Comparative Study of Hemodynamic Changes of Intrathecal Bupivacaine with or without Ketamine for Lower Limb Surgeries

Vaidya PR*, Jha BD**, Shrestha S***

*Clinical tutor, Department of Anesthesiology & Intensive Care. National Academy of Medical Sciences, Bir Hospital, **Senior Consultant Anaesthesiologist and Academic Director, Phect, Nepal, ***Lecturer, Manmohan Institute of Health Sciences

ABSTRACT

INTRODUCTION: Spinal anaesthesia is well accepted anaesthetic procedure for lower limb surgeries. Though spinal anaesthesia has many advantages, it has some major complications like hypotension and bradycardia. This prospective double blind study was carried out to see whether the sympathomimetic effect of intrathecal ketamine attenuates bupivacaine induced hypotension and bradycardia.

METHODS: Sixty patients of American Society of Anaesthesiologist (ASA) physical status I and II undergoing lower limb surgeries were randomly allocated into two groups. Group Bupivacaine (B) patients received intrathecal Bupivacaine 0.5% heavy and Group Bupivacaine+Ketamine (BK) received bupivacaine along with Ketamine. Hemodynamics was monitored.

RESULTS: Heart rate fluctuation in group B was ± 10% and in group BK was ± 14% from the baseline. Mean arterial pressure fluctuation in group B was ±10 % and in group BK was ±8% from the baseline. 24.13% of patients in group B and 18.5% patients in group BK had hypotension. 17.24% patients in group B and 3.70% patients in group BK had bradycardia. More fluids were required to maintain intraoperative hemodynamics in group B.

CONCLUSION: We conclude that intrathecal addition of ketamine with bupivacaine gives better hemodynamic stability and minimize requirement of vasopressors and intraoperative fluid.

KEY WORDS: bupivacaine, hemodynamic, intrathecal, ketamine.

INTRODUCTION

Spinal anaesthesia is well accepted anaesthetic procedure for lower limb and lower abdominal surgeries. But it has complications like hypotension, bradycardia, post dural puncture headache and urinary retention. Cardiovascular affects of spinal anaesthesia manifest predominantly as hypotension and bradycardia. Large surveillance studies have shown incidence of hypotension about 33% and bradycardia about 13% in non obstetrics population. The prophylactic measures like prehydration, use of ephedrine have been studied in the past but they have not much benifit. Intrathecal adjuncts, such as opioids, alpha-2 agonist and neostigmine are often added to enhance spinal anaesthesia. Even though these adjuncts are effective in improving the efficacy of low dose spinal anaesthesia, their use is limited because of side effects. Some of these complications can be minimized by adding intrathecal adjunct like ketamine. Spinal ketamine binds to the phencyclidine site of the NMDA receptor –gated calcium channel and inhibits the NMDA receptors noncompetitively. It also acts at opiates, monoaminergic receptors and voltage-sensitive calcium channels. Ketamine causes tachycardia and hypertension. When ketamine is combined with local anaesthetic like bupivacaine during spinal anaesthesia, it attenuates hypotension and bradycardia. Its direct axonal blocking effect produces local anaesthetic effect and contributes to the analgesic effect of spinal ketamine. Thus decreases the dose of local anesthetic agents and the incidence of hypotension and bradycardia.
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Preservative free 1% ketamine can be safely administered both via epidural and intrathecal route. This study was aimed to see whether addition of low dose of ketamine with bupivacaine for lower limb surgeries attenuates hypotension and bradycardia during spinal anaesthesia.

METHODS

After approval from Institutional Review Board, this prospective randomized double blind trial was conducted in Bir hospital, NAMS. A total number of 60 patients, age ranging from 16 to 65 years, ASA I and II requiring lower limb (orthopaedic) surgery were enrolled for the study. Patients who were contraindicated to spinal anaesthesia, hypersensitive to study drugs, duration of surgery more than two hours were excluded. Written informed consent was taken. Patient were randomly allocated to receive either Inj. Bupivacaine 0.5% heavy 3ml (Anawin®) or Inj. Bupivacaine heavy 0.5% (Inj. Anawin®) 2.8ml (i.e. 14mg) with preservative free Inj. Ketamine (Inj. Aneket®) 0.2 ml (i.e.10 mg). The patients and the doctor who observed the patients were blinded.

Patients were fasted 6 hours preoperatively. Patients from both the study groups were prehydrated with 10ml/kg of Ringer’s lactate over 20 mins. Baseline vitals were recorded. Spinal anaesthesia was performed in sitting position at L3/4 interspace, midline approach with 25G Quincke spinal needle. Drug was pushed at rate of 0.2ml/sec. The patients were kept supine immediately after spinal injection. Heart rate, systolic and diastolic blood pressure (B.P.), means arterial pressures (MAP) were recorded just after the insertion of spinal needle and every 5 mins interval for 30 min then every 15 min until the end of procedure. Heart rate (HR) < 20% from the baseline value was considered as bradycardia and was treated with 0.3mg IV atropine. Decrease in MAP >20% below baseline value was considered as hypotension and was treated with crystalloid solution and incremental dose of 3mg of mephentermine as required. Sensory block was assessed by pinprick. Motor block was assessed by modified Bromage scores (0, no motor block; 1, inability to flex the hip; 2, inability to flex the knee; 3, inability to flex the ankle). The variables measured were age, sex, weight, heart rate, mean arterial pressure, intraoperative fluid requirement, systolic and dystolic blood pressure. Patients were followed up for 24 hrs to see any post operative complications like urinary retention and post dural puncture headache (PDPH).

RESULTS

Table 1: Demographic data of study groups

<table>
<thead>
<tr>
<th>Study group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B Group</td>
<td>29</td>
<td>153.68</td>
<td>5.63</td>
</tr>
<tr>
<td>B+K Group</td>
<td>27</td>
<td>153.07</td>
<td>6.16</td>
</tr>
</tbody>
</table>

Table 2: Demographic Data of study groups

<table>
<thead>
<tr>
<th>Study group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of patients</td>
<td>B Group</td>
<td>29</td>
<td>153.68</td>
</tr>
<tr>
<td></td>
<td>B+K Group</td>
<td>27</td>
<td>153.07</td>
</tr>
<tr>
<td>Weight of patients</td>
<td>B Group</td>
<td>29</td>
<td>58.17</td>
</tr>
<tr>
<td></td>
<td>B+K Group</td>
<td>27</td>
<td>55.3</td>
</tr>
<tr>
<td>Age of patients</td>
<td>B Group</td>
<td>29</td>
<td>35.48</td>
</tr>
<tr>
<td></td>
<td>B+K Group</td>
<td>27</td>
<td>36.85</td>
</tr>
<tr>
<td>Intra-operative fluid requirement</td>
<td>B Group</td>
<td>29</td>
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</tr>
<tr>
<td></td>
<td>B+K Group</td>
<td>27</td>
<td>1777.78</td>
</tr>
</tbody>
</table>

Total number of cases studied were sixty. Out of them four cases were excluded. Two cases; one from each group were excluded because of spinal failure and other two cases were excluded from Group BK because of prolong surgery time. The distribution of the patients according to sex, ASA, height, weight and age were similar in both the groups.
In group B, the highest number of patient (41.37%) achieved sensory block up to T10 level and the range of sensory block was from T6 to T12. In group BK, the highest number of patient (18.51%) achieved a level of sensory block up to T9 and the range of sensory block was from L1 to T4. The level of sensory block in two study groups were not comparable due to small sample size.

Heart rate in both the groups were higher from the baseline after spinal injection but it was more in group BK.

Systolic blood pressure increased more from the baseline value in group BK after spinal injection in comparison to group B.

The table shows intraoperative fluid requirement in two study groups. More fluid was required in group B to maintain intraoperative blood pressure.

**DISCUSSION**

Spinal anaesthesia is a well accepted and effective procedure for lower limb surgery. But it has complication like hypotension and bradycardia. Various methods like preloading, coloading, prophylactic use of vasopressors, unilateral anaesthesia etc have been recommended to minimize these complications but none of them have shown to be ideal. These hemodynamic changes can be minimized, by the use of intrathecal preservative free ketamine with bupivacaine. Bion first used spinal ketamine in a human population and he showed that intrathecal ketamine 50mg produce significant analgesia without interfering with cardiovascular and respiratory function. In our study, there was increase in heart rate in both B group and
BK group from the baseline value after spinal injection. The increment in the heart rate was due to the pain and stress. Though there was fluctuation in heart rate in both the groups, patients in group BK were more tachycardic in first 25 min. Heart rate fluctuation in group B was ±10% and in group BK it was ±14% from the baseline value and was statistically not significant. Similar results have been shown in the study done by Kathirvel S et al. They found the heart rate were more in the group where ketamine was added to bupivacaine.

There was increase in systolic blood pressure after spinal injection in both the study groups. The increment in systolic blood pressure was higher from the baseline value in group BK than in group B. Systolic blood pressure in both the groups decreased after 10 min. Fluctuation in systolic blood pressure was more in the Group B than in the Group BK from the baseline value. But it was statistically not significant. In the study done by Kathirvel S et al, systolic blood pressure in Group BK has increased significantly in first 5 min after spinal injection. Our study had similar result. Later, there were no significant changes in systolic blood pressure.

There was increased in diastolic blood pressure from the baseline value in both the study groups after spinal injection. In Group B, diastolic blood pressure dropped from the baseline after 5 min post spinal injection while in Group BK it dropped down after 10 min. In both the groups diastolic blood pressure was below baseline value till 100 min

Diastolic blood pressure in Group B at the time interval 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 75, 80, 85, 90 min were found to be statistically significant from the baseline value (p values: 0.02, 0.01, 0.001, 0.01, 0.03, 0.01, 0.001, 0.02, 0.01, 0.02, 0.003, 0.01, 0.01, 0.02).

Diastolic blood pressure in Group BK at the time interval 35, 40, 45, 50, 55, 60, 65, 70 min were found to be statistically significant from the baseline value. (p-values: 0.01, 0.03, 0.01, 0.01, 0.01, 0.03, 0.02, 0.03)

MAP in both the study groups from the baseline value till 10 min of spinal anaesthesia. After 10 min of spinal anaesthesia, MAP dropped from the baseline value till 90 min. MAP fluctuation in group B was ±10% and in group BK was ±8% from the baseline value.

In our study, 7 (24.13%) incidences hypotension and 5 (17.24%) incidences of bradycardia were recorded in group B, whereas in group BK 5 (18.5%) incidences of hypotension and 3 (3.70%) incidences of bradycardia were recorded. Hypotension was treated with intravenous fluid and mephentermine. Bradycardia was treated with atropine. Similarly intravenous fluid requirement in group B was more than in group BK. Since the incidences of hypotension were more in group B, more fluid was required to maintain the blood pressure. In the study done by Kathirvel S et al., fluid requirement in bupivacaine group was more but hypotension or bradycardia was not found in either of the group in their study. Similarly in the study done by T. Togal et al there was no significant change of arterial BP in both the groups (B and BK), none of them require treatment for hypotension and bradycardia. Both the studies have used lesser dose (10 mg) of bupivacaine. This may be the cause of less incidence of hypotension and bradycardia. Intraoperative fluid requirement depends not only on hemodynamic stability of patient, but also on type of surgery, intraoperative blood loss, prolongation of surgery etc.

In our study the level of sensory block achieved in Group BK and B was up to T4 and T6 respectively. In the study done by Kathirvel S et al, the highest level of sensory block achieved was T8. Bion had reported that hypotension related to higher level of sensory block up to T2. So it is seen that level of block achieved is directly related to volume of drug injected. Onset of motor block in our study was early in the group BK.

11.1% (3) of patients in group BK and 3.44% (1) in group B developed urinary retention. Stricker and Steiner reported 26% incidence of urinary retention after spinal anaesthesia with tetracaine and lignocaine with or without adrenaline, with or without urinary tract problems.

3.74% (1) of patient developed nausea and vomiting, 7.4% developed hallucination in group BK. 7.40% (2) patients in group BK had post dural puncture headache within 24 hrs after operation. Both were females of 17 and 27 years of age. The incidence of post dural puncture headache was more seen in younger age females in our study.

**CONCLUSION**

Intrathecal addition of ketamine with bupivacaine gives better hemodynamic stability compared to bupivacaine alone. The incidence of hypotension,
bradycardia and intraoperative fluid requirement were lesser in the group where ketamine was added to bupivacaine. But the complications like nausea vomiting, urinary retention, PDPH, hallucination limits the intrathecal use of ketamine.

REFERENCES