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To Compare the Effects of IV Bolus Doses Phenylephrine, And Ephedrine Injection in Maintaining Arterial Blood Pressure During Spinal Anesthesia for Cesarean Sections-A Randomized Comparative Study

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Abstract

Spinal anesthesia is the preferred anesthetic approach for cesarean sections due to its benefits for both the mother and fetus. However, hypotension is a common and potentially harmful complication. Phenylephrine (PE) is frequently used as a vasopressor to manage hypotension during spinal anesthesia, but it can cause maternal sinus bradycardia. This study aimed to compare two strategies for maintaining arterial blood pressure during cesarean delivery: a 20 mcg bolus of phenylephrine followed by a 10 mcg/min infusion (Group P) versus a 6 mg bolus of ephedrine followed by a 0.1 mg/min infusion (Group E). A total of 100 pregnant women scheduled for elective or emergency cesarean sections under spinal anesthesia were randomly assigned to either Group P or Group E. Systolic blood pressure was well-maintained in both groups during the first 20 minutes. After this period, Group P's blood pressure stabilized towards basal values, while Group E's remained slightly above basal levels—a statistically significant difference ($p < 0.005$). Diastolic blood pressure fell in both groups, but Group E maintained slightly higher levels than Group P. Group P had a 24% incidence of bradycardia requiring atropine, while no such cases were observed in Group E. Despite these differences, overall maternal arterial blood pressure was effectively maintained in both groups, with no significant difference in uterine tone or bleeding levels.

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INTRODUCTION

Spinal anesthesia, also known as spinal block, intrathecal block, subarachnoid block, and intradural block, It is a type of neuraxial regional anesthesia in which a fine needle, typically measuring 9 cm (3.5 in) in length, is used to inject a local anesthetic or opioid into the subarachnoid space. This is a safe and efficient type of anesthesia that is often administered by anesthesiologists. It can be used as a substitute for general anesthesia in procedures that are typically conducted below the umbilicus and on the lower limbs.

However, spinal anesthesia can sometimes have unintended effects. The most frequent one is hypotension, which is brought on by preganglionic sympathetic inhibition. Mothers experience hypotension as a result of vasodilatation brought on by spinal block-induced sympatholysis. Reduced systolic pressure can lead to fetal hypoxia and acidosis by impairing foetal circulation and uterine blood flow.

The three main elements of management are: (1) fluid management, which includes co-loading and preloading; (2) positioning protocols, which include using a wedge, leg wrapping, sequential compression, and left lateral position; and (3) pharmacological agents, which include mephentermine, ephedrine, norepinephrine, and phenylephrine.

Phenylephrine is a sympathomimetic that can be used in an emergency to treat hypotension and relieve allergy symptoms in the eyes and ears. - Phenylephrine may cause constriction in uterine vessels (which are ordinarily maximally dilated during pregnancy), lowering uterine blood flow and perhaps causing fetal hypoxia. Phenylephrine may interact with oxytocic or ergot derivatives, resulting in prolonged maternal hypertension and the possibility of cerebral vascular rupture. It is proposed that frequent infusions of phenylephrine may lead to a lower incidence of hypotension compared with one bolus, but the stability of hemodynamic profile needs to be balanced between prevention and avoidance of excessive blood pressure. Alpha and Beta adrenoreceptor activity are both present in ephedrine. The primary activity is to increase the heart rate and cardiac output, which maintains arterial blood pressure. Therefore, our goal was to assess and contrast the benefits of a phenylephrine infusion vs a bolus for preserving stable hemodynamics following an intraoperative subarachnoid block during a cesarean operation.

Materials and methods

With prior approval from the ethics committee and given informed agreement, 100 pregnant women scheduled for elective or emergency cesarean sections under SAB were randomly allocated to one of two groups, group P or group E. Group P received a 20 mcg bolus of phenylephrine intravenously immediately after spinal anesthesia, followed by a 10 mcg/min infusion (Gr.P); group E received a 6 mg bolus of ephedrine intravenously followed by a 0.1 mg/min infusion (Gr.E). Other than that, both groups had the same preoperative, intraoperative, and postoperative care.

Inclusion criteria

- The patients, who ranged in age from 18 to 35
- Had both elective and emergency lower segment Caesarean sections scheduled.
- Individuals in ASA Classes I and II

Exclusion criteria

- The study excluded patients who met the standard exclusion criteria for spinal anesthesia, ASA grades >III.
- Significant medical diseases (PIH, difficult obstetrics, severe anaemia, etc.).
- Patient with hypertension brought on by pregnancy
- Individuals who have experienced serious systemic diseases in the past (cardiovascular, respiratory, or central nervous system)
- Individuals using vasoactive medications

Group P: Administer 20 mcg of phenylephrine intravenously as a bolus right after SAB, then 10 mcg/min during infusion.

Group E: Administer 6 mg of ephedrine via IV bolus right after SAB, then 0.1 mg/min infusion

Statistical Analysis

The unpaired t-test was used to compare the quantitative data between groups, which were reported as mean ± SD. Fisher's test and Chi-square analysis were used to examine qualitative data. The information was kept in a Microsoft Excel spreadsheet and IBM SPSS Statistics for Windows was used to conduct the statistical analysis. A P-value of less than 0.05 was deemed statistically significant.

RESULTS

In our present study the heart rate in group E decreased from 98.48±18.55 to 78.62±10.15, while the heart rate in the group P decreased from 95.23±15.57 to 84.35±7.58. Heart rate changes were not statistically significant. The ephedrine group's SBP decreased from 124.60±7.61 to 114.55±4.50, while the Phenylephrine group's SBP gradually decreased from 114.50±10.29 to 115.98±7.24. The difference in SBP between the two groups was statistically significant at only 10

minutes. DBP was successfully maintained in both groups, remaining constant and comparable between them. Both groups experienced a drop in MAP during the first minute following surgery, remained constant and comparable between two groups. Uterine tone, uterine haemorrhage, and APGAR score did not significantly differ between the two groups.

DISCUSSION

One of the oldest procedures in history is the Caesarean section; anesthesia for this procedure has only been around for a century and is not without controversy. Because of the sensuously complicated obstetric airway and the terror it instils in anaesthesiologists, general anesthesia is not the preferred option. As a result, parturients receiving general anesthesia had to proceed very cautiously and carefully consider their options. Therefore, it was determined that the most recommended method for cesarean sections was spinal anesthesia. The reason for this is the special ability of the spinal approach to produce anesthesia while combining significant levels of sensory denervation and muscular relaxation with a low degree of physiologic trespass. As a result, there are two aspects to the safety of spinal anesthesia: pharmacological and physiological.

PA Hal et al. evaluated the effects of phenylephrine and ephedrine in spinal anesthesia for elective cesarean section on maternal cardiovascular alterations and neonatal acid-base status. It was shown that maternal bradycardia in the phenylephrine group associated with periods when a number of bolus doses of phenylephrine were given for maternal hypotension.

In this research, the ephedrine group had 6% more nausea than the phenylephrine group. Nausea was not associated with hypotension and was treated with intravenous ondansetron 4mg. This rate is lower than the general rate of nausea in parturients having caesarean section under spinal anesthesia (23-68%) 55. In both groups, no patients vomited.

Brandi A Bottiger et al. investigated the effect of preload on phenylephrine infusion for spinal-induced hypotension after elective cesarean delivery. They concluded that preloading colloids had a phenylephrine sparing effect, implying that colloids may be superior to crystalloids in the prevention and treatment of spinal anesthesia-induced hypotension. Bradycardia, reactive hypertension, and intraoperative nausea and vomiting should all be considered clinically significant. Phenylephrine is more effective than ephedrine at reducing reactive hypotension, nausea, vomiting, and the need for vasopressor rescue therapy.

In the current research, patients in the phenylephrine group had a 24% incidence of bradycardia that required treatment, while no patients in the ephedrine group had bradycardia. Bradycardia brought on by phenylephrine did not correlate with hypotension. Atropine may be used to treat the temporary baroreceptor-mediated reflex mechanism that causes bradycardia in the phenylephrine group.

Iqra Nazir et al. A comparison of phenylephrine and ephedrine in avoiding hypotension during spinal anesthesia for cesarean delivery. In their study, patients receiving phenylephrine had a greater rate of bradycardia than those getting ephedrine. A rise in blood pressure with an α-agonist may cause reactive bradycardia (baroreceptor reflex). However, this was responsive to atropine with no deleterious effects.

In our present study, none of the patients in the ephedrine group experienced vomiting, hypotension, or bradycardia, however 6% reported nausea. In the phenylephrine group, there was no hypotension, 12 individuals had bradycardia that needed to be treated, no nausea or vomiting.

La Porta et al. examined the effectiveness of phenylephrine and ephedrine in treating maternal hypotension caused by spinal anesthesia after cesarean delivery. Ephedrine 5mg IV bolus and phenylephrine 40 mcg IV bolus injections were used for treatment. There were no significant variations in APGAR scores or acid/base levels.

In the present study the APGAR score revealed no adverse effect on fetal condition because all babies in both groups had an APGAR score greater than 7. It was not statistically significant.

Ramanathan et al. investigated the use of 5mg Ephedrine and 100 mcg Phenylephrine IV bolus. They determined that temporary maternal hypotension has no effect on neonatal acid-base balance, and that ephedrine and phenylephrine do

not produce fetal acidosis when used to treat maternal hypotension.

The research found that group E's heart rate decreased from 98 ± 18 to 78 ± 9, while the phenylephrine group's heart rate decreased from 95 ± 15 to 84 ± 15. The heart rate variations were not statistically significant.

The ephedrine group's SBP decreased from 125±7 to 114 ±4. Similarly, the Phenylephrine group had a progressive decrease from 117±1 to 112±9. SBP drop between the two groups was statistically significant after just 10 minutes.

DBP was successfully maintained in both groups, remaining constant and similar between them. Both groups saw a drop in MAP during the first minute following surgery. Both groups remained steady and similar.

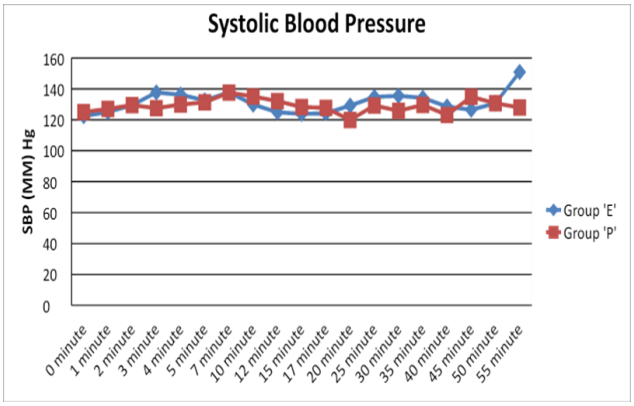

Figure 1 Comparison of Systolic Blood Pressure

SBP well maintained in both the groups till 20thmin. Subsequently, the Phenylephrine group stabilized towards the basal &Ephedrine group stayed slightly higher than the basal values. The difference was statically significant with p-value (<0.005).

Persistent fall in DBP in both the groups, DBP in the Phenylepherine group stayed slightly higher compared to the Ephedrine group. The difference was statically significant with p-value (<0.005).

In group Ephedrine heart rate reduced from 98.48±18.55 to 78.62±10.15, in Phenylephrine group heart rate reduced from 95.23±15.57to 84.35±7.58. Heart rate changes were not statistically significant.

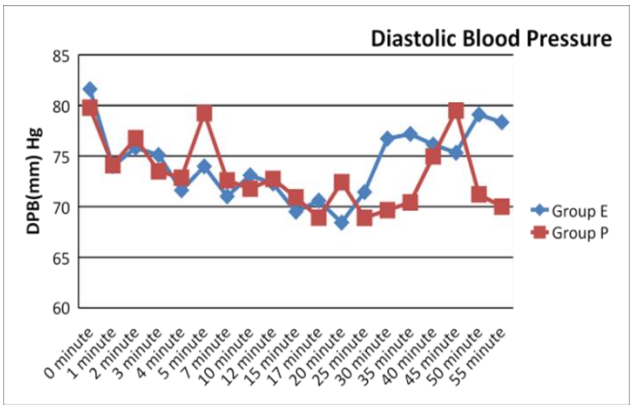

Figure 2 Comparison of Diastolic Blood Pressure

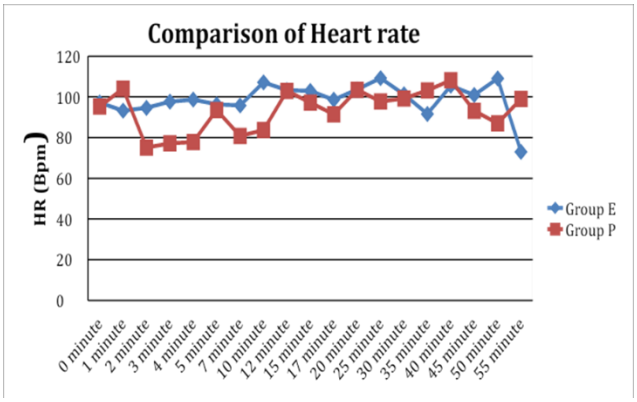

Figure 3 Comparison of Heart rate

Table 1 Comparison of Fetal APGAR Scoring Between Two Groups

Groups	Group E	Group P	P valve	Inference
Apgar 1	9.89	9.89	0.51	NS
Apgar 5	9.45	9.78	0.51	NS

Table 2 Comparison of Adverse Effects in Both the Groups

Groups	Nausea (%)	Vomiting (%)	Hypotension Requiring Rescue (%)	Bradycardia (%)
Group E	7	0	0	0
Group P	0	0	0	23

Ephedrine group, none of the patients, had vomiting, hypotension, or bradycardia, but 7% of them had nausea. Phenylephrine group had no

Table 3 Haemodynamics in the Postoperative Period of Phenylephrine (Group P)

Time (min)	Group Phenylephrine			
	SBP	DBP	MAP	HR
0 min	114.50±10.29	69.64±13.99	102.48±5.73	95.23±15.57
1st min	112.02±8.60	68.30±9.59	84.32±7.98	93.37±13.76
5 min	114.34±17.52	67.00±9.82	83.72±8.53	91.88±11.33
10 min	116.84±6.82	68.70±10.03	83.22±7.82	87.95±11.16
20min	114.30±5.69	66.18±9.05	82.12±7.05	86.01±10.57
30 min	113.24±4.94	68.32±9.77	81.88±6.88	83.97±9.58
40 min	114.28±5.67	73.04±9.64	86.24±7.52	82.26±8.99
50min	115.98±7.24	74.106±8.54	87.10±6.71	84.35±7.58
60 min	-	-	-	-

Table 4 Haemodynamics in the Postoperative Period of Ephedrine (Group E)

Time (min)	Group Ephedrine			
	SBP	DBP	MAP	HR
0 min	124.60±7.61	75.20±7.50	103.32±4.02	98.48±18.55
1st min	125.70±5.83	74.20±7.45	90.94±6.14	95.46±19.14
5 min	126.20±7.83	75.64±7.59	92.52±7.19	93.26±17.10
10 min	123.08±8.88	71.72±9.46	88.44±9.06	91.46±14.88
20 min	117.03±6.97	70.55±7.20	86.16±6.95	89.02±12.67
30 min	115.38±6.67	70.38±4.51	85.66±6.72	82.20±10.49
40 min	116.20±5.57	70.70±9.19	85.56±7.93	80.72±10.14
50 min	114.55±4.50	71.20±7.23	85.58±6.17	78.62±10.15
60 min	-	-	-	-

hypotension, 23 patients had bradycardia requiring treatment, no nausea, and no vomiting.

CONCLUSION

In the present research, 100 pregnant women who were scheduled for a spinal anesthetic elective or emergency caesarean section were randomized to one of two groups, group P or group E, and given the following treatments: A 20μg IV bolus of phenylephrine followed by a 10μg/min infusion or a 6μg IV bolus of ephedrine followed by a mg/m injection may be used to maintain arterial pressure during surgery.

The research also shows that, when comparing the efficacy of a preventative bolus followed by an ephedrine and phenylephrine infusion, ephedrine prophylaxis is associated with improved overall hemodynamic maintenance following cesarean sections. Benigna was more frequent when phenylephrine was administered. There was no significant difference seen in uterine tone, uterine bleeding, or APGAR score between the two groups.

Therefore, it is reasonable to draw the conclusion that, in order to avoid hypotension during spinal anesthesia for a caesarean section, a prophylactic IV bolus followed by an infusion of study drugs, such as phenylephrine and ephedrine, may be used safely. In patients with hyperthyroidism, PIH, mitral stenosis, aortic stenosis, and other cardiac diseases needing strict and variable hemodynamic treatment, phenylephrine is preferred.

Ethical Approval

This research was conducted in line with the principles of the Declaration of Helsinki. All procedures involving study participants were carried out with care and consideration for their welfare, in compliance with ethical standards and regulations.

Author Contribution

All authors made substantial contributions to the conception, design, acquisition, analysis, or interpretation of data for the work. They were involved in drafting the manuscript or revising it critically for important intellectual content. All authors gave final approval of the version to be published and agreed to be accountable for all

aspects of the work, ensuring its accuracy and integrity.

Ethical Approval

No ethical approval was necessary for this study.

Author Contribution

Dr. Anand. B, Professor, Department of Anesthesiology, Sri Venkateswaraa Medical College Hospital and Research Institute made substantial contributions to the conception, design, acquisition, analysis, or interpretation of data for the work. Dr. Raghuraman. T.R, Assistant Professor, Department of Anesthesiology, Sri Venkateswaraa Medical College Hospital and Research Institute, Dr. Prabhuram Niranjan, Assistant Professor, Department of Anesthesiology, Sri Venkateswaraa Medical College Hospital and Research Institute were involved in drafting the manuscript. Dr. Selvi. A, Associate Professor, Department of Obstetrics and Gynaecology, Sri Venkateswaraa Medical College Hospital and Research Institute was instrumental in revising it critically for important intellectual content. All authors gave final approval of the version to be published and agreed to be accountable for all aspects of the work, ensuring its accuracy and integrity.

Conflict of Interest

The authors declare no conflict of interest, financial or otherwise.

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