

Fixed dose vs height and weight adjusted dose of bupivacaine for caesarean section: A randomised controlled trial

Waqas Alam, Khan Muhammad Yaqub, Mobasher Ahmad Saeed

Abstract

Objective: To determine frequency of maternal hypotension during spinal anaesthesia for elective caesarean section by comparing fixed dose with height and weight-adjusted dose of hyperbaric 0.5% bupivacaine.

Method: This randomised controlled trial was carried out at Pakistan Naval Ship Shifa Hospital, Karachi, and comprised patients with singleton pregnancy who were randomly divided into two groups. After preloading with 10ml/kg of Ringers lactate, Group A received fixed dose of 10mg of 0.5% hyperbaric bupivacaine, while Group B received dose according to height and weight using Harten's dose chart. Patients were made supine with wedge placed below the right hip. Variation in blood pressure was recorded and hypotension was treated with phenylephrine. Data was analysed with SPSS 16.

Results: There were 80 subjects divided into groups of 40(50%) each. Hypotension occurred in 20(50%) subjects in group A and in 15(37.5%) patients in group B ($p>0.05$). Median dose of 0.5% bupivacaine in group B was 9(IQR=0.5)mg and minimum dose was 8mg. Additional analgesia with ketamine was given to 2(5%) patients in group A and 3(7.5%) patients in group B.

Conclusion: Fixed dose of 10mg of hyperbaric 0.5% bupivacaine had similar results to height and weight-adjusted dose of bupivacaine in spinal anaesthesia for caesarean section.

Keywords: Spinal anaesthesia, Height and weight, Adjusted dose, Hypotension, Caesarean section. (JPMA 68: 1345; 2018)

Introduction

Spinal anaesthesia is preferred for caesarean section (CS) because of less risk of foetal complications, maternal gastric aspiration and failed intubation.¹ During spinal anaesthesia subarachnoid local anaesthetic injection blocks nerves supplying corresponding structures and dermatomes of body.² CS pain is of somatic origin due to surgical incision and visceral origin due to exteriorisation of uterus and is transmitted through thoracolumbosacral spinal segments, 4th thoracic vertebra to 5th sacral spine segment (T4-S5).³ So a minimal sensory block level up to T4 is required for CS to avoid patient discomfort.¹ Autonomic block level is few segments higher than sensory block and is associated with maternal hypotension.

Height of block level is difficult to predict and it depends upon position of patient, site and speed of injection and properties of anaesthetic agent such as baricity, volume and dose. In obstetric patients, increased intra-abdominal pressure results in more cephalad spread of local anaesthetic drug, thus causing higher incidence of complications such as hypotension.^{4,5} A number of strategies for preventing

hypotension have been used, including lateral uterine displacement, intravenous (IV) fluid preload, gravity (Trendelenburg or leg raising), compression devices on the legs, and prophylactic vasopressors.⁶⁻⁸ Reducing dose of anaesthetic agent in these patients results in block level reduction and consequently less hypotension. At the end more maternal satisfaction is achieved.⁹

Hyperbaric bupivacaine is routinely used. Studies are available which compared different doses of bupivacaine. The low effective dose of hyperbaric bupivacaine is found to be 7.53 mg.¹⁰ However, in these studies same doses were used for patients of different heights and weights. Internationally, very few studies are available which compared doses according to heights and weights. In one such study, hypotension occurred in 64% females in fixed dose group compared to 30% in height and weight-adjusted group.¹¹

In our setup hyperbaric 0.75% bupivacaine and 0.5% bupivacaine is used but 0.5% hyperbaric bupivacaine is categorised to be superior. In one study, individuals who received ephedrine for hypotension after spinal anaesthesia were 17 out of 30 in 0.75% group compared with 9 out of 30 in 0.5% group ($p=0.0345$). Our study compared different doses of this concentration to find more effectiveness of this drug.

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PNS Shifa Hospital Karachi.

Correspondence: Waqas Alam. Email: waqacalam@gmail.com

Our female population has different heights and weights compared to Nepalese and Caucasian females. The current study was planned to find out whether adjusting dose of hyperbaric 0.5% bupivacaine according to heights and weights of our female population gives more haemodynamic stability or not.

Subjects and Method

This randomised controlled trial was carried out at the department of anaesthesiology and intensive care at the Pakistan Naval Ship (PNS) Shifa Hospital, Karachi, from December 2015 to June 2016 after permission from the institutional ethics committee.

Sample size was calculated with the help of Sample Size software version 2.0 (hypothesis testing two sample proportions-one sided test) on the basis of an earlier study.¹¹ Power was kept at 90% and significance level at 5%. Consecutive type of non-probability sampling technique was used.

Patients with American Society of Anaesthesiologists (ASA) physical status 1, age 20-40 years, weight 50-110kg, height 140-180cms, full term uncomplicated singleton gestation and undergoing CS were included in the study.

Those with pre-existing hypertension, pregnancy-induced hypertension (PIH), gestational or pre-existing diabetes, cardio-respiratory problems, any contraindication to spinal anaesthesia or patients unwilling to participate were excluded.

After taking written informed consent, the subjects were divided randomly into two equal groups, using codes placed in sealed and sequentially numbered

envelopes. Group A received fixed dose of 10mg which is routinely used,¹² while Group B received height and weight-adjusted dose. Harten's dose chart¹¹ was used for calculating dose and volume of drug (Table-1).

All patients were evaluated one night before surgery for the inclusion-exclusion criteria, for getting written informed consent from the ones included and their height and weight measurements. On the day of the surgery, premedication with IV metoclopramide 10mg and dexamethasone 8mg injections were given. After placing the wedge below the right hip, baseline blood pressure was noted 20 minutes before intrathecal injection.

Preloading was done with 10ml/kg Ringer's lactate through 18-G IV cannula over 15 minutes and the same solution was used as maintenance fluid during the surgery. Under aseptic technique 1ml of local anaesthetic, 2% plain lidocaine was infiltrated in 3rd and 4th lumbar spine disc (L3-L4) space. Intrathecal injection was given by using 25-GQuincke spinal needle after ascertaining free clear flow of cerebrospinal fluid (CSF). Patients were placed immediately in head-down position. Oxygen was administered through Hudson face mask when saturation dropped below 94%.

Surgery was allowed when sensory block level of T4 was achieved. When patient felt discomfort during the surgery, rescue dose of 0.25 mg/kg ketamine was given. In case spinal block failed completely, general anaesthesia or re-injection was given and the patient was excluded from the study.

Systolic blood pressure was measured one minute after

Table-1: Height and Weight adjusted 0.5% Bupivacaine Dosing Regimen.

| Weight (kg) | Height (cm) | | | | | | | | |
|-------------|-------------|-----|-----|-----|-----|-----|-----|-----|-----|
| | 140 | 145 | 150 | 155 | 160 | 165 | 170 | 175 | 180 |
| 50 | 1.5 | 1.7 | 1.8 | 1.9 | | | | | |
| 55 | 1.5 | 1.6 | 1.8 | 1.9 | 2.0 | | | | |
| 60 | 1.4 | 1.6 | 1.7 | 1.8 | 1.0 | 2.1 | | | |
| 65 | 1.4 | 1.5 | 1.7 | 1.8 | 1.9 | 2.0 | 2.2 | | |
| 70 | 1.3 | 1.5 | 1.6 | 1.8 | 1.9 | 2.0 | 2.2 | 2.3 | |
| 75 | | 1.4 | 1.6 | 1.7 | 1.9 | 2.0 | 2.1 | 2.3 | 2.4 |
| 80 | | 1.4 | 1.5 | 1.7 | 1.8 | 2.0 | 2.1 | 2.2 | 2.4 |
| 85 | | | 1.5 | 1.6 | 1.8 | 1.9 | 2.1 | 2.2 | 2.3 |
| 90 | | | 1.4 | 1.6 | 1.7 | 1.9 | 2.0 | 2.2 | 2.3 |
| 95 | | | | 1.5 | 1.7 | 1.8 | 2.0 | 2.1 | 2.3 |
| 100 | | | | 1.5 | 1.7 | 1.8 | 1.9 | 2.1 | 2.2 |
| 105 | | | | | 1.6 | 1.7 | 1.9 | 2.0 | 2.2 |
| 110 | | | | | | 1.7 | 1.8 | 2.0 | 2.2 |

Values are in millilitres.

the spinal injection and then at 10 minutes, 15 minutes, 30 minutes and at the end of the surgery. At any time between intrathecal injection and the end of surgery, if the systolic blood pressure fell below 100mmHg or 20% below the baseline value, it was considered as hypotension.¹³

In terms of mean arterial pressure (MAP), hypotension was considered when MAP was less than 65mmHg or 20% decrease from baseline MAP at any time during the surgery. Readings of MAP were noted along with systolic blood pressure at the same time intervals. Whenever hypotension occurred, it was treated with 0.1mg phenylephrine.

To control bias, data was recorded by the anaesthetist or his assistant who was unaware of the dose group of patients.

Data was analysed using SPSS 16. Descriptive statistics were calculated for both quantitative and qualitative variables. Mean and standard deviation were calculated for quantitative variables like age, height and weight. Frequencies and percentages were calculated for variables like episodes of hypotension. Chi square test was used to compare hypotension between the groups. $P < 0.05$ was considered statistically significant.

Results

There were 80 females divided into groups A and B of 40(50%) each. Overall mean age was 27.76 ± 4.33 years. In group A, the mean age was 27.4 ± 3.99 years (range: 20-35 years) and the median age was 26.5(IQR=6.0) years. In group B, the mean age was 28.12 ± 4.67 years (range: 21-39 years) and the median age was 27.5(IQR=6.75) years ($p > 0.05$).

Table-2: Comparison of hypotension with respect to Systolic Blood Pressure.

| Variable | Fixed Dose Group(n=40) | Adjusted Dose Group(n=40) | P-Value |
|---|------------------------|---------------------------|---------|
| Baseline systolic BP (mm Hg) | 124.35 ± 8.67 | 126.9 ± 8.03 | 0.17 |
| Lowest systolic BP at any time during procedure(mmHg) | 98.97 ± 11.16 | 102.0 ± 12.1 | 0.239 |
| Hypotension | 20 (50%) | 15(37.5%) | 0.260 |

BP: Blood pressure.

Table-3: Comparison of hypotension with respect to Mean arterial pressure.

| Variable | Fixed Dose Group(n=40) | Adjusted Dose Group(n=40) | P-Value |
|---|------------------------|---------------------------|---------|
| Lowest MAP at any time during surgery(mmHg) | 69.27 ± 9.43 | 70.37 ± 8.83 | 0.592 |
| Hypotension | 10(25%) | 9(22.5%) | 0.793 |

MAP: Mean arterial pressure.

Overall mean height was 158.18 ± 4.49 cm. In group A, the mean height was 157.85 ± 4.59 cm (range: 148-168 cm) and the median height was 158.5 cm. In Group B, the mean height was 158.52 ± 4.42 cm (range: 150-166 cm) and the median height was 159 cm ($p > 0.05$).

Overall mean weight was 72.25 ± 4.33 kg. In group A, the mean weight was 71.05 ± 10.06 kg (range: 51-100 kg) and the median weight was 70 kg. In group B, the mean weight was 73.45 ± 6.3 kg (range: 60-83 kg) and the median weight was 72.5 kg ($p > 0.05$).

Mean dose and volume used in group B was 9.21 ± 0.52 mg and 1.84 ± 0.105 ml respectively. The minimum dose of 0.5% hyperbaric bupivacaine used was 8mg (1.6 ml) and it was used in 1(2.5%) patient. Seven (17.5%) patients in group B received 8.5mg (1.7ml), 13(32.5%) received 9mg (1.8ml), 12(30%) received 9.5mg (1.9ml) and 7(17.5%) patients received 10mg (2.0ml). The calculated median dose was 9(IQR=0.5)mg (1.8 ml) in group B.

The incidence of hypotension was not significantly higher in group B than in the AD Group B ($p = 0.26$) (Table-2).

Hypotension calculated with respect to drop in MAP was also not statistically significant ($p > 0.05$) (Table-3).

None of the patients required general anaesthesia or re-injection in the subarachnoid space due to inadequate spinal block. However, 2(5%) patients in group A and 3(7.5%) in group B required ketamine due to discomfort during uterine manipulation.

Discussion

Spinal anaesthesia is the preferred technique for CS because lesser drugs used, no airway manipulation, lower risk of aspiration pneumonitis, lesser foetal adverse

effects and better mother satisfaction. However, this technique is frequently associated with hypotension which can cause nausea, vomiting and depressed foetoplacental circulation.

Multiple strategies have been used to prevent hypotension episodes such as preloading, co-loading, prophylactic vasopressors, changing baricity and reducing dosage but none of these is acceptable as the single best technique to avoid maternal hypotension.

At present in our setup, fixed dose of bupivacaine is used for CS. It is observed that the dose for spinal anaesthesia is directly proportional to height, and inversely proportional to weight. Pregnant women have increased weight and smaller amount of CSF so they require lesser dose of spinal anaesthetic compared to non-pregnant females.¹⁴ We also used height and weight-adjusted dose of bupivacaine in our study and compared it with fixed dose group. Our results showed that episodes of hypotension were reduced when adjusted dose (AD) was used compared to the fixed dose (FD). But when both groups were compared, reduction in hypotension episodes was statistically non-significant.

Few studies have been conducted with adjusted dose of hyperbaric bupivacaine previously but our results are in contrast to those. A study¹⁵ included 84 patients and hypotension episodes were 71.7% in FD group and 50% in AD group ($p < 0.05$). The lowest dose and median dose of 0.5% hyperbaric bupivacaine used in AD group were 8.0mg (1.6ml) and 9.5 mg(1.9 ml) respectively. The AD group values are comparable to our results, but the FD group received higher dose (12mg) of hyperbaric 0.5% bupivacaine than the FD group in our study which received 10mg. And this may be the cause of difference in our results.

A similar study¹¹ showed significant reduction in maternal hypotension in AD group. The median dose in AD group was 9 mg which is similar to our study. But again it used 11mg of hyperbaric 0.5% bupivacaine in the FD group which is higher than our FD group and may be the reason of difference in results.

Recently a study compared height and weight-adjusted dose with height-adjusted dose. Hypotension was significantly more frequent with dosage based on height alone compared to height and weight-adjusted dose ($p = 0.018$). The study had added 25µg fentanyl with bupivacaine in both groups.¹⁶

Minimum effective dose calculated for CS is 9.0mg^{17,18} which is similar to median dose calculated in our study

and the other ones^{5,11,16} even though they used higher doses of bupivacaine for FD groups compared to our study. Another study should be conducted in which this minimum effective dose should be compared to height and weight-adjusted dose. And then significance of results should be assessed. This height and weight adjustment is studied with 0.5% bupivacaine only while in many of our setups 0.75% hyperbaric bupivacaine is used routinely. So this concentration should also be studied.

Conclusion

Although there were lesser episodes of hypotension when height and weight adjusted-dose was used for spinal anaesthesia compared to the fixed dose, these results were statistically non-significant.

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