A COMPARATIVE STUDY OF INTRATHECAL BUPIVACAINE AND BUPIVACAINE WITH BUPRENORPHINE FOR POST-OPERATIVE ANALGESIA IN ORTHOPEDIC SURGERIES

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ABSTRACT

Introduction: *Pain is a unique emotional experience, which is associated with actual or potential tissue damage. Postoperative pain management is necessary. The most effective preemptive analgesic regimens are those that are capable of limiting sensitization of the nervous system throughout the entire perioperative period.*

Material & Methods: *Radomly patients were assigned in two groups of 60 patients who underwent lower limb orthopedic surgery. The clinical effects of intrathecally administered Inj Bupivacaine 0.5% hyperbaric 2.5 ml (group B) with Inj Buprenorphine preservative free 150 mcg additional to the hyperbaric bupivacaine 0.5% 2.5 ml (group B) for lower limb orthopedic surgeries were studied .*

Results: *Surgery had mean duration of 87.3(16.7) min for group B and 96.3(17.1) min for group BN. There was statistically no significant (P>0.05) difference of time of onset, maximum level and time required reaching maximum level of sensory block in between the groups. All patients in both groups had complete motor blockade. There was statistically no significant (P>0.05) difference in preoperative, during surgery and postoperative hemodynamic parameters in between two groups. Sensory recovery was significantly (P<0.01) delayed in BN group compared to B group. Mean duration of effective analgesic was markedly raised (P<0.001) to 909 (216.9) min in group BN from 158(17.3) min in group B. Complication of nausea, vomiting and shivering was noted in both the groups with no significant difference(P>0.05).*

Conclusion: *Buprenorphine added to Bupivacaine hyperbaric have effective and considerably prolonged postoperative analgesia.*

Keywords: *Postoperative pain, intrathecal, Buprenorphine, Bupivacaine.*

INTRODUCTION

Pain is a unique emotional experience, which is associated with actual or potential tissue damage. Post-operative pain management is necessary as severe pain leads to systemic adversaries, increased self-concern, social relationships, reduction in tolerance to external events and adverse relationship with doctors and nurses who are perceived to be withholding pain relief.[1]

The most effective preemptive analgesic regimens are those that are capable of limiting sensitization of the nervous system throughout the entire perioperative period.

IM/IV narcotics were tried but those have some disadvantages and the systemic absorption is more as compared to intrathecal narcotics. Intrathecal opioids enhance the sensory blockade of local anaesthetics without affecting the sympathetic activity.[2] Buprenorphine a μ receptor agonist with low intrinsic activity can also be administered safely in the subarachanoid space.

Intrathecal administration of drugs along with local anaesthetic is beneficial as no extra technique is required i.e. ease of administration, dose required is less as compared to IM/IV route, so the side effects of systemic absorption can be avoided.

Quality of epidural blockade is studied for influence on physical factors.[3] Local anaesthetics alone were administered for spinal anaesthesia for several years but combination of narcotics and local anaesthetics administered intrathecally have a potent synergistic effect in the control of postoperative pain.[4] Laboratory studies have also indicated that all local anaesthetics are neurotoxic in high concentration and spinally administered narcotics seem to have a low potential of neurotoxicity.[5]

Addition of narcotics to local anaesthetic used for spinal anesthesia was found to improve quality of anesthesia.[6-15] Hyperbaric solutions are also associated with lesser incidence of respiratory depression.[7] There is paucity of literature comparing intrathecal buprenorphine and its quality of analgesia to other narcotics used by intrathecal route.

So present study was undertaken to evaluate effect of addition of buprenorphine to bupivacaine compared with bupivacaine alone as an anesthetic solution for spinal anaesthesia. The objectives were to evaluate Onset, degree, maximum level, time required to achieve maximum level and duration of sensory blockade, duration of motor paralysis, hemodynamic variable, side effects and duration of effective post-operative analgesia.

MATERIAL AND METHOD

This randomized control trial study was undertaken at Shri Bhausaheb Hire Government Medical College and Hospital, Dhule, during the year 2013-2014, in 60 patients undergoing inferior extremity orthopedic surgeries, after approval from Hospital Ethics Committee.

Patients included in the study were ASA Grade I or Grade II between 18-50 years age group with weight between 40-70 Kg. Informed consent was taken from all patients for the procedure. Patients were excluded from study due to refusal for the procedure, hypersensitivity to local anaesthetic agents, Opioids, NSAID drugs and those with history of major systemic disease.

The included subjects were randomly assigned in two groups having 30 patient each, based on spinal injectate as follows: Group 'B' received 12.5 mg (2.5ml) of 0.5% hyperbaric bupivacaine with 0.5 ml NS, Group 'BN' received 150 µg of buprenorphine mixed with 12.5 mg (2.5 ml) of 0.5% hyperbaric bupivacaine. All equipments and drugs necessary for resuscitation and general anesthesia were kept ready. Before spinal blocks, each patient was preloaded with 7 ml kg-1 of Lactate Ringer solution with vitals monitoring.

Pinprick testing was used every minute to check the onset and to establish the peak level of block to T10 level on both side. Dermatomal testing was performed by an anaesthesiologist blinded to patient grouping. Dermatomal score was calculated as per Bromage P.R.[3]

Onset of sensory block was determined by loss of touch sensation at knee joint. The onset of motor block noted as the time from the injection of the drug in subarachanoid space till the patient unable to raise the extended leg. Noninvasive blood pressure, pulse rate, oxygen saturation and respiratory rate were charted every five minutes throughout surgery. Intraoperative and postoperative side effects were recorded and managed accordingly. Both sensory and motor block were assessed every ten minutes in the recovery room for sixty minutes. Patients were discharged to the ward as per departmental guidelines and only after the sensory and motor blocks started regressing.

In the ward, patients were assessed at three, six, twelve and twenty-four hours following surgery. Monitoring of complication of drowsiness, pruritis, urinary retention and respiratory rate was done.

STATISTICAL METHODOLOGY

Statistical analysis was performed using SPSS (Statistical Package for social sciences) Version 16. Data were presented as frequency and mean (Standard Deviation). Hemodynamic data including heart rate, systolic and diastolic blood pressure were compared in between the groups using unpaired t test at different time interval. Differences of motor characteristic and sensory level were also tested by unpaired t test. P value of less than 0.05 was considered significant.

RESULTS

The clinical effects of intrathecally administered, preservative free Buprenorphine alone and with 0.5% hyperbaric bupivacaine were assessed in 30 patients in each group who underwent lower limb orthopedic surgery under spinal anesthesia. Mean age of patients in group B was 37.8(3.8) yrs and 36.4(3.7) yrs in group BN. Average approximate weight was 60.3(6.5) Kg in group B and 57.8(5.8) Kg in group BN. Average height of patients was 157(6.7) cm in group B and 158 (6.6) cm in group BN.

Orthopedic surgery had mean duration of 87.3(16.7) min for group B and 96.3(17.1) min for group BN. There was statistically no significant (P>0.05) difference of age, weight, height and duration of surgery of patients in between the two groups.

Sensory Block

Time of onset was between 60 to 70 sec in 21 cases of B group and 23 cases of group BN. The mean duration of onset was 69 (9) min and 66(8) min in group B and BN respectivel. Maximum level of sensory block ranged T10 – T6. 15 patients of B group achieved T_8 level compared to 16 patients in BN group. Mean dermatomal score was 15 (11.2) and 15 (10.8) in group B and BN respectively. All patients achieved maximum sensory level within 10 minutes. The mean time required to achieve maximum sensory level was 7.1 min in group B and 6.8 min in group BN. There was statistically no significant (P>0.05) difference of time of onset, maximum level and time required reaching maximum level of sensory block in between the groups.

Motor blockade: Mean time required for onset of motor blockade was 77(9.5) min in B group compared to 75 (7.6) min in BN group. There was no significant (P >0.05) difference in the onset of motor blockade in two groups). Degree of motor Blockade in all patients in both groups had complete motor blockade of Bromage scale grade IV as assessed by inability to move feet and leg.

Haemodynamics: All procedure completed within 180 min. There was statistically no significant (P>0.05) difference in pulse rate, systolic blood pressure and respiratory rate preoperatively, during surgery and postoperative period in between two groups.(Table No 1). Mean Sp02 % in between the groups ranged between 96%-99% with no significant (P>0.05) difference in between the groups.

Table No 1: Comparison of Pulse rate, Systolic Blood pressure and Respiratory rate in between two groups.

Duration	Pulse Rate (/min)		Systolic BP (mm of Hg)		RR (per min)	
	B Group	BN Group	B Group	BN Group	B Group	BN Group
Preoperative	84.3 (9.4)	85.6 (7.5)	125.7 (5.7)	130.3 (12.2)	17.6 (1.2)	17.3 (1.3)
After 15 min	84.3 (6.8)	84.5 (6.7)	114.4 (11.2)	119.5 (13.1)	16.5 (1.1)	14.7 (1.7)
After 90 min	84.1 (7.1)	83.9 (6.4)	116.5 (6.1)	120.5 (8.9)	16.6 (0.9)	15.4 (1)
After 180 min	84.9 (5.6)	83.1 (7.3)	119.6 (6.5)	120.8 (7.6)	17.1 (1.2)	17.0 (1.1)
After 6 hrs	83 (7.4)	85.3 (6.8)	127 (11.1)	119.8 (9.9)	17.2 (1.6)	16.1 (1.3)
After 12 hrs	82.8 (7.4)	83.7 (5.6)	117.6 (8.7)	118.9 (7.1)	16.7 (0.8)	15.1 (1.4)
After 24 hrs	83.3 (4.8)	84.5 (7.1)	117.7 (5.8)	119.6 (9.3)	16.9 (1.0)	16.2 (1.5)

Motor recovery

There was statistically no significant effect (P>0.05) on mean duration of motor recovery while sensory recovery was significantly (P<0.01) delayed in BN group compared to B group (Table No 2).

Table No. 2: Onset of motor and sensory recovery

Duration (min)	Groups		P value
	B	BN	
Motor Recovery	121 (9.6)	125 (6.5)	> 0.05
Two dermatome regression	68 (8.3)	84 (12.0)	< 0.01
Great toe sensation	132.8(16.5)	215.4 (26.2)	< 0.01

Duration of effective analgesia was between 0 to 299 min in all cases from group B compared to no case from group BN. In group BN 26 patients had effective analgesia for the period of 10 hrs (600 min) to 16 hrs (1200 min). Mean duration of effective analgesic was markedly raised to 909(216.9) min in group BN from 158(17.3) min in group B. statistically the difference was significantly (P<0.001) more in BN group as compared to Group B.

Complications: Nausea and Vomiting was more i.e. in 5 patients in BN group as compared to 3 patients in B group. The incidence of Shivering was also less in BN group i.e. 1 case as compared to 3 cases in group B. Hypotension was seen in 3 patients from group B and 2 patients of group BN in early intraoperative period only.

DISCUSSION

The clinical effects of intrathecally administered, 0.5% hyperbaric bupivacaine were assessed in patients who underwent lower limb orthopedic surgery under spinal anaesthesia using preservative free Buprenorphine as an adjuvant.

Buprenorphine is a lipid soluble drug and rapid absorption into the spinal venous plexus allows minimal increase in spinal fluid concentration with minimal risk of respiratory depression associated with rostral spread.[7] Buprenorphine has a high affinity for narcotics receptors and therefore produces longer duration of analgesia compared to other agents. [9] Wang C[10], in study confirms the limited ceiling effect of buprenorphine on nociceptive reflexes. Rudra A[8] concluded that the analgesia was twice using buprenorphine in dose of 150 mcg than using it as 100 mcg.

Sensory Analgesia

The onset time was similar in both the groups 69(9.07 Sec.) in group 'B' and 66(8.40) Sec in group 'BN'. The time of onset of sensory analgesia was similar, as the clinical action of local anaesthetic and opioids are additive only after some time has elapsed following intrathecal administration. .

Study results as maximum sensory level ranged between T6 - T10 and are comparable in both groups. The addition of Buprenorphine to bupivacaine did not change the height of block (P>0.05). Most of the patients required 5-10 min to reach maximum sensory level with addition of Buprenorphine to bupivacaine in various dosages.

Motor Blockade: Our study results of the onset of motor block was statistically similar(p>0.05) in both groups, 77(9.5) sec in group B and 75(7.6) sec in group BN and all patients had complete motor blockade.

Findings in our study coincide with Chansoriya KP [6], Capogna G et al [7], Celleno D et al[12], Rudra A et al [8], Sen M [11], Thomas W et al [13], Lata R.K. et al [14] and Khan F [15] who also found no change of time of onset of sensory analgesia and maximum level of sensory block and motor blockade with addition of Buprenorphine to bupivacaine in various dosages.

Haemodynamics

There was no significant variation in the intraoperative and postoperative pulse rate, Systolic Blood pressure, respiratory rate and SPO2% in both groups. No case of bradycardia was recorded. Spinal anaesthesia induced hypotension is supposed to be due to sympathetic B fibres causing pooling of blood in inferior extremity leading to reduced cardiac output hence reduced systolic blood pressure.

Wang C. et al[10] have shown that intrathecal buprenorphine acts on Að and C fibres without any effect on sympathetic outflow. These observations in previous study by Chansoriya KP[6], Capogna G et al[7], Celleno D et al[12], Rudra A et al[8], Sen M[11], Thomas W et al [13] Lata R.K. et al[14] and Khan F [15] also found the same results regarding haemodynamic variables after addition of buprenorphine to bupivacaine .

Recovery

Motor recovery was comparable in both groups (Table no 2). It was 121 (9.6) min in group B and 125(6.5) min in group BN.

This prolongation of sensory recovery is attributed to the clinical action of local anaesthetic and opioids are additive only after some time has elapsed following intrathecal administration. This is due to the time taken by the opioid from CSF to penetrate the deeper layer (substantia gelatinosa) where opioid receptors are present.

In our study time for two dermatomal regressions was increased in Buprenorphine group. Sensory recovery was 68(8.3) min in group B & 84(12.0) min in group BN group. Time for complete sensory recovery was 132.8 (16.5) min in B group and 215.4(26.2) min in BN group. BN group had significantly ($P<0.01$) prolonged sensory recovery than B group (Table No. 2). Khan F[15] duration of sensory block was significantly longer in buprenorphine-bupivacaine group.

Duration of effective analgesia: The duration of analgesia was prolonged from 158(17.3) min to 909(216.9) min with addition of 150 mcg of buprenorphine to bupivacaine ($P<0.001$).

Capogna G et al[7] found excellent sensory analgesia for average 183 min to 430 min respectively. Celleno D[12] noted buprenorphine had a longer pain-free interval for average 420 min. Sen M.[11] noted duration of effective postoperative analgesia was 190 min. Khan F[15] found patients did not required postoperative analgesia in the first twenty four hours in group B. Chansoriya KP et al[6], Rudra A[8], Thomas W[13] have studied patients receiving buprenorphine had excellent pain relief.

Complications

The incidence of Nausea and Vomiting was more in BN group as compared to control. The incidence of Shivering was less in BN group as compared to control. No patient had urinary retention, bradycardia, pruritus or respiratory depression. It is likely that highly lipophilic opioids when administered intrathecally at the lumbar level to reach the chemoreceptor trigger zone in concentration sufficient to directly induce nausea vomiting.

According to Capogna G[7], Sen M.[11] the only side-effect found due to buprenorphine group was nausea and vomiting. While Rudra A[8] had not noted any side effects in patients. Celleno D et al [12], Lata R.K. et al [14] and Thomas W et al [13] also studied intrathecal buprenorphine in various doses observed rise in incidence of nausea and vomiting but statistically not significantly ($P>0.05$) different than other drug used.

Shivering may be due to decreased core temperature secondary to peripheral vasodilatation from sympathetic blockade and or cold intravenous fluids.

All these characteristics were confirmed in our study. Buprenorphine due to high lipid solubility and slow receptor dissociation, once bound to spinal opioids receptors is responsible for prolonging post-operative analgesia. It potentiates the action of spinal anaesthetic agents. The synergism is characterized by enhanced somatic analgesia without effect on the degree or level of local anaesthetic induced sympathetic or motor blockade.

CONCLUSION

Intrathecal Buprenorphine added to Bupivacaine hyperbaric can be recommended in orthopedic lower limb surgeries to have effective and considerably prolonged postoperative analgesia, inspite of slightly raised incidence of nausea and vomiting.

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