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Original Research Article

Comparative Analysis of Conventional Dose to Low Dose of Hyperbaric Bupivacaine for Spinal Anaesthesia in Elective Caesarean Section

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Abstract:

Background and Aim: Various local anesthetics, such as bupivacaine, chloroprocaine, levobupivacaine, lidocaine, ropivacaine, and tetracaine, are commonly used in combination with opioids like morphine or fentanyl, or their derivatives, for caesarean sections. In order to assess the effectiveness of two varying doses of 0.5% hyperbaric bupivacaine (7.5mg and 10mg), this study was carried out on women who were undergoing caesarean section.

Material and Methods: We conducted research at a prestigious teaching institute in India. Over the course of one year, we enrolled 100 patients who were scheduled for elective caesarean section. These patients had an American Society of Anaesthesiologists (ASA) physical status of I or II. Monitoring of haemodynamic parameters during the spinal anaesthetic included heart rate, non-invasive blood pressure, ECG, mean arterial pressure (MAP), and SpO2. The recorded data included the sensory and motor onset time, as well as the time to regression.

Results: The results show that the age, BMI, and ASA grades were similar between the two groups of patients. Group B patients exhibited a notable increase in pulse rate following the spinal procedure, while experiencing a significant decrease in pulse rate at various time intervals (6, 8, 10, 16, 19, 25, 30, 35, 40, 45, and 60 minutes) compared to Group A ($P \leq 0.05$). Patients in Group B experienced a notable increase in systolic blood pressure after receiving a spinal procedure, with significant elevations observed at 2, 4, 6, 35, and 50 minutes. Patients in group B required a longer duration to achieve maximum motor and sensory block compared to those in group A.

Conclusion: The study found that using a lower dose (7.5mg) of Bupivacaine instead of the conventional dose (10mg) resulted in improved hemodynamic stability. This was evidenced by a decrease in falls in blood pressure, pulse rate, and mean arterial pressure, as well as a significant reduction in the incidence of intraoperative hypotension.

Keywords: Bupivacaine, Caesarean Section, Sensory Block, Spinal Anaesthesia.

Introduction

General anaesthesia is no longer recommended for caesarean sections due to the significant risks it poses to the mother's health and well-being. Spinal anaesthesia has emerged as the safest technique for caesarean section over the past two decades. Spinal anaesthesia is often chosen over epidural anaesthesia because it is easier to perform, takes effect quickly, provides effective pain relief, and has a low failure rate. However, spinal anaesthesia does come with the risk of systemic toxicity, which is a significant complication. One of the most common systemic complications is maternal hypotension, which has a high incidence rate. [1-3] Spinal anaesthesia is a well-established technique

for caesarean section and is commonly used for both planned and unplanned/emergency procedures. It is widely utilized in both developed and developing countries, including ours. One option is the use of epidural or spinal anaesthesia, which allows patients to remain conscious during surgery. [4]

Spinal anaesthesia is often preferred over epidural anaesthesia for caesarean procedures, both elective and emergency, due to its ease of administration, reduced systemic toxicity, and faster onset of action. While it is generally considered safe and effective, there are some potential side effects, with hypotension and bradycardia being the most common. Spinal-induced hypotension is a significant side effect, with reported incidences ranging from 20 to 100%. In caesarean sections, the drugs used for spinal anaesthesia primarily consist of local anesthetics from the amide or ester class. Commonly used local anaesthetics for caesarean sections include bupivacaine, chloroprocaine, levobupivacaine, lidocaine, ropivacaine, and tetracaine. These are often combined with opioids such as morphine or fentanyl and its derivatives. [6-8]

Bupivacaine is an amide anesthetic that is typically given in concentrations of 0.5-0.75% at a dosage of 10-15mg. [9] the onset of action is relatively slow, lasting approximately 5-10 minutes. It is worth noting that the incidence of hypotension is low, likely due to its dependence on baricity. It can also be achieved in a hyperbaric solution with a concentration of 7.5%. Due to its extended duration of action and superior motor block quality compared to tetracaine, it is widely utilized. [10-12] According to various clinical studies, it has been found that transient neurologic symptoms (TNS) are extremely rare when using spinal bupivacaine. Lui SS et al [13] also discovered that small doses of spinal bupivacaine can be used effectively for ambulatory anaesthesia, as shown by dose-response data on clinical anaesthetic characteristics. It is important to choose smaller doses of bupivacaine (≤10mg) to prevent prolonged detrusor block, difficulty in urination, and longer discharge time compared to equivalent doses of lidocaine. [14]

One drawback of spinal anaesthesia is the limited ability to adjust the block height if it is deemed insufficient or if the surgery takes longer than expected. Ensuring proper preoperative block is crucial to avoid patient discomfort, the need for general anaesthesia, and potential legal consequences. [15-17] Higher doses in the range of 2.0 to 3.0 ml were previously used for caesarean delivery, but these large doses of intrathecal bupivacaine can cause severe hypotension and delayed recovery of motor block. On the other hand, low dose spinal anaesthesia has the potential to promote faster recovery through early mobilization and reduced postoperative nausea and vomiting (PONV). Both play crucial roles in the enhanced recovery after surgery (ERAS) protocol for caesarean delivery. ERAS initiatives strive to enhance various aspects of patient care in order to enhance recovery and enable earlier discharge, all while maintaining patient satisfaction and the quality of care. There is a lack of research on the use of low dose spinal anaesthesia in ERAS, as it has not been extensively studied.

In order to assess the effectiveness of two different doses of 0.5% hyperbaric bupivacaine (7.5mg and 10mg), a study was conducted on women undergoing caesarean section.

Material and Methods

The study took place in the Department of Anesthesiology at a Tertiary Care Teaching Institute in India over the course of one year. It involved 100 patients who were members of the American Society of Anesthesiologists (ASA) and had a physical status of either I or II. These patients were scheduled to undergo elective caesarean section and were included in the study.

The study involved patients with ASA grade I & II who were undergoing elective C-section and had a BMI of 18-24 kg/m2. The study did not include patients with Sepsis at the site of injection or any pre-existing systemic diseases, spine deformities, or a history of laminectomy. It also excluded patients with intrauterine growth restriction, those in labour or with twin pregnancies, and those showing signs of foetal distress or any other obstetric complication.

According to a study conducted by Mebazaa MS et al [18], it was determined that 50 patients were needed in each group, with a significance level of $\alpha = 0.05$ and a power of $\beta = 0.20$. We enrolled 50 patients in each group and they were randomly divided into two groups.

This study was conducted using a rigorous methodology to ensure unbiased and reliable results. Two groups of patients undergoing elective caesarean sections were given different doses of Hyperbaric Bupivacaine (7.5mg and 10mg).

All the necessary information, including demographic data, personal history, examination details, and findings, were carefully documented in the study proforma. Patients were given Spinal anaesthesia while in a sitting position, using a 25G Quincke spinal needle in either the L3-L4 or L4-L5 interspace. Prior to the procedure, the skin was numbed with 2 ml of 2% lignocaine. After observing the smooth movement and flow of Cerebrospinal Fluid, the medical professional administered Injection Bupivacaine 0.5% into the subarachnoid space. The normal dose of Injection

Bupivacaine 0.5% heavy 10mg (2ml) was administered in group A. A low dose of Injection Bupivacaine 0.5% heavy 7.5mg (1.5ml) was administered in group B. We recorded the highest level of sensory block and the time it took to reach that level. The modified Bromage scale was used to assess motor blockade. The time it took for the sensory or motor blockade to take effect was determined by measuring the interval between the intrathecal administration and the point at which the maximum block height or a modified Bromage score of 3 was reached. The surgical incision was made once sufficient paraesthesia was achieved.

The hemodynamic parameters during the spinal anesthetic were closely monitored and carefully maintained within 80-120% of their baseline values. This ensured the stability of vital signs such as heart rate, non-invasive blood pressure, ECG, mean arterial pressure (MAP), and oxygen saturation (SpO2) throughout the surgery. The haemodynamic parameters were recorded right after the administration of spinal anaesthesia. They were then recorded every 2 minutes for the first 10 minutes, every 3 minutes for the next 30 minutes, and every 5 minutes until the surgery was completed.

Statistical analysis

The data was compiled and entered into a spreadsheet computer programme (Microsoft Excel 2007) and then exported to the data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA). Quantitative variables were reported using measures such as means and standard deviations or median and interquartile range, depending on their distribution.

The qualitative variables were displayed as counts and percentages. Confidence level and level of significance were set at 95% and 5% respectively for all tests.

Results

The age, BMI, and ASA of the two groups were compared, and it was found that the patients in both groups had similar average age, BMI, and ASA grades (P>0.05). Here is Table 1:

The average pre-operative pulse rate was similar between the two groups (81.70 vs 83.65, P≤0.5). Group B patients showed a notable increase in pulse rate after the spinal procedure, followed by a significant decrease at various time intervals (6, 8, 10, 16, 19, 25, 30, 35, 40, 45, and 60 minutes) compared to Group A (P≤0.05). The pre-operative systolic blood pressure was similar between the two groups (121.56 vs 121.81, P>0.05). Group B patients exhibited significantly higher systolic blood pressure (SBP) levels compared to Group A patients at multiple time points post-spinal anaesthesia administration (2, 4, 6, 35, and 50 minutes; P≤0.05). The pre-operative diastolic blood pressure was similar in both groups, with no significant difference observed (79.26 vs 80.74, P>0.05). Group B patients exhibited significantly higher diastolic blood pressure (DBP) levels compared to Group A patients at multiple time points post-spinal anaesthesia, including 2, 4, and 6 minutes (P≤0.05). In both groups, the mean pre-operative MAP was similar (93.40 vs 94.09, P>0.05). However, patients in Group B had significantly higher MAP levels postspinal at 2, 4, and 6 minutes compared to Group A (P≤0.05).

Patients in group B took a significantly longer time to reach maximum motor block compared to group A (7.7 vs 5.10 minutes, P≤0.05). The dosage administered to both groups was similar (Table 2).

The APGAR scores of Group A and B were similar at both 1 minute and 5 minutes. The neonatal APGAR scores at 1 minute and 5 minutes did not show any notable variation when different doses of Bupivacaine were administered.

Table 1: Comparison of demographic characteristics between groups

Demographic characteristic	**Group**		Total
	A (n=50)	**B (n=50)**	
Age distribution (years)			
20-25	37 (74 %)	28 (56 %)	0.1
26-30	13 (26 %)	22 (44 %)	
Body mass index (kg/m2)			
Mean±SD	21.67±1.68	22.49±1.20	0.09
ASA			
1	36 (72%)	35 (70 %)	0.32
2	12 (24 %)	15 (30 %)	
3	2 (4 %)	0	

Statistically significance at p≤0.05

Table 2: Comparison of motor and sensory block between groups

Variables	Group A (n=40)	Group B (n=40)	P value
	Mean±SD	Mean±SD	
Motor Block			
Time max block (mins)	5.10±0.6	7.7±1.2	**0.01***
Duration of block (mins)	133.65±12.4	96.98±7.10	
Sensory Block			
Max block (mins)	4.48±0.32	6.75±1.03	**0.002***
Regression (mins)	114.85±8.23	67.2±2.36	

* indicate statistically significance at p≤0.05

Discussion

Spinal anaesthesia is a technique used to block nerves by injecting a local anesthetic agent into the subarachnoid space. This helps to numb specific areas of the body. Regional anaesthesia has a significant advantage when it comes to blocking sensations locally, which helps to preserve the overall hemodynamics of the body. [19,20] In developed countries, over 90% of caesarean sections are performed using regional anaesthesia. Specifically, spinal anaesthesia is commonly used for elective caesarean sections, while it is used in over 80% of cases for emergencies.

The two groups in our study had similar age, BMI, ASA grade, and Hb levels. Group B patients had similar mean age, mean BMI, Hb%, and ASA grades compared to Group A (P>0.05). In other studies, there were no notable differences in the demographic variables between the groups. [21,22] For example, Cenkowski et al [23] found that the average age in the conventional dose group was 31±3, while in the low dose group it was 32±6. Similarly, Venkata et al [24] observed that their study group had patients with similar mean age, weight, height, and ASA status (I/II vs I/II) (P>0.05).

The cardiovascular effects of spinal anaesthesia involve a decrease in arterial blood pressure and central venous pressure (CVP), accompanied by only a slight decrease in heart rate, stroke volume, or cardiac output. The mean pre-operative systolic blood pressure was similar between the two groups in the current study. Following the administration of the dose, patients in Group A experienced a notable decrease in systolic blood pressure at various time intervals compared to Group B (P≤0.05). Additionally, the occurrence of low blood pressure was significantly higher in Group A compared to Group B.

The average pre-operative diastolic blood pressure was similar between the two groups in our study. Following the administration, the conventional dose of 10mg showed a notable decrease in DBP at post-spinal, 2, 4, and 6 minutes. Our research indicates that reducing the dose to 7.5mg effectively prevents the Diastolic fall during the post-spinal period. In the study conducted by Venkata et al. [24], the average pre-operative diastolic blood pressure (DBP) was found to be comparable between the control group and the study group. In the control group, there was a notable decrease in DBP after 3 minutes and 5 minutes of spinal anaesthesia. Other studies by Seyedhejazi et al [25] and Bogra et al [26] have also reported similar findings.

According to our study, patients in the low-dose group experienced a significant increase in pulse rate after spinal treatment. However, their pulse rate was significantly lower at various time intervals, including 6, 8, 10, 16, 19, 25, 30, 35, 40, 45, and 60 minutes.

Previous studies by Kiran et al. [27] and Bogra J et al [26] have also reported similar findings. They found that the incidence of Bradycardia, after administration of anaesthesia, was comparable among different groups. Bradycardia occurs when sympathetic cardio accelerator fibres are blocked and there is a decrease in venous return to the heart.

During a caesarean section, hypotension is a common issue that can cause maternal nausea and vomiting, as well as pose a risk to the foetus and newborn with the potential for acidosis. Considering a combination of vasopressors, colloid preloading, and low dose CSE may be the most effective approach. Hypotension is typically defined by systolic blood pressures below 85-90mm Hg or a decrease of over 25%-30% from the preanesthetic value.

During spinal anaesthesia for caesarean section, it is worth noting that the occurrence of hypotension can be quite high, reaching rates of 70-80% when using conventional local anesthetic doses. According to the latest study, patients in the lower dose group experienced a significantly lower occurrence of intra-operative hypotension. When sympathetic block occurs, it can lead to a decrease in peripheral vascular resistance (PVR), venous return (VR), and cardiac output.

In cases of extensive blocks, bradycardia may occur as a result of low VR. In the third trimester, aortocaval compression can lead to hypotension due to the mechanical effects of the pregnant uterus, particularly when in a supine position. Pregnant mothers may experience an autonomic

imbalance that can lead to an increased risk of hypotension during SAB due to relative sympathetic hyperactivity. It's important to remember that these patients sometimes have to go through extended periods of fasting.

Group B patients exhibited a longer time to reach maximum sensory block and experienced a shorter duration of sensory regression, according to the study findings. In a different study conducted by Kiran et al [27], it was found that there was no significant difference in the time to maximum sensory blockade among the groups. In the high-dose group, there was a longer duration before the regression of sensory block began.

In the 7.mg group, the time required for the sensory block to fully regress was longer. In a study conducted by Cenkowski et al [23], it was found that patients who received low-dose spinal anaesthesia experienced a significantly faster block onset time compared to those in the conventional-dose spinal group. The low-dose group had an average block onset time of 103 minutes, which was significantly faster ($P<0.01$). Additionally, these patients also recovered their sensory levels at a quicker rate.

According to our study, patients in Group B took longer to reach maximum motor block and experienced a shorter duration of motor block compared to those in Group A. In a study conducted by Kiran et al [27], they found that the time it took to reach maximum motor blockade was not different across different doses of bupivacaine.

However, they did observe a significant increase in the duration of motor blockade with higher doses of bupivacaine. In a study conducted by Mebazaa et al [18], it was found that patients in Group A took longer to recover from motor block compared to those in Group B. The regression of the block was also faster in Group B than in Group A. It has been suggested that this approach could lead to earlier mobilisation and a shorter length of stay in the post-anesthesia care unit.

The primary goal of the low dose spinal drug bupivacaine is to reduce any potential side-effects experienced by mothers, shorten their stay in the recovery room, and enhance overall maternal satisfaction. However, implementing such a strategy may have negative effects on the effectiveness of anaesthesia. This could lead to the need for additional pain relief, which could have potential consequences for newborns.

In some cases, it may even be necessary to switch to general anaesthesia, which is known to increase the risk of complications for mothers. In a previous study [28], it was found that using a low dose of bupivacaine may not provide sufficient pain relief, with patients experiencing pain at around 71%.

As a result, adjuvants were used alongside the local anaesthetic to enhance the analgesic effect. It's important to note that this aspect was not included in our study, which is a limitation that could be addressed in future research. Nevertheless, the inclusion of opoids drugs and clonidine 75µg alongside bupivacaine proved to be effective in providing sufficient anaesthesia and postoperative pain relief. However, it is important to note that these medications can lead to certain side effects. For instance, clonidine may cause increased sedation during the perioperative period and result in a longer recovery time for motor block. It was observed that pruritus occurred when opioids were used.

The study findings may not be applicable to a larger population due to the small sample size. Considering that the study was conducted in a single institute, it is important to exercise caution when extrapolating the results to the broader population.

Conclusion

When comparing the effects of different doses of Bupivacaine, it has been observed that a lower dose of 7.5mg results in improved hemodynamic stability. This is evident through a decrease in falls in blood pressure, pulse rate, and mean arterial pressure, as well as a significant reduction in the occurrence of intraoperative hypotension. On the other hand, the standard dose of 10mg resulted in a quicker onset and longer duration of sensory block, as well as a prolonged motor block.

References

1. McDonald S, Fernando R, Ashpole K, Columb M. Maternal cardiac output changes after crystalloid or colloid coload following spinal anesthesia for elective cesarean delivery: A randomized controlled trial. Anesth Analg 2011; 113(4): 803-10.
2. D'Ambrosio A, Spadaro S, Mirabella L, Natale C, Cotoia A, DeCapraris A. The anaesthetic and recovery profile of two concentrations (0.25% and 0.50%), of intrathecal isobaric levo bupivacaine for combined spinal-epidural (CSE) anesthesia in patients undergoing modified Stark method caesarean delivery: a double blinded randomized trial. Eur Rev Med Pharmacol Sci 2013; 17(23): 3229-36.
3. Bhardwaj N, Jain K, Arora S, Bharti N. A comparison of three vasopressors for tight control of maternal blood pressure during cesarean section under spinal anesthesia: effect on maternal and fetal outcome. J Anaesthesiol Clin Pharmacol 2013; 29(1): 26-31.
4. Jenkins JG, Khan MM. Anesthesia for Caesarean section: a survey in a UK region from 1992 to 2002. Anesthesia. 2003; 58(11):1114-18.

5. Chooi C, Cox JJ, Lumb RS, Middleton P, Chemali M, Emmett RS et al. Techniques for preventing hypotension during spinal anaesthesia for caesarean section. Cochrane Database Syst Rev. 2017; 8:CD002251.
6. Ngan Kee WD, Khaw KS, Lee BB. A dose–response study of prophylactic intravenous ephedrine for the prevention of hypotension during spinal anesthesia for cesarean delivery. Anesth Analg 2000; 90:1390-95.
7. Becker DE, Reed KL. Essentials of local anesthetic pharmacology. Anesthesia Prog. 2006; 53(3):98- 109.
8. Gogarten W. Spinal anesthesia for obstetrics. Best Prac Res Clin Anaesthesiol. 2003; 17(3):377- 92.
9. Rollins M, Lucero J. Overview of anesthetic considerations for cesarean delivery. Br Med Bulletin. 2012; 101:105- 25.
10. Sng BL, Han NLR, Leong WL et al. Hyperbaric vs. isobaric bupivacaine for spinal anaesthesia for elective caesarean section: a Cochrane systematic review. Anaesthesia. 2018; 73(4):499-511.
11. Bano F, Sabbar S, Zafar S, Rafeeq N, Iqbal MN, Haider S et al. Intrathecal fentanyl as adjunct to hyperbaric bupivacaine in spinal anesthesia for caesarean section J Coll Physicians Surg Pak. 2006; 16(2):87-90.
12. Atalay C, Aksoy M, Aksoy AN, Dogan N, Kürsad H. Combining intrathecal bupivacaine and meperidine during caesarean section to prevent spinal anesthesia- induced hypotension and other side- effects. J Int Med Res. 2010; 38(5):1626- 36.
13. Liu SS, Ware PD, Allen HW, Neal JM, Pollock JE. Dose-response characteristics of spinal bupivacaine in volunteers: Clinical implications for ambulatory anesthesia. Anesthesiology. 1996; 85:729-36.
14. Kamphuis ET, Ionescu TI, Kuipers PW, De Gier J, van Venrooij GE, Boon TA. Recovery of storage and emptying functions of the urinary bladder after spinal anesthesia with lidocaine and with bupivacaine in men. Anesthesiology. 1998; 88:310-6.
15. Yeoh SB, Leong SB, Heng AS. Anesthesia for lowersegment caesarean section: Changing perspectives. Indian J Anesth. 2010; 54(5):409-14.
16. Qiu MT, Lin FQ, Fu SK, Zhang HB, Li HH, Zhang LM, et al. Combination of low-dose bupivacaine and opioids provides satisfactory analgesia with less intraoperative hypotension for spinal anesthesia in cesarean section. CNS Neurosci Ther. 2012; 18(5):426–32.
17. Ituk U, Habib AS. Enhanced recovery after cesarean delivery. F1000Res. 2018; 7. doi: 10.12688/f1000research.13895.1
18. Mebazaa MS, Ouerghi S, Ben Meftah R, Ben Cheikh M, Mestiri T, Ben Ammar MS. Reduction of bupivacaine dose in spinal anesthesia for caesarean section may improve maternal satisfaction by reducing incidence of low blood pressure episodes Middle East J Anaesthesiol. 2010; 20(5):673-8.
19. Ben-David B, Miller G, Gavriel R, Gurevitch A. Low-dose bupivacaine-fentanyl spinal anesthesia for cesarean delivery. Reg Anesth Pain Med 2000; 25(3): 235–9.
20. NganKWD. Confidential enquiries into maternal deaths: 50 years of closing the loop. Br J Anaesth 2005; 94(4): 413–6.
21. Hawkins JL, Koonin LM, Palmer SK, Gibbs CP. Anesthesiarelated deaths during obstetric delivery in the United States, 1979–1990. Anesthesiol 1997; 86(2): 277–84.
22. Zahir J, Hussain T, Qureshi QA, Rehman HR. Level of Block Achieved with 1.6ml of 0.75% Bupivacaine along with the Hemodynamic Variations after Spinal Anesthesia: A Prospective Study among Pakistani Women undergoing Elective Caesarean Sections. Ann Pak Inst Med Sci 2013; 9(2): 88-90.
23. Cenkowski MJ, Maguire D, Kowalski S, Al Gurashi FA, Funk D. Hemodynamic effects of low-dose bupivacaine spinal anesthesia for cesarean section: A randomized controlled trial. Saudi J Anaesth. 2019; 13(3):208-14.
24. Venkata HG, Pasupuleti S, Pabba UG, Porika S, Talari G. A randomized controlled prospective study comparing a low dose bupivacaine and fentanyl mixture to a conventional dose of hyperbaric bupivacaine for cesarean section. Saudi J Anaesth. 2015; 9:122-7.
25. Seyedhejazi M, Madarek E. Effect of small dose bupivaciane-fentanyl in spinal anesthesia on hemodynamic nausea and vomiting in caesarean section. Pak J Med Sci. 2007; 23:747-50.
26. Bogra J, Arora N, Srivastava P. Synergistic effect of intrathecal fentanyl and bupivacaine in spinal anesthesia for cesarean section. BMC Anesthesiology. 2005; 5(1):5.
27. Kiran S, Singal NK. A comparative study of three different doses of 0.5% hyperbaric bupivacaine for spinal anesthesia in elective caesarean section. Int J Obstet Anesth. 2002; 11(3):185-9.
28. Dyer RA, Joubert I. A Low-dose spinal anaesthesia for Caesarean section. Curr Opin Anaesthesiol 2004; 17(4): 301-8.