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ORIGINAL RESEARCH

A prospective comparative study of intravenous bolus norepinephrine and phenylephrine in maintaining arterial blood pressure during spinal anaesthesia in caesarean section

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ABSTRACT
Maternal hypotension is the most common complication after spinal anaesthesia during cesarean delivery, therefore preventing hypotension reduces the incidences of intraoperative nausea and vomiting other effects like dizziness and decreased consciousness. It also leads to hypoxia and acidosis in fetus. A vasopressor is usually required due to the poor efficacy of non-pharmacological techniques. Primary aim of this study is to compare the efficacy of Intermittent Intravenous bolus Norepinephrine and Phenylephrine in maintaining arterial blood pressure during spinal anaesthesia in caesarean section. A prospective comparative study conducted in the Department of Anesthesiology, in 102 Pregnant women belonging to the age group of 18-40 years posted for either elective/emergency caesarean surgeries under subarachnoid block accepted under ASA 2, satisfying the inclusion criteria and willing to participate in the study. The selected patients were randomly allocated into 2 groups containing 51 patients each according to the study drug; Norepinephrine group (4µg/ml) (Group N) and Phenylephrine group (100µg/ml) (Group P).
Both the drugs maintained the systolic blood pressure following spinal anaesthesia throughout the surgery. In group N, not a single patient developed bradycardia, whereas in group P, bradycardia was observed in 7 patients (p=0.018).We conclude that the study of intravenous bolus norepinephrine and phenylephrine in maintaining arterial blood pressure during spinal anesthesia in cesarean section, both drugs effectively counteracted hypotension.
Key words: Norepinephrine, phenylephrine, arterial blood pressure

INTRODUCTION

Spinal anaesthesia was first introduced in clinical practice on 16th of August in 1898 by August Bier. Since then spinal anaesthesia became the most preferred mode of anaesthesia for infraumbilical surgeries[1].

Spinal anaesthesia is still the choice for caesarean section to avoid the risk of airway complications and to limit the neonatal drug transfer associated with general anaesthesia and it is quicker, easier to place, provides a denser block, cost-effective, and less likely to fail but the drawback is maternal hypotension[2].

Maternal hypotension may lead to cerebral hypo-perfusion and brain stem ischemia activating vomiting centre, therefore preventing hypotension reduces the incidences of intraoperative nausea and vomiting other effects like dizziness and decreased consciousness. Foetal effects includes decreased utero-placental blood flow leading to impaired oxygenation and foetal acidosis[2].

A vasopressor is usually required due to the poor efficacy of non-pharmacological techniques. Conventionally ephedrine was considered the vasopressor of choice to manage hypotension due to

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evidence of preservation of utero-placental circulation however it lead to foetal acidosis[3].

Phenylephrine and α-adrenergic agonist with no β-adrenergic receptor activity has been the vasopressor of choice. It increases systemic vascular resistance and MAP and increases venous return. But the drawback with this drug is the reduction in heart rate (HR) and cardiac output, which may adversely affect the outcomes of both the mother and the foetus [4, 5].

Recently, Norepinephrine an endogenous neurotransmitter has stimulant effect on α1 adrenergic receptors and minimal effect at β2 receptor is being suggested as an alternative to phenylephrine to treat spinal-induced hypotension for caesarean delivery as it causes less reduction in HR and cardiac output. Phenylephrine 100 µg is found to be equipotent to norepinephrine 8 µg7 [6].

METHODOLOGY

STUDY POPULATION: 102 pregnant women belonging to the age group of 18-40 years posted for either elective/emergency caesarean surgeries under subarachnoid block accepted under ASA 2 was the target population.

SAMPLE SIZE

Sample Size (n) = 51 in each group.

Total Sample size is 102, hence, study was undertaken with 51 samples in each group.

STUDY DESIGN

This study was a prospective, comparative study.

INCLUSION CRITERIA

- Patients undergoing elective/emergency caesarean surgeries under subarachnoid block.
- Pregnant women between the age group of 18 to 40 years.
- American Society of Anaesthesiologists physical status II.

EXCLUSION CRITERIA

- Contraindications to spinal anaesthesia.
- Patients with.

i) Pregnancy induced hypertension.
ii) Diabetes mellitus including gestational diabetes.
iii) Cardiovascular and Cerebrovascular.
iv) Respiratory disease.
v) Renal disease.
vi) Intrauterine growth retardation.
vii) Oligohydramnios.
viii) Placenta previa.

METHOD OF COLLECTION OF DATA

Patients [American Society of Anaesthesiologists (ASA) physical status II], aged (18-40years) pregnant women, scheduled for elective/emergency caesarean surgeries under subarachnoid block will be enrolled in the prospective comparative study after obtaining approval from the ethical committee.

The selected patients were randomly allocated using computer generated method into 2 groups containing 51 patients each according to the study drug,

- **GROUP N:** Norepinephrine group (4µg/ml).
- **GROUP P:** Phenylephrine group (100µ g/ml).

Each patient received 15ml/kg of lactated Ringers solutions as preload. Under strict aseptic precaution, 10mg of hyperbaric 0.5% bupivacaine is instituted in subarachnoid space at either the L3-4 or L4-5 interspaces using 25G Quincke's spinal needle. Neither patient height nor weight affect block extension, although dosing may require adjustment at extremes of the height spectrum. Supplemental oxygen will be delivered via a facemask during the operation. One minute after the intrathecal injection, one of the study drugs will be given slowly by IV route and maternal hemodynamic is monitored every 5 minutes.

RESULTS

Table 1:Distribution of Mean Heart rate

	Group N	Group P	P-value
HR Baseline	89.1765	90.1176	0.7261
HR 5 mins	94.9412	94.8235	0.9651
HR 10 mins	98.4902	84	<0.0001
HR 15 mins	99.7059	81.3333	<0.0001
HR 20 mins	96.2157	81.5294	<0.0001
HR 25 mins	94.0588	80.5098	<0.0001
HR 30 mins	92.0784	81.7255	<0.0001
HR 35 mins	90.9412	84.3137	0.003
HR 40 mins	90.6275	81.8431	<0.0001
HR 45 mins	89.9804	83.0588	0.0003

Table 1 shows that within 5 minutes of SAB there is no significant difference between Group N and Group P. But after 10 mins of administration of study drugs, Group P shows a fall in heart rate compared to Group N which is statistically significant (p<0.0001).

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Table 2:Distribution of Mean SBP

	Group N	Group P	P value
Baseline	124.05	122.86	0.44
5 minutes	112.66	109.686	0.07
10 minutes	95.33	92.54	0.16
15 minutes	99.68	100.03	0.8
20 minutes	103.29	104.82	0.85
25 minutes	108.64	108.94	0.35
30 minutes	110.56	107.72	0.0006
35 minutes	110.56	107.72	<0.0001
40 minutes	113.78	109.37	<0.0001
45 minutes	118.21	109.52	<0.0001

Table 2 shows that within 30 minutes of SAB there is no significant difference between Group N and Group P. But after 30 mins of administration of study drugs, there is significant difference of mean SBP, statistically significant (p<0.0001)

Table 3:Distribution of Mean MAP

	Group N	Group P	P value
Baseline	93.0654	90.9412	0.0611
5 minutes	81.2092	81.8693	0.5518
10 minutes	69.3464	69.6993	0.7108
15 minutes	72.7582	75.3464	0.0067
20 minutes	77.8562	79.1503	0.0654
25 minutes	81.6667	82.9935	0.0167
30 minutes	83.902	82.183	0.0209
35 minutes	85.9608	80.1961	<0.0001
40 minutes	85.8235	83.9085	2.9581
45 minutes	88.9216	84.2222	<0.0001

Table 3 shows that Mean Arterial Blood Pressure was comparable between the groups at baseline and was comparable in both groups throughout the period of observation.

Table 4: Distribution of Mean Baby's APGAR after 5 min

		Number	Mean	SD	Minimum	Maximum	Median	P-value
Baby's APGAR 5min	Group-N	51	35.0000	14.8661	10.0000	60.0000	35.0000	<0.0001
	Group-P	51	35.0000	14.8661	10.0000	60.0000	35.0000	

Table 4 shows that distribution of mean Baby's APGAR 5 min with Group was not statistically significant (p<0.0001)

DISCUSSION

In our study heart rate monitoring done for a period of 45 min from the time of subarachnoid block. Even though within 5 minutes of SAB there is no significant difference between Group N and Group P. But after 10 mins of administration of study drugs, Group P shows a fall in heart rate compared to Group N which is statistically significant (p<0.0001), corresponds to the study done by Dong, Ling *et al.* [7].

A study by Sharkey AM *et al.* [8] norepinephrine resulted in a significant reduction in the incidence of bradycardia as compared to an equipotent bolus regimen of Phenylephrine. This study concluded that the hemodynamic profile offered by Norepinephrine during Cesarean delivery is superior to that of Phenylephrine due to less fluctuations in HR and possibly cardiac output, which was similar to our study but limitation was cardiac output couldn't be measured in our hospital.

A study done by Shiqin *et al.* [9] showed that Group-N is less likely to experience Bradycardia (18.4%) compared to Group-P(55.8%).

Similarly a study done by Ngan Kee *et al.* [10] showed that incidence of Bradycardia was lower in the norepinephrine group (18.4%) compared with that in the phenylephrine group (55.8%, P < 0.001).

Spinal hypotension is considered when systolic blood pressure falls below 90mmHg or below 30% from the baseline preoperative systolic blood pressure.

MAP Baseline was higher in Group-N [74.2745±3.4239] compared to Group-P [71.5686±2.4021], but this difference was not statistically significant (p=0.0611). Similarly a study done by Wang X *et al.* [11] (2020), compared that intermittent bolus norepinephrine provides a greater CO for management of maternal hypotension during elective cesarean section with spinal anesthesia; however, no obvious maternal or neonatal clinical

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advantages were observed for norepinephrine which is comparable to our study.

The mean number of boluses dose required was significantly lower in Group-N (1.8039±0.7217) compared to Group-P (2.1176±0.7911) with a statistically significant difference (p=0.0389).

Similar study by Osmani SG *et al.* [12] (2022) examined that Noradrenaline is a rational substitute to phenylephrine due to its mild β and prominent α adrenergic properties, but it is reserved for medical crisis management as an inotrope.

CONCLUSION

We conclude that the study of intravenous bolus norepinephrine and phenylephrine in maintaining arterial blood pressure during spinal anesthesia in cesarean section, both drugs effectively counteracted hypotension. Norepinephrine, with its combined alpha and beta-adrenergic effects, provided a more stable heart rate compared to phenylephrine, which solely acts on alpha-adrenergic receptors. The findings suggest that norepinephrine is a preferable agent for maintaining hemodynamic stability in such procedures, reducing the incidence of bradycardia while ensuring adequate arterial blood pressure.

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