DOI: https://doi.org/10.53350/pjmhs02024181302

ORIGINAL ARTICLE

Fluid Preloading Versus Ephedrine in the Management of Spinal Anesthesia-Induced Hypotension in patients undergoing Cesarean Delivery

ASAD KHAN[1], MAQSOOD AHMED SIDDIQUI[2], HIRA ASAD[3], SHAHID HUSSAIN[4], MUHAMMAD TAQI[5], KELASH KUMAR[6]
[1]*Assistant Professor, Department of Anesthesia, Hayatabad Medical Complex / Khyber Girl's Medical College, Peshawar*
[2]*Associate Professor & Head, Department of Anesthesiology, Surgical ICU & Pain Management, Ghulam Muhammad Mahar Medical College, Sukkur, Sindh*
[3]*Registrar, Department of Anesthesiology, Memon Medical Institute Hospital, Karachi*
[4]*Registrar, Department of Anesthesiology, JMDC, Sohail Trust Hospital, Sohail University, Korangi, Karachi*
[5]*Assistant Professor, Department of Anaesthesia, Al-Aleem Medical College / Gulab Devi Teaching Hospital, Lahore*
[6*]*Assistant Professor, FCPS Anesthesiology, Department of Anesthesiology and Intensive Care, Liaquat University of Medical and Health Sciences, Hyderabad*
Correspondence to: Kelash Kumar, Email: drkelashmalhi@gmail.com

ABSTRACT

Objective: To compare the efficacy of prophylactic ephedrine versus fluid preload (Hartmann's solution) in preventing hypotension in women undergoing cesarean section under spinal anesthesia at a teaching hospital

Methodology: Study was conducted in the Department of Anesthesiology at Liaquat University Hospital, Hyderabad from January 2023 to September 2023. Patients were randomly divided into two groups (Group A and Group B) using a draw method, where they selected sealed envelopes marked A or B. Group A received prophylactic ephedrine (0.25 mg/kg intravenous infusion immediately after bupivacaine injection), while Group B received prophylactic fluid preload (20 mL/kg Hartmann's solution over 10–15 minutes before spinal anesthesia).

Results: The study enrolled a total of 62 patients, equally divided into Group A and Group B, with 31 patients in each group. The two groups were comparable in terms of age (32.32 ± 5.62 years in Group A vs. 30.35 ± 3.31 years in Group B, p = 0.197) and BMI (26.96 ± 2.88 kg/m² in Group A vs. 27.03 ± 3.31 kg/m² in Group B, p = 0.964). In terms of efficacy, Group A demonstrated a significantly higher success rate compared to Group B (67.7% vs. 38.7%, p = 0.022).

Conclusion: The frequency of hypotension is lower in women receiving prophylactic ephedrine during spinal anesthesia for cesarean section compared to those given a Hartmann's solution preload.

Keywords: Spinal anesthesia, Fluid preload, Hypotension, Ephedrine, Cesarean section.

INTRODUCTION

Spinal anesthesia is widely used for cesarean deliveries due to its rapid onset and effective pain control[1]. However, a significant complication is spinal anesthesia-induced hypotension (SAIH), which occurs in 50-80%[2] of parturients without prophylactic intervention. This abrupt drop in blood pressure results from sympathetic blockade, leading to reduced systemic vascular resistance and venous return[3]. Hypotension can compromise uteroplacental perfusion, increasing the risk of fetal acidosis and maternal nausea or vomiting. Given its high incidence and potential adverse effects, effective prevention and management strategies are essential in obstetric anesthesia[4].

Two common approaches to mitigate SAIH are fluid preloading and vasopressor administration, such as ephedrine[5]. Fluid preloading, typically with crystalloids or colloids, aims to expand intravascular volume and counteract vasodilation[6]. However, its efficacy remains debated, as rapid fluid shifts and limited duration of action may reduce its effectiveness. Conversely, ephedrine, a mixed alpha- and beta-adrenergic agonist, increases blood pressure by enhancing cardiac output and peripheral resistance[7]. While effective, ephedrine may cross the placenta and cause fetal tachycardia or acidosis, raising concerns about its safety[8,9].

The optimal strategy for preventing SAIH in cesarean deliveries remains controversial. Some studies advocate for combined fluid and vasopressor therapy, while others suggest that vasopressors alone may suffice[10]. Fluid preloading is non-pharmacological and avoids drug-related side effects, but its benefits may be limited in parturients with rapid hemodynamic changes. On the other hand, ephedrine provides a reliable pressor response but requires careful dosing to minimize fetal effects. Understanding the comparative efficacy and safety of these interventions is important for improving maternal and neonatal outcomes[11].

The findings of this study will contribute to evidence-based guidelines for managing SAIH in obstetric anesthesia. If fluid preloading proves non-inferior to ephedrine, it could reduce reliance on vasopressors and minimize fetal drug exposure. Conversely, if ephedrine demonstrates superior hemodynamic control, its judicious use may be prioritized. Ultimately, this research will help optimize anesthesia protocols to enhance outcomes for both mothers and newborns undergoing cesarean delivery.

Received on 10-10-2023
Accepted on 26-12-2023

METHODOLOGY

Study was randomized controlled trial in design and conducted in the Department of Anesthesiology at Liaquat University Hospital, Hyderabad from January 2023 to September 2023. Study was started after obtaining approval from the Ethics Committee. Sample size of 62 patients was calculated using 95 CI, margin of error 0.5% and efficacy of ephedrine 74%[2] and fluid preload 50%[2]. Participants were women aged 20 to 40 years, both nulliparous and multiparous, with a gestational age greater than 37 weeks, undergoing cesarean section under subarachnoid block. Exclusion criteria comprised patients with local anesthetic allergies, hypertension, shock, bleeding disorders, spinal injection site infections, spinal deformities, or known valvular heart disease.

Before the procedure, all patients were thoroughly briefed about the study protocol, potential risks, and benefits, and written informed consent was obtained from each participant. Baseline demographic and clinical data, including weight, height, body mass index (BMI), age, type of cesarean section (elective or emergency), and baseline blood pressure measurements, were meticulously recorded. Using a randomized draw method, patients were allocated into two groups Group A and Group B by selecting sealed, opaque envelopes labeled either "A" or "B." Group A received prophylactic intravenous ephedrine at a dose of 0.25 mg/kg, administered immediately after the intrathecal injection of bupivacaine, while Group B received a prophylactic fluid preload consisting of 20 mL/kg of Hartmann's solution, infused over 10–15 minutes prior to the administration of spinal anesthesia.

Spinal anesthesia was performed by a senior consultant anesthetist using a standardized technique with a 27-gauge pencil-point spinal needle at the L3-L4 or L4-L5 interspace, with correct positioning confirmed by free cerebrospinal fluid (CSF) flow.

Following the induction of spinal anesthesia, blood pressure was continuously monitored at regular intervals for the first 15 minutes to promptly detect any episodes of hypotension, which was defined as a reduction of more than 20% in systolic and/or diastolic blood pressure compared to the patient's baseline values. This rigorous monitoring protocol ensured timely intervention if hypotension occurred, thereby maintaining maternal and fetal hemodynamic stability throughout the procedure.

The researcher recorded all relevant data, which were analyzed using SPSS-27. Numerical variables are presented as mean ± SD, to compare the two means (Student's t-test) was applied . Categorical variable are presented as N (%) , to check the association (chi-square test) was applied. P value less than or equal to 0.05 was considered as significant.

RESULTS

The study enrolled a total of 62 patients, equally divided into Group A and Group B, with 31 patients in each group. The two groups were comparable in terms of age (32.32 ± 5.62 years in Group A vs. 30.35 ± 3.31 years in Group B, p = 0.197) and BMI (26.96 ± 2.88 kg/m² in Group A vs. 27.03 ± 3.31 kg/m² in Group B, p = 0.964). However, Group A had a significantly higher proportion of urban residents (64.5% vs. 38.7%, p = 0.042), while Group B had more rural participants (61.3% vs. 35.5%, p = 0.042). No significant difference was observed in procedure type (emergency/elective) between the groups (p = 0.442). Table-1

In terms of efficacy, Group A demonstrated a significantly higher success rate compared to Group B (67.7% vs. 38.7%, p = 0.022). Table-2

Table 1: Demographics and baseline profile

Variable	Group A 31 (50.0%)	Group B 31 (50.0%)	Test of sig.
Age (years)	32.32±5.62	30.35±3.31	t=1.31, d.f=60, p=0.197
BMI (kg/m^2)	26.96±2.88	27.03±3.31	t=-0.045, d.f=60, p=0.964
Area of residence			
Urban	20 (64.5)	12 (38.7)	χ^2=4.13, d.f=1, p=0.042
Rural	11 (35.5)	19 (61.3)	
Procedure type			
Emergency	12 (38.7)	15 (48.4)	χ^2=0.59, d.f=1, p=0.442
Elective	19 (61.3)	16 (51.6)	
N (%), chi-square test was applied.			

Table 2: Comparison of efficacy among the study groups

Efficacy	Group A 31 (50.0%)	Group B 31 (50.0%)	Test of sig.
Yes	21 (67.7)	12 (38.7)	χ^2=5.25d.f=1, p=0.022
No	10 (32.3)	19 (61.3)	
N (%), chi-square test was applied.			

DISCUSSION

The demographic similarity between the two groups in this study aligns with previous research, where age and BMI were well-matched in trials comparing vasopressors and fluid preload for hypotension management. A study by Prakash et al[12] also reported no significant differences in age or BMI between groups receiving ephedrine or crystalloid preload (p>0.05), supporting the validity of our findings.

Our findings on ephedrine's effectiveness are consistent with earlier studies demonstrating its reliability in preventing spinal anesthesia-induced hypotension. Ngan Kee et al[13] found that prophylactic ephedrine significantly reduced hypotension incidence compared to placebo (p<0.001). However, some studies suggest that phenylephrine may be superior due to fewer fetal acid-base disturbances, indicating a need for further comparative studies[14].

The fluid preload group's results are comparable to those reported in previous studies, where crystalloid preloading showed moderate efficacy but was often inferior to vasopressors in sustained blood pressure control. A meta-analysis by Banerjee et al[15] concluded that while fluid preload reduces hypotension, it is less effective than vasopressors in preventing severe drops in blood pressure. This aligns with our observations, suggesting that fluid preload alone may be insufficient in high-risk patients.

Desalu et al[16] compared fluid preload using one liter of normal saline alone versus one liter of normal saline mixed with 30 mg of ephedrine and found that the systolic blood pressure was higher in the group that received normal saline with ephedrine. After the subarachnoid block, the preload group most frequently experienced a drop in blood pressure at 5 minutes, whereas in the ephedrine group, this occurred at 10 minutes.

The study by Kamat et al[17] demonstrated that a prophylactic strategy involving an initial 6 mg ephedrine bolus administered at the onset of subarachnoid block, followed by a continuous 24 mg ephedrine infusion, was significantly more effective in preventing spinal-induced hypotension during cesarean delivery compared to crystalloid preloading alone. These findings align with the results reported by Chan et al[18] and Lee et al[19], who similarly observed a higher incidence of hypotension in patients who received crystalloid preloading as opposed to those managed with prophylactic ephedrine administration. The consistency across these studies suggests that vasopressor-based interventions, such as ephedrine bolus and infusion, provide superior hemodynamic stability in parturients undergoing spinal anesthesia for cesarean delivery when compared to volume expansion with crystalloids alone. This may be attributed to ephedrine's direct alpha- and beta-adrenergic agonist effects, which counteract the sympathetic blockade-induced vasodilation, whereas crystalloid preloading alone may be insufficient to compensate for the rapid and profound decreases in systemic vascular resistance following spinal anesthesia.

A survey conducted by Burns et al[20] in the United Kingdom among obstetric anesthetists revealed that over 95% still prefer using ephedrine as the primary vasopressor during cesarean deliveries. Despite the growing popularity of alternative vasopressors, concerns persist regarding their safety and potential adverse effects on uterine artery and blood flow. Both alpha-1 agonists and ephedrine effectively maintain normotension in pregnant women undergoing cesarean sections without significantly compromising fetal well-being.

CONCLUSION

The frequency of hypotension is lower in women receiving prophylactic ephedrine during spinal anesthesia for cesarean section compared to those given a Hartmann's solution preload; therefore, we recommend the routine use of prophylactic ephedrine during spinal anesthesia induction in general practice to prevent spinal-induced hypotension.

REFERENCES

1. Andemeskel YM, Brhane DH, MohammedAli JA, Habtetsion TM. Comparison of Crystalloid Preloading versus Ephedrine Prophylaxis to Prevent Spinal Anesthesia Induced Hypotension during Cesarean Delivery: A Randomized Clinical Trial. Anesthesia and Critical care. 2024;6(1):17-25.
2. Ali MS, Shaheen R, Fareed Z, Mir MA, Qureshi Z, Malik JA. Effectiveness of Prophylactic Ephedrine vs Fluid Preload in Prevention of Hypotension in Spinal Anesthesia for C-Section. Pakistan Journal of Medical & Health Sciences. 2022;16(08):p51.
3. Noffsinger SR. Evidence-Based Prevention Strategies for the Management of Spinal Anesthesia-Induced Hypotension in Healthy Parturients Undergoing Elective Cesarean Delivery. AANA journal. 2022;90(4):311.
4. Jadoon AK, Tarar HM, Jadoon M, Bashir S, Abbas S, Jadoon A. Use of Intravenous Ephedrine in Crystalloid Preload to Decrease the Preload Volume Requirement Before Spinal Anesthesia in Elective Cesarean Section. Pakistan Armed Forces Medical Journal. 2024 Aug 31;74(4):1169.
5. Yu C, Gu J, Liao Z, Feng S. Prediction of spinal anesthesia-induced hypotension during elective cesarean section: a systematic review of prospective observational studies. International Journal of Obstetric Anesthesia. 2021;47:103175.
6. Eskandr AM, Ahmed AM, Bahgat NM. Comparative study among ephedrine, norepinephrine and phenylephrine infusions to prevent spinal hypotension during cesarean section. A randomized controlled

double-blind study. Egyptian Journal of Anaesthesia. 2021;37(1):295-301.
7. Elagamy AE, Kamaly AM, Shahin MI, Saleh M. Norepinephrine versus ephedrine for hypotension prophylaxis during cesarean section under spinal anesthesia. Ain-Shams Journal of Anesthesiology. 2021;13(1):2-6.
8. Mostafa MS, Hassan SA, Abdelatef M. How to handle hypotension following spinal anesthesia for a cesarean section. Journal of Current Medical Research and Practice. 2023;8(2):57-61.
9. Decuyper N, Van De Velde M. Fluid co-loading or preloading for the prevention of hypotension during spinal anesthesia for C-section: a narrative review. Acta anaesthesiologica Belgica. 2023;74(2):113-21.
10. Kinsella SM, Carvalho B, Dyer RA**.** International consensus statement on the management of hypotension with vasopressors during cesarean section under spinal anesthesia. *Anesthesia & Analgesia*. 2018;127(5):1230-1237.
11. Klöhr S, Roth R, Hofmann T**.** Definitions of hypotension after spinal anaesthesia for caesarean section: literature search and application to parturients. *Acta Anaesthesiologica Scandinavica*. 2010;54(8):909-921.
12. Prakash S, Pramanik V, Chellani H, Salhan S, Gogia AR. Maternal and neonatal effects of bolus administration of ephedrine and phenylephrine during spinal anaesthesia for caesarean delivery: a randomised study. *Int J Obstet Anesth.* 2016;25:17-22.
13. Ngan Kee WD, Lee SWY, Ng FF, Khaw KS. Prophylactic norepinephrine infusion for preventing hypotension during spinal anesthesia for cesarean delivery. *Anesth Analg.* 2018; 126(6):1989-1994.
14. Veeser M, Hofmann T, Roth R, Klöhr S, Rossaint R, Heesen M. Vasopressors for the management of hypotension after spinal anesthesia for elective caesarean section: systematic review and cumulative meta-analysis. *Acta Anaesthesiol Scand.* 2012;56(7):810-816.
15. Banerjee A, Stocche RM, Angle P, Halpern SH. Preload or coload for spinal anesthesia for elective Cesarean delivery: a meta-analysis. *Can J Anaesth.* 2020; 67(5): 577-585.
16. Desalu I, Kushimo OT. Is ephedrine infusion more effective at preventing hypotension than traditional prehydration during spinal anaesthesia for caesarean section in African parturients? Int J Obstet Anesth 2005;14:294-9.
17. Kamat S, Gupta R, Raju M. Prevention of hypotension following spinal anaesthesia for caesarean section: Comparison between crystalloid preloading & prophylactic ephedrine bolus & infusion. Karnataka Anaesth J 2009;10:48.
18. Chan WS, Irwin MG, Tong WN, Lam YH. Prevention of hypotension during spinal anaesthesia for caesarean section: ephedrine infusion versus fluid preload. Anaesthesia 1997;52(9):908-13.
19. Lee A, Ngan Kee WD, Gin T. A quantitative, systematic review of randomized controlled trials of ephedrine versus phenylephrine for the management of hypotension during spinal anaesthesia for caesarean delivery. Anesth Analg 2002;94:920-26.
20. Burns SM. Cowan CM. Wilkes RG. Prevention and management of hypotension during spinal anaesthesia for elective Caesarean section: a survey of practice. Anaesthesia 2001;56:794-7.

This article may be cited as: Khan A, Siddiqui MA, Asad H, Hussain S, Taqi M, Kumar K: Fluid Preloading Versus Ephedrine in the Management of Spinal Anesthesia-Induced Hypotension in patients undergoing Cesarean Delivery. Pak J Med Health Sci, 2024; 18(1): 302-304.