

# An Evidence Based Practice Educational Module Explaining the Use of Norepinephrine to Treat Post-Spinal Anesthesia-Induced Hypotension in Parturient undergoing elective C-sections.

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## Introduction

Cesarean sections (C-sections) account for about 32% of all births in the United States. Spinal anesthesia is the primary choice of anesthesia for elective C-sections due to its quick and predictable onset. Spinal anesthesia allows the parturient to actively engage in the childbirth process while providing a sense of involvement and awareness. Spinal anesthesia is preferred over general anesthesia due to its ability to bypass potential complications like aspiration, airway difficulties and the transfer of anesthetic drugs to the neonate, making it a safer option for both the parturient and neonate. Spinal anesthesia is generally considered safe and effective for C-sections, but it is not without inherent risks.

## Purpose

Evaluate and assimilate the literature highlighting the most efficacious vasopressor to treat post-spinal anesthesia-induced hypotension in a parturient who undergoes elective C-sections. This effort will lead to improved patient safety, a reduction in maternal and fetal complications, and an overall enhancement in the quality of care within obstetric anesthesia by increasing anesthesia provider knowledge and increasing attitude toward practice change with evidence-based recommendations.



## PICO Question

*(P) In a parturient that undergoes spinal anesthesia for elective C-section, (I) does an education module on the administration of norepinephrine (C) compared to phenylephrine (O) increase anesthesia providers' knowledge and attitude in decreasing maternal hypotension, maternal bradycardia and fetal compromise?*

## Literature Review

Author	Design and Objectives	Conclusion
<b>Sharkey et al. 2019</b>	Randomized double-blinded controlled study. To evaluate in equipotent doses as an intermittent bolus regimen to prevent and treat spinal-induced hypotension, does norepinephrine (NE) result in a reduced incidence of bradycardia compared to phenylephrine (PE).	When used as an intermittent bolus regimen to prevent and treat spinal-induced hypotension during CD, NE resulted in a significant reduction in the incidence of bradycardia as compared to an equipotent bolus regimen of PE. The hemodynamic profile offered by NE during CD is superior to that of PE due to less fluctuations in HR and possibly cardiac output.
<b>Rai et al. 2022</b>	Randomized double-blinded controlled study. To compare the effect of bolus administration of norepinephrine and phenylephrine on umbilical artery pH (primary objective) and their efficacy for the treatment of maternal hypotension (secondary objective) in term parturients undergoing elective CD under spinal anesthesia.	In term normotensive parturients who received bolus norepinephrine or phenylephrine for the treatment of post-spinal hypotension during CD, neonatal umbilical cord blood gas analysis and Apgar scores were comparable. Norepinephrine use was associated with a lower incidence of maternal bradycardia and reactive hypertension compared with phenylephrine. The HRs in the study were lower in patients receiving phenylephrine than in those receiving norepinephrine, when compared after spinal injection as well as after vasopressor administration.
<b>Hasanin et al. 2019</b>	Randomized double-blinded controlled study. The aim of the study is to compare the efficacy and safety of phenylephrine and norepinephrine when used in variable infusion rate during caesarean delivery.	When given in a manually adjusted infusion, norepinephrine effectively maintained maternal SBP during caesarean delivery under spinal anesthesia with lower number of physician interventions, and less incidence of reactive hypertension and bradycardia compared to phenylephrine.
<b>Puthenveettil et al. 2019</b>	Randomized double-blinded controlled study. The aim of the study was to compare the effectiveness of bolus doses of norepinephrine with phenylephrine to treat spinal hypotension during caesarean section.	The number of boluses of vasopressors required to treat hypotension was significantly lower in group N ( $1.40 \pm 0.577$ vs. $2.28 \pm 1.061$ , $P = 0.001$ ). The frequency of bradycardia was high in group P, but this difference was not statistically significant (4% vs. 20%, $P = 0.192$ ). Maternal complications such as nausea and vomiting and shivering were comparable between the groups. The fetal parameters were also comparable between the two groups. The results of the study showed that intermittent boluses of intravenous norepinephrine are effective in managing spinal hypotension with no detrimental effects on the neonatal and maternal outcome. The number of norepinephrine boluses required to maintain blood pressure was significantly less than when phenylephrine boluses were used. There was less incidence of bradycardia in the norepinephrine group.
<b>Theodoraki et al. 2020</b>	Randomized double-blinded controlled study. The aim of the present study was to compare a fixed-rate prophylactic norepinephrine infusion to a fixed-rate prophylactic phenylephrine infusion during elective cesarean section under combined spinal-epidural anesthesia.	The incidence of bradycardia as well as the requirement for atropine administration was lower in the norepinephrine group (4.8% vs. 31.7%, $P = 0.004$ and 2.4% vs. 24.3%, $P = 0.01$ , respectively). Fetal pH, and fetal blood glucose concentration were higher in the norepinephrine group ( $P = 0.027$ and 0.019, respectively). No difference in the occurrence of hypotension, hypertension, in the requirement for bolus vasoconstrictive medication or in Apgar scores was demonstrated.
<b>Renu et al. 2022</b>	Randomized double-blinded controlled study. The aim of the research is to study the effect of intravenous phenylephrine and norepinephrine on hemodynamics during spinal anesthesia in cesarean section and to determine the effect on neonatal appearance, pulse, grimace, activity, and respiration (Apgar) score and acid-base analysis of neonatal blood.	Intraoperatively, norepinephrine group had a significantly higher mean heart rate than phenylephrine group. Neonatal outcome was similar in both the groups with respect to appearance, pulse, grimace, activity, and respiration (Apgar) scores and umbilical arterial pH.

## Spinal hypotension

Neonatal acidosis

Decreased placental perfusion

Peripheral vasodilation and maternal hypotension

$\downarrow O_2$   
 $\uparrow CO_2$



## Clinical Significance

- Spinal anesthesia can lead to complications such as maternal hypotension, maternal bradycardia, and fetal compromise, posing risks to both the parturient and the neonate.
- Phenylephrine is currently the preferred vasopressor for counteracting hypotension induced by spinal anesthesia in parturients.
- Phenylephrine often results in dose-dependent reductions in heart rate and cardiac output due to the baroreceptor reflex, which may not be ideal for parturients with pre-existing cardiac conditions or other risk factors.
- The uterus is not autoregulated, so there is a decrease in uterine blood flow leading to fetal acidosis and fetal distress.
- Research shows that norepinephrine is a more effective vasopressor for managing post-spinal anesthesia-induced hypotension during elective C-sections, offering several advantages over phenylephrine.

## Methodology

An expansive analysis was conducted as facilitated Google Scholar, Cumulative Index to Nursing and Allied Health Literature (CINAHL), MEDLINE and PubMed.

Keywords: obstetric anesthesia, norepinephrine, phenylephrine, elective C-section, spinal anesthesia, maternal hypotension, maternal bradycardia and fetal compromise.

Inclusion criteria:

- Literature published within the past 10 years
- Full text articles
- Written in English
- Research that focused on the population where only parturients undergoing spinal anesthesia for elective C-sections.
- Literature studies featured the selected population where norepinephrine or phenylephrine was administered in managing post-spinal anesthesia-induced hypotension.

Exclusion criteria:

- Systematic reviews, literature reviews, and meta-analyses

N = 15

The Florida International University Institutional Review Board (IRB) has deemed this project Exempt. Documentation available upon request.

## Results

- Lower Incidence of Bradycardia: Norepinephrine significantly reduced bradycardia, preserving maternal cardiac output and hemodynamic stability.
- Fewer Episodes of Reactive Hypertension: Norepinephrine tended to cause fewer episodes of reactive hypertension.
- Reduced Physician Interventions: Parturients receiving norepinephrine required fewer physician interventions.
- Decreased Complications: Reduced incidence of nausea and vomiting and improved maternal comfort.
- Similar Neonatal Outcomes: Apgar scores and umbilical cord blood analysis showed no significant differences between norepinephrine and phenylephrine, emphasizing the safety of norepinephrine for both parturients and neonates.

## Clinical Recommendations

Influence anesthesia providers to utilize norepinephrine in obstetric anesthesia:

- Enhance knowledge and attitudes towards norepinephrine use, improving maternal hemodynamics during elective C-sections.
- Encourage further research on norepinephrine's efficacy in obstetric anesthesia.

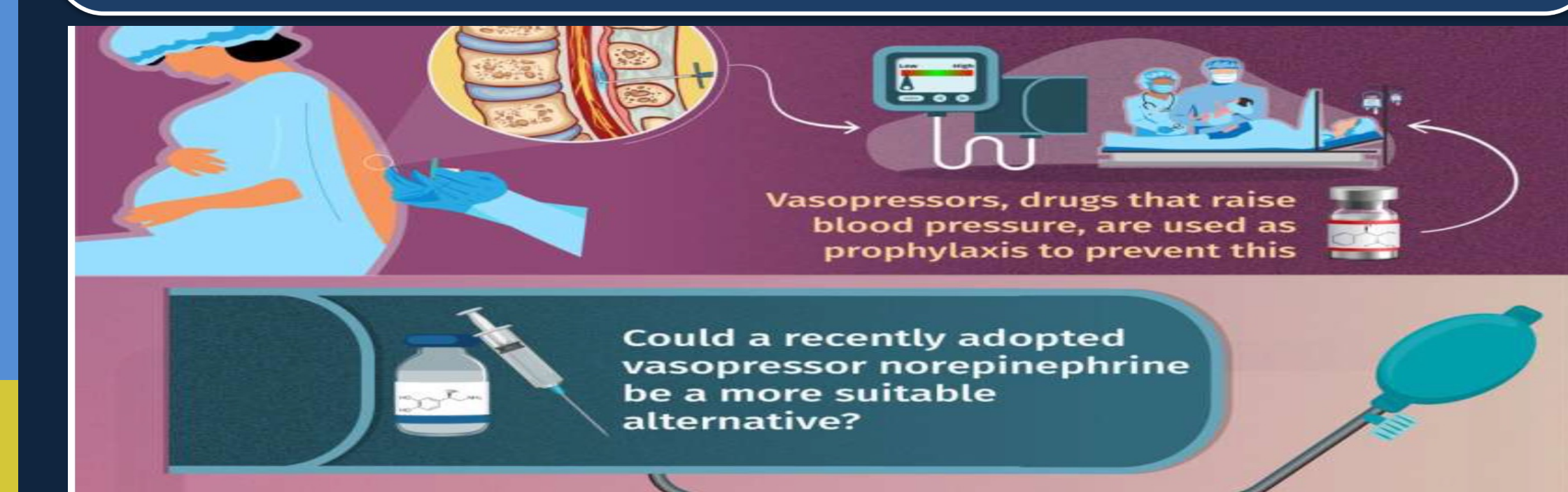
For Intravenous Administration:

- Establish large-bore intravenous access.
- Administer diluted norepinephrine solutions or equipotent doses similar to phenylephrine or ephedrine.

Addressing Knowledge Gaps:

- Investigate the use of preemptive vasopressor administration for post-spinal anesthesia-induced hypotension.
- Compare outcomes of intermittent vasopressor bolus versus continuous infusion in managing maternal hypotension.

Implementing an education module on norepinephrine will equip anesthesia providers to manage maternal hypotension and improve patient outcomes during elective C-sections.



## Conclusion

- Effectiveness of Norepinephrine: Research and high-quality randomized controlled trials highlight norepinephrine as a highly effective option for managing post-spinal anesthesia-induced hypotension.
- Advantages Over Phenylephrine: Norepinephrine significantly lowers the incidence of bradycardia, preserving maternal cardiac output and hemodynamic stability.
- Safety Profile Neonatal outcomes are similar between norepinephrine and phenylephrine, demonstrating the safety of norepinephrine.
- No Increased Risk of Extravasation: Norepinephrine does not cause extravasation at equipotent doses compared to other vasopressors.
- Patient Safety and Outcomes: Norepinephrine improves care quality for parturients by reducing maternal hypotension, bradycardia, and fetal compromise.

Reflecting on past practices where clinical adoption lagged behind evidence, we now have robust evidence to support the superior efficacy and safety of norepinephrine in managing maternal hypotension during C-sections. By embracing norepinephrine, we can significantly improve maternal and neonatal outcomes during elective C-sections.

## References

References available upon request

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