e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2023; 13(1); 73-80

Original Research Article

Norepinephrine versus Phenylephrine in Controlling Blood Pressure During Caesarean Section

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Received: 10-11-2022 / Revised: 18-12-2022 / Accepted: 29-12-2022

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Conflict of interest: Nil

Abstract

Objectives: Despite proper fluid loading, hypotension after spinal anaesthesia for a caesarean section is typical. To treat spinal hypotension during a caesarean section, phenylephrine is advised. Norepinephrine boluses have recently been recommended as a substitute for phenylephrine boluses. Our study's objective was to evaluate the efficacy of norepinephrine and phenylephrine bolus dosages for treating spinal hypotension during caesarean delivery.

Methodology: 50 patients getting a spinal anaesthetic for an elective caesarean section were divided into two groups at random. In order to address spinal hypotension, Group 1 patients were given a 50 mg intravenous bolus of phenylephrine, and Group 2 patients were given a 4 mg intravenous bolus of norepinephrine. The main goal of study was to compare the number of norepinephrine or phenylephrine bolus doses needed to cure spinal hypotension. Comparing the prevalence of bradycardia, hypertension, nausea, and vomiting in the mother and foetal outcomes were the secondary goals.

Results: Group 1 required considerably fewer vasopressor boluses to address hypotension (1.39 0.45 vs. 2.28 1.04, P = 0.001). Although bradycardia was more common in Group 1, the difference (4% vs. 20%, P = 0.192) was not statistically significant. Shivering, nausea, and vomiting among other pregnancy problems were similar between the groups. Additionally comparable across the two groups were the foetal parameters.

Conclusion: Norepinephrine intermittent boluses are useful for controlling spinal-induced hypotension after caesarean delivery. Both groups' neonatal results were comparable.

Keywords: Epinephrine, Norepinephrin, Cesearean, Blood pressure

Introduction

Today, spinal anaesthesia is frequently used during caesarean sections to reduce the danger of infant drug transfer during general anaesthesia and the possibility of respiratory difficulties. However, maternal hypotension is a frequent consequence following spinal anaesthesia, despite sufficient fluid loading. Reduced uterine blood flow, hypoxia and

acidosis in the foetus, as well as fainting, nausea, and vomiting in the mother, are all possible effects of hypotension. To prevent these harmful effects on the mother and the newborn, hypotension must be treated right away with intravenous fluids or a vasopressor [1,2].

Since it results in less foetal acidity than ephedrine, phenylephrine is recommended as the first-line medication for the treatment of hypotension after caesarean delivery. However, this medication's disadvantage is the decrease in heart rate (HR) and cardiac output, which could have a negative impact on both the mother's and the foetus' outcomes. A strong vasopressor with "-adrenergic" characteristics, norepinephrine. Spinal-induced hypotension during caesarean delivery is currently being treated with norepinephrine infusion instead of phenylephrine [3-7].

Given that it results in less reduction in heart rate and cardiac output than phenylephrine, it might be more advantageous. It is discovered that 100 g of phenylephrine and 8 g of norepinephrine are equivalent. Our research compared the efficacy of bolus doses of norepinephrine and phenylephrine in treating spinal hypotension during caesarean delivery.

Methodology

Between September 2021 and August 2022, with the consent of the patients and approval from the Institutional ethics committee, this prospective double-blinded randomized control experiment was carried out in a tertiary care teaching hospital. In the study, 50 term pregnant women between the ages of 18 and 50 who were carrying singletons and had ASA physical class I or II postings for elective caesarean sections under spinal anaesthesia were included.

The study excluded pregnant women with phenylephrine or norepinephrine allergies or hypersensitivity, heights of 140 cm or above, any pregnancy-related hypertension problems, cardiovascular or cerebrovascular disease, and foetal abnormalities. On the night before and the morning of the procedure, all parturient received oral doses of ranitidine 150 mg and metoclopramide 10 mg as premedication. An 18-gauge intravenous catheter was placed in the operating room, and baseline electrocardiogram, pulse oximetry, and noninvasive arterial pressure monitoring were established. The initial vitals were recorded. Then, 15 mL/kg of lactated Ringer's solution was poured onto them. Using a 25-G Whitacre needle in the left lateral position, a subarachnoid block was administered (at the L3-L4 or L4-L5 level using conventional method) with 1.8 mL of 0.5% hyperbaric bupivacaine and 0.2 mL of fentanyl.

With a wedge under the right buttock, the patients were then turned supine. A facemask was used to administer additional oxygen at a flow rate of 5 L/min. Ice cubes were used to measure the level of sensory blocking that could be achieved five minutes after intrathecal injection. The parturients were randomly assigned to groups 1 and 2 using computer-generated random numbers, and they were kept secret using the closed envelope approach. Drugs were loaded by the anaesthetist stationed in the recovery area. Norepinephrine and phenylephrine were diluted and placed into identically coded 10-mL syringes to produce norepinephrine at a concentration of 4 g/mL and phenylephrine at a concentration of 50 g/mL, respectively. A theatre-based anaesthetist treated the hypotension with a syringe labelled "vasopressor" while also gathering data for study.

Both the patient and the researcher were rendered blind by the vasopressor. Up until 10 minutes into the surgery, blood pressure and heart rate were checked every 2 minutes, and then every 5 minutes after that. When the systolic arterial pressure dropped below 20% of baseline, group 1 patients received a 50-gas intravenous bolus of phenylephrine and group 2 patients got a 4-gas intravenous bolus of norepinephrine. 10U of oxytocin were

administered as a gradual infusion following the delivery of the infant. The total dose of vasopressor and intravenous fluid infused intraoperatively, as well as the incidences of hypotension, bradycardia, tachycardia, and hypertension, were documented. Bradycardia was treated with intravenous atropine 0.6 mg and was defined as a heart rate (HR) of fewer than 50 beats per minute (bpm).

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The length of the surgery as a whole, the time from the skin incision to the baby's delivery, and the time from the uterine incision to the baby's delivery were recorded. There were also instances of nausea, vomiting, or dizziness brought on by maternal hypotension.

Our study's main goal was to examine the number of intravenous bolus doses of norepinephrine or phenylephrine needed to treat caesarean patients' spinal hypotension. Secondary goals included comparing maternal and foetal outcomes such the Apgar score and umbilical vein blood gases for bradycardia, hypertension, nausea, and vomiting.

A pilot research was undertaken with 10 patients in each group because there were no studies with the same dosage at the time of the study period in the body of existing literature, with respect to the main goal of the total number of doses administered in two groups. A minimum sample size of 25 in each group was determined using the mean and standard deviation (1.40 0.548 vs. 2.2 1.304), along with 95% confidence and 80% power. In graph pad 7.0, all of the statistical analysis were completed. For all continuous variables, the results are presented as mean standard deviation, and for categorical variables, as frequency.

The connection between two categorical variables was determined using Pearson's Chi-square test with continuity correction. For comparing the mean of continuous parameters between two groups, an independent sample t-test was used. The average Apgar score within the groups was compared using a paired sample t-test at 1 and 5 minutes.

A difference with a P value of 0.05 was deemed statistically significant.

Results

50 patients were enrolled in the trial, and they were split into two equal groups at random. The patient demographics for the two groups were comparable in terms of age, height, weight, and ASA physical status. (Table 1) At 5 minutes, all patients had sufficient spinal block height above T5, and there was little difference in dermatomal height between the groups. Additionally, the groups' surgery times required were comparable.(Table1, 2)

Table 1: Demographic parameters in Group 1(Norepinephrine) and Group2 (phenylephrine)

Demographic Parameters	Group 1 (Group N) Mean ± SD (N=25)	Group 2 (Group P) Mean ± SD (N=25)	p- value
Age (years)	30.56 ± 3.98	28.97 ± 3.78	0.15
Weight (Kg)	73.78 ± 13.67	74.34 ± 11.34	0.87
Height (cm)	156.32 ± 6.45	158.55 ± 5.33	0.18
ASA grade	**Group 1 (N=25) No. %**	**Group 2 (N=25) No. %**	
ASA 1	14 (56%)	16 (65%)	
ASA2	11 (44%)	9 (36%)	

Both groups experienced equivalent intraoperative blood loss and total intravenous fluid transfusions. Patients in Group 2 required significantly fewer vasopressor boluses to address hypotension (1.39 ± 0.45 vs. 2.28 ± 1.04, P = 0.001). Despite the fact that bradycardia occurred more frequently in Group 1 (4% vs. 20% P = 0.192), the difference was not statistically significant.(Table 4)

Table 2: Block parameters in Group 1and Group 2.

Parameters	Group 1 (Group N) (N=25)	Group 2 (Group P) (N=25)
Dermatomal block	No. %	No. %
T3	1 (4%)	2 (8%)
T4	20 (80%)	20 (80%)
T5	4 (16%)	3 (12%)

In both groups, maternal complications such nausea, vomiting, and shivering were comparable. Between the two groups, the foetal parameters were comparable, and no significant difference was seen.(Table 4)

Table 3: Surgical data in both Group 1 and Group 2

Parameters	Group 1 (Group N) Mean ± SD (N=25)	Group 2 (Group P) Mean ± SD (N=25)	p- value
Surgical time (Min)			
Induction to delivery	11.45 ± 2.67	10.00 ± 2.33	0.04
Skin incision to delivery	5.46 ± 1.71	5.44 ± 1.65	0.96
Uterine incision to delivery	2.10 ± 0.60	1.94 ± 1.03	0.50
Duration of surgery	69.50 ± 10.23	71.23 ± 9.56	0.53

Table 4: Hemodynamic variables and maternal complications

	Group 1 (Group N) Mean ± SD (N=25)	Group 2 (Group P) Mean ± SD (N=25)
No. of boluses of vasopressors	1.39 ± 0.45	2.28 ± 1.04
	No. %	**No. %**
Incidence of bradycardia	1 (4%)	5 (20%)
Maternal complications		
Nausea/vomiting	2 (8%)	2 (8%)
Shivering	4 (16%)	1 (4%)

Table 5: Foetal parameters in Group 1 and Group 2.

	Group 1 (Group N) Mean ± SD (N=25)	Group 2 (Group P) Mean ± SD (N=25)	P- value
Umbilical pH	7.32 ± 0.034	7.31 ± 0.44	0.91
pCO2	43. 86 ± 5.78	46.70 ± 1.12	0.01
pO2	28.18 ± 9.40	25.67 ± 5.86	0.26
Lactate	1.92 ± 0.433	2.30 ± 1.49	0.22
Apgar 1	8.1 ± 0.01	7.93 ± 0.64	0.19
Apgar 5	8.92 ± 0.27	8.88 ± 0.33	0.64

Both groups did not experience any instances of tachycardia or hypertension.(Table 4)

Discussion

The effects of intermittent bolus injections of norepinephrine and phenylephrine in treating spinal-induced hypotension after caesarean section were compared in the study. The study's findings demonstrated that intermittent intravenous norepinephrine boluses can effectively treat spinal hypotension without negatively affecting neonatal or maternal outcomes. Norepinephrine boluses were much more effective at maintaining blood pressure than phenylephrine boluses. In the norepinephrine group, bradycardia was less common.

Spinal hypotension has been treated with a variety of vasopressors. The preferred medication for obstetric patients is phenylephrine. The vasopressor can be administered intravenously or in the form of intermittent boluses to treat spinal hypotension. Infusions enable tighter blood pressure control with less anesthesiologist intervention. In low-resource situations where infusion pumps are not available or are only available in limited supply and hence cannot be made available to all parturient undergoing caesarean sections, the use of intermittent boluses of the medication may be viable. Therefore, even though phenylephrine infusions have been demonstrated to be superior than boluses, phenylephrine dosages are still often utilised in many centres to treat spinal-induced hypotension. Norepinephrine has the additional benefit of being more affordable than phenylephrine. The use of norepinephrine in the peripheral vein caused some worry. But when it was administered through a peripheral vein, there were no symptoms of ischemic problems in the limbs [8-11].

The use of ephedrine was linked to neonatal acidosis, according to studies contrasting its usage with that of phenylephrine for treating spinal hypotension in obstetric patients. Even though cardiac output and HR were better

sustained with ephedrine, less neonatal acidosis was observed with the administration of phenylephrine, according to their randomised control experiment on cardiac output alterations with phenylephrine and ephedrine. Consequently, phenylephrine, a short-acting adrenergic agonist, is now viewed as the primary treatment for hysteria. caesarean section posttension However, it is connected to a decrease in cardiac output and HR, which may not be good for the mother or the foetus. For the treatment of spinal-induced hypotension after caesarean delivery, norepinephrine boluses have recently been recommended as an alternative to phenylephrine boluses. As a result, phenylephrine, a short-acting adrenergic agonist, is now regarded as the primary treatment for hypotension following caesarean delivery. However, it is linked to decreased cardiac output and HR, which may be harmful to the mother and the foetus. For the treatment of spinal-induced hypotension after caesarean delivery, norepinephrine boluses have recently been recommended as an alternative to phenylephrine boluses. Norepinephrine has strong vasoconstrictor effects in addition to having adrenergic properties. As a result, it is linked to a reduction in cardiac output or a reduction in bradycardia incidence [12-17].

The equivalent dosages of norepinephrine and phenylephrine have been determined through a number of investigations. The norepinephrine intermittent bolus dosage has an ED 90 of 6 g. We used 4 mg of norepinephrine to treat hypotension based on the findings of the study by Ngan Kee *et al*. since 4 mg of norepinephrine was found to be equivalent to 50 mg of phenylephrine. Norepinephrine was shown to be 11 times more potent than phenylephrine in a study by Mohta *et al*., and 100 g of phenylephrine was about equivalent to 9 g of norepinephrine. AM Sharkey *et al*.

The haemodynamic control during caesarean section was found to be better with norepinephrine due to decreased changes in HR when phenylephrine and norepinephrine were tested at bulk dosages of 100 and 6 mg, respectively. Norepinephrine intermittent bolus dose was compared to phenylephrine and ephedrine and was found to be a powerful medication to treat spinal hypotension. Norepinephrine and phenylephrine were shown to have comparable efficacy in controlling maternal hypertension by Xu *et al* in a systematic review and meta-analysis [7,18-22]. Ngan Kee and others employed a 5 g/mL infusion of norepinephrine and discovered that it was successful at maintaining blood pressure with no negative effects on newborn outcomes. Norepinephrine prophylactic infusions were also employed to maintain maternal blood pressure without causing any negative neonatal effects [6,23].

Although norepinephrine administration through peripheral veins is controversial, none of our patients had any negative side effects from its administration. The primary drawback of the current study was that we didn't track the cardiac output while using vasopressor to maintain the systolic pressure. Non-invasive cardiac output monitoring was an option. Additionally, a bigger sample size might have offered a more comprehensive view of the impacts on both the mother and the foetus. In this investigation, we discovered that intermittent norepinephrine boluses are useful for treating spinally caused hypotension after caesarean delivery. With norepinephrine infusions that are either intermittent or continuous, the trial can be expanded to include more individuals.

Conclusion

Norepinephrine intermittent boluses are useful for controlling spinal-induced hypotension after caesarean delivery. In addition to phenylephrine, the newborn arterial blood gases and Apgar scores can be compared. Boluses of norepinephrine can be used as an alternative to phenylephrine.

Ethical approval: The study was approved by the Institutional Ethics Committee

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