



COMPARISON OF BOLUS EPHEDRINE AND PHENYLEPHRINE FOR PREVENTION OF HYPOTENSION DURING SPINAL ANAESTHESIA IN CAESAREAN SECTION

Anesthesiology

Dr. Mahipal Singh Assistant Professor; Dept. of Anaesthesia, SMS Medical College, Jaipur - Corresponding Author

Dr. Manoj Soni Assistant Professor; Dept. of Anaesthesia, SMS Medical College, Jaipur

ABSTRACT

Background & Objectives: In the present study compared bolus ephedrine versus phenylephrine for prevention of hypotension during caesarean section under spinal anaesthesia.

Methods: This was a randomized double blinded study conducted in 100 ASA I and II patients aged 20- 35 years, randomly assigned in two groups (50 each).

Group E: Received I.V. bolus ephedrine 6mg in 1ml

Group P: Received I.V. bolus phenylephrine 100µg in 1ml

Perioperative hemodynamics and other parameters were noted.

Conclusion: We concluded that Phenylephrine was more effective than ephedrine in controlling the maternal arterial pressure with less episodes of hypotension without any significant complications.

KEYWORDS

Ephedrine, Phenylephrine, Hypotension, Spinal Anaesthesia

Introduction

Caesarean section has become a very common hospital based operative procedure accounting for more than 25% of all live births worldwide. Anaesthesia to a parturient is not only unique but requires highest degree of care in view of mother and fetus.¹ Studies have shown that infants born by caesarean section under spinal anaesthesia were in better condition than general anaesthesia. This advantage is extended into the first few hours of life. The most frequent immediate complication following spinal anaesthesia is fall in arterial blood pressure. Hypotension is a physiological effect of centroneuraxis block but it can become a serious complication when it crosses limits and is harmful to the patient. The maternal hypotension may have detrimental effects on both mother and fetus due to decrease in uteroplacental blood flow and maternal symptoms of low cardiac output such as nausea, vomiting, dizziness and decreased consciousness thus affecting maternal and fetal outcomes. Hypotension has been variously defined but definition of reduction in blood pressure of 30 mm Hg, or a reduction to less than 100 mm Hg or a reduction in arterial blood pressure of 20% below baseline pressure is more accepted (Wright and Snider, 1979).²

Hypotension is better prevented than treated. Efforts are still on to find the best alternative to minimize the hypotension induced by spinal anaesthesia. A variety of different strategies have been employed to reduce the incidence and severity of maternal hypotension and each has its own merits and demerits. Because of the poor efficacy of non-pharmacological techniques, a vasopressor is almost always required. However, there is controversy regarding both the choice of vasopressor and optimal method of administration. Many factors need to be considered for choosing an appropriate vasopressor in obstetrics like; efficacy, maternal and fetal effects, cost and availability. The actual drugs used vary according to local experience and availability. However, most commonly used drugs are ephedrine, mephentermine and phenylephrine.

An ideal vasopressor agent is one that can reverse the adverse physiological changes due to spinal anaesthesia without significant complications. There are limited reports comparing the effects of ephedrine, phenylephrine and mephentermine for maintaining maternal blood pressure during spinal anaesthesia. The present study was carried out to compare and evaluate the relative effectiveness as well as the efficacy and safety of intravenous bolus dose of ephedrine and phenylephrine for prevention of hypotension during spinal anaesthesia in caesarean section.

Methods

After obtaining approval from the ethical committee, the study was carried out in 100 patients of ASA grade I and II, of 20-35 years of age, weighing 50-80 kg, 150-180 cm height, and who had a normal singleton pregnancy beyond 36 weeks gestation, undergoing elective

as well as emergency caesarean section under spinal anaesthesia. All the patients were subjected to a detailed preanesthetic evaluation to rule out any major respiratory, cardiovascular, central nervous system, renal or metabolic disorders. Patients were inquired about history of past illness and drug therapy. Routine investigations were carried out during the evaluation. Patients with known allergy to used drugs, patients with fetal abnormalities or any clinically significant systemic illness and uncooperative patients or contraindicated to spinal anaesthesia were excluded from the study. Written informed consent was obtained from all patients. After recording baseline pulse rate, blood pressure, respiratory rate, SpO₂ a suitable vein was cannulated and intravenous fluid was given Ringer's lactate solution 10ml/kg I.V. rapidly as preload, and thereafter, maintenance and replacement was done with Ringer's lactate solution at a rate of 10ml/kg/hour during the operative procedure without adjustment, regardless of maternal haemodynamic changes.

All patients were premedicated in the form of atropine (0.3mg), ranitidine (50mg) and metoclopramide (5mg) were given I.M. 30-45 minutes before the operation.

All the patients were then randomized into two groups (each 50) by block method to receive;

Group E: Received I.V. bolus ephedrine 6mg in 1ml just after sub-arachnoid block

Group P: Received I.V. bolus phenylephrine 100µg in 1ml just after sub-arachnoid block

Under all aseptic conditions, Sub-arachnoid block was performed in left lateral decubitus position. Then immediately 6mg in 1ml of ephedrine was given I.V. bolus to the patient's in group E and 100µg in 1ml of phenylephrine was given I.V. bolus to the patient's in group P.

Clinically the following parameters were monitored and recorded;

1. HR, SBP, DBP, and RR were recorded at regular interval
2. Continuous SpO₂ and ECG monitoring
3. Level of sensory anaesthesia at 5 and 10 minutes after Sub-Arachnoid block
4. Duration of surgery (minutes).
5. Skin incision-delivery (SI-D) interval (minutes).
6. Uterine incision-delivery (UI-D) interval (minutes).
7. Intra-operative complications like nausea, vomiting, respiratory depression, hypotension, bradycardia, pruritis, urticaria, shivering was observed.
8. Total dose of vasopressor used prior to delivery was recorded.

Hypotension was defined as fall in systolic blood pressure more than 20% of basic value or systolic blood pressure less than 100 mmHg. When SBP was not maintained within the range 90-100% of baseline

value after three successive BP measurements, repeat I.V. bolus dose of rescue drug was given. Bradycardia (defined as HR <60 beat/min) was treated with bolus of I.V. atropine 0.6mg. Any nausea (reported by patients) or vomiting (observed by investigator) was treated with I.V. ondansetron 4mg.

Prospective analysis was based on the primary outcome of incidence, frequency and magnitude of hypotension, the incidence of reactive hypertension (defined for the analysis as an increase in SBP above baseline by more than 20%), the incidence of bradycardia, and the incidence of other complications.

Observations & Analysis

The relevant data were noted in the proforma and master chart prepared. Observed data compiled and analyzed statistically using student t-test or chi-square test. Data was expressed as the number of patients or mean $\pm$ SD or percentage. $p > 0.05$ was considered not significant, $p < 0.05$ was considered significant and $p < 0.01$ was highly significant. The significant observations were depicted in tables.

There was no significant difference in mean age, weight and height among patients in both groups. There was no significant difference in level of sensory anaesthesia, Duration of surgery, Skin incision-delivery (SI-D) interval and Uterine incision-delivery (UI-D) interval among in both group

Table 1 Comparison of Incidence & Frequency of hypotension between both group

Incidence (No. of Patients)	Group E	Group P	X2 value	DF	p Value
	24	9	10.176	1	0.001**
Frequency (No. of Patients)					
Single	21	7	10.56	2	0.005**
Twice	3	2			

(*p value<0.05=significant) (**p value<0.01=Highly significant)

Table 2 Comparison of total drug (Vasopressor in mg) Requirement between both group

Group	Number of Patients	Range(mg)	Mean $\pm$ SD	p Value
E	50	6-18	9.240 $\pm$ 3.68	0.001**
P	50	0.1-0.3	0.122 $\pm$ 0.05	

The heart rate was more closed to baseline in group P and significant at 4 to 20 minutes time interval as compared to Group E. The systolic BP fall from baseline value were more in group E and significant at 4 to 13 minutes time interval as compared to group P. The diastolic BP fall from baseline value were more in group E and significant at 5 to 13 minutes time interval as compared to group P. There was more episode of hypotension in group E than Group P and highly significant. Also, requirement of vasopressor was more in group E and highly significant than group P. There was no significant difference in respiratory rate and SpO₂. Bradycardia more in group P (4 patients) while in group E were 2. Requirement of atropine was non-significant ($p=0.24$). Other complications were insignificant in both group.

Table 3 Comparison of HR and Systolic & Diastolic BP $\pm$ SD at different time interval

Time Interval	HR (per Min)		SBP (mm of Hg)		DBP (mm of Hg)	
	Gp E	Gp P	Gp E	Gp P	Gp E	Gp P
Before pre-medication	83 $\pm$ 5.53	84 $\pm$ 8.33	123 $\pm$ 8.3 2	122 $\pm$ 7.6 1	80 $\pm$ 5.51	80 $\pm$ 4.30
After pre-medication	87 $\pm$ 5.25	88 $\pm$ 7.85	122 $\pm$ 6.6 5	121 $\pm$ 7.0 7	81 $\pm$ 4.13	81 $\pm$ 4.16
After block 1 min	87 $\pm$ 5.74	88 $\pm$ 7.20	113 $\pm$ 5.2 7	114 $\pm$ 6.4 8	76 $\pm$ 4.98	77 $\pm$ 4.20
2 min	88 $\pm$ 6.96	87 $\pm$ 7.85	108 $\pm$ 5.3 6	110 $\pm$ 7.9 1	72 $\pm$ 5.39	73 $\pm$ 5.94
3 min	88 $\pm$ 7.18	86 $\pm$ 8.52	108 $\pm$ 4.2 3	109 $\pm$ 7.8 6	70 $\pm$ 5.68	73 $\pm$ 7.29
4 min	90 $\pm$ 8.04	85 $\pm$ 9.19 **	109 $\pm$ 4.7 7	112 $\pm$ 6.9 3*	72 $\pm$ 4.94	72 $\pm$ 6.39
5 min	88 $\pm$ 6.01	84 $\pm$ 9.41 **	111 $\pm$ 4.0 9	113 $\pm$ 6.3 3*	72 $\pm$ 5.26	75 $\pm$ 5.74 **

7 min	87 $\pm$ 6.64	84 $\pm$ 7.21 **	109 $\pm$ 5.7 1	114 $\pm$ 8.9 8**	74 $\pm$ 5.29	77 $\pm$ 4.56 **
9 min	88 $\pm$ 7.43	84 $\pm$ 6.77 *	112 $\pm$ 6.9 0	115 $\pm$ 9.2 7*	74 $\pm$ 5.71	77 $\pm$ 5.01 **
11 min	88 $\pm$ 5.83	84 $\pm$ 5.96 **	112 $\pm$ 4.1 1	115 $\pm$ 8.9 2*	75 $\pm$ 5.54	78 $\pm$ 3.35 **
13 min	89 $\pm$ 6.16	85 $\pm$ 6.09 **	115 $\pm$ 3.9 2	118 $\pm$ 7.5 5**	76 $\pm$ 4.23	78 $\pm$ 3.55 **
15 min	89 $\pm$ 5.61	84 $\pm$ 6.26 **	114 $\pm$ 4.0 1	116 $\pm$ 6.7 3	76 $\pm$ 4.46	78 $\pm$ 3.82
20 min	88 $\pm$ 5.33	85 $\pm$ 6.54 *	116 $\pm$ 4.4 9	117 $\pm$ 6.7 2	77 $\pm$ 4.22	78 $\pm$ 3.01

Discussion

After subarachnoid block for caesarean section, hypotension can be minimized using IV fluid preload, avoidance of aortocaval compression and judicious use of vasopressor agent. It has been shown that the percentage decrease in placental perfusion is related to the percentage reduction in maternal arterial pressure. Because of the poor efficacy of non-pharmacological techniques in effectively managing hypotension, a vasopressor is almost always required. However, there is controversy regarding both the choice of vasopressor and optimal method of administration. The present study was thus planned to compare the effects of ephedrine and phenylephrine administered intravenously for the maintenance of arterial pressure and associated complications. For this study, hypotension was defined as a decrease in arterial pressure greater than 20% or SBP less than 100 mmHg from baseline systolic pressure. Ephedrine and mephentermine have got a mixed action directly as well as indirectly on α and β receptors, whereas phenylephrine has pure α receptors activity. Thomas and Colleagues reported that bolus phenylephrine 100 μ g is as effective as ephedrine 5mg restoring maternal arterial pressure above 100mmHg.³ Moran and colleagues gave ephedrine 10 mg or phenylephrine 80 μ g IV bolus to maintain systolic arterial pressure above 100mmHg. They concluded that phenylephrine is as effective as ephedrine and when used in small incremental bolus injections, it appears to have no adverse neonatal effects.⁴ In this study both vasopressor effectively maintained arterial pressure within 20% limit of baseline value though phenylephrine maintained better in first 15min of bolus dose as compared to ephedrine. This may be due to that, phenylephrine has peak effect within 3-5 minute, whereas ephedrine has taken 4-8 minutes. Sahu et al compared ephedrine, mephentermine and phenylephrine for maintenance of arterial pressure found maximum fall in mean systolic blood pressure occurred at 4 minutes in all groups.⁵ They also observed that on inter group comparison rise in systolic blood pressure were less in ephedrine group as compared to phenylephrine group (0.001) and the diastolic blood pressure at 6 minutes was significantly less in ephedrine than the phenylephrine group (0.05). The blood pressure was better maintained in phenylephrine group than ephedrine group, findings almost like our study. In the present study, the mean dose of vasopressors required to maintain the blood pressure near the baseline value was 9.24 $\pm$ 3.68 and 0.122 $\pm$ 0.05 for ephedrine and phenylephrine group respectively and was highly significant on statistical analysis. This study demonstrated a potency ratio of 75.74 for equivalence between ephedrine and phenylephrine in prevention of hypotension after spinal anaesthesia for caesarean section. Similar study by Saravanan S et al compared the equivalent dose of ephedrine and phenylephrine and found that a potency ratio of 81.2 for equivalence.⁶ In our study phenylephrine causes reduction in heart rate after the bolus dose, which is a consistent effect in phenylephrine treated women in other studies also because phenylephrine lacks action on the β receptors. Hall PA et al compared the infusions of phenylephrine 10 μ g/ml, ephedrine 1mg/ml and ephedrine 2mg/ml in restoring the blood pressure and highlighted the decrease in heart rate in the phenylephrine group.⁷ In spinal anaesthesia, since there is decreased venous return, decreased venous pressure and a decreased right heart pressure thus slowing of the heart rate is expected based on the Brain-bridge reflex. Bradycardia is also expected in high spinal, probably due to some paralysis of the cardiac accelerator nerve.

Conclusion

In conclusion, we have found that the phenylephrine and ephedrine are effective in IV bolus form in maintenance of arterial pressure within 20% limit of baseline though phenylephrine has quicker peak effect and better restoration of BP in comparison to ephedrine and it causes reduction in heart rate, which may be advantageous in cardiac patients and patients in whom tachycardia is undesirable.

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