

Effect of Preload with Colloid Vs Crystalloid in Prevention of Oxytocin Induced Hypotension in Caesarean Section by Phenylephrine; A Comparative Study

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Abstract:

Background: One of the leading causes of maternal mortality with uterine atony is Postpartum haemorrhage (PPH) and can be reduced by proper use of uterotonic agents like oxytocin which is most commonly used. Approximately 80% of the patients suffers Spinal-induced hypotension (SIH) for cesarean delivery (CD) and is a frequently encountered problem. Postpartum haemorrhage (PPH) is one of the leading causes of maternal mortality with uterine atony in about 50% cases. There are many approaches to prevent hypotension but no single approach has been shown as the gold standard, and each prophylactic treatment comes with accompanying risks. Crystalloid preload can prevent hypotension has a poor efficacy in preventing hypotension, due to rapid redistribution into the extracellular space. Phenylephrine is a short-acting alpha agonist, can be administered by bolus as well as by infusion to treat oxytocin induced hypotension. Phenylephrine obtunds oxytocin-induced decrease in systemic vascular resistance (SVR) and increase in heart rate and cardiac output.

Material and Methods: Patients were randomized to be in the colloid or crystalloid infusion groups. Normal singleton pregnancy, beyond 36 weeks gestation, between 19 and 35 years of age, weight between 50 and 100 kg, and height ranging from 150-180 cm. Pre-anaesthetic evaluation of all the patients was done. Intravenous administration of preload was delivered for 30 min, prior to spinal anaesthesia and when the fluid load was complete, IV patency was maintained at a rate of 5 ml/hour and medications were flushed with LR. Standard monitoring for all patients was done through use of non-invasive blood pressure (NIBP) measurement, electrocardiography, and pulse oximetry. Oxygen (2 l/min) was administered via nasal cannula. The average Systolic BP and accompanying heart rate (HR) of these 3 measurements were recorded as mean baseline values. Patients feeling about nausea was recorded from start of anaesthesia at every 5 minutes interval.

Conclusion: In prevention of SIH and treatment, Phenylephrine with collids are found to be superior than crystalloids because of the sparing effect of phenylephrine associated with preloading colloids.

Keywords: Crystelloids, Collids, Lactated, Cesarean Delivery.

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Introduction

One of the leading causes of maternal mortality with uterine atony is Postpartum haemorrhage (PPH) [1] and can be reduced by proper use of uterotonic agents like oxytocin which is most commonly used [2]. Approximately 80% of the patients suffers Spinal-induced hypotension (SIH) for cesarean delivery (CD) and is a frequently encountered problem [3]. Postpartum haemorrhage (PPH) is one of the leading causes of maternal mortality with uterine atony in about 50% cases [4]. Prophylactic use of oxytocin has been shown to reduce the PPH by up to 40% [5]. as oxytocin receptors found in the heart and large vessels it causes hypotension and reflex tachycardia as an adverse effect [6]. If hypotension is prolonged, impairment in placental blood flow and fetal acidosis can occur [7]. to prevent this prophylactic

phenylephrine infusion can be given. There are many approaches to prevent hypotension but no single approach has been shown as the gold standard, and each prophylactic treatment comes with accompanying risks. Crystalloid preload can prevent hypotension has a poor efficacy in preventing hypotension, due to rapid redistribution into the extracellular space [8].

To prevent oxytocin induced hypotension, many approaches have been recommended, commonly used, synthetic colloids such as hydroxyethyl starch are more expensive than crystalloid and side effects include pruritis, anaphylactoid reactions, association with kidney injury, and coagulopathy [9,10]. Phenylephrine is a short-acting alpha agonist, can be administered by bolus as well as by infusion to treat

oxytocin induced hypotension [11]. Phenylephrine obtunds oxytocin-induced decrease in systemic vascular resistance (SVR) and increase in heart rate and cardiac output [12]. Phenylephrine, a short-acting alpha agonist, can be administered by bolus as well as by infusion for prevention of hypotension [13]. Phenylephrine has been associated with a decreased incidence of hypotension and maternal nausea and vomiting and improved umbilical artery pH [14,15]. In *ex vivo* studies, phenylephrine has been shown to improve fetal arterial perfusion than ephedrine [16]. In this prospective, comparative study, we created two groups of patients receiving prophylactic phenylephrine infusions which was combined with either a colloid or crystalloid preload. We assume that patients receiving prophylaxis with a phenylephrine infusion and colloid preload would show a reduced incidence of hypotension i.e. <20% below baseline as compared to patients receiving a phenylephrine infusion with crystalloid preload. [17]

Material and Methods

Department of Anaesthesia, at Nalanda medical College and Hospital Patna, Bihar. Patients were randomized to be in the colloid or crystalloid infusion groups. Normal singleton pregnancy, beyond 36 weeks gestation, between 19 and 35 years of age, weight between 50 and 100 kg, and height ranging from 150-180 cm. patients were excluded if: Contraindications to spinal anesthesia, pregnancy-induced hypertension, preeclampsia, known uteroplacental insufficiency, multiple gestation, fetal abnormalities, congenital heart abnormalities, prematurity, or clinical evidence of fetal distress, signs of onset of labor, or history of adverse reactions to hydroxyethyl starch. Pre-anaesthetic evaluation of all the patients was done and an informed written consent was taken. 18-gauge intravenous (IV) catheter was inserted into a forearm vein, and vein patency was maintained with Lactated Ringer's solution

(LR) at a rate of 5 ml/h before administering the preload. Colloid preload was 500 ml hydroxyethyl starch in 0.9% normal saline and crystalloid preload was LR (1500 ml). Volume of crystalloid and colloid preload was 1:3 colloid to crystalloid ratio to achieve a similar degree of volume expansion^{xvii}. Intravenous administration of preload was delivered for 30 min, prior to spinal anaesthesia and when the fluid load was complete, IV patency was maintained at a rate of 5 ml/hour and medications were flushed with LR. Standard monitoring for all patients was done through use of non-invasive blood pressure (NIBP) measurement, electrocardiography, and pulse oximetry. Oxygen (2 l/min) was administered via nasal cannula. The average Systolic BP and accompanying heart rate (HR) of these 3 measurements were recorded as mean baseline values. All patients were given a phenylephrine infusion (10 mg phenylephrine in 100 ml 0.9% NS). Just after intrathecal injection at a rate of 100 mcg/min. Phenylephrine infusion protocol was continued until the time of uterine incision. The infusion was stopped if the HR decreased below 60 beats per minute (bpm), or if the SBP increased to >20% above baseline, and was again restarted when the BP decreased to <20% below baseline (defined as hypotension). The total dose of phenylephrine used during the study period was recorded. After delivery, test drug solutions (10 mL) were administered based on group allocation over a period of 5 min using a syringe infusion pump. Patients feeling about nausea was recorded from start of anaesthesia at every 5 minutes interval.

Results

A total of 100 patients were included in the study, 50 patients were divided in each group of preload and colloid group

Table 1: Patients characteristics in each group

Characteristics	Lactated ringer solution group (n=50)	Hydroxyethyl starch group (n=50)	P value
Age (mean±SD)	25.27±5.11	26.19±4.67	P = 0.3497
Height (mean±SD)	158.11±7.45	157.04±6.77	P = 0.4541
Spinal uterine incision time (mean±SD)	15.88±4.27	17.18±3.35	P = 0.0935
Estimated blood loss in ml (mean±SD)	443±59.44	479±61.32	P < 0.001
Systolic blood pressure baseline (mean±SD)	126.45±11.33	129.12±9.24	P = 0.1996
Heart rate (mean±SD)	88.87±9.45	88.21±10.55	P = 0.7425

Mean age in lactated ringer solution group was 25.27±5.11 years while in hydroxyethyl starch group it was 26.19±4.67. Mean Spinal uterine incision time was 15.88±4.27 and 17.18±3.35 in lactated ringer solution group and hydroxyethyl starch group respectively. Estimated blood loss in ml (mean±SD) was 443±59.44 and 479±61.32 in lactated ringer

solution group and hydroxyethyl starch group respectively. Systolic blood pressure baseline (mean±SD) 126.45±11.33 and 129.12±9.24 in lactated ringer solution group and hydroxyethyl starch group respectively. Heart rate (mean±SD) was 88.87±9.45 and 88.21±10.55 in lactated ringer solution group and hydroxyethyl starch group respectively.

Significantly less phenylephrine was used in the colloid group (1058 ± 558 mcg) compared to the crystalloid group (1400 ± 513 mcg) ($P = 0.0019$). There was no significant difference in the incidence of maternal nausea and vomiting, as well as APGAR scores at 1 and 5 min.

Emergency rescue medications were administered to a total of 11 patients. 6 in crystalloid group and 5 in colloid group for supraventricular tachycardia.

Discussion

Oxytocin causes hypotension and reflex tachycardia as an adverse effect because oxytocin receptors are also found in the heart and large vessels [18]. Some authors have shown that phenylephrine (100 µg) had quicker control of BP compared to mephentermine (6 mg) and ephedrine (6 mg) groups [19]. The benefits of prophylactic phenylephrine infusion are still controversial. However, it has been associated with a decreased incidence of hypotension and maternal nausea and vomiting and improved umbilical artery pH [20,21]. In this study there was lower incidence of hypotension with colloid preload when compared with the crystalloid group this results were comparable with the study by Bottiger BA et al [22] observed that here was a lower incidence of hypotension with colloid preload (10.8%) when compared with the crystalloid group (27.0%). In a study by Gangadharaiyah R [23] et al it has been observed that co-administration of 75 µg phenylephrine with oxytocin reduced the incidence and the number of episodes of oxytocin-induced hypotension whereas 50 µg of phenylephrine did not reduce the incidence of hypotension but reduced the number of episodes of hypotension and rescue vasopressor requirement compared to control. Some studies have compared the efficacy of different doses of phenylephrine i.e. 100 µg, 125 µg and 150 µg to treat post-spinal hypotension in elective caesarean section and concluded that there was no significant difference in all groups [24].

There was a gradual decrease in HR in both groups, despite the different dose required, may be attributed to the effect of the spinal anesthetic as well as the phenylephrine infusion. Phenylephrine has been associated with decreased cardiac output and dysrhythmias, including ventricular tachycardia, supraventricular tachycardia, coronary artery spasm, and myocardial infarction, although these side effects seem to be reduced when compared with ephedrine [25]. In our study 3 in crystalloid group and 1 in colloid group experienced supraventricular tachycardia. In our study no significant difference was observed in relation to clinical evidence of reduced cardiac output; nausea, and vomiting, as well as APGAR scores at 1 and 5 min.

Conclusion

In prevention of SIH and treatment, Phenylephrine with collids are found to be superior than crystalloids because of the phenylephrine sparing effect associated with preloading colloids. However more studies of similar types are required to confirm the results.

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