THERAPEUTIC VASOPRESSOR USE FOR POSTSPINAL HYPOTENSION IN HIGH-RISK CESAREAN DELIVERY: A SYSTEMATIC REVIEW AND META-ANALYSIS

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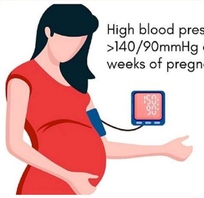
Background



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Postspinal hypotension (PSH) is a common complication of cesarean delivery (CD), particularly in high-risk parturients such as those with preeclampsia, fetal compromise, or emergency surgery. Maternal hypotension may cause nausea, vomiting, reduced utero-placental perfusion, and adverse neonatal outcomes. The optimal VP for established PSH remains uncertain.

Objectives

Primary objective: To compare the effectiveness of norepinephrine (NE), phenylephrine (PE), and ephedrine (EP) in treating established postspinal hypotension (PSH) during high-risk cesarean delivery (CD).

Secondary objectives: To assess maternal and neonatal outcomes and examine differences by vasopressor (VP) type and method of administration (bolus vs infusion).

Study Design

Design: Systematic review and meta-analysis

Registration: PROSPERO (CRD420251050321)

Guidelines: PRISMA 2020

Data Sources: PubMed, Embase, CENTRAL, Scopus (through April 2025)

Included Studies: 19 RCTS

Population: High-risk parturients undergoing CD under spinal anesthesia (SA) or combined spinal-epidural anesthesia (CSEA)

Interventions: Therapeutic IV NE, PE or EP after onset of hypotension

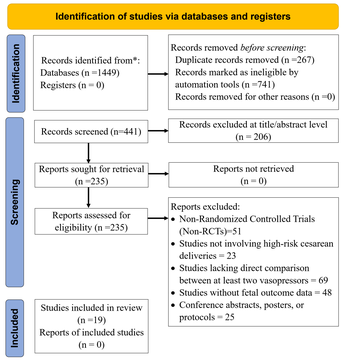
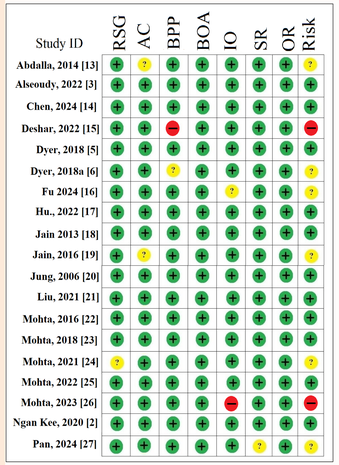


Figure 1: PRISMA flow diagram

Analysis: Random-effects meta-analysis reporting risk ratios (RR) with 95% confidence intervals (CI)

Results



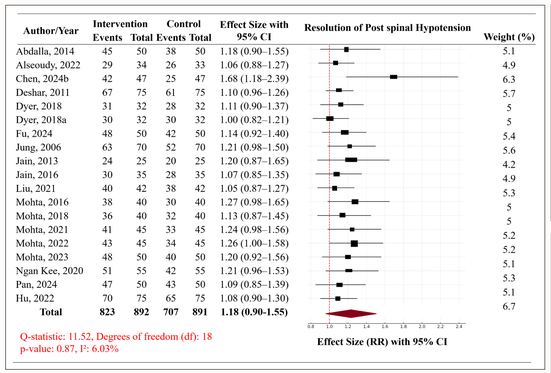
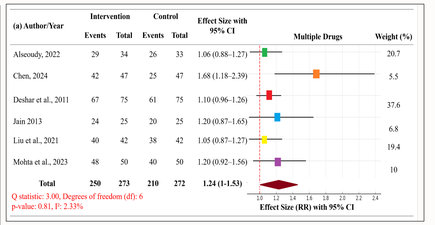
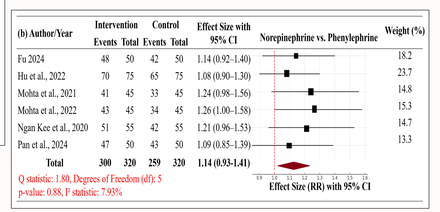


Figure 3. Meta-analysis- Primary Outcome: Therapeutic vasopressors demonstrated comparable efficacy in correcting established PSH. There was no statistically significant difference among NE, PE, and EP (RR 1.18, 95% CI 0.90–1.55; I² = 6%)

Study ID	P	I	C	O
Abdalla, 2014 [13]	Pre-eclampsia, high-risk cesarean under spinal anesthesia	IV PE 75 µg bolus when SBP ≥25% or < 90 mmHg	IV EP 6 mg bolus	Correction of hypotension, fetal outcomes (UA pH)
Alseoudy, 2022 [3]	Healthy cesarean patients (reference control group)	Oral Midodrine 10 mg 1 h pre-op; rescue IV EP 5–10 mg	Placebo	Incidence of postspinal hypotension
Chen, 2024 [14]	Preeclampsia under spinal anesthesia	Prophylactic IV NE 0.025–0.075 µg/kg/min infusion	Control (no NE infusion)	Incidence of maternal hypotension; bradycardia; UA pH
Deshar, 2022 [15]	Non-elective CD (ASA II), excluded hypertensive disorders	IV Glycopyrrolate vs Placebo (as adjunct) with PE 25 µg/min infusion	Placebo	Need for rescue vasopressor; incidence of hypotension
Dyer, 2018 [5]	Severe preeclampsia + non-reassuring FHR	IV EP 7.5–45 mg	IV PE 50–650 µg	Base excess; hemodynamic stability; fetal acidosis
Dyer, 2018a [6]	Severe preeclampsia ≤ 34 weeks	IV PE 50–150 µg	IV EP 7.5–37.5 mg	Change in cardiac index; MAP restoration
Fu, 2024 [16]	Preeclampsia	IV NE 4 µg bolus	IV PE 50 µg bolus	Uteroplacental RI/PI; UA pH
Hu, 2022 [17]	Severe preeclampsia vs normotensive	IV PE 40–80 µg (dose-finding)	—	Effective dose (ED50/ED90) to restore MAP ≥80% baseline
Jain, 2013 [18]	Severe preeclampsia	IV PE 50 µg PRN	—	Incidence + duration of hypotension
Jain, 2016 [19]	Fetal compromise (Category II FHR, FGR)	IV PE 30 µg/min infusion	IV EP 2.5 mg/min	UA pH < 7.2 or base deficit > 12 mmol/L
Jung, 2006 [20]	Elective CD (ASA I–II, term)	IV EP, PE, or combo half-dose infusion + bolus	Head-to-head comparison	Maternal hypotension, fetal acidosis (UA pH < 7.2)
Liu, 2021 [21]	Severe preeclampsia	IV PE 40–80 µg (BCUD method)	—	ED90 62 µg for MAP ≥ 80% baseline
Mohta, 2016 [22]	Emergency CD with fetal compromise	IV PE 100 µg	IV EP 8 mg	UA pH; fetal acidosis
Mohta, 2018 [23]	Preeclampsia	IV PE 50 µg	IV EP 4 mg	UA pH; maternal HR changes
Mohta, 2021 [24]	Preeclampsia	IV NE 4 µg	IV PE 50 µg	UA pH; number of boluses required
Mohta, 2022 [25]	Fetal compromise (non-reassuring FHR, IUGR)	IV NE 8 µg	IV PE 100 µg	UA pH; Apgar < 7
Mohta, 2023 [26]	Preeclampsia vs normotensive	IV PE vs NE (adjusted by BCUD method)	Head-to-head	ED95/ED50 for PE treatment
Ngan Kee, 2020 [2]	Elective and non-elective CD	IV NE 6 µg/mL infusion	IV PE 100 µg/mL infusion	UA pH; bradycardia; hypotension incidence
Pan, 2024 [27]	Severe preeclampsia	IV NE 4.5 µg	IV PE 60 µg	UA pH; hypotension correction





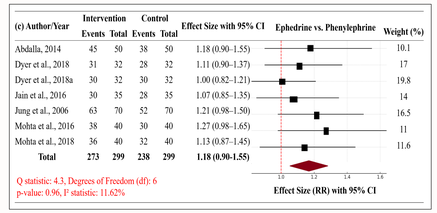


FIGURE 4: Secondary outcomes among vasopressors: (a) multiple vasopressors or combinations (e.g., NE, midodrine) with placebo or controls, pooled effect size (RR) 1.24 (95% CI: 1.01–1.53); (b) NE vs. PE, RR = 1.14 (95% CI: 0.93–1.41); and (c) EP vs. PE, RR = 1.18 (95% CI: 0.90–1.55)
CI: confidence interval; RR: relative risk (effect size)

TABLE 1. PICO-aligned characteristics of RCTs evaluating therapeutic vasopressor use for PSH during high-risk CD

Figure 2. Risk-of-bias (RoB) assessment for included RCTs Cochrane RoB evaluation for the 19 RCTs included in the review.

Results

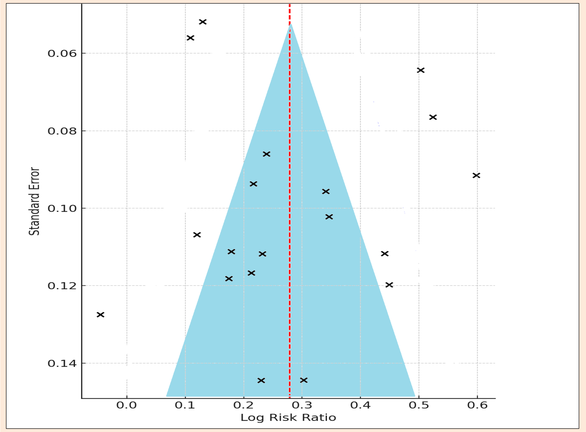


FIGURE 5: Funnel plot for assessing publication bias across included studies

Conclusion

Therapeutic vasopressors demonstrate **similar overall efficacy** in treating established PSH during high-risk CD. **Norepinephrine shows a modest advantage** in subgroup analyses, particularly when administered via infusion. However, heterogeneous dosing protocols and study designs limit definitive conclusions. **Large, standardized head-to-head trials** are needed to establish optimal vasopressor selection and administration strategies for high-risk obstetric anesthesia.

References

1. **Patel S, Ninave S:** Postspinal anesthesia hypotension in caesarean delivery: a narrative review . Cureus. 2024, 16:e59232. 10.7759/cureus.59232

2**. Sun L et al**. Norepinephrine or phenylephrine for the prevention of post-spinal hypotension after caesarean section: a double-blinded, randomized, controlled study of fetal heart rate and fetal cardiac output. J Clin Anesth. 2024, 97:111533.10.1016/j.jclinane.2024.111533.