DOI: https://doi.org/10.3329/medtoday.v31i1.40321

ORIGINAL ARTICLE OPEN ACCSESS

Volume Preload versus Ephedrine Infusion for Prevention of Hypotension Due to Spinal Anesthesia for Cesarean Section

Md. Ashraful Anam *[1], Mohammad Mizanoor Rahman [2], Md. Aminur Rahman [3], Syed Md. Nurul Huda [4], Md. Mostafijur Rahaman [5], Md. Mohim Ibn Sina [6]

Abstract

Introduction: *Spinal anesthesia is used for 95% of planned cesarean sections in Bangladesh. It provides a fast and profound sensory and motor block. However, hypotension is a very common complication of spinal anesthesia during cesarean section, causing significant maternal and fetal morbidity and mortality. It could be associated with severe nausea, vomiting and even unconsciousness and pulmonary aspiration in the mother and for the baby hypoxia, acidosis and neurological injuries may result.* ***Materials and Methods:*** *This prospective randomized comparative study was conducted in the Department of Anesthesiology at Institute of Child and Mother Health (ICMH) from July 2017 to December 2017, on 110 adult pregnant women who underwent caesarean delivery. All study patients were randomly allocated into two groups. Group I (F group) patients received volume preloading with 15 ml/kg Ringer lactate solution before induction of spinal anesthesia and group II (E group) patients received IV ephedrine (5 mg in 1st minute after spinal anesthesia, 5 mg in 2nd minute and thereafter 1 mg in every minute for 15 minutes).* ***Results:*** *A statistically significant difference in the incidence of hypotension between group F (48%) and group E (24%) was found (p = 0.03). Regarding side effects, statistically significant (p = 0.23) incidence of nausea and vomiting was found in group F (20%) in comparison to group E (12%).* ***Conclusion:*** *We conclude that prophylactic IV ephedrine infusion is more effective than fluid preload to prevent spinal anesthesia-induced hypotension during caesarean section without causing significant tachycardia or hypertension.*

Keywords: *Cesarean section, Ephedrine, Hypotension, Spinal anesthesia.*

Number of Tables: 04; Number of Figures: 01; Number of References: 17; Number of Correspondences: 06

*** 1. Corresponding Author: Dr. Md. Ashraful Anam**
Assistant Professor & Head
Department of Anesthesiology
Institute of Child and Mother Health (ICMH), Matuail, Dhaka.
Email: anamdr66@gamil.com
Mobile: 01819199802

2. Dr. Mohammad Mizanoor Rahman
Assistant Professor
Department of Anesthesiology
Institute of Child and Mother Health (ICMH), Matuail, Dhaka.

3. Dr. Md. Aminur Rahman
Assistant Professor
Department of Anesthesiology
Institute of Child and Mother Health (ICMH), Matuail, Dhaka.

4. Dr. Syed Md. Nurul Huda
Assistant Professor
Department of Anesthesiology
Abdul Malek Ukil Medical College, Noakhali.

5. Dr. Md. Mostafijur Rahaman
Registrar
Department of Anesthesiology
Institute of Child and Mother Health (ICMH), Matuail, Dhaka.

6. Dr. Md. Mohim Ibn Sina
FCPS Part-II course student
Department of Obs. & Gynae
Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka.

Introduction

Anesthesia for caesarean delivery is generally chosen considering safety of both the mother and the fetus. Regional anesthesia is commonly used for almost 95% of planned cesarean deliveries[1]. Spinal anesthesia has several advantages as it provides fast, profound sensory and motor block[2], adequate muscle relaxation[3], better airway control with reduced risk of airway obstruction or aspiration of gastric contents. Postoperative deep vein thrombosis and pulmonary emboli are less common following spinal anesthesia[4], due to earlier ambulation and discharge. However, the most common complication of spinal anesthesia during cesarean section is hypotension[5] which can cause significant maternal and fetal morbidity and mortality[6]. Other serious maternal complications include nausea, vomiting, unconsciousness and pulmonary aspiration and hypoxia, acidosis and neurological injuries for the baby[7]. Hypotension occurs due to sympathetic nervous system blockade, leading to diminished systemic vascular resistance and peripheral pooling of blood which reduces cardiac output[8]. The incidence of hypotension is higher in cesarean sections due to significant cardiovascular changes of the parturient, compression of inferior venacava by gravid uterus and development of collateral venous circulation in the epidural space, leading to a decrease in the amount of cerebrospinal fluid (CSF) in the lumbosacral area and higher cephalic spread of local anesthetics[9]. Different techniques have been employed to reduce the incidence and severity of hypotension induced by spinal anesthesia including routine use of lateral uterine displacement[10],

Received: 20 September 2018 *Accepted revised version:* 27 November 2018

infusion of up to 2 liters of IV fluid for intravascular volume expansion[11] or use of vasopressor (ephedrine) may be an effective alternative for hypotension prevention[12]. Ephedrine is a sympathomimetic agent, non-catecholamine-mediated, which directly stimulates alpha and beta adrenergic receptors and producing its hypertensive effects through releasing nor-epinephrine from autonomic nerve endings[12]. On the other hand, IV infusion of Ringer lactate solution may reduce the risk of hypotension but does not eliminate it[11]. The primary aim of this study was to compare the efficacy of ephedrine infusion versus crystalloid preloading in reducing the incidence of hypotension during spinal anesthesia for cesarean section. The secondary aim was to detect complications including nausea & vomiting, chest symptoms and number of ephedrine boluses to treat hypotension.

Materials and Methods

This prospective randomized comparative study was conducted in Department of Anaesthesiology at Institute of Child and Mother Health (ICMH) from July 2017 to December 2017. One hundred and ten adult pregnant women scheduled for caesarean delivery were enrolled. Inclusion criteria were set as age between 20-40 years, with Body Mass Index (BMI) between 25 and 40 and American Society of Anesthesiologist (ASA) physical status class I or class II. Patients who refused spinal anesthesia, with history of allergic reactions to local anesthetics and opioids, patients with coagulopathy due to any cause, patients with severe cardiac, respiratory, hepatic or renal disease and pre-eclamptic and eclamptic patients were excluded from this study. All study patients were assessed by detailed history taking, physical examination and routine preoperative investigations (e.g. CBC, PT, PTT, INR, liver function tests, kidney function tests and fasting blood sugar) for evaluation of the patient medical status. No pre-medication was given. Upon arrival on operating room, baseline systolic blood pressure, heart rate and arterial oxygen saturation were recorded. Patients were randomly divided into two equal groups of 55 patients each. Group F: Those who received crystalloid preloading 15 ml/kg (Ringer lactate solution) before the procedure. Group E: Those who received prophylactic 25 mg ephedrine intravenously (before hypotension occurrence) in 50 ml normal saline as follow: 5 mg at 1st and 2nd minute and then infusion of 1 mg/min over 15 minutes after block. After performing spinal anesthesia, heart rate and systolic blood pressure were recorded noninvasively at 1 min and then every 3 minutes for the first 30 minutes and then every 5 minutes for another 30 minutes and lastly at 90 minutes. O_2 saturation was monitored by pulse oximetry at every 30 minutes. An infusion of Ringer lactate solution at a rate of 2 ml/kg/hr was given during the whole surgical procedure. Hypotension of both groups was identified by 20% decrease in SBP from the baseline and treated immediately by 5 mg bolus IV ephedrine at every 3 minutes until SBP returned to normal value. Occurrences of nausea, vomiting and chest symptoms (dyspnoea and tachypnoea) were also recorded. Postoperatively heart rate, systolic blood pressure and oxygen saturation were recorded after 30 minutes in both study groups. Data were presented as mean ± standard deviation or frequencies and percentages as appropriate. Comparisons were performed using student t-test, Chi-square test or analysis of variance (ANOVA) according to the type of variance. Data were analyzed using SPSS version 20. p value ≤ 0.05 was considered statistically significant.

Results

No statistically significant differences were found in age, BMI and parity of both study groups (Table I). Systolic blood pressure was significantly higher in E group in comparison to F group except at 4 min and 22 minutes (Table II). Though heart rate was found higher in E group but was not statistically significant ($p > 0.05$) (Figure-1). Incidence of hypotension was significantly higher ($p = 0.03$) in F group than E group. Oxygen saturation changes throughout study time did not show any statistically significant differences between the two groups (Table III). Nausea and vomiting was higher in F group compared to E group, but it was not statistically significant and no chest symptoms were found in both groups (Table IV). Significantly lower number of ephedrine boluses were required to correct hypotension in ephedrine group than fluid group ($p = 0.046$) (Table III).

Table-I: Demographic variables of study patients.

Demographic variables	F group Mean (± SD)	E group Mean (± SD)	p value
Age	28.7 ± 0.65	26.8 ± 1.1	0.21
BMI	35.2 ± 1.7	35.3 ± 1.7	0.40
Parity	2.2 ± 0.47	2.3 ± 0.49	0.44

Table-II: Systolic blood pressure (SBP) (in mm Hg) of study population.

Systolic blood pressure	F group Mean (± SD)	E group Mean (± SD)	p value
Baseline	122.6 ± 7.8	119 ± 9.9	0.09
1 min	116.3 ± 12.3	116.4 ± 12.3	0.48
4 min	103.9 ± 8.8	110.2 ± 15.5	0.04
7 min	110.6 ± 12.8	111.7 ± 13.7	0.4
10 min	111.7 ± 10.1	112.4 ± 13.2	0.4
13 min	108.7 ± 6.6	110.4 ± 12.0	0.3
16 min	111.4 ± 10.2	115.6 ± 10.9	0.08
19 min	111.9 ± 10.9	113.7 ± 13.5	0.3
22 min	112.1 ± 11.8	117.8 ± 10.8	0.04
25 min	113.3 ± 8.6	116.4 ± 9.7	0.1
28 min	113.3 ± 12.5	117.5 ± 11.9	0.08
31 min	114.3 ± 8.3	118.1 ± 9.7	0.0
36 min	112.4 ± 9.7	116 ± 9	0.0
41 min	115.1 ± 6.1	116.2 ± 6.0	0.3
46 min	113.4 ± 6.8	116.4 ± 9.8	0.1
51 min	117.0 ± 5.4	118 ± 6.7	0.3
56 min	119.1 ± 9	119.7 ± 6.2	0.4
61 min	122.5 ± 6.2	122.9 ± 5.2	0.4
90 min	120.5 ± 6.5	121.4 ± 7.59	0.3

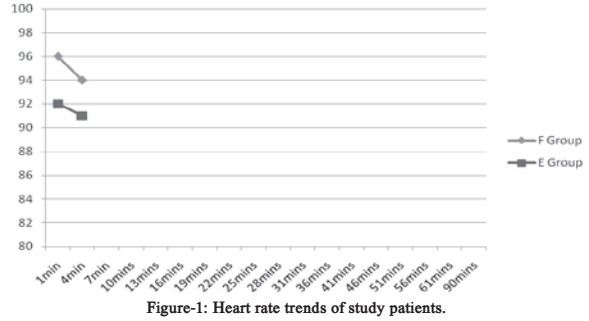

Figure-1: Heart rate trends of study patients.

Table-III: Oxygen saturation of study population.

O_2 saturation	F group	E group	p value
Baseline	98.5 ± 0.8	98.3 ± 0.7	0.23
30 minutes	99.7 ± 0.5	99.8 ± 0.4	0.26
60 minutes	99.8 ± 0.4	99.8± 0.4	0.5
90 minutes	98.9 ± 0.5	98.7 ± 0.6	0.11

Table-IV: Distribution of complications of study patients.

Complications	F group	E group	p value
Hypotension	12 (48%)	6 (24%)	0.03
Nausea & vomiting	5 (20%)	3 (12%)	0.23
Chest symptoms	0 (0%)	0 (0%)	0
Number of ephedrine boluses to treat hypotension	0.6 ± 0.8	0.3 ± 0.54	0.046

Discussion

The goal of this study was to compare the efficacy of ephedrine infusion versus crystalloid preloading in reducing the incidence of hypotension in spinal anesthesia for cesarean section. Nausea & vomiting, chest symptoms and number of ephedrine boluses to treat hypotension were also recorded. The effect of an IV bolus of ephedrine on arterial pressure is transient and lasts for only 10-15 minutes[12]. This study found that the incidence of hypotension was significantly lower in E group when compared to F group (Table II). Gajraj et al. similarly found that hypotension incidence was significantly higher in the crystalloid group compared to the infusion group[13]. Rout et al.[14] (1992) concluded that prophylactic IV ephedrine administered either by infusion or multiple bolus injections has been considered the gold standard for preventing and treating hypotension. But Thiangtham et al. found no statistically significant difference in the incidence of hypotension between the two groups[15]. Though this study found higher heart rate in E group but was not statistically significant ($p > 0.05$) (Figure 1). This could be explained both by the effect of rescue ephedrine and by baroreceptor-mediated reflex increase in heart rate in patients who became hypotensive. Bhovi et al. found similar finding in his study [16]. Kol I.O. et al.[17] found lower incidences of nausea and vomiting in the ephedrine group compared to the fluid group and this was consistent with our findings (Table IV). This study showed significantly lower number of ephedrine boluses were required to correct hypotension in ephedrine group than fluid group (Table III). Thiangtham et al. showed similar results[15].

Conclusion

We conclude that prophylactic IV ephedrine infusion is more effective than fluid preload to prevent spinal anesthesia-induced hypotension during caesarean section without causing significant tachycardia or hypertension.

Conflict of Interests: None.

Acknowledgement

The authors would like to thank all participating patients for taking part in this study. We are greatly indebted to the institutional anesthetist group, Post Anesthetic Care Unit staff and Obstetric team for their endless support. The authors would like to thank specially our institutional Executive Director for his continuous supervision and guidance.

References

1. Bucklin, B.A., Hawkins, J.L., Anderson, J.R., Ullrich, F.A. Obstetric Anesthesia Workforce Survey: Twenty-Year Update. Anesthesiology. 2005; 103: 645-653. http://dx.doi.org/10.1097/00000542-200509000-00030.
2. Hawkins, J.L., Arens, J.F., Bucklin, B.A., et al. Practice Guidelines for Obstetric Anesthesia: An Updated Report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia. Anesthesiology. 2007; 106: 843-863.
3. Campbell, J., Sultan, P. Regional Anesthesia for Caesarean Section: A Choice of Three Techniques. British Journal of Hospital Medicine (London). 2009; 70: 605.
4. Kuczkopwski, K.M., Reisner, L.S., Lin, D. Anesthesia for Cesarean Section. In: Chestnut, D.H., Polley, L.S., Tsen, L.C, et al editors. Chestnut's Obstetric Anesthesia: Principles & Practice. 4th Edition. Mosby: Philadelphia; 2009: 422-25.
5. Carvalho, B., Coleman, L., Saxena, A., et al. Analgesic Requirements and Postoperative Recovery after Scheduled Compared to Unplanned Cesarean Delivery: A Retrospective Chart Review. International Journal of Obstetric Anesthesia. 2010; 19: 10-15.
6. Carpenter, R.L., Caplan, R.A., Brown, D.L., et al. Incidence and Risk Factors for Side Effects of Spinal Anesthesia. Anesthesiology. 1992; 76: 906-916. http://dx.doi.org/10.1097/00000542-199206000-00006
7. Cyna, A.M., Andrew, M., Emmett, R.S., et al. (2006) Techniques for Preventing Hypotension during Spinal Anesthesia for Caesarean Section. Cochrane Database of Systematic Reviews, 18, CD002251.
8. Bhagat, H., Malohtra, K., Ghildyal, S.K., et al. Evaluation of Preloading and Vasoconstrictors as a Combined Prophylaxis for Hypotension during Subarachnoid Anaesthesia. Indian Journal of Anaesthesia. 2004; 48: 299-303.
9. Higuchi, H., Hirata, J., Adachi, Y., et al. Influence of Lumbosacral Cerebrospinal Fluid Density, Velocity, and Volume on Extent and Duration of Plain Bupivacaine Spinal Anesthesia. Anesthesiology. 2004; 100: 106-114.
10. Clark, S.L., Cotton, D.B., Pivarnik, J.M., et al. Position Change and Central Haemodynamic Profile during Normal Third-Trimester Pregnancy and Post Partum. American Journal of Obstetrics & Gynecology. 1991; 164: 883-887.
11. Jackson, R., Reid, J.A., Thorburn, J. Volume Preload Is Not Essential to Prevent Spinal Induced Hypotension at Cesarean Section. British Journal of Anesthesiology. 1995; 75: 262-265. http://dx.doi.org/10.1093/bja/75.3.262.
12. Hollmen, A.J., Joppila, R., Albright, G.A., et al. Intervillous Blood Flow during Caesarean Section with Prophylactic Ephedrine and Epidural anesthesia. Acta AnaesthesiologicaScandinavica. 1984; 28: 396-400.
13. Gajraj, N.M. Comparison of an Ephedrine Infusion with Crystalloid Administration for Prevention of Hypotension during Spinal Anesthesia. Anesthesia & Analgesia. 1993; 76: 1023-1026.
14. Rout, C.C., Rocke, D.A., Brijball, R. et al. Prophylactic Intramuscular Ephedrine Prior to Caesarean Section. Anaesthesia and Intensive Care. 1992; 20: 448-452.
15. Thiangtham, K., Asampinwat, T. Intravenous Ephedrine Infusion for Prophylaxis of Hypotension during Spinal Anesthesia for Cesarean Section. Songklanagarind Medical Journal 2009; 27: 291-300.
16. Bhovi, A, Madhusoodana, R. Comparative Study of Ephedrine Infusion with the Preload of Crystalloids for Prevention of Hypotension during Spinal Anaesthesia for Elective Caesarean Section. Indian Journal of Applied Research. 2014; 4: 2249-2255.
17. Kol, I.O., Kaygusuz, K., Gursoy, S., et al. The Effects of Intravenous Ephedrine during Spinal Anesthesia for Cesarean Delivery: A Randomized Controlled Trial. Journal of Korean Medical Science. 2009; 24: 883-888.