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Original Research Article

Prevention of Hypotension During Spinal Anaesthesia for Caesarean Delivery: Comparative Study of Different Doses of Phenylephrine

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Conflict of interest: Nil

Abstract:

Objective: To compare between the different doses of phenylephrine for the prevention of hypotension and which dose regimen is more responsible for producing adverse effects like bradycardia after spinal in caesarean section.

Methods: A prospective, observational, comparative study in which 54 patients were included in the study with 18 patients in each of the three group.

Group A: include cases which get 25mcg/min infusion of phenylephrine.

Group B: include cases which get 50mcg/min infusion of phenylephrine.

Group C: include cases which get 100mcg/min infusion of phenylephrine.

The baseline blood pressure was measured . The Phenylephrine infusion was started just after giving the spinal anaesthesia at a dose as per the patient's group. Heart Rate and Blood Pressure were measured at every 1minute interval intra-operatively till the delivery of the baby, and Apgar Score were measured at 1minute and 5 minute after the delivery of the baby. Any intervention like administration of atropine or administration of phenylephrine bolus were also noted.

Results: Demographic differences between the three study groups were not significant. The decrease in heart rate (bradycardia) was statistically significant between three groups. (p value < 0.05) The episodes of hypotension were also statistically significant between the three groups. (p value <0.05). Bradycardia, Nausea, Vomiting were also not present with infusion dose of 50mcg/min.

Conclusion: Phenylephrine infusion dose of 50mcg/min, prevents hypotension more effectively, after administration of Spinal anesthesia in Caesarean Section, as compare to infusion dose of 25mcg/min and 100mcg/min. Bradycardia, Nausea, Vomiting were also not present with infusion dose of 50mcg/min. Hence, Phenylephrine infusion dose of 50mcg/min, prevents hypotension more effectively.

Keywords: Phenylephrine infusion . hypotension. Spinal anesthesia . Caesarean Section

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Introduction

Spinal anesthesia (SA) is a preferred technique for cesarean delivery because of its distinct advantages over general anesthesia (GA) like avoidance of airway-related complications, aspiration, neonatal depression with anesthetic agents, and ability of mother to enjoy the birth experience of her baby. Pregnant females at term are susceptible for hypotension, especially in the supine position and with sympathetic blockade of SA; there is a decrease in systemic vascular resistance (SVR) causing a reduction in venous return, cardiac output, and dependent uterine blood flow.[1] Apart from the above mechanisms, aortocaval compressions and contracted sub-arachnoid space also been responsible for causing hypotension after spinal anaesthesia.

Spinal-induced hypotension for cesarean delivery is a frequently encountered problem, with a reported incidence of about 80%. Morbidity includes maternal nausea, vomiting, and dizziness. If hypotension is prolonged, impairment in placental blood flow and fetal acidosis may occur. Many strategies have been described to prevent and treat hypotension in the obstetric population. There has been growing evidence to support the use of coloading with IV fluids along with the use of vasopressors.

Preloading with crystalloid alone has a poor efficacy in preventing hypotension, due to rapid redistribution into the extracellular space, while colloid has been more effective. Although commonly used, synthetic colloids such as hydroxyethyl starch are more expensive than crystalloid; side effects of colloids include pruritis, anaphylactoid reactions, association with kidney injury, and coagulopathy.

The ideal vasopressor would maintain maternal cardiovascular stability and prevent nausea and

vomiting, but have little adverse effect on uteroplacental perfusion, therefore no adverse effects on foetus. The ideal vasopressor always been in much controversy and debate, but it is now widely accepted that the vasopressor of choice in the parturient is phenylephrine. Large doses of vasopressor are commonly required during cesarean delivery after spinal anesthesia because of increased baroreceptor sensitivity. There have been concerns that large doses of phenylephrine, helpful in maintaining maternal systolic blood pressure (SBP), but can cause reflex bradycardia and consequently a reduction in cardiac output (CO).[4]

However, in ex vivo studies, phenylephrine has been shown to improve fetal arterial perfusion more effectively than ephedrine, which is known to cross the placenta, resulting in increased fetal heart rate (HR), HR variability, and fetal acidosis. Although previous work has demonstrated that maternal CO correlates closely with uteroplacental blood flow, most of the work done till now examining the cardiovascular effects of phenylephrine has focussed on its effect on maternal heart rate (HR) and SBP. It is a long-held belief that measurements of SBP can be used as alternative for maternal CO in predicting uterine blood flow, because of the absence of a reliable non-invasive method of assessing maternal CO.

Despite of countless research studies on this issue, the search for ideal technique or agents for attenuation of hypotension is still going on. A drug which does not affect heart rate or influence CO with maintenance of blood pressure without causing any side effect.

Materials and Methods

Approval for the study was taken from the institutional ethical committee and written informed consent from the scheduled participant was taken before enrolling them into study.

Study Site: Apollo Gleneagles Hospitals Limited, Kolkata.

Study Population: Patients admitted in Apollo Gleneagles Hospitals Limited, Kolkata during the study period for elective caesarean section under spinal anaesthesia (only that patient which comes under inclusion criteria).

Study Design: A prospective, observational, comparative study.

Time Frame of Study: Time frame of study was from 1-1-2015 to 30-9-2015.

Sample Size: 54 were included in the study with 18 patients in each of the three group.

Inclusion Criteria

- A healthy female with full term gestation
- Age 20-40years
- Weight 40-80 Kg.

Exclusion Criteria

- Patients' refusal for Spinal anaesthesia
- ASA grade II,III and IV
- Age < 20 years &> 40 years

Methodology

Study Groups: Equal number of patients were taken (18 patients in each group) in all three groups.
Group A: include cases which get 25mcg/min infusion of phenylephrine.
Group B: include cases which get 50mcg/min infusion of phenylephrine.
Group C: include cases which get 100mcg/min infusion of phenylephrine.
Procedure: Nil per oral status was confirmed. Intravenous line was secured and intravenous fluid was started using ringer lactate. Standard intra-operative monitoring including non-invasive blood pressure (NIBP), ECG, SpO_2 were initiated and continued peri-operatively.

The baseline blood pressure was measured in the pre-operative area just before taking the patient into the OT. The Phenylephrine infusion was started just after giving the spinal anaesthesia at a dose as per the patient's group.

Parameters observed

- Heart rate (HR)
- Systolic blood pressure (SBP)
- Diastolic blood pressure (DBP)
- Apgar Score

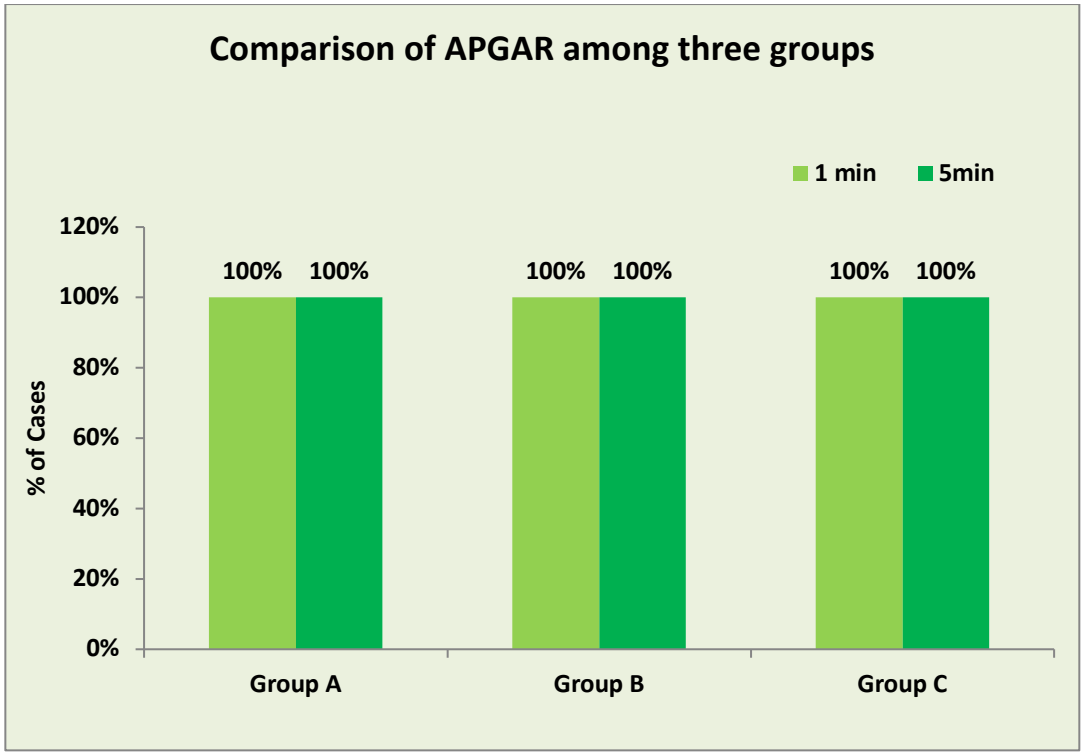
Heart Rate and Blood Pressure were measured at every 1 minute interval intra-operatively till the delivery of the baby, and Apgar Score were measured at 1minute and 5 minutes after the delivery of the baby. Any intervention like administration of atropine or administration of phenylephrine bolus were also noted.

Observation Chart

Table 1: Weight, Height and BMI among all three groups

	Group A (n=18)	Group B (n=18)	Group C (n=18)	P Value
	Mean ± SD	Mean ± SD	Mean ± SD	
Weight	62.17 ± 8.29	68.39 ± 8.52	65.56 ± 11.01	0.146
Height	156.17 ± 8.43	154.11 ± 9.67	155.67 ± 7.20	0.752
BMI	25.64 ± 4.08	29.00 ± 4.37	27.05 ± 4.14	0.064

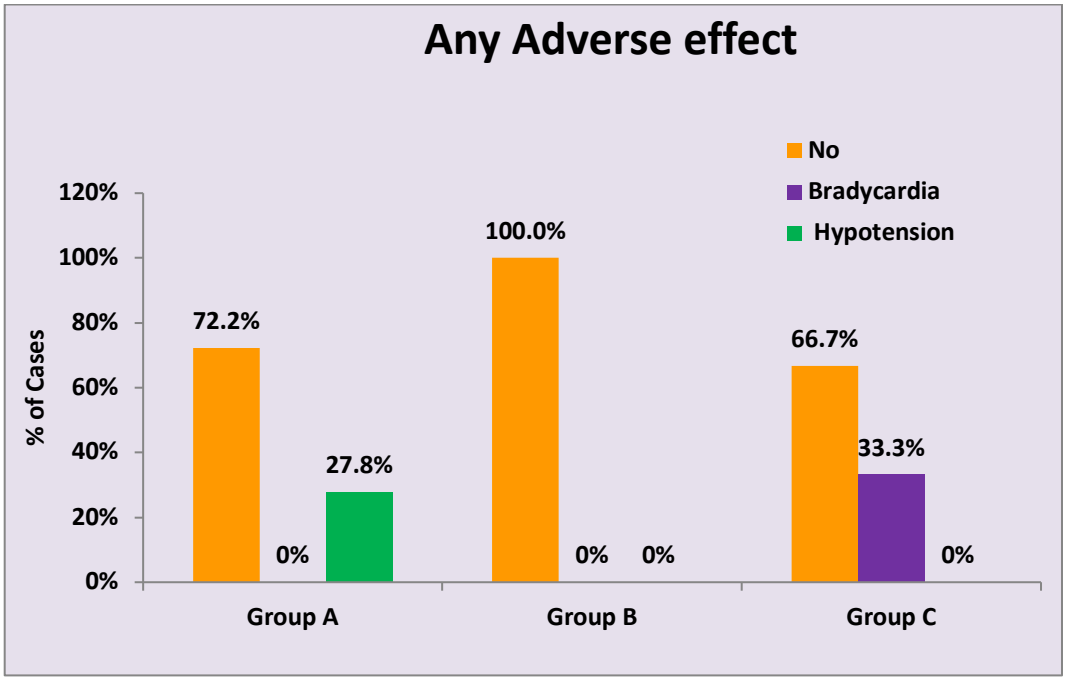
Weight, Height and BMI of all the three groups are comparable and were statistically non-significant.



Graph 1:

Table 2: Comparison Of Side Effects

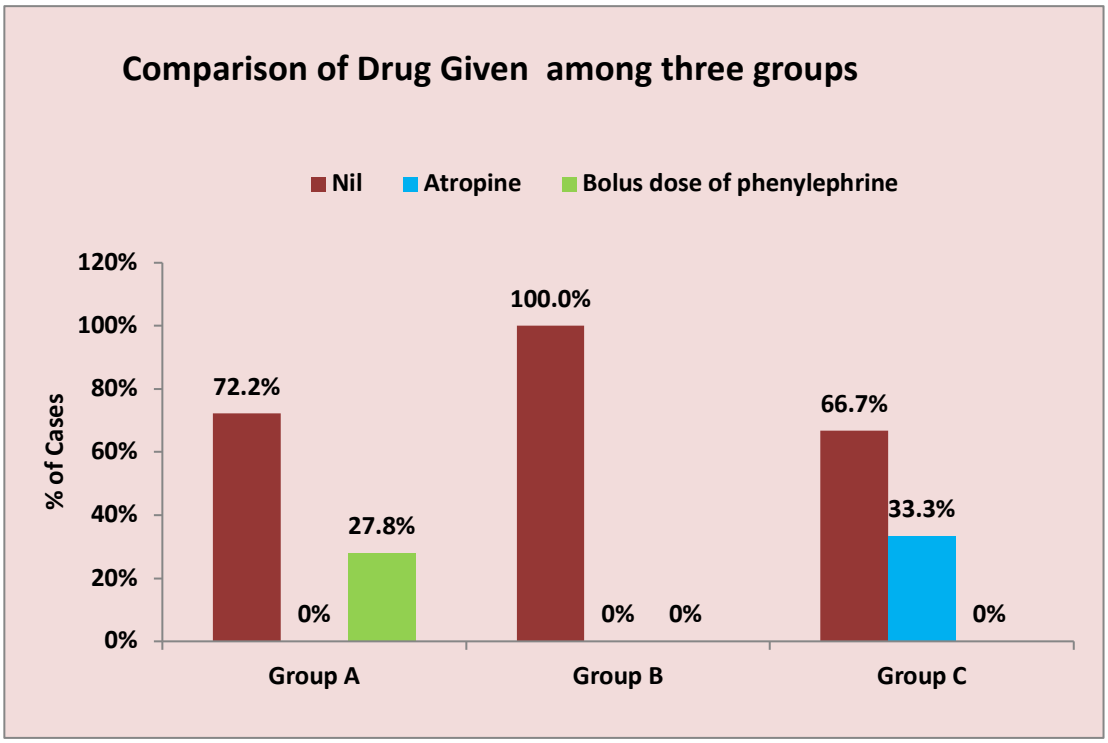
Any Adverse effect	Group A (n=18)	Group B (n=18)	Group C (n=18)	P Value
	Frequency (%)	Frequency (%)	Frequency (%)	
No	13(72.2%)	18 (100%)	12 (66.7%)	<0.001
Bradycardia	0 (0.0%)	0 (0.0%)	6 (33.3%)	
Hypotension	5 (27.8%)	0 (0.0%)	0 (0.0%)	
Total	18 (100%)	18 (100%)	18 (100%)	



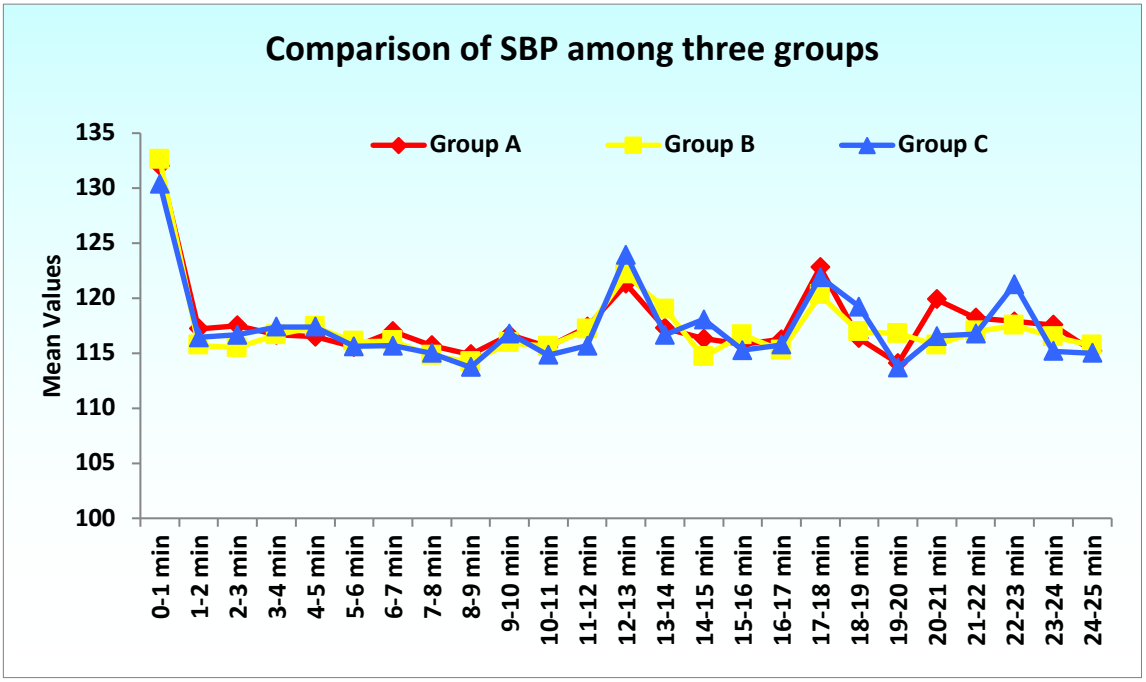
Graph 2: Bar diagram showing adverse effects in between groups.

Table 3: Showing any drug intervention during the study

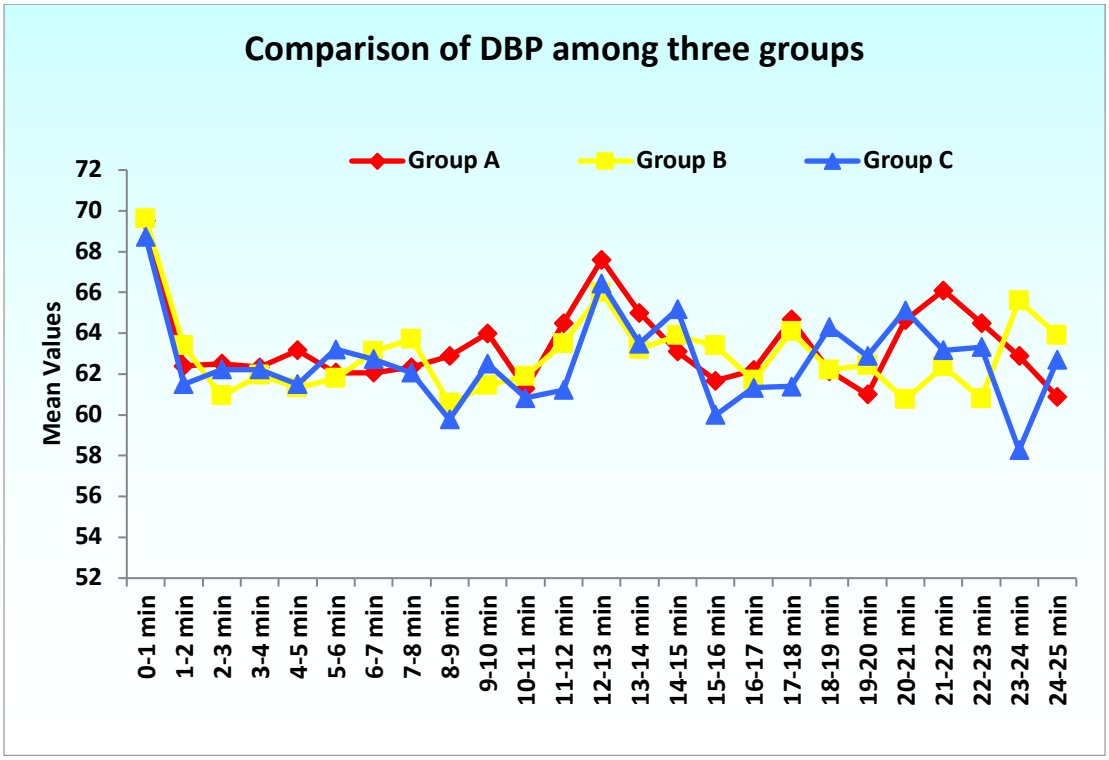
Any Drug Given	Group A (n=18) Frequency (%)	Group B (n=18) Frequency (%)	Group C (n=18) Frequency (%)	P Value
Nil	13(72.2%)	18 (100%)	12 (66.7%)	<0.001
Atropine	0 (0.0%)	0 (0.0%)	6 (33.3%)	
Bolus dose of phenylephrine	5 (27.8%)	0 (0.0%)	0 (0.0%)	
Total	18 (100%)	18 (100%)	18 (100%)	



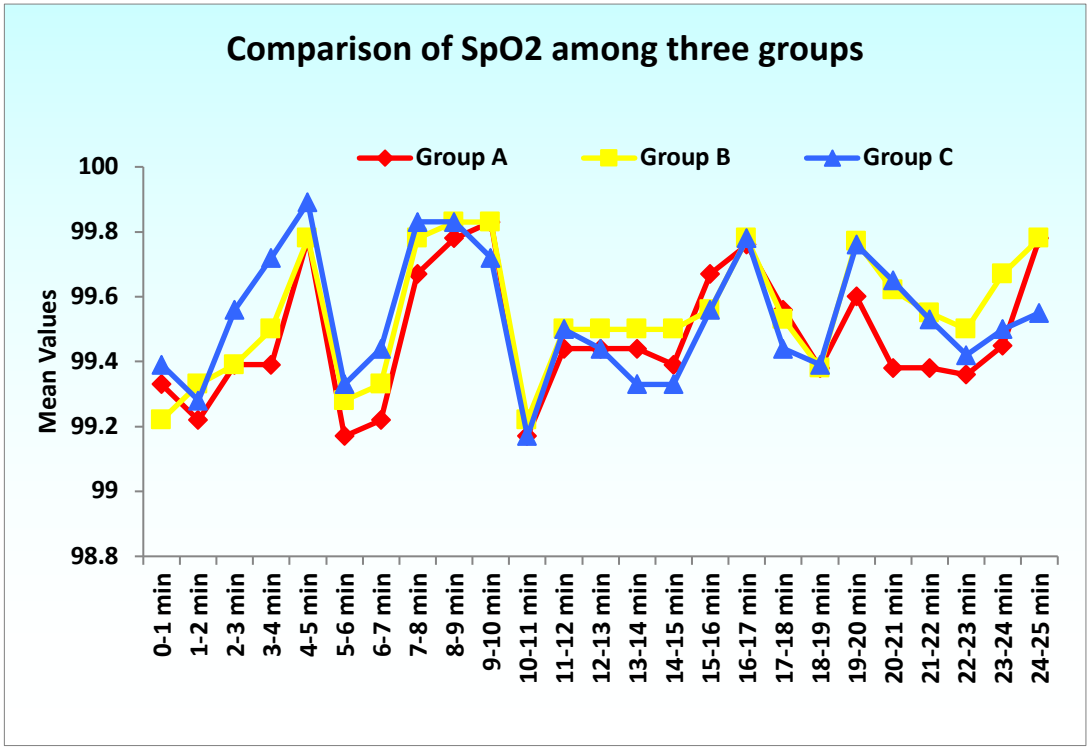
Graph 3: Bar diagram showing any drug intervention in between groups.



Graph 4: Line diagram showing comparison of systolic blood pressure changes between three groups at different points of time



Graph 5: Line diagram showing comparison of diastolic blood pressure changes between three groups at different points of time



Graph 6: Line diagram showing comparison of Spo2 between three groups at different points of time

Results

- Demographic differences between the three study groups were not significant.
- The decrease in heart rate (bradycardia) was statistically significant between three groups. (p value < 0.05)
- The episodes of hypotension were also statistically significant between the three groups. (p value <0.05)

Statistical Analysis

Categorical variables will be expressed as Number of patients and percentage of patients and compared across the groups using Pearson's Chi Square test for Independence of Attributes. Continuous variables will be expressed as Mean ± Standard Deviation and compared across the groups using ONE WAY ANOVA if the data follows normal distribution and Kruskal allis test if the data does not follow normal distribution. The statistical software SPSS version 20 will be used for the analysis. An alpha level of 5% has been taken, i.e. if any p value is less than 0.05 it will be considered as significant.

Discussion

In pregnant women at term, spinal anesthesia typically causes hypotension and an increase in CO, because of an increase in SV and HR, to compensate for a decreasing vascular resistance. The administration of phenylephrine in high doses, to increase vascular tone and maintain BP, results in a baroreceptor-mediated decrease in HR, which can decrease CO. It also increases the splanchnic arterial tone resulting in decreased splanchnic blood flow and decreased venous return, and SV may decrease as a result, further reducing CO. However, myocardial contractility may also increase in the face of increased vascular resistance, which may help to maintain SV. This is known as the Anrep effect.

HR is now regarded as the best surrogate marker for CO during cesarean delivery under spinal anesthesia. The activation of the baroreflex by a rapid increase in BP has been shown, in nonpregnant subjects, to produce a greater decrease in HR than with a more gradual increase in BP. Many different strategies have been investigated for the prevention of hypotension (usually defined as a decrease in systolic arterial blood pressure [SAP] by more than 20%–30% or to <90–100 mm Hg). Hypotension after spinal anaesthesia may cause nausea, vomiting, or low apgar scores.

Various studies have used various methods to prevent hypotension after spinal anaesthesia. Ngan Kee WD et al, Allen, Terrence K. et al have used the infusion regimens of phenylephrine like the present study. Ngan Kee WD et al compared between the different infusion regimens of phenylephrine, which is in concordance with the present study. While the Allen, Terrence K. et al have used the phenylephrine infusion but intermittently whenever the B.P. goes down unlike the present study, in which the infusions have been used continuously. While some like Ansari T et al, also observed the combined effects of phenylephrine with co-loading of IV fluids.

Demographic Data: The demographic data of age, weight, height and BMI were comparable, which is in concordance with Ngan Kee WD et al and Doherty A et al.

Apgar Scores: Vasocontrictors, as they may cause changes in uteroplacental circulation, so there are chances that they may cause fetal acidosis and low apgar scores, which are usually measured at 1 min and 5min intervals. In the present study, there are no changes in the Apgar scores and all are found to be more than 7, this finding is concordance with Fábio Farias de Aragão et al., Allen, Terrence K. et al, Doherty A et al., Seppo Alahuhta et al., Ansari T et al, which also shows no changes in Apgar scores.

Adverse Effects

Bradycardia: In the present study, in group C, which has received 100mcg/min infusion dose of phenylephrine, had 6 cases out of 18 (33.3%), which had an episode of bradycardia, and is statistically significant, and is concordance with Ansari T et al, which also had significant bradycardia in group which is receiving 100 mcg/min infusion of phenylephrine.

Present study also in concordance with Ngan Kee WD, Khaw KS, Ng FF, Lee BB study, where they must discontinue infusion of phenylephrine, however, not required administration of atropine. They have found significant difference in heart rates between infusion and control groups, two patients in their study had episode of bradycardia (HR<50). Present study not in concordance with Doherty A et al, das Neves JF et al, Allen, Terrence K. et al, Ngan Kee WD, Khaw KS, Ng FF.

Doherty A et al, finds less episodes of bradycardia in bolus group, which is around 30% predelivery as compare to infusion group where the episodes of bradycardia is slightly more 36.7% predelivery, however, the episodes of bradycardia post-delivery is same 3.3%. However, das Neves JF et al, observed almost identical incidence of bradycardia in their three groups who were receiving infusion, bolus and rescue doses respectively.

Allen, Terrence K. et al, in their study found no differences in the incidence of bradycardia among the groups. They also compared between 25mcg/min, 50mcg/min, 75mcg/min and 100mcg/min, where 25mcg/min and 50 mcg/min groups require less interventions as compare to 75mcg/min and 100mcg/min groups.

Hypotension: In present study, in group A, which had received 25mcg/min of phenylephrine infusion, 5 out of 18 cases (27.8%) had an episode of hypotension, which required an additional bolus of phynylephrine, and this is a statistically significant finding, and is in concordance with Ngan Kee WD, Khaw KS, Ng FF, which also had hypotensive episodes in the groups which has assigned lower percentage of systolic blood pressure baseline values.

But present study is not concordant with das Neves JF et al and Doherty A et al, which did not find any significant episodes of hypotension. In study of Doherty A et al, the infusion and bolus doses almost had same episodes of hypotension, in predelivery (23.3%; 26.7%) and post-delivery periods (10%; 6.7%) respectively.

Atropine administration after bradycardia: In the present study, as there were 6 out of 18 cases had an episode of bradycardia, which necessitate the administration of atropine in all the 6 cases and is statistically significant, but this is not in concordance with Ngan Kee WD, Khaw KS, Ng FF, Lee BB, as in their study after the stopping of the administration of phenylephrine infusion, which causes bradycardia to settled down and need of atropine was not there. Present study is also not in concordance with Ansari T et al.

Conclusion

From the present study, it can be concluded that the patients in Group B, who received 50mcg/min of infusion dose of phenylephrine, have showed better control of Blood Pressure and Heart Rate, without any adverse effects on Apgar Scores as compare to Group A and Group C, who received 25mcg/min and 100mcg/min of infusion doses, respectively. Side effects like Bradycardia, Nausea, Vomiting were also not present with infusion dose of 50mcg/min. Hence, Phenylephrine infusion dose of 50mcg/min, prevents hypotension more effectively, after administration of spinal anaesthesia in caesarean section, as compare to infusion dose of 25mcg/min and 100mcg/min.

Recommendation

Phenylephrine infusion proved to be a better alternative for prevention of hypotension after spinal anaesthesia in elective caesarean sections. But further studies need to be done in pregnant patient with comorbidities and in emergency caesarean sections.

Declarations

Funding: None

Availability of data and material: Apollo Gleneagles Hospitals Limited, Kolkata

Code availability: Not applicable

Consent to participate: Consent taken

Ethical Consideration: There are no ethical conflicts related to this study.

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