of unilateral spinal anaesthesia.

The onset of sensory block was comparable between both groups, similar to findings by Gomaa et al.[12] in their study comparing 0.8 mg of nalbuphine with 25 μg of fentanyl in patients posted for elective ceserean deliveries. The onset of sensory block in their study was 1.64±0.09 (mins) in fentanyl group and 1.60 ± 0.10 (mins) in nalbuphine group (p= 0.13). Gupta et al.[13] in their study on patients undergoing lower limb surgeries compared fentanyl 25 μg and nalbuphine 2 mg as adjuvants and found that onset time of sensory block was 4.30 ±0,79 (mins) in fentanyl group and 3.91 ± 2,25 (mins) in nalbuphine group with a p value of 0.08. Onset in their study was defined as time to reach T10 level, where as in our study it was defined as time to attain sensory block at T12. Naaz et al.[5] had also observed similar results in their study wherein time to reach peak sensory level (T6) was taken as time for onset.

The duration of sensory block was significantly longer in fentanyl group as compared to nalbuphine. This finding was similar to study by bindra et al.[14] comparing 0.8 mg nalbuphine as adjuvant with 20 μg fentanyl in patients

Table 1: Patient characteristics (M-Male, F-Female)

Variable	Group I (Nalbuphine) N=30	Group II (Fentanyl) N=30	P value
Age (yrs)	46.93 ± 12.96	47.20 ± 12.89	0.93
Gender	M-22, F-8	M-21,F-9	0.95
ASA	I-22,II-8	I-23,II-7	0.95
Duration of surgery (mins)	94.83 ± 18.12	98.83 ± 21.48	0.44

Table 2: Block characteristics (mins: minutes)

S.No.	Parameter	Nalbuphine (30)	Fentanyl (30)	P-Value
1	Sensory Onset (T12) (mins)	2.80±0.71	2.97±0.71	0.371
2	TT10 (mins)	4.33±0.99	4.77±0.89	0.082
3	Tmax	T8	T8	
4	TPeak Motor (mins)	5.37±0.96	5.97±1.03	0.024
5	Duration of motor block(III) (mins)	128.83±7.5	126.50±10.43	0.324
6	Time to regression to L2 (mins)	170.67±15.34	178.83±15.04	0.04
7	Duration of analgesia (mins)	265.17±17.73	260.23±31.03	0.453
8	Unilateral or bilateral	B – 4	B-4	1.0
9	Non dependent limb T peak level	L2-3, L3-23, T12-4	L2-2, L3-24, T12-4	0.895
10	Non dependent limb motor	0-4, 1-22, 2-1,3-3	0-4, 1-22, 2-3,3-4	0.572

undergoing caesarean section. The duration of sensory block (two level regression) in their study was 111.46 ± 6.49 in fentanyl group and 108.46 ± 5.51 minutes in nalbuphine group with P value of 0.03. Gupta el al[13] found that duration of sensory block defined as time taken for regression to two level was prolonged in nalbuphine group (127.86 ± 18.23 mins) as compared to fentanyl group (116.75 ± 12.82 mins) with p value of 0.001. This finding might be because of nalbuphine dose (2mg) used and the total volume of 4ml in their study.

Both groups were comparable in the onset of motor block as seen in study by Tiwari et al.[6] The duration of grade III motor block was similar in both groups. The duration of motor block was 125.33 ± 5.71 mins in nalbuphine group as compared to 125.87 ± 20.17 mins in fentanyl group with p value of 0.89 in study by Gomaa et al[12] similar to observation in our study. Bindra et al[14] also had observed similar results with 154.72 ± 5.89 (mins) in nalbuphine group and 154.44 ± 5.24 (mins) in fentanyl group. However, Gupta el al.[13] had observed significant increase in duration of motor block in nalbuphine group (183.26 ± 29.63 mins) as compared to fentanyl (141.63 ± 18.05 mins) with a p value of 0.003. This discrepancy might be due to definition of duration of motor block used in their study which was complete recovery from motor block whereas in our study the duration of grade III block was assessed.

The duration of effective analgesia defined as time taken for administering rescue analgesia in nalbuphine group was similar to that observed by Bindra et al who had observed 259.20± 23.23 minutes.[14] However, there was no significant difference in duration when compared to fentanyl group in our study in contrast to better analgesia in nalbuphine group (259.20± 23.23 minutes) as compared to fentanyl (232.70 ± 13.15 minutes) in study by brinda et al.[14] This discrepancy is noted despite similar doses of adjuvant's being used in both study and probably might be due to difference in total volume of drug used. Nalbuphine significantly prolongs the request for rescue analgesia as demonstrated by Jyothi et al[15] in their study comparing three different doses of nalbuphine, 0.8, 1.6 and 2.5 mg with control as normal saline. The mean VAS at different points of observation during post operative period was comparable between groups.

Hemodynamic stability is one of the main advantages of unilateral spinal anaesthesia. Restricting blockade of sympathetic fibres of one side is achieved by position of patient, duration of lateral position and rate of drug administration.[9,11,16] Thus, there were no episodes of hypotension or bradycardia in both groups. This observation was seen in spite of not pre-loading patients with intravenous fluids prior to administration of unilateral spinal anaesthesia as was done in studies by Khadse PB et al,[17] and Singh T K et al.[18]

We didn't use control group in our study as previous studies have demonstrated that nalbuphine and fentanyl prolonged duration of sensory block and analgesia.[14,17–19] We were able to achieve unilateral in 85% of our enrolled patients, this might be due to variation in height, weight, rate of drug administration in these patients. These parameters were not noted in our study which is one of the limitations. We used 0.8 mg dose of nalbuphine as Culebras et al,[4] and Mukherjee et al[20,21] found that 0.8 mg gives good post operative analgesia with less side effects and further increase in dose to 1.6 mg did not increase efficacy. However, further studies are required to determine effective dose of nalbuphine in unilateral spinal anaesthesia as previous studies to determine effective dose were in bilateral spinal anaesthesia.

Thus we conclude that intrathecal nalbuphine 0.8 mg provides comparable postoperative analgesia and motor block to fentanyl 20 μg when used as adjuvant in unilateral spinal anaesthesia without increase in side effects.

5. Source of Funding

None.

6. Conflict of Interest

The authors declare no conflict of interest.

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