

Comparison of Bolus Phenylephrine and Mephentermine for Maintenance of Arterial Pressure during Spinal Anaesthesia in Caesarean Section

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Abstract: Anaesthesia to a parturient is not only unique but requires highest degree of care because the anaesthesiologist has to look after two individuals, the mother and foetus. In elective caesarean section under spinal anaesthesia hypotension has been reported in as many as 85% of patients. Hypotension may be detrimental to the mother and the resulting placental hypoperfusion to the foetus. Careful positioning and volume preloading with crystalloid or colloids have been used to prevent it, but these are not complete measures and Vasopressor is required to correct hypotension quickly. Hence, the present study is carried out to compare the bolus of phenylephrine and mephentermine for the maintenance of arterial pressure during spinal anaesthesia. The study enrolled 60 full term pregnant females of ASA grade I and II belonging to the age group of 20-40 years, undergoing elective caesarean section, were divided into two groups, Group P and Group M, receiving 100mg of phenylephrine and 6mg in 1 ml of mephentermine as bolus intravenous, respectively. The patients who refused for spinal anaesthesia, patients having gastrointestinal diseases, liver diseases, hyperemesis gravidarum, hyperlipidemia and patients having cardiac diseases, pregnancy induced hypertension, supine hypotension syndrome were excluded from the study. The data obtained is statistically analysed by using ANOVA test and students' two-tailed t-test. The values are found to be significant statistically at $p < 0.05$ level. The final results suggest that phenylephrine and mephentermine are both effective in maintenance of arterial pressure during spinal anaesthesia in caesarean delivery. However, phenylephrine has a quickonset of action and decreases the heart rate which may be favourable in patients in whom tachycardia is undesirable. Here, the major limitation is that the non-cooperation of patients.

Keywords: Caesarean Section; Spinal Anesthesia; Hypotension; Vasopressor

1. Introduction

With the increasing incidence of Caesarean section [1], the anaesthesiologist is trapped in a delicate web of decision making over the type of anaesthetic technique to be employed which guarantees the safety of both the mother and fetus. In the recent decades there has been a worldwide shift in obstetric anaesthesia practice in favour of regional anaesthesia with spinal anaesthesia being the most popular among them [2]. Spinal anaesthesia was introduced into clinical practice by German Surgeon Karl August Bier in 1898 [3]. Its popularity is due to the advantages it confers – relative simplicity, rapidity, certainty, duration, low failure rates, minimal side effects, an awake mother, least exposure of mother and fetus to anaesthetic drug and circumvention of life threatening complications like aspiration, failed intubations and depressed neonate. But, like any other anaesthetic technique, it is not devoid of complications, the most common being hypotension which may adversely affect both mother and fetus.

In elective caesarean section under spinal anaesthesia hypotension has been reported in as many as 85% of patients [4]. Hypotension may be detrimental to the mother and the resulting placental hypo-perfusion to the foetus. Various methods for preventing hypotension are left uterine displacement, intravenous fluid preload, trendelenburg position, compression devices on legs, and prophylactic vasopressors. However, no method has proved entirely satisfactory [5]. In spite of these measures, the administration of vasopressor drugs is often required to maintain the hemodynamic stability of the mother and in turn, the baby respectively. Hence, the present study is carried out to

compare the bolus of phenylephrine and mephentermine for the maintenance of arterial pressure during spinal anaesthesia.

Mephentermine is a mixed sympathomimetic amine that acts both directly and indirectly via an action on α - and β -adrenergic receptors. It has both cardiac and peripheral actions [6]. It has a prominent β -receptor and a weak α -receptor stimulant effect and increases the blood pressure mainly by augmenting the cardiac output [7]. To a lesser degree, a selective constrictive effect on the peripheral vascular bed causing veno-constriction may also contribute to the increase in blood pressure [8]. The change in heart rate is variable, depending on the degree of vagal tone. Mephentermine has been used to treat hypotension by intravenous and intramuscular routes. Mephentermine is readily available and is the most commonly used vasopressor in India to treat spinal anaesthesia induced hypotension.

Phenylephrine is a selective α_1 -adrenergic receptor agonist used primarily as a decongestant, as an agent to dilate the pupil, and to increase blood pressure. It is commonly used as a vasopressor to increase the blood pressure in unstable patients with hypotension, especially resulting from septic shock. Such use is common in anaesthesia or critical-care practice. It is especially useful in counteracting the hypotensive effect of epidural and subarachnoid anaesthetics, as well as the vasodilating effect of bacterial toxins and the inflammatory response in sepsis and systemic inflammatory response syndrome. It has the advantage of not being inotropic or chronotropic, so it strictly elevates the blood pressure without increasing the heart rate or contractility.

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2. Material and Methods

This study enrolled 60 patients' singleton full term pregnant females undergoing elective caesarean section. Approval from the Institutes Review Board and Ethical Committee and informed consent from each patient was taken. The patients were in the age group of 20 -40 years with ASA Grade I and II, who were divided into two groups of each 30 patients as, Group P (Phenylephrine) and Group M (Mephentermine) receiving 100 mg of phenylephrine and 6 mg in 1 ml of mephentermine as bolus intravenous respectively. The patients who refused for spinal anaesthesia, patients having gastrointestinal diseases, liver diseases, hyperemesis gravidarum, hyperlipidemia and patients having cardiac diseases, pregnancy induced hypertension, supine hypotension syndrome were excluded from the study.

The patients were preloaded with Ringer's lactate solution 10ml/kg. The patients are monitored for heart rate, non-invasive blood pressure, pulse oximetry and ECG. With careful antiseptic preparation and patients in the lateral position, 1.6-2.0ml of bupivacaine 0.5% is administered in subarachnoid space through a 23 gauge Quincke needle at either L2-3 or L3-4 space. The patient is turned to supine position and after 5 min wedge is placed under the right flank. Inj.Oxytocin 10-20U is given after clamping the cord.

After preloading pulse rate, systolic and diastolic arterial pressures are recorded thrice when middle value is taken as a base line values. Then same parameters are recorded after subarachnoid block, then at every 2 min for 20 min and thereafter every 5 min till the end of the surgery. Whenever hypotension (fall in systolic pressure >20% from the baseline value or a value less than 90mmhg) occurs, the study drug is given IV bolus. The number of boluses and time taken to develop hypotension are noted.

The bradycardia i.e. a pulse rate of 60min-1 or less is treated with atropine 0.3mg I.V. The highest level of sensory block of T6 will be assessed by pinprick method 5min after the SAB. The induction delivery and incision delivery interval are recorded. Paediatrician will assess the Apgar score of every neonate at 1 and 5min after delivery.

Comparability of groups will be analysed with analysis of variance (ANOVA) test. Student's two-tailed 't' test applied to analysed parametric data. P value <0.05 is considered significant.

3. Results

The two groups were comparable in physical characteristics. Both the groups were similar in terms of sensory block level, time to develop hypotension and the mean time to delivery and uterine incision to delivery time interval. [Table no. 1]

Table 1: Patients characteristics

	Phenylephrine	Mephentermine
Maternal age (Mean+/-SD) years	25.5+/-3.1	26.0+/-4.2
Maternal weight (Mean+/-SD) kgs	63.5+/-1.5	63.5+/-1.7
Maternal height (Mean+/-SD) inches	65.2+/-4.0	65.5+/-5.4
SAB – Hypotension time (mins)	4.2	4.4
Level of sensory height (median)	T6	T6
SAB-Delivery interval (Mean+/-SD) secs.	570+/-64	580+/-66
UI-Delivery interval (Mean+/-SD) secs.	57+/-9	60+/-10

The systolic and diastolic arterial pressure were decreased at the onset of hypotension and increased after administration of bolus dose of vasopressor in both the groups which was statistically significant (p<0.001). [Table no. 2 & 3]

Table 2: Changes in systolic blood pressure

Time interval	Systolic BP (mmHg) (Mean+/-SD)	
	Group P	Group M
Baseline values	127.6+/-6.6	126.7+/-7.6
Hypotension (VP given)	95.9*+/-7.9	94.9*+/-7.6
2 min after VP	114.8*+/-16	107.8*+/-10
4 min after VP	121*+/-16	109*+/-12
6 min after VP	119 ^x +/-14.6	115.9 ^x +/-9.8
8 min after VP	121*+/-11.8	116*+/-6.7
10 min after VP	120*+/-10	116.2*+/-6.9
14 min after VP	118.7*+/-10	117.7*+/-7.6
20 min after VP	121.7*+/-8.6	117.8*+/-7.8
30 min after VP	122.3*+/-8.4	120.3*+/-7.2
*P <0.001		

Table 3: Changes in diastolic blood pressure

Time interval	Diastolic BP (mmHg) (Mean+/-SD)	
	Group P	Group M
Baseline values	80.5+/-5.7	79.6+/-6.7
Hypotension (VP given)	60.9*+/-4.5	62.5*+/-7.0
2 min after VP	72.4*+/-7.9	67 ⁰ +/-7.4
4 min after VP	74.2*+/-9.6	71.6*+/-5.4
6 min after VP	74*+/-6.9	70.6**+/-6.4
8 min after VP	75.9*+/-7	70.3*+/-4.3
10 min after VP	75.6*+/-6.1	73*+/-4.6
14 min after VP	73.2*+/-4.1	73*+/-4.9
20 min after VP	74.3*+/-5	73.6*+/-4.4
30 min after VP	75*+/-4.8	74.8*+/-4.5
*P<0.001; **P<0.05; ⁰ P>0.05		

In both the groups, the heart rate increased during hypotension. In Group P, the heart rate after administration of the study drug decreased significantly from the episode of hypotension till the end of surgery. In Group M, the heart rate was high after the administration of the study drug till the end of the surgery in comparison to the value at the onset of hypotension which was statistically nonsignificant. [Table no. 4]

Table 4: Changes in heart rate

Time interval	Heart Rate (per min) (Mean+/-SD)	
	Group P	Group M
Baseline values	100.5+/-16	98.3+/-18
Hypotension (VP given)	116.7*+/-21	106.7*+/-19
2 min after VP	90.4*+/-15.9	102 ⁰ +/-21.6
4 min after VP	87.7*+/-17.8	100*+/-21
6 min after VP	91.8*+/-19	101 ⁰ +/-19
8 min after VP	96.2*+/-15.8	99.4 ⁰ +/-19.1
10 min after VP	96.6*+/-17	100.4 ⁰ +/-20.8
14 min after VP	97*+/-14.4	102 ⁰ +/-20
20 min after VP	99.6*+/-13.9	102.5 ⁰ +/-20
30 min after VP	99.8*+/-15	104 ⁰ +/-20

*P<0.001; **P<0.05; ⁰P>0.05

Out of 100%, 80% patients required single bolus dose, 15% and 5% patients required two and three bolus doses to maintain the arterial pressure in Group P whereas in Group M, 55% patients required single bolus dose, 40% and 5% patients required two and three bolus doses respectively.

Apgar score did not reveal any untoward effect of these drugs on the foetus as all new born in both the groups had an Apgar score greater than 7.

4. Discussion

Caesarean section is one of the oldest operations in recorded history, however anaesthesia for Caesarean section is just a century old. Over time, regional anaesthesia especially spinal anaesthesia proved to be the most preferred technique for Caesarean section^[9, 10]. The reason being, the unique potential of spinal technique to provide anaesthesia with a blend of low degree of physiologic trespass and with profound degrees of sensory denervation and muscle relaxation. Thus, the safety of spinal anaesthesia is of dual nature; pharmacological as well as physiologic. However, one main hurdle with this technique is the troublesome and persistent incidence of hypotension especially in gravid parturients. Hypotension is the commonest serious problem endangering both the mother and the child^[9, 11]. Dinesh Sahuet *al*^[12] found that maternal hypotension during spinal anaesthesia for Caesarean delivery was a persistent problem in approximately 85% of cases^[12]. This high incidence and severity of maternal hypotension following spinal anaesthesia could be attributed to various factors like the amount of local anaesthetic injected, sympathetic blockade, uterus impairing venous return from extremities in supine position etc^[10].

After subarachnoid block for caesarean section, hypotension can be minimized by the use of IV fluid preload, avoidance of aortocaval compression and judicious use of vasopressor agent. For the purpose of this study, hypotension was defined as a decrease in arterial pressure greater than 20% from baseline systolic pressure. mephentermine have got a mixed action directly as well as indirectly on a and b receptors, whereas phenylephrine has pure a receptors activity.

In this study, both the vasopressors effectively maintained the arterial pressure within 20% limit of baseline value though, it was found that phenylephrine maintained better haemodynamics in the first 6 minutes of bolus dose when compared to mephentermine.

In the present study, it was found that phenylephrine caused significant reduction in the heart rate after the bolus dose, when compared to mephentermine and also it was found that the maternal heart rate was slower with phenylephrine because of its lack of action on β-receptors.

5. Conclusion

In conclusion, it was found that phenylephrine and mephentermine are both effective in maintenance of arterial pressure within 20% of baseline. However, phenylephrine has quicker onset of action and it causes reduction in heart rate when compared to mephentermine which may be advantageous in patients in whom tachycardia is undesirable.

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