

Haemodynamic effects of intrathecal Bupivacaine for surgical repair of hip fracture

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Abstract

Objective: To determine the optimal dose of bupivacaine in providing adequate surgical anaesthesia with minimal haemodynamic disturbances.

Methods: Three different doses of spinal bupivacaine in combination with or without fentanyl for surgical repair of hip fracture were used. Sixty patients were randomly divided into three groups (A, B and C) to receive a spinal anaesthetic of bupivacaine 10mg, 8mg and 6mg respectively. In addition to bupivacaine, group B and C also received fentanyl 20µg in spinal mixture.

Results: Intra operative heart rate was statistically insignificant in all three groups. Statistically significant drop in systolic blood pressure was found in group A & B at different study timings while statistically significant drop in diastolic blood pressure was only found in group A. Sensory block characteristics were similar among all three groups. Motor block pattern was found marginally significant in group C with highest time to achieve desired block. All patients had satisfactory level of surgical anaesthesia.

Conclusion: This study concluded that low dose, 6mg bupivacaine with 20µg fentanyl provide adequate anaesthesia for surgical repair of hip fracture with stable haemodynamics (JPMA 57:245;2007).

Introduction

The conventional spinal anaesthesia has been a standard technique for surgical repair of fracture neck of femur. The most common side effects from spinal anaesthesia is hypotension and bradycardia which can lead to deleterious consequences specially in patients with coronary artery disease.¹⁻⁴ Various prophylactic and rescue regimens have been used to prevent these haemodynamic disturbances with limited success. The unilateral spinal anaesthesia has been claimed by many as an alternate technique to restrict the undesired haemodynamic side effects.⁵ However it is considered technically more difficult than conventional spinal anaesthesia.

In the recent past, many clinical studies have demonstrated the beneficial effects of adding small doses of intrathecal opioids. This allows the use of less amount of local anaesthetic causing less adverse haemodynamic effects.⁶⁻⁸ Fentanyl in combination with reduced doses of lidocaine and bupivacaine has shown lower incidence of hypotension compared to conventional doses of local anaesthetic during spinal anaesthesia.^{9,10} This study was designed to determine the minimum dose of bupivacaine to provide adequate surgical anaesthesia with less adverse haemodynamic effects.

Patients and Methods

The study was approved from the hospital ethical committee and written informed consent was obtained from all sixty patients. American Society of Anaesthesiology (ASA) I-III elderly patients, aged 65 or more, scheduled for surgical repair of hip fracture were included in this trial. Patients with any contraindication for spinal anaesthesia were excluded from the study. By using sealed envelope technique patients were randomly assigned to one of the three groups. The volume (A,B,C) of spinal injection for all three groups was 2ml. It was given as isobaric bupivacaine 10 mg, group B isobaric bupivacaine 8 mg with 20µg fentanyl and group C isobaric bupivacaine 6mg with 20µg fentanyl. 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.

On arrival in the operating theater standard monitoring was applied for continuous electrocardiogram, pulse oximetry and, non-invasive automated blood pressure measurement (Datex AS/3 Anesthesia monitor). Before spinal injection, all patients were preloaded with 500ml crystalloid solution. Lumbar puncture was performed in lateral position with fractured side up through midline approach at L2-L3 or L3-L4 inter vertebral space using 25-gauge Whitacre pencil-point needle. Spinal injection was given according to randomization of the patient. The patients were immediately turned to supine position after completion of injection. Blood pressure, heart rate, sensory and motor block were recorded at baseline i.e. before spinal injection (T1), at spinal injection (T2) and after spinal injection (T3) and then every 5 minutes until half an hour (T4-

T8).

Sensory blockade was checked by loss of ice sensation. Bromage scale was used to check the motor blockade as follows: 0=full flexion of knees and ankle; 1=just able to flex knees, but full flexion of ankle; 2=unable to flex knees, but some flexion of ankle possible; 3=unable to move legs or feet. 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.⁵

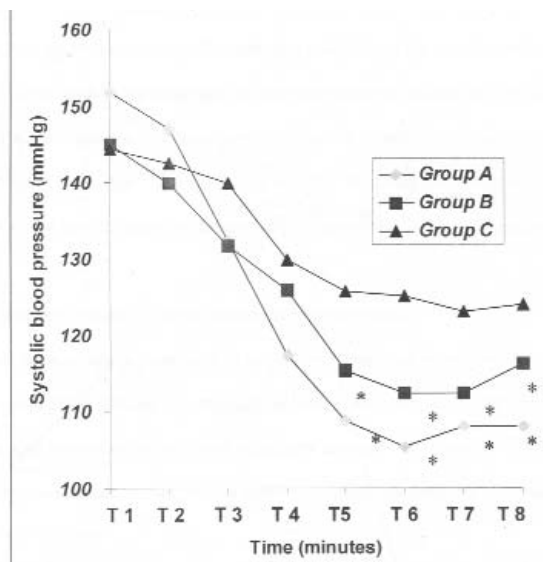
For the purpose of study, hypotension was defined as systolic blood pressure of less than 90mmHg or decrease of more than 25% of baseline mean arterial pressure. Reaching either criterion was considered as hypotension and was treated with incremental intravenous bolus of 5mg ephedrine. If hypotension persisted even after 50mg of ephedrine, protocol for conversion to phenylephrine 100-200µg boluses was followed. The number of hypotensive episodes, total vasopressor used for each patient and intra-operative patient complains of pain, nausea and vomiting were also recorded.

The characteristics of age, weight, height of patient in three treatment groups were compared with the analysis of variance methods. Repeated measure analysis of variance was used to compare haemodynamic and sensory response. These analyses were performed using SPSS version 12.0. The repeated ordinal motor responses were analyzed with the proportion odds models available in GENMOD procedure of SAS in all analysis. In all analysis p-value of less than 0.05 was considered significant.

Results

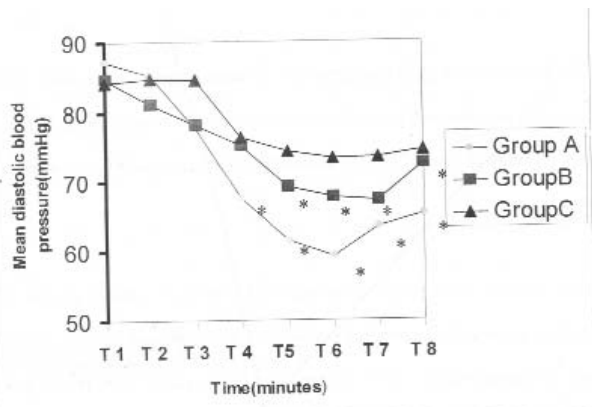
Patients' characteristic which included age, height, weight and male to female ratio were statistically insignificant in all three (A, B and C) groups. Intra-operative heart rate was also found statistically insignificant in all three groups at all study timings from base line to 30 minutes after giving spinal injection (T1-T8). Comparing systolic blood pressure among all three groups, a statistically significant difference was found in group A and B at T5-T8 i.e. 15, 20, 25 and 30 minutes after spinal injections (Figure 1). Group A also showed a drop in diastolic pressure at 10 minutes after spinal drug administration (T4) which is also statistically significant (Figure 2). Mean ephedrine usage for hypotension was also found highly significant in group A (37mg as compared to 8.5mg in group B and 2.7mg in group C). No patient in any group required epinephrine or atropine. The pattern of sensory block (as assessed by loss of ice sensation) was found similar in all three groups at all study timings. Motor block pattern was statistically significant as group C took longer time to achieve Bromage 2 than group A and B (Table). The mean duration of spinal anaesthesia were 119, 123 and 136 minutes respectively with no statistical difference. None of the patient complained of intraoperative pain, nausea and vomiting during surgery in any group.

Figure 1. Systolic blood pressure versus time.



* P-value less than 0.05
 Before spinal injectate T1 At spinal injection T2
 After spinal injection T3 Then every 5 minutes until half an hour T4-T8

Figure 2. Diastolic blood pressure versus time.



* P Value less than 0.05
 Before spinal injectate T1 At spinal injection T2
 After spinal injection T3 Then every 5 minutes until half an hour T4-T8

Table. Comparison of different groups according to Bromage scale for motor block at different study times.

Time in minutes	Group A	Group B	Group C
Baseline Bromage scale	0	0	0
Spinal drug	0	0	0
5-minutes	2	2	1*
10-minutes	3	2	2
15-minutes	3	3	3
20-minutes	3	3	3
25-minutes	3	3	3
30-minutes	3	3	3

* Statistically significant as P-value <0.05

diastolic pressure at 10 minutes after spinal drug administration (T4) which is also statistically significant

Discussion

Patients with hip fractures are usually frail and elderly with 30 days mortality in excess of 10 % in European series.¹¹ Spinal anaesthesia has been considered a standard technique for surgical repair of hip fracture but with a risk of haemodynamic disturbances. The purpose of our study was to determine the lowest possible dose of local anaesthetic providing adequate surgical anaesthesia with minimal haemodynamic disturbance.

In this study the adequacy of surgical anaesthesia in all three groups were identical with relatively little delay in achieving bromage 3 in group C with similar sensory ascending pattern. This explains the benefits of synergism (use of bupivacaine with fentanyl) in achieving the sensory block. However, a small dose of bupivacaine (6 mg) in group C required a longer time to achieve motor block than Group A and B (10 and 8 mg of bupivacaine respectively). It is also important to note that a small dose bupivacaine in group C did not reduce the duration of spinal anaesthesia which further confirms the findings of earlier study by Bruce et al.¹² This may explain the delayed pharmacokinetics in elderly subjects.

The present study has also demonstrated that by synergism, the incidence of haemodynamic disturbances (which are usually associated with conventional dosage of local anaesthetic agents) are significantly reduced. This finding further augments the previous work done by Bruce et al.¹²

In another study, 7.5mg of bupivacaine without fentanyl was used successfully to provide adequate block for knee arthroscopy.¹³ The current study attempted to reduce the dose of spinal anaesthetic agent further with the addition of fentanyl.

In view of the above facts, it was concluded that mini dose of 6 mg bupivacaine in combination with 20µg of fentanyl provides satisfactory spinal anaesthesia in elderly population requiring below T10 level of anaesthesia. However in this study the mean population age was in a range of 68 - 73 years, so the minimum dose of local anaesthetic in other age groups require further research in clinical pharmacology for regional anaesthesia.

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