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Original Research Article

A Comparative Study on the Use of Prophylactic Intravenous Ephedrine to Reduce Hypotension During Spinal Anaesthesia for Caesarean Sections

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Abstract

Background: The most frequently used and favoured method for caesarean birth is spinal anaesthesia. It is however linked to hypotension, which is harmful to the mother and foetus. The goal of the study is to ascertain how bolus intravenous ephedrine can reduce spinal-induced hypotension. Due to decreased uteroplacental blood flow, regional anaesthetic for Caesarean delivery is linked to a high prevalence of maternal hypotension and may cause foetal acidemia. Preloading with fluids, avoiding aortocaval compression, and giving vasopressor medications are all common ways to prevent or treat this hypotension. Many vasopressor medications, including ephedrine, mephentermine, methoxamine, metaraminol, phenylephrine, angiotensin II, dopamine, and dobutamine, have been researched for this purpose. Both phenylephrine and ephedrine are used to avoid maternal hypotension, but each has disadvantages of its own.

Aim: The study has been undertaken to determine the effect of bolus intravenous ephedrine in ameliorating spinal-induced hypotension.

Material and Method: The research was carried out in the anesthesiology department and was randomised, prospective, and double-blind. The 40 participants were divided into two groups of 20 patients each by computer-generated randomization after receiving approval from the Institutional Ethics Committee and written informed consent from the 40 primiparous term participants, aged 19 to 42 and American Society of Anesthesiologists I, who were scheduled for an elective caesarean section. Group 1 (study group) was given 1 ml of 5 mg of injection ephedrine intravenously, and Group 2 (control group) was given an ephedrine placebo.

Results: Episodes of hypotension, reactive hypertension, the number of patients who needed rescue ephedrine, the total dose of rescue ephedrine (mg), bradycardia, nausea, and vomiting, as well as the average length of labour in the two groups are all factors to consider. The incident episode of hypotension in the ephedrine group was marginally lower than in the control group, necessitating an ephedrine injection to restore blood pressure. Neonatal outcome data, including umbilical cord blood pH and Apgar scores at 1 and 5 minutes, were comparable across the two groups, and no discernible difference was seen.

Conclusion: While being lower than in the control group, prophylactic intravenous ephedrine 5 mg bolus administration did not significantly reduce the incidence of maternal hypotension. We advise trying doses more than 5 mg in order to effectively treat hypotension. Following spinal anesthesia-induced hypotension during an elective caesarean section, intravenous norepinephrine is more effective than mephentermine in terms of response percentage to the first dose and

maintaining a stable maternal heart rate without having any unfavourable effects on the Apgar score.

Keywords: Cesarean Section, Hypotension, Intravenous Bolus Ephedrine, Spinal Anaesthesia-Induced Hypotension, Ephedrine and Phenylephrine

Introduction

Both elective and emergency caesarean sections frequently employ spinal anaesthetic. When general anaesthesia is avoided, anesthesia-related maternal mortality is reduced [1]. The percentage of women having caesarean sections has been continuously rising [2]. Today, the recommended procedure for lower abdomen surgery is spinal anaesthesia [3]. Yet, because of sympathetic blocking, hypotension is the neuraxial blocks' most frequent adverse impact in pregnant individuals. If left untreated, spinal-induced hypotension and the gravid uterus's constriction of the inferior vena cava in the pregnant patient further hinder venous return, which can result in both maternal and uterine hypoperfusion [4]. Hence, when weighing the risks and advantages to the mother and the foetus, regional anaesthetic for elective caesarean section is frequently the favoured choice of providers. Due to anaesthetic blocking up to the T4 level, spinal anesthesia-induced hypotension (SAIH) is documented in 80% of parturients undergoing caesarean section (CS). Both the mother and the child suffer consequences from severe and prolonged SAIH [5]. For SAIH, many methods and different vasopressors have been tried and evaluated, but no one treatment has been shown to be sufficient or superior [6].

The preferred treatment and prophylaxis for hypotension that develops after spinal anaesthesia in pregnant women is ephedrine. Recently, though, there have been questions raised about its use due to side effects include supraventricular tachycardia, tachyphylaxis, and the potential for foetal acidosis [7,8]. Ephedrine is a powerful sympathomimetic medication that acts both directly and indirectly on adrenergic nerve endings and has both a- and b-adrenergic agonist effects. A more notable action is cardiac stimulation, which raises blood pressure and cardiac output [9].

The most frequently prescribed medication for treating hypotension brought on by regional anaesthesia in obstetrics is ephedrine. According to a survey, 95% of consultant obstetric anaesthetists in the UK use it as the only vasopressor [10]. Current results show that using ephedrine worsens foetal acidosis and show the superiority of alternative vasopressor medications such angiotensin II, phenylephrine, and metaraminol [11,12].

A powerful alpha- and beta-agonist, ephedrine operates through both direct and indirect routes. Because it has been demonstrated to have a greater protective effect on uterine blood flow and perfusion pressure than adrenergic agonists in gravid ewes and humans, it has become the vasopressor of choice [13]. Ephedrine administration has been discovered to be significantly linked to increased foetal heart rate and beat-to-beat variability, however.

The assessment of foetal scalp blood pH and Apgar scores indicate that these alterations are dose-related and unrelated to foetal hypoxia [14]. In the prevention of hypotension during spinal anaesthesia for elective caesarean section, prophylactic ephedrine administered by conventional infusion set was more successful than crystalloid hydration. There are, however, few trials on the use of prophylactic intravenous bolus ephedrine for

preventing spinal-induced hypotension in pregnant women [15].

Maternal hypotension can be prevented and treated with phenylephrine, a potent -agonist of sympathetic receptors. While it lessens the likelihood of nausea, vomiting, and foetal acidity, it may also result in maternal bradycardia and a reduced cardiac output in some women. Thus, it is rare to utilise phenylephrine, especially for the prevention of hypotension [16]. Mixing medications reduces the amount of each medication, which reduces the amount of each drug's undesirable effects [17]. The purpose of the current study is to investigate the role of intravenous bolus ephedrine in treating post-intrathecal bupivacaine hypotension during caesarean delivery. The lack of studies examining the impact of vasopressors prior to spinal injection was the driving force for this topic.

Material and Methods

The randomised, prospective, double-blind trial was carried out in the anesthesiology department. 40 primiparous term participants who were scheduled for an elective caesarean section and who provided written informed consent to the Institutional Ethics Committee were divided into two groups of 20 patients each by computer-generated randomization. Group 1 (study group) received 1 ml of 5 mg of injection ephedrine intravenously, while Group 2 (control group) received an ephedrine placebo. All of the patients received thorough explanations of the procedure in their native tongues, and informed consent was obtained. Data from typical deliveries were used for prospective power analysis to look for potential variations in umbilical cord blood gases.

Exclusion Criteria:

The study excluded participants with known foetal abnormalities, more than expected blood loss, cardiovascular or cerebrovascular disease, hepato-renal disease, diabetes mellitus, allergy to study drugs, not required study drugs intraoperatively, intraoperative use of uterotonic other than oxytocin, and contraindication to SAB.

Statistical Analysis

The Statistical Package for Social Sciences was used to do statistical analysis on the acquired data after entering them into a computer (SPSS Inc., version 21, Chicago, IL, USA). The independent sample t-test was used to compare continuous data, the Chi-square test was used to compare categorical variables, and P 0.05 was regarded as statistically significant.

Result

The trial protocol was followed by all 40 subjects. Age, height, and weight of the patients were unremarkable and equivalent. With the exception of the fourth minute in the ephedrine group, where it was minor, the systolic blood pressure decreased markedly from its baseline value in both groups at various time intervals.

Table 1: Comparison of hemodynamic data and other variables in the two groups

Parameter	N (%) or mean ± SD	
	Group 1 (n=20)	Group 2 (n=20)
Hypotension	12 (60)	15 (72)
Reactive hypertension	0	0
Rescue ephedrine	12 (60)	15 (72)
Rescue ephedrine dose (mgs)	2.01±0.3	3.02±0.2
Bradycardia	0	0
Nausea and vomiting	0	0
Average time of baby delivery	2.82±0.53	2.77±0.55

Table 1 compares the rates of hypotension episodes, reactive hypertension, the number of patients who needed rescue ephedrine, the total dose of rescue ephedrine (mgs), bradycardia, nausea, or vomiting, and the typical time for baby delivery in the two groups. The incident episode of hypotension in the ephedrine group was marginally lower than in the control group, necessitating an ephedrine injection to restore blood pressure. Reactive hypertension did not occur in either group. Also, the ephedrine group documented patients who required rescue ephedrine as opposed to patients in the control group. When compared to the control group, the ephedrine group needed less rescue ephedrine, however the difference was statistically insignificant. In both groups, the average delivery intervals were brief and comparable. In neither of the two groups were there any instances of bradycardia episodes, nausea, or vomiting.

Table 2: The distribution and comparison of neonatal outcome data in the two groups

Parameter	N (%) or mean ± SD	
	Group 1 (n=20)	Group 2 (n=20)
Apgar score at 1 min	5.92±0.12	5.82±0.30
Apgar score at 5th min	6.93±0.17	6.72±0.28
Umbilical cord blood pH	5.22±0.03	5.19±0.02

Neonatal outcome data, including umbilical cord blood pH and Apgar scores at 1 and 5 minutes, were comparable across the two groups and no discernible difference was seen. The maximum percentage decrease in SBP as compared to baseline was significantly correlated with umbilical arterial pH, according to the stepwise multiple regression analysis. However, there was no correlation between umbilical artery pH and other factors like the time from uterine incision to delivery, the total amount of vasopressor medication used, or the duration of hypotension in either group.

Discussion

An prominent side effect of spinal anaesthetic is hypotension, which requires fast and appropriate treatment to avoid foetal acidemia. According to the findings of our study, mephentermine is just as effective as ephedrine in maintaining the mother's blood pressure while she is under spinal anaesthetic, and both medications have comparable impacts on the newborn's outcome in terms of umbilical artery pH and Apgar score. Apgar scores have been reported by Sahu *et al*.2003 [18], the only study in the literature comparing ephedrine and mephentermine administered as an intravenous bolus for the treatment of hypotension associated with spinal anesthesia during Caesarean section. They did not, however, examine how these medications affected the pH of the umbilical artery. Ours is the first study to compare the newborn outcome after ephedrine and mephentermine use in terms of umbilical arterial pH.

Ephedrine does not have strong arterial vasoconstriction properties; instead, it raises cardiac output and heart rate to maintain blood pressure. 19 This may be the cause of the negative effects, such as reactive hypertension, which is often defined as systolic blood pressure >140 mmHg, that are linked to large doses of prophylactic intravenous ephedrine. 20 In our study, we found that both groups' systolic and diastolic blood pressure significantly decreased with time, with the exception of the early fourth minute in the ephedrine group, which may be related to the bolus ephedrine's protective effect against hypotension. Our findings are different from those conducted by Ngan Kee *et al*.2000. [21] Vercauteren *et al*.2000 [20] and Iqbal *et al*.2010 [22] where they recorded an insignificant fall in BP which may be due to the lower dose of bupivacaine against 10 mg in our study, even though they used 5 mg bolus ephedrine. Again, Ngan Kee *et al*.2000 [21]

and Iqbal *et al*.2010 [22] used higher doses of ephedrine

When Modak A, *et al* [23]. compared the boluses of mephentermine and phenylephrine for maintaining arterial pressure during spinal anaesthesia in CS, they discovered a significant increase in HR following a bolus dose of mephentermine as compared to phenylephrine when compared to the values at the onset of hypotension due to its -agonist property. Norepinephrine and phenylephrine were compared by Ngan Kee *et al* [21] for maintaining SBP in CS with a computer-controlled closed-loop feedback system during spinal anaesthesia. They found a larger response percentage, which is well aligned with our finding.

Because norepinephrine has a quicker onset of action and a shorter half-life than mephentermine, there may be a connection between the higher response rate with norepinephrine and the need for numerous boluses in our trial. The effectiveness of various intermittent intravenous norepinephrine boluses to avoid SAIH after caesarean delivery was examined by Onwochei *et al* [24]. The acquired results were plausible and did not significantly coincide with our study's findings in terms of detrimental effects on the mother or the foetus.

Amira Abo Elnasr Awad 2019 [25] and El Shafei MM, *et al*. 2015 [26] compared 5µg norepinephrine with 5mg ephedrine to prevent SAIH in lower limb orthopedic surgery and coronary artery disease patients undergoing knee arthroscopy. They discovered that norepinephrine is more efficient than ephedrine at maintaining blood pressure and has less of a negative impact on patients' heart rates. Despite the fact that we studied pregnant women, these findings are consistent with those of our study. Ngan Kee *et al*.2000 [21] conducted a comparative dose-response analysis and revealed relative potency for norepinephrine: phenylephrine when given as a bolus for restoring BP in SAIH in obstetric patients to be 13.1:1.0 and found that phenylephrine 100µg was equivalent to norepinephrine 8 µg, although in the previous dose-finding study bolus injection of 6µg norepinephrine was reported effective. Hence, using 8 mg of norepinephrine and 6 mg of mephentermine as equivalent doses, we calculated the relative potency of the two drugs.

In our study, both groups' apgar values at the first and fifth minutes were greater than 7. Both groups experienced the same level of maternal unfavourable occurrences. Bradycardia was not regarded in our study as a negative event or consequence. Bradycardia-affected expectant mothers were eliminated from the study because they were receiving injection atropine, which could have impacted their blood pressure and tampered with the data. As all of the parturients involved in the study suffered hypotension, hypotension was not noted as an adverse event or consequence. The majority of the studies we reviewed included all participants as denominators or included patients with bradycardia as part of the denominator to calculate the incidence of adverse events/complications, which is why the incidence of adverse events in our study is inconsistent with those studies' results.

The fact that we only extended the research time till the conclusion of surgery when it should have continued until the SAB passing-off effect was one of the study's weaknesses. Analysis of umbilical blood was not studied to assess the newborn outcome.

Conclusion

While being lower than in the control group, prophylactic intravenous ephedrine 5 mg bolus administration did not significantly reduce the incidence of maternal hypotension. We advise trying doses more than 5 mg in order to effectively treat hypotension. Following spinal anesthesia-induced hypotension during an elective caesarean section, intravenous norepinephrine is more effective than mephentermine in terms of response

percentage to the first dose and maintaining a stable maternal heart rate without having any unfavourable effects on the Apgar score. Although norepinephrine and mephentermine intravenous boluses are equally effective in maintaining systolic blood pressure, norepinephrine requires more boluses than mephentermine.

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