Section: Anaesthesiology

Research

A PROSPECTIVE STUDY OF INTRATHECAL NALBUPHINE AND BUTORPHANOL AS ADJUVANTS TO HYPERBARIC BUPIVACAINE IN SPINAL ANAESTHESIA FOR ELECTIVE LOWER LIMB ORTHOPAEDIC SURGERIES

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Abstract

Background: To extend the duration of the analgesia provided by a local intrathecal anaesthetic, several opioids are administered to them. Nalbuphine is an effective adjuvant that, when injected intrathecally, has only mild adverse effects while providing substantial analgesia. This study compares the efficacy of intrathecal nalbuphine and butorphanol as adjuvants to hyperbaric bupivacaine in spinal anaesthesia for lower limb orthopaedic surgeries. **Materials and Methods:** A Prospective randomised study was conducted in elective lower limb orthopaedic surgeries. 80 patients divided into 2 group, BN group: 40 patients will receive 3ml 0.5% hyperbaric bupivacaine (15mg) + 2mg nalbuphine (0.2ml), BB group: 40 patients will receive 3ml 0.5% hyperbaric bupivacaine (15mg) + 200ug butorphanol (0.2ml). The following parameters are noted, time of injection of the subarachnoid block, onset and duration of motor and sensory duration of analgesia and duration of surgical procedure. **Result:** Among 80 patients, the groups had no significant difference in age or weight. There is a statistically significant difference in the duration of surgery and onset time of sensory block at the T10 level (min) between the groups, and the p-value is 0.001, <0.0001. The mean arterial pressure at 5, 10, 15, 30, 45, and 60 minutes showed a statistically significant difference at P<0.0001. In addition, 3 (7.5%) patients shivered in group BB. A total volume of injection solution will be 3.2ml in both groups. **Conclusion:** As an adjuvant, Intrathecal nalbuphine hyperbaric bupivacaine for the subarachnoid blockade was more efficient than butorphanol for rapid onset with prolonged sensory and motor duration blockade and better post-operative analgesia for lower limb orthopaedic surgery with no significant adverse effects.

INTRODUCTION

Lower limb orthopaedic treatments are frequently performed under spinal anaesthesia. It's easier since it has a quick start and causes significant muscular relaxation. Spinal anaesthesia enables fewer medication dosages and a reduced rate of unsuccessful blocks. Over the years, lignocaine was the preferred local anaesthetic for spinal anaesthesia. Its usage is limited due to its short impact period, and It has been associated with temporary neurological symptoms, including cauda equina syndrome after a subarachnoid block. Compared to lignocaine, bupivacaine has a slower onset, better potency and longer duration of action. Its drawbacks are a sluggish start of the effect and a reduced motor block.[1] The recovery time after spinal anaesthesia is notably shorter, and the patient often experiences pain soon after surgery, various adjuvants must be used, and their functions are being investigated in diverse research. Adjuvant medication given intravenously to local anaesthesia increases the quality and duration of spinal blocking while extending post-operative analgesia. Furthermore, local anaesthetic drugs' dosage and volume are reduced during the subarachnoid block. Intrathecal opioids combine with local anaesthetics to increase sensory blockage without impacting sympathetic blockage. Opioids are routinely administered to local anaesthetics to enhance their effects, reduce their dose, and reduce possible side effects and problems. They also increase the duration of pain

relief after surgery.[2,3] Nalbuphine is a synthetically produced opioid with κ agonist and μ antagonist characteristics. When injected intravenously, nalbuphine acts on kappa receptors in the central nervous system, causing analgesia and drowsiness without μ side effects. Compared to other centrally acting opioid analgesics, it has the least amount of respiratory depressive impact and the least amount of misuse potential. With nalbuphine hydrochloride, shivering, vomiting, and urine retention are uncommon. Increased medication dose is unnecessary since nalbuphine achieves maximum impact at a lower intrathecal dosage.[3,4] Butorphanol and its primary metabolites bind to opioid receptors and act as agonists and mixed agonists – antagonists. Its interactions with these receptors in the brain and central nervous system seem responsible for most of its pharmacological activities, including its analgesic properties. Butorphanol is a potent analgesic that works as an opioid agonist and antagonist. Butorphanol is primarily used to treat moderate to severe surgical pain and pre-anaesthetic medicines, supplement balanced anaesthesia, and alleviate post-partum discomfort and cancer pain when opioids are necessary. Butorphanol is rapidly and almost completely absorbed after intramuscular injection. In post-operative patients, 2 to 3 mg IM produces analgesia. Intranasal butorphanol –post-operative pain and migraine pain.[5,6]

Aim

This study compares the efficacy of intrathecal nalbuphine and butorphanol as adjuvants to hyperbaric bupivacaine in spinal anaesthesia for lower limb orthopaedic surgeries.

MATERIALS AND METHODS

A Prospective randomised study was conducted in the Department of Anesthesia, Government Medical College and Hospital, Thoothukudi, from February 2021- November 2021, duration of 10 Months.

The patients who are qualified per the selection criteria will be explained the anaesthesia procedure in their vernacular. Written informed consent will be obtained in each case. Each patient will be provided with the patient information sheet. Inclusion criteria: Patients of either sex, aged 20-60, ASA 1 and 2 patients, and Patients who have elective lower limb orthopaedic surgery.

Exclusion Criteria

Patient refusal, Local infection, Patients who cannot get spinal anaesthesia due to certain conditions, Patients who are bleeding or taking anticoagulants, Patients with heart blocks, cardiac disease, and dysrhythmias, and Patients with beta-blockers & alpha antagonists. BN group: Patients will receive 3ml hyperbaric bupivacaine 0.5% (15mg) + 2mg nalbuphine (0.2ml). BB group: Patients will receive 3ml hyperbaric bupivacaine 0.5% (15mg) + 200ug butorphanol (0.2ml). ASA standard monitors non-invasive blood pressure, heart rate (HR), pulse oximetry(spo2), and ECG leads connected to the patient. In addition, preoperative baseline systolic and diastolic blood pressure, mean arterial pressure, pulse rate, respiratory rate, and oxygen saturation will be recorded. The skin over the back will be prepared with an antiseptic solution and draped with a sterile sheet in a sitting position. The following parameters are noted; time of injection of the subarachnoid block, time of onset of sensory block at T10 level, time of onset of motor block (MBS-3), duration of sensory block, duration of motor block(MBS-0), duration of analgesia and duration of surgical procedure. Data are presented as percentages and the number of cases. Continuous variables were compared using an independent sample t-test. Categorical data were analysed with Pearson chi-square tests. Significance was defined by P values less than 0.05 using a two-tailed test. Data analysis was performed using IBM-SPSS version 21.0 (IBM-SPSS Science Inc., Chicago, IL).

RESULTS

Table 1: Distribution of patient's parameters and characteristics

Parameters	Mean and Std deviation		P-value
	Group BB	Group BN	
Age	46.13 ± 11.59	41.98 ± 11.17	0.107
Weight	63.00 ± 6.39	65.70 ± 6.78	0.070
Duration of surgery	99.38 ± 17.36	113.00 ± 19.11	0.001
Onset time of sensory block at T10 level (min)	4.15 ± 0.83	3.38 ± 0.54	<0.0001
Time taken to achieve sensory blockade at most cephalic level (min)	8.55 ± 1.34	8.58 ± 1.01	0.925
Time taken to achieve complete motor blockade (MBS-3)	9.05 ± 0.90	7.88 ± 0.91	<0.0001
Time taken for two segmental regressions to S1 (min)	228.38 ± 20.42	318.13 ±16.86	<0.0001
Duration of blockade (MBS-0)	177.38 ± 17.94	219.25 ±20.40	<0.0001
Duration of analgesia	292.38 ± 22.04	398.75 ± 21.48	<0.0001

Among 80 patients, the groups had no significant differences in age or weight. There is a statistically significant difference between groups in the duration of operation and the onset time of sensory block at the T10 level (min), with a p-value of 0.001, 0.0001. However, the time required to achieve sensory blocking at most cephalic levels (min) is not significantly different; the p-value is 0.925. In the time required to achieve complete motor

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blockade (MBS-3), time taken for two segmental regressions to S1 (min), duration of blockade (MBS-0), and duration of analgesia, there is a significant difference between the groups; a p-value of <0.0001.

Table 2: Distribution of heart rate between study groups

HR	GROUP	Mean and Std Deviation	P value
Baseline	Group BB	79.73 ± 5.51	0.112
	Group BN	77.20 ± 8.27	
3 mins	Group BB	83.20 ± 5.97	0.006
	Group BN	78.75 ± 8.06	
5 mins	Group BB	85.05 ± 6.11	<0.0001
	Group BN	79.75 ± 5.96	
10 mins	Group BB	85.05 ± 5.87	0.010
	Group BN	81.68 ± 5.59	
15 mins	Group BB	82.70 ± 6.40	0.901
	Group BN	82.88 ± 6.09	
30 mins	Group BB	83.05 ± 5.84	1.000
	Group BN	83.05 ± 6.53	
45 mins	Group BB	84.75 ± 6.12	0.109
	Group BN	82.50 ± 6.28	
60 mins	Group BB	83.70 ± 5.29	0.971
	Group BN	83.65 ± 6.81	
Postop	Group BB	84.55 ± 5.04	0.138
	Group BN	82.50 ± 7.03	

The change in mean heart rate was statistically significant at 5 min (P<0.0001). The systolic blood pressure shows no significant differences between the groups. However, diastolic blood pressure significantly differs at 3, 5, 10, 15, 30, 45, and 60 minutes (P<0.0001).

Table 3: Distribution of mean arterial pressure between study groups

MAP	GROUP	Mean and Std Deviation	P value
Baseline	Group BB	95.60 ± 6.59	0.342
	Group BN	94.25 ± 6.04	
3 mins	Group BB	93.73 ± 5.42	0.002
	Group BN	89.63 ± 6.21	
5 mins	Group BB	92.33 ± 4.29	<0.0001
	Group BN	87.08 ± 5.45	
10 mins	Group BB	92.08 ± 5.23	<0.0001
	Group BN	85.75 ± 4.91	
15 mins	Group BB	93.50 ± 5.86	<0.0001
	Group BN	86.75 ± 5.66	
30 mins	Group BB	93.78 ± 7.77	<0.0001
	Group BN	87.50 ± 6.74	
45 mins	Group BB	94.05 ± 5.35	<0.0001
	Group BN	87.55 ± 5.31	
60 mins	Group BB	94.10 ± 5.34	<0.0001
	Group BN	88.63 ± 7.68	
Postop	Group BB	94.30 ± 5.88	<0.0001
	Group BN	87.10 ± 6.73	
	Group BN	82.50 ± 7.03	

When comparing the two groups' mean arterial pressure at 5, 10, 15, 30, 45, and 60 minutes, there was a statistically significant difference at P<0.0001.

Table 4: Distribution of SPO2 between study groups

SPO2	GROUP	Mean and Std Deviation	P-value
Baseline	Group BB	99.95 ± 0.22	0.156
	Group BN	100.00 ± 0.00	
3 mins	Group BB	99.98 ± 0.16	0.320
	Group BN	100.00 ± 0.00	
5 mins	Group BB	99.85 ± 0.43	0.029
	Group BN	100.00 ± 0.00	
10 mins	Group BB	99.93 ± 0.27	0.079
	Group BN	100.00 ± 0.00	
15 mins	Group BB	99.88 ± 0.33	0.021
	Group BN	100.00 ± 0.00	
30 mins	Group BB	99.93 ± 0.27	0.079

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	Group BN	100.00 ± 0.00	
45 mins	Group BB	99.93 ± 0.27	0.079
	Group BN	100.00 ± 0.00	
60 mins	Group BB	99.98 ± 0.16	0.320
	Group BN	100.00 ± 0.00	
Postop	Group BB	100.00 ± 0.00	N/A
	Group BN	100.00 ± 0.00	

The SPO2 levels were also compared in group BB and group BN, which was statistically non-significant as mean SPO2 levels remained constant in group BN.

Out of 80 patients, only 3 (7.5%) patients showed shivering in group BB. These results are not statistically significant.

DISCUSSION

In the Tiwari AK et al. study, there was no change in the timing of motor blockade, the duration of motor blockade, or the severity of the onset of sensory. C Group (hyperbaric bupivacaine 0.5% + 1mL nalbuphine (400 g) intrathecally) had the longest two-segment regression time of sensory blocking and analgesia. Intrathecally administered nalbuphine hydrochloride (400 g) in combination with hyperbaric bupivacaine significantly prolonged the duration of the sensory blockade and surgical analgesia without any side effects or complications.[7] Ahluwalia P et al. studied the motor blockade, duration of sensory block, onset time of sensory, and duration of analgesia. There was a statistically significant difference between the two groups. B-Group 2.5ml bupivacaine 0.5% and N-Group 0.5% bupivacaine 2.5ml + nalbuphine 0.8 mg. Results showed that nalbuphine had favourable post-operative analgesia and intraoperative outcome with few adverse effects.[8] Shakooh S et al. studied both senses; the N group (hyperbaric bupivacaine 0.5% + 0.8mg nalbuphine) had a quicker onset of blockage. According to the VAS scores, the individuals in group N experienced considerably longer-lasting post-operative analgesia than those in group B (hyperbaric bupivacaine 0.5%). Neither group had any serious adverse effects. Intragastric nalbuphine was found to have fewer adverse effects and provide better pain relief during and after surgery.[9] Madhusudhana R et al. reported a significant difference in the onset of sensory block in both groups undergoing lower limb operations under the subarachnoid block with (0.3mg) nalbuphine or fentanyl 25µg in combination with hyperbaric bupivacaine (3mL) on a total of 124 patients. Nalbuphine patients experienced a later onset of sensory blockade compared to fentanyl patients.[10] Meitei et al. studied a statistically significant difference between the groups' beginning time of the motor block. Still, it's not between Group BD (0.5% bupivacaine + 0.5ml dexmedetomidine 2.5 g) and Group BB (0.5% bupivacaine + 25 g butorphanol 0.5 ml). Group BD had a considerably longer regression time than groups B and BB, but there is no difference between the groups. When comparing groups B and BB, group BD had a substantially longer duration for 2-segment regression and the onset of the need for recovery analgesia. In contrast, the BD group had considerably higher rates of sedation.[11] Goyal et al. studied in the research group that the average time to rescue analgesia was 227 mins, while in the control group, it was 149 mins, which is significant. According to the findings, compared to the control group, patients who receive injections of butorphanol after surgery have less pain for longer.[12] Manjula R et al. performed a study between the two groups with no significant difference. Still, the mean time of post-operative analgesia in group N (15mg hyperbaric bupivacaine + 0.1ml nalbuphine) was significantly shorter than in group B (0.5 % hyperbaric bupivacaine 15mg). Based on the findings, intrathecal nalbuphine at a dose of 1mg can be administered as an efficient adjuvant in conjunction with hyperbaric bupivacaine 0.5% to ensure optimal post-operative analgesia.[13] In a study by Jaisinghani RN et al., the pain relief with nalbuphine after surgery lasted substantially longer than that from fentanyl. Fentanyl had more adverse effects, including vomiting, bradycardia, hypotension, nausea, and shivering, whereas both medications caused only mild drowsiness. After analysing the data, the findings suggest that Nalbuphine hydrochloride is preferable to fentanyl as an adjuvant for post-operative analgesia in lower limb cases.[14] Narayanappa et al. studied both groups and had similar onset, motor and sensory block length, and analgesic effect duration. Between the post-operative VAS scores of the BN Group (0.8mg of nalbuphine + 0.5% hyperbaric bupivacaine 12.5mg) and BF Group (Fentanyl 25µg + 0.5% hyperbaric bupivacaine 12.5mg), there is a significant difference. Among individuals in the early post-operative period, only 23.3% in Group BF and 60.0% in Group BN underwent rescue analgesia. When added to hyperbaric bupivacaine as an adjuvant, the results showed that fentanyl was more effective than nalbuphine in reducing pain immediately after surgery.[15] Above mentioned results were similar to our study. However, adding nalbuphine was more effective than butorphanol for lower limb orthopaedic surgery with minimal side effects.

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CONCLUSION

As an adjuvant, Intrathecal nalbuphine in a dose of 2mg to 0.5% hyperbaric bupivacaine 15mg for the subarachnoid blockade was more efficient than butorphanol 200µg for rapid onset with prolonging the duration of sensory, motor blockade and better post-operative analgesia for lower limb orthopaedic surgery with no significant adverse effects.

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