Original Article

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HEMODYNAMIC RESPONSE OF LOW DOSE BUPIVACAINE WITH FENTANYL SPINAL ANESTHESIA IN ELDERLY PATIENTS

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ABSTRACT

Objectives: To determine whether a reduced dose of bupivacaine in combination with fentanyl could give reliable block with greater hemodynamic stability in elderly patients.

Study design: Quasi experimental study

Settings: Department of Anaesthesiology, Intensive Care and Pain Management Combined Military Hospital Rawalpindi

Duration and dates: One year duration, from May 2006 to April 2007.

Subjects: ASA I-III elderly patients (n=60) undergoing surgery for fracture neck of femur, meeting the inclusion and exclusion criteria.

Methods: Sixty elderly patients were randomized in two groups. The study group (group-A) received spinal anesthesia as a combination of hyperbaric bupivacaine 7.5 mg and fentanyl 15 µgm while the control group (group-B) received hyperbaric bupivacaine 15 mg. The hemodynamic stability of the patients and the quality of the blocks were compared.

Results: All patients had adequate duration of block. There was no significant difference in the change of heart rate between the two groups. Fall in blood pressure was more pronounced in the control group (group-B) patients requiring more ephedrine as compared with the study group (group-A) patients which remained more hemodynamically stable..

Conclusion: A reduced dose of hyperbaric bupivacaine in combination with fentanyl provides reliable spinal anesthesia in elderly patients with few events of hypotension and little need for vasopressor support of blood pressure.

Keywords: Elderly patients, fentanyl, hypotention, low dose bupivacaine, spinal anaesthesia, , ,

INTRODUCTION

Spinal anaesthesia is a widely used anaesthetic technique for surgery in the elderly[1,2]. Spinal anaesthesia is often preferred for its efficacy, rapidity, minimal effect on mental status, reduction of blood loss, and protection against thromboembolic complications[3,4]. However, in the elderly there is a high prevalence of medical problems and a reduction in physiologic compensatory mechanisms and spinal anaesthesia is associated with a risk of severe and prolonged hypotension in elderly patients with an incidence of 25-82% [5,7].

Strategies for treating spinal anaesthesia induced hypotension include intravenous volume administration, which increases circulating volume and cardiac output in an effort to compensate for the expansion of the capacitance vessels, or pharmacological reversal of the reduction in systemic vascular resistance, which inevitably accompanies spinal anaesthesia, using vasopressor agents[8]. However there is considerable controversy over the use of vasopressors and intravenous fluids to treat or prevent the hypotension of spinal anaesthesia (HSA)[7,8]. Unfortunately, none of these methods is without potential ill effect. Another approach to minimize HSA is by using very small or titrated doses of local anaesthetic. Although the use of a single shot low dosage local anaesthetic for spinal blockade may limit hypotension, it may not provide acceptable anaesthesia.

Opioids and local anaesthetics administered together intrathecally, on the other hand, have a potent synergistic analgesic effect[9-10]. Intrathecal opioids like fentanyl enhance analgesia from sub therapeutic doses of local anaesthetic and make it possible to

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achieve successful spinal anaesthesia using otherwise inadequate doses of local anaesthetic[11-12]. Yet because intrathecal opioids causes neither by itself nor in combination with bupivacaine any further depression of efferent sympathetic activity[13] it is possible to enhance the sensory blockade without altering the degree of sympathetic blockade and causing less adverse haemodynamic effects[10,14,15].

The aim of this study was to compare the hemodynamic effects of low dose bupivacaine (7.5 mg) with fentanyl (15 ugm) spinal anesthetic versus a conventional dose of spinal bupivacaine (15mg) in elderly patients. We seek to develop a reliable spinal block for the elderly, with better hemodynamic stability, few side-effects, using a single-shot and low-dose technique.

PATIENTS AND METHODS

These randomized controlled trials were carried out at Department of Anaesthesiology, Intensive Care and Pain Management, Combined Military Hospital Rawalpindi from 2006 to April 2007. The study was approved from the hospital ethics committee and written informed consent was obtained. Sixty (60) American Society of Anaesthesiology (ASA) status I-III elderly patients aged 65 or more, scheduled for surgical repair of fracture neck of femur were included. Patients with any contraindication for spinal anaesthesia were excluded from the study. The patients were randomly assigned to two groups (defined by the spinal injectate) using a sealed-envelope technique. Patients in group A received a combination of low dose hyperbaric bupivacaine (0.75%) i.e. 7.5 mg with fentanyl 15 µgm. Patients in group B received hyperbaric bupivacaine (0.75%) i.e. 15 mg alone. The spinal injection was prepared by one investigator and administered by another who was blinded to its contents and responsible for patient assessment and data collection.

Before induction of the spinal block, 500 ml of acetated Ringer's solution was infused. All received fentanyl (1ugm/kg) intravenously for pain relief several minutes before induction of the spinal block. Standard monitoring was applied for continuous electrocardiogram, pulse oximetry and non-invasive automated blood pressure measurement. The baseline mean arterial pressure was determined from the average of three consecutive readings taken after the administration of fluid and fentanyl. Lumbar puncture was performed in lateral position with fractured side down through midline approach at L3-L4 or L4-L5 inter vertebral space using 25-gauge Quincke needle. Spinal injection was given according to randomization of the patient. The patients were immediately turned to supine position after completion of injection. Noninvasive automated blood pressure measurements were recorded at 2.5-min intervals. Hemodynamic response (mean blood pressure and heart rate) ,for the purpose of study, was noted at baseline i.e. before spinal injection then 05 min, 15 min, 30 min, 60 min, 90 min and 120 min after performing the spinal block, for each patient of both the groups. Sensory blockade was checked by loss of pin-prick sensation. Bromage scale was used to check the motor blockade. In case of inadequate spinal anaesthesia (not achieving sensory level below T10 or Bromage scale less than 2), protocol for conversion to general anaesthesia was employed.

For the purpose of study, hypotension was defined as systolic blood pressure of less than 90 mmHg or decrease of more than 25% of baseline mean arterial pressure. Reaching either criterion was considered as hypotension and was treated with incremental intravenous boluses of 5mg ephedrine. All the patients received supplemental oxygen (3 L /min) through a nasal catheter during the procedure, including the first postoperative hours. A urinary catheter was inserted after block. The mean BP, HR, number of hypotension episodes, number of ephedrine usage, total ephedrine dose for each patient and intraoperative patient complaints were recorded. Data had been analyzed using SPSS version 13. Descriptive statistics were used to describe the data. Independent sample's t-test was used to compare qualitative variables while qualitative variables were compared using chi-square test between both the groups. A *p*-value <0.05 was considered significiant.

RESULTS

There were 30 patients in each group. Patients' characteristic which included age, male to female ratio and ASA status were statistically insignificant in both (A and B) groups (table-1).

Intra-operative heart rate was also found statistically insignificant in both groups at all study timings from base line to 120 minutes after giving spinal injection.

Fall in mean blood pressure at 15 minutes, 30 minutes and 60 minutes after spinal anesthesia in group B (bupivacaine alone) was significantly greater then group A (low dose bupivacaine with fentanyl group). Statistically significant difference (p= 0.010, 0.011 and 0.026 respectively) was found at these time intervals between the two groups (table-2)

The occurrence of hypotension in the group B (bupivacaine alone) was also significantly higher 73.3% (22 of 30 patients) compared to 10% (3 of 30 patients) in the group A (low dose bupivacaine with fentanyl). Statistically significant difference (p< 0.05) was found in this respect.

Mean ephedrine usage for hypotension was also found highly significant in group B as compared to group A. In group B 22 patients from 30 (73.3%) needed ephedrine and the mean dose of 40 mg ephedrine was injected. in group A, 3 patients from 30 (10%) in were injected ephedrine for treatment of hypotension. The mean dose of 10 mg ephedrine was used in these patients, (figure-1). The difference between two groups was significant (p-value < 0.05). No patient in any group required epinephrine or atropine.

The pattern of sensory block (as assessed by loss of pin prick sensation) was found similar in both groups at all study timings. There was no statistically significant difference in level of motor block in the two groups (p =0.073). None of the patient complained of intraoperative pain, nausea and vomiting during surgery in any group.

DISCUSSION

Spinal anesthesia is associated with a risk of severe and prolonged hypotension due to the rapid extension of the sympathetic block. Hemodynamic consequences are of greater importance in elderly patients with impaired physiological compensatory mechanisms. A spinal block given to a high-risk patient must provide anesthesia of high quality and with adequate duration to avoid the negative effects of any additional anesthesia. A decreased dose

Table-1: Patients Demographic Characteristics
Data are mean ± SD unless otherwise indicated

TIME after performing block (minutes)	MEAN BP mmhg (GROUP-A) (Low dose bupivacaine 7.5 mg with fentanyl 15 ugm)	MEAN BP mmHg (GROUP-A) (Bupivacaine 15mg only)	P value
05	90.4 ± 9.68	89.0 ± 9.84	0.581^{NS}
15	87.2 ± 10.26	80.8 ± 8.04	0.010*
30	83.7 ± 9.57	77.8 ± 7.46	0.011*
60	86.6 ± 7.68	82.6 ± 5.82	0.026*
90	88.1 ± 7.41	89.6 ± 6.36	0.414^{NS}
120	89.6 ± 5.96	91.3 ± 5.11	0.260^{NS}

Table 2: Mean Blood Pressure (Hemodynamic Response).
Data are mean ± SD unless otherwise indicated
NS= Non Significant *****=Significant

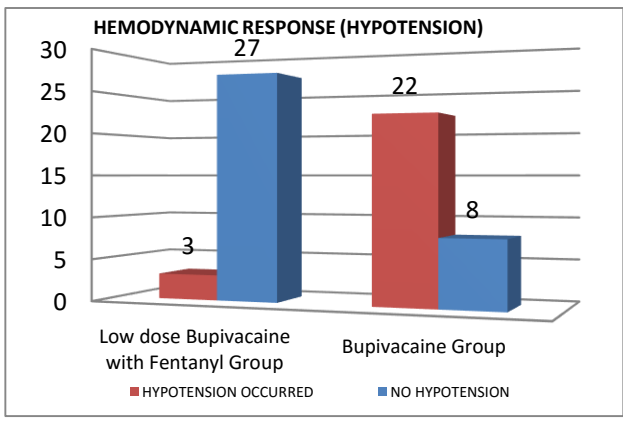

Figure: Hemodynamic response

of local anesthetic reduces the severity and incidence of hypotension after spinal block[16-17]. However it increases the risk of anesthesia failure in the form of inadequate blocks[18-19].

To prevent such failures, an opioid can be used. In the present study reduced dose of bupivacaine (7.5 mg) given in combination with fentanyl (15 µg) as a single-shot dose provided an adequate spinal block in elderly patients undergoing hip repair surgery. It gave better hemodynamic stability and fewer adverse effects than bupivacaine (15 mg) only. Hemodynamic stability was also reflected in the minimal need for vasopressor support of blood pressure. The addition of fentanyl with its very high lipid solubility and high affinity to opioid receptors[20,21] potentially allowed relief of fracture pain, which facilitated positioning on the fracture operation table and fracture reduction.

Alonso et al[22], conducted a study of 60 patients over 75 years of age, undergoing semi-urgent surgical repair of a fractured femur, reported that low dose (5 mg) bupivacaine with fentanyl (15ugm) provide successful spinal anesthesia and cause greater hemodynamic stability at 10 and 20 minutes after infusion of the anesthetic then bupivacaine (7.5 mg) alone and allow use of a lower dose of hyperbaric bupivacaine and reduce the need for intravenous ephedrine during surgery. The results of this study are in accordance to our study. Results of our study resembles with the work of BenDavid et al[16] , who demonstrated that the use of a minidose bupivacaine plus fentanyl spinal anaesthetic (4 mg bupivacaine plus 20 mg fentanyl) for surgical hip fracture repair in the elderly provide successful anaesthesia and incurred a minimum of hypotension. Qamarulhuda et al[23] at Aga Khan University, Karachi reported that 6mg bupivacaine with 20µg fentanyl provide adequate anaesthesia for surgical repair of hip fracture with stable haemodynamics as compare to bupivacaine 8 mg and 10mg.

In this study Hyperbaric Bupivacaine was chosen because it is a common clinical practice in our setup. Johanna et al[24] in a study found no major differences between hyperbaric and plain bupivacaine in onset or duration of anaesthesia with similar hemodynamic changes. Motor block, however, developed and vanished faster when hyperbaric bupivacaine was used.

We used fentanyl (15µgm) as an opioid because in our army setup fentanyl is relatively commonly available type of synthetic opioid. Fentanyl is a lipophilic and is preferred for having a rapid onset and short duration of action with lesser incidence of respiratory depressions.

We used ephedrine (5mg) boluses as an adrenergic agonist to treat hypotension of spinal anaesthesia (HSA). Ephedrine, although probably the most commonly used pressor for HSA, may not in fact be the agent of choice in this situation because ephedrine treatment of hypotension increases heart rate[25,26]. Our choice of ephedrine as the first-line vasopressor in the study was based on what we believed to represent common clinical practice.

Although some of the operations lasted as long as 110 min from the time of the spinal injection, none of the patients complained of pain intraoperatively. Based on work with younger adults, this duration of effect was not expected with the low dose group, 18 and it suggests delayed pharmacokinetics in these elderly patients. Because we did not map the change in sensory levels with time we do not have data to compare with previously published data on younger patients. Certainly this issue of block duration versus age warrants further study.

Respiratory depression after intrathecal fentanyl is a well-known effect[27,28] and may develop within 30 min of spinal injection. None of our patients developed low oxygen saturation or respiratory depression. The advantages of postoperative pain relief are brief after intrathecal administration of fentanyl due to its rapid clearance from the cerebrospinal fluid[29]. However, no patient required additional analgesia throughout surgery or while in the postoperative unit. Urinary retention has been reported after spinal opioids[29,30] but since all our patients had indwelling urinary catheters during surgery and for 24 h postoperatively this was not a problem.

One should be cautious in extrapolating the results of this study to younger patients either in terms of the adequacy of the dosage for hip surgery or in terms of the duration of surgical anaesthesia with it. Neither can one extrapolate these findings to other surgeries for which a higher cephalad level of block may be required.

CONCLUSION

The study concluded that low dose (7.5 mg) hyperbaric bupivacaine with fentanyl (15µgm) provides completely satisfactory spinal anesthesia in elderly population requiring below T10 level of anaesthesia. The small dose combination, in comparison with a 15mg dose of hyperbaric bupivacaine causes dramatically less hypotension, better hemodynamic stability and less ephedrine support of blood pressure,

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