Co-Loading Vs. Pre-Loading For Hypotension Prevention After Spinal Anaesthesia

Gurulingappa I Herakal[1], Dr Ellen Ghazi Safadi[1], Prathima Prasad Rai[2], Suma Ashok[2], Ashli Shaji[2], Jibin Simon[2.]

Institution- Department of Anesthesia Technology, College of Health Science, Gulf Medical University, AJMAN, United Arab Emirates1.
Department of Anesthesia & Operation Theatre Technology, KSHEMA, NITTE (Deemed to be) University, Mangalore, Karnataka, INDIA.
Department of Anesthesia & Operation Theatre Technology, College of Health Professionals, Manipal University, Udupi, Karnataka, INDIA.
Department of Anesthesia & Operation Theatre Technology, College of Health Professionals, Manipal University, Udupi, Karnataka, INDIA

DOI: 10.29322/IJSRP.13.01.2023.p13304
http://dx.doi.org/10.29322/IJSRP.13.01.2023.p13304

Paper Received Date: 18th November 2022
Paper Acceptance Date: 27th December 2022
Paper Publication Date: 6th January 2023

***Abstract*- Background:**

The prevention of spinal anesthesia induced hypotension is important, especially among pregnant women. The women receiving crystalloid loading in spinal anesthesia for cesarean delivery, the co-load strategy reduced the incidence of intra operative maternal hypotension and the need for vasopressors. Even though, both pre-loading and co-loading techniques are effective in prevention of hypotension among pregnant women, the co-loading was found to be more efficient. Therefore, the purpose of this study was to evaluate how different internal policies affected the management of spinal anesthesia-induced hypotension.

Methodology:

The cross-sectional study design was used with a total of 60 mothers. They were grouped in to two: thirty cases were preloaded with 1000ml Ringer Lactate, and the other 30, co-loaded with 1000 ml ringer lactate. All individuals in the trial are ASA II, between the ages of 18 and 40 years, and undergoing a cesarean section. Cases with PIH, diabetes, obesity, Abruption placenta, other than ASA II, Gemelli pregnancy, history of allergies to local anesthetic, basal systolic pressure < 90 mmHg, preeclampsia, cardiac abnormalities and participants who got a blood transfusion or if spinal anesthesia failed were the exclusion criteria. For each case, heart rate, systolic blood pressure, diastolic blood pressure, arterial pressure baseline, need for vasopressors, total fluid requirement, and the neonatal assessment by APGAR score at birth were obtained and subjected for analytics by using SPSS software (SPSS Inc.; Chicago, IL) version 26.0.

Results:

In pre loading, there was a difference in SBP, DBP, mean artery pressure (MAP), SPO2, respiratory rate, and pulse rate from baseline to seventy minutes. Regarding co-loading, only the SBP, DBP, MAP, and pulse rate exhibited a change from baseline to seventy minutes. Also, usage of ephedrine in the beginning of spinal was almost same between the groups. However, at 15 minutes time interval co-loading groups used more ephedrine than pre-loading group and at 20 minutes interval there was no more incidence of hypotension in co-loading group. At 20 minutes interval pre-loading group received the maximum dose of ephedrine.

Conclusion:

The incidence of hypotension was different between the groups: preloading and co-loading, there for it affects the hemodynamic stability of patients. In co-loading, the episodes of hypotension were less and hence patients were more hemodynamic stable when comparing with pre-loading by crystalloid fluid Ringer Lactate 1000ml.

***Index Terms*-** Pregnant women, Cesarean section, Ephedrine dose, Maternal Hypotension

I. INTRODUCTION

Hypotension is one of the commonest serious problems following spinal anesthesia, especially for cesarean section, potentially endangering both mother and child which can increase intra-op and post-op morbidity. Hypotension, generally defined as a greater than 20% decrease in the patient's baseline blood pressure, or a systolic blood pressure less than 100 mm Hg, hypotension is a common side-effect of neuraxial anesthesia [1]. In order to avoid hypotension during the neuraxial block, co-loading is more successful than pre-loading. Prevention of spinal anesthesia- induced hypotension is the most important, especially in the pregnant

population as the life of the mother as well as the fetus is at risk [2]. Measures to decrease the incidence and severity of maternal hypotension include left uterine displacement, fluid preload, fluid co-load, prophylactic vasoconstrictors, Trendelenburg position and legs elevation, etc. Type or timing of the fluid following spinal anesthesia and the use of vasopressors were associated with the incidence of hypotension among the pregnant women [3]. Patients receiving crystalloid loading in spinal anesthesia for cesarean delivery, co-load strategy reduced the incidence of intra operative maternal hypotension and the need for vasopressors. The incidence of hypotension was lesser in the co-load group as compared to the preload cases [4].

Several studies have been done to evaluate the efficiency of preloading and co-loading, the intravenous fluids can be used both before and during the administration of spinal anesthesia, the techniques appropriately named as pre-loading and co-loading respectively. Based on current evidence, intravenous pre-hydration has poor efficacy, probably because of rapid distribution, It has been shown that administration of a fluid bolus starting at the time of injection of neuraxial anesthetic (co-hydration) is more effective because maximum effect can be achieved at the time of the block and consequent vasodilatation [5]. Although rapid crystalloid administration after, rather than over 20 minutes before the induction of spinal anesthesia for elective caesarean section, may be advantageous for controlling maternal blood pressure before giving birth [6]. Numerous research studies and available literary evidence suggest that both techniques can be equally effective in the prevention of hypotension; most of them revealed that co-loading is more efficient.

Occasionally, spinal anesthesia induced hypotension can be significantly severe, more so in pregnant women, which can increase intra-op and post-op morbidity. This study will help to determine the best way for spinal anesthesia with less complication [7]. Spinal anesthesia is the preferred technique of anesthesia for cesarean surgeries which has minimum maternal and neonatal complications as difficult airway and risk of aspiration as compared to general anesthesia. However, hypotension and bradycardia during spinal anesthesia for cesarean section is the most common complication associated with nausea and vomiting. Ringer lactate is the most commonly used loading in spinal anesthesia for cesarean section.

It is intriguing to evaluate the hemodynamic stability in pregnant women undergoing spinal anesthesia especially the aspects of stability in heart rate and blood pressure and its association with preloading and co-loading. Majority of the pregnant cases needed intra operative vasopressors when receiving crystalloid preload. For patients receiving crystalloid loading in spinal anesthesia for cesarean delivery, co-loading strategy is superior to preload for the prevention of maternal hypotension [1-2]. This study helps to identify the variable which positively predicts hypotension, thus, the anesthesiologist and the health care providers can prepare accordingly for prevent hypotension among pregnant cases.

II. Objective:

To compare the outcomes of internal policy implementation in managing the hypotension induced by spinal anesthesia.

III. Methodology:

The cross-sectional study design was used with a total of 60 mothers, who underwent elective lower segment cesarean section in Thumbay Hospital, Ajman, United Arab Emirates. The participants were grouped in to two: thirty cases were preloaded with 1000ml Ringer lactateover a period of 15 minutes before spinal anesthesia, and the other 30, co-loaded with 1000 ml ringer lactatevia a pressurized giving set to administer the fluid at the maximum possible rate at the time of identification of CSF.

All participants included in this study were ASA 11, aged between 18 and 40 years, and who is undergoing for cesarean section. Cases with PIH, diabetes, obesity, Abruption placenta, other than ASA II, Gemelli pregnancy, history of allergies to local anesthetic, basal systolic pressure <90 mmHg, preeclampsia, cardiac abnormalities and participants who got a blood transfusion or if spinal anesthesia failed were the exclusion criteria.

After the approval from the institutional review board and the anesthesia department, cases who qualify the inclusion criteria were identified and explained and educated the participants regarding the study followed by the consent. Each case had a patent IV line (18 G) and secured at receiving time. They were placed in left lateral position and to measure baseline vitals including non-invasive blood pressure and heart rate. To initiate the spinal anesthesia, 25 G/27G pencil point needle and 0.5% heavy bupivacaine injection 2.5ml with 15-25 mcg of fentanyl citrate injection were used. Cases were monitored non invasive blood pressure measurements, heart rate, pulse rate and use of ephedrine in both groups at every three minutes for the first 20 minutes and for every five minutes there after till the end of surgery. If the systolic arterial blood pressure decreased to less than 20% of the calculated baseline value, then compensated with Inj. Ephedrine.

For each case, heart rate, systolic blood pressure, diastolic blood pressure, arterial pressure baseline, need for vasopressors, total fluid requirement, and the neonatal assessment by APGAR score at birth were obtained and subjected for analytics by using SPSS software (SPSS Inc.; Chicago, IL) version 26.0. The study done by comparing the average of each clinical parameters using repeated measure ANOVA. Normality for each parameter tested for normality using Kolmogorv Smrinvnov test. Analysis techniques were chosen according to the type of the variable and decisions were taken at 5% of level of significance.

IV. RESULTS

Table 1: Comparison of SBP, DBP, MAP, SPO_2, RR, and Pulse Rate at baseline between pre loading and co-loading groups

	Pre loading		Co-loading		"t"	p value
	Mean	S.D.	Mean	S.D.		
SBP (mmHg)	123.43	12.05	119.60	15.90	1.053	0.297
DBP (mmHg)	72.50	9.48	67.70	12.82	1.649	0.105
MAP (mmHg)	89.48	9.02	85.00	12.79	1.567	0.123
SPO_2	99.87	0.35	99.10	1.93	2.128	0.038*
RR	19.93	0.25	19.33	0.48	6.058	< 0.001*
Pulse Rate	98.83	13.98	95.93	11.34	0.882	0.381

(* Significant)

A difference ($p < 0.05$) in the mean SPO_2, and RR at baseline was found between the pre loading and co-loading groups. The SBP, DBP, MAP, and Pulse Rate at baseline were exhibited no difference ($p > 0.05$) between pre loading and co-loading groups. Thus, at baseline, the SBP, DBP, MAP, and Pulse Rate were homogenous between pre loading and co-loading groups [Table 1].

Table 2: Comparison of SBP, DBP within pre loading and co-loading groups

	SBP (mmHg)				DBP (mmHg)			
	Pre loading		Co-loading		Pre loading		Co-loading	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Base line	124.08	11.08	119.60	15.90	72.48	9.07	67.70	12.82
Spinal Started	120.38	13.62	111.23	20.28	68.12	12.10	61.50	12.91
5 minutes	106.54	15.36	99.13	19.48	57.36	8.50	52.67	12.29
10 minutes	109.73	15.07	100.53	14.81	57.92	8.62	54.63	12.35
15 minutes	108.96	13.65	102.70	12.31	59.08	10.59	57.07	11.35
20 minutes	110.65	12.02	103.57	11.80	56.40	6.82	56.43	11.51
25 minutes	105.81	15.76	105.17	13.13	57.32	13.81	56.13	10.49
30 minutes	110.81	12.21	109.50	10.42	58.20	14.09	57.73	9.68
40 minutes	109.85	15.79	110.57	11.62	57.28	5.73	57.83	10.43
50 minutes	112.04	9.89	111.60	11.40	59.00	8.04	58.70	10.34
60 minutes	113.23	8.08	113.57	12.79	57.44	3.61	60.73	10.58
70 minutes	114.73	8.26	113.20	12.67	59.64	3.76	61.07	11.48
"F"	6.530		11.220		8.142		9.094	
p value	< 0.001*		< 0.001*		< 0.001*		< 0.001*	

(* Significant)

The measurements of SBP, DBP, MAP,RR and Pulse Rate exhibited an improvement ($p < 0.05$) within the groups: pre loading as well as co-loading. However, SPO_2 was consistent ($p > 0.05$) within pre loading as well as co-loading groups [Table 2 – 4; Figure 1 - 6].

Table 3: Comparison of MAP, SPO_2within pre loading and co-loading groups

	MAP (mmHg)				SPO_2			
	Pre loading		Co-loading		Pre loading		Co-loading	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Base line	89.48	9.02	85.00	12.79	99.84	0.37	99.10	1.93
Spinal Started	86.41	12.04	78.08	14.44	99.84	0.47	99.52	0.79
5 minutes	74.66	12.12	68.16	14.25	99.88	0.44	99.45	0.78
10 minutes	75.96	10.34	69.93	12.44	99.96	0.20	99.48	0.87
15 minutes	76.32	10.38	72.28	10.65	99.92	0.40	99.28	1.16
20 minutes	74.08	7.13	72.14	10.90	99.88	0.44	99.55	0.78
25 minutes	74.10	8.89	72.48	10.93	99.88	0.44	99.28	1.39
30 minutes	76.51	10.74	74.99	9.28	99.84	0.47	99.55	0.87
40 minutes	74.69	12.85	75.41	10.32	99.80	0.50	99.62	0.62
50 minutes	77.92	8.18	76.33	10.30	99.84	0.37	99.34	1.57
60 minutes	71.66	20.00	78.34	10.87	99.76	0.52	99.72	0.53
70 minutes	67.68	27.33	78.44	11.26	99.44	0.77	99.59	0.68
"F"	6.408		11.535		2.464		0.915	
p value	< 0.001*		< 0.001*		0.058		0.461	

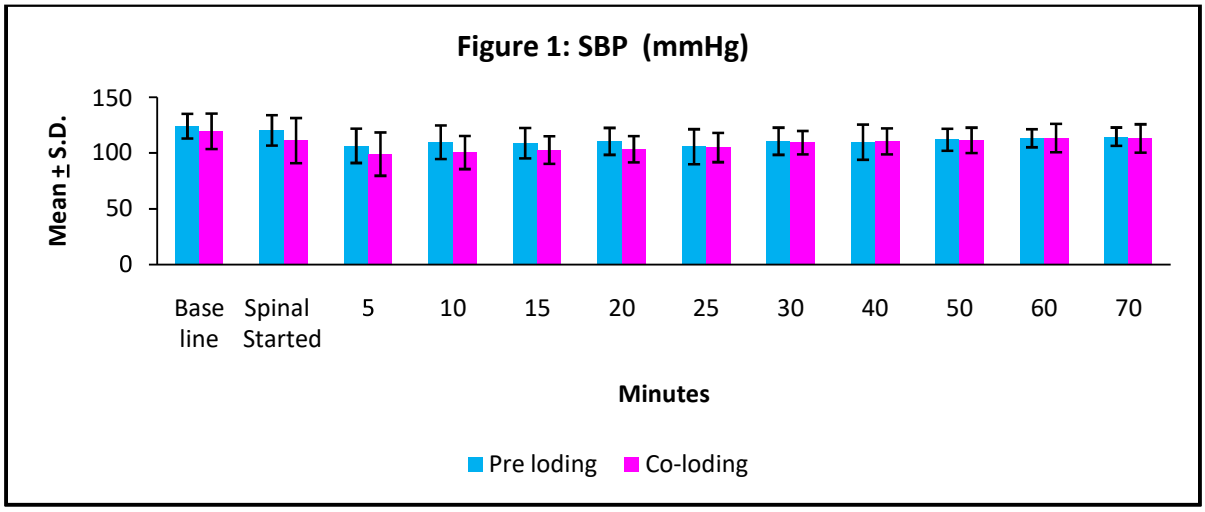
(* Significant)

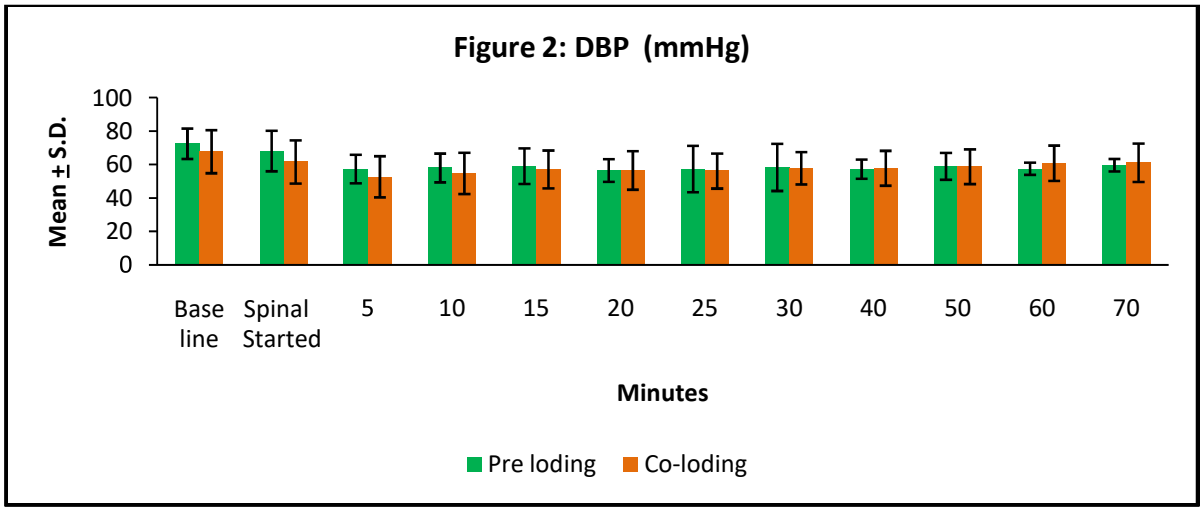
Table 4:Comparison of RR, Pulse Rate within pre loading and co-loading groups

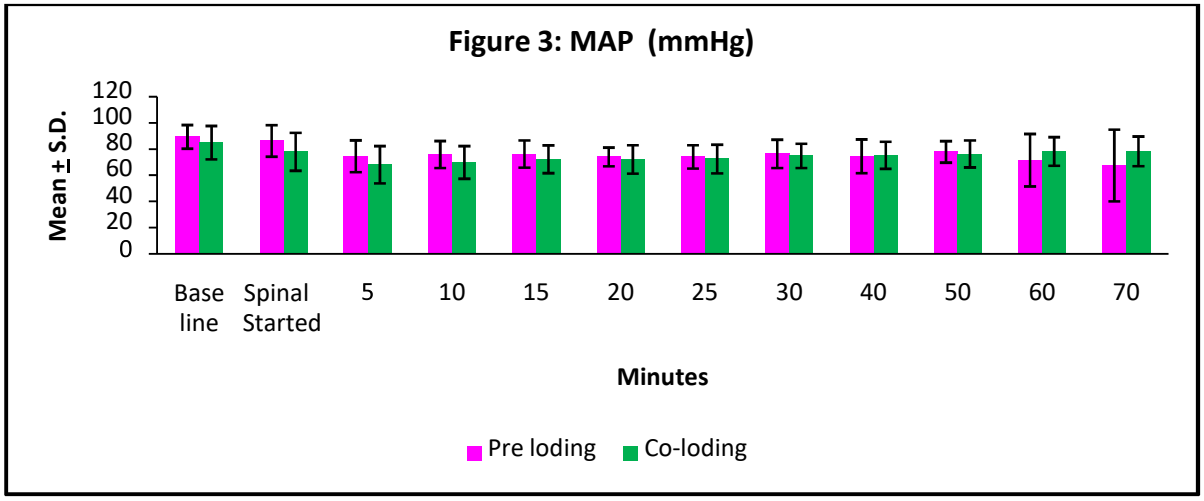
	RR (mmHg)				Pulse Rate			
	Pre loading		Co-loading		Pre loading		Co-loading	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Base line	19.93	0.25	19.34	0.48	99.37	13.63	95.93	11.34
Spinal Started	--	--	19.62	0.49	99.88	16.88	97.50	14.13
5 minutes	17.40	0.97	19.38	0.49	96.46	18.84	94.53	17.56
10 minutes	19.80	0.41	19.66	0.61	93.63	14.67	96.37	20.69
15 minutes	19.00	0.00	19.52	0.51	95.58	13.87	92.20	17.04
20 minutes	19.37	0.62	19.62	0.49	92.42	13.92	92.00	16.72
25 minutes	18.93	0.69	19.66	0.48	89.08	12.50	93.00	17.91
30 minutes	19.40	0.50	19.52	0.51	86.62	13.00	91.80	17.59
40 minutes	19.50	0.51	19.41	0.50	85.42	12.64	88.40	16.84
50 minutes	19.00	0.72	19.45	0.51	83.71	12.72	87.20	14.39
60 minutes	19.62	0.50	19.17	0.60	19.63	0.50	19.17	0.59
70 minutes	19.54	0.51	19.41	0.50	82.54	10.67	85.77	13.62
"F"	66.781		2.267		121.166		102.598	

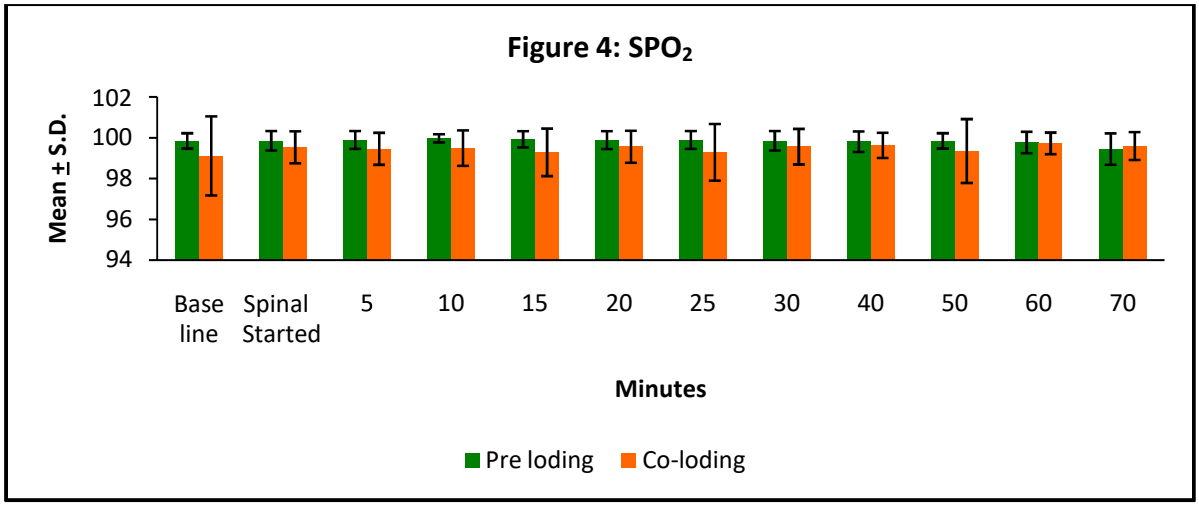
p value	< 0.001*	0.059	< 0.001*	< 0.001*

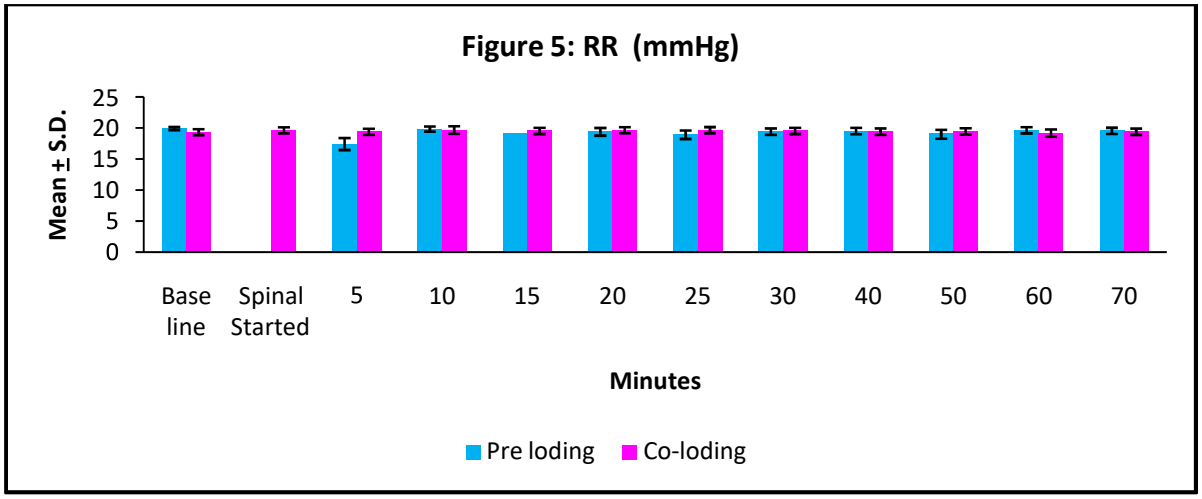
(* Significant)











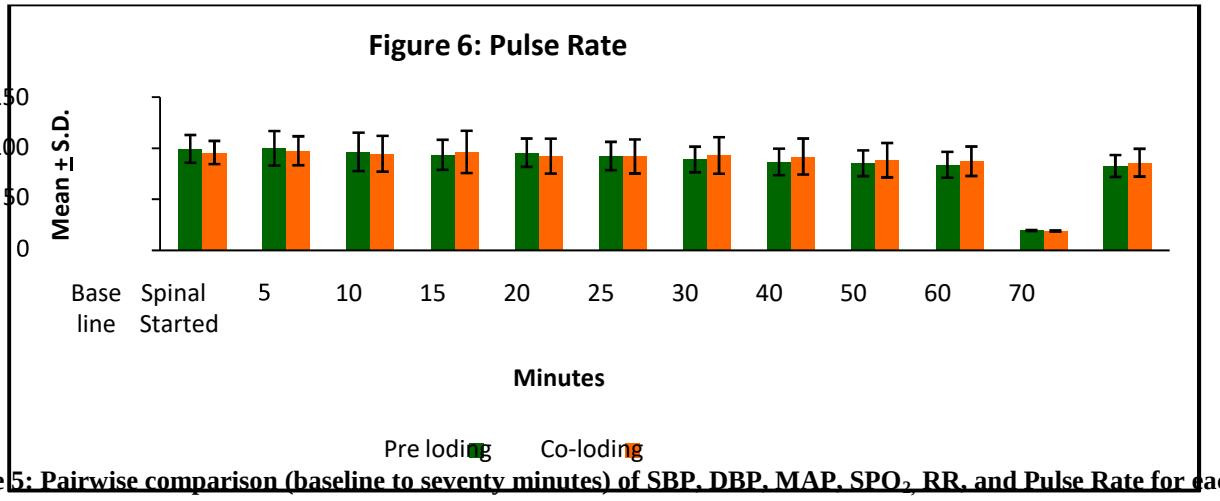


Table 5: Pairwise comparison (baseline to seventy minutes) of SBP, DBP, MAP, SPO_2, RR, and Pulse Rate for each group

	Pre loading		"t"	p value	Co-loading		"t"	p value
	Mean difference	S.D.			Mean difference	S.D.		

SBP (mmHg)	9.35	13.10	3.638	0.001*	6.40	14.86	2.358	0.025*
DBP (mmHg)	12.15	10.02	6.186	< 0.001*	6.63	8.67	4.19	< 0.001*
MAP (mmHg)	21.80	29.13	4.098	< 0.001*	6.56	9.82	3.658	0.001*
SPO_2	0.39	0.94	2.083	0.048*	-0.48	1.94	-1.341	0.191
RR	0.46	0.51	4.412	< 0.001*	-0.07	0.88	-0.42	0.677
Pulse Rate	16.89	14.72	5.848	< 0.001*	10.17	16.94	3.287	0.003*

In pre loading, there was a difference ($p < 0.05$) in SBP, DBP, MAP, SPO_2, RR, and Pulse Rate from baseline to seventy minutes. Regarding co-loading, only the SBP, DBP, MAP, and Pulse Rate exhibited a change ($p < 0.05$) from baseline to seventy minutes [Table 5].

Table 6: Dose of ephedrine

Ephedrin dose	Pre loading		Co-loading	
	Mean	S.D.	Mean	S.D.
5 minutes	8.69	3.55	9.80	4.34
10 minutes	7.82	3.71	6.67	2.58
15 minutes	7.40	3.36	4.60	3.65
20 minutes	3.33	2.89		

Usage of ephedrine in the beginning of spinal was almost same between pre load and co-load cases. But at 15 minutes time interval co-loading groups used more ephedrine than pre-loading group and at 20 minutes interval there was no more incidence of hypotension in co-loading group. At the same time at 20 minutes interval pre-loading group received the maximum dose of ephedrine [Table 6].

V. Discussion:

Hypotension following spinal anesthesia is a common among general population with an incidence of 25 to 75% and it is 60 to 70% among caesarean cases [1, 2]. Pre-loading with colloid solutions was beneficial in preventing spinal induced hypotension and the co-loading technique is more appropriate physiologically, thus reducing the severity of hypotension. The systolic blood pressure of 90 or 100 mmHg or a 20% decrease in blood pressure from the baseline induces

Hypotension following spinal anesthesia [2]. Age of the mother (≥ 35 years), body mass index (≥ 25 kg/m^2), doses of local anesthetics, and higher weight of infants are the determinants for hypotension caused by spinal anesthesia [3]. The non-pharmacological methods to prevent the hypotension include: leg wrapping methods, inflatable splints/boots, or thrombo embolic deterrent stockings [3, 5]. Administering intravenous vasopressors drugs: Ephedrine bolus 5-15 mg or Phenylephrine 25-50 mcg, supplemental oxygen and intravenous fluid bolus administration are the comprehensively used Pharmacological methods [3].

This study compared co-loading and preloading in relation to prevention of hypotension and helping hemodynamic stability by continuous monitoring of vital parameters like heart rate and blood pressure. There was a difference in the incidence of hypotension between: pre loading and co-loading cases. Despite the variations in systolic blood pressure (SBP) for both groups, in the co-loading group SBP was more stable than pre-loading group. From the beginning both groups showing significant variation, but later on co-loading patients shows more stable vitals . Even though there was more variation in the beginning of spinal, the fluctuation of diastolic blood was less in co-loading. Thus, comparatively co-loading patients were more stable than pre loading patients.

In this study, a difference ($p < 0.05$) in the mean SPO_2, and RR at baseline was found between the pre loading and co-loading groups. The SBP, DBP, MAP, and Pulse Rate at baseline were exhibited no difference between pre loading and co-loading groups. Thus, at baseline, the SBP, DBP, MAP, and Pulse Rate were homogenous between pre loading and co-loading groups. These results are consistent to the study by Artawan *et al*. in 2020 comparing the effectiveness of crystalloid fluid preloading and co-loading to reduce the incidence of hypotension among cesarean cases with spinal anesthesia [3].

According to this study, the incidence of hypotension seen from a reduction in SBP, DBP, and MAP decreased significantly in the co-loading group compared with the preloading. This result is similar to the results of a study conducted by Rao et al. in 2015 comparing the effectiveness of preloading with co-loading with crystalloid fluid in cesarean section with spinal anesthesia. In Rao

study, the incidence of hypotension in the co-loading group was significantly lower compared to the preloading group, where the incidence of hypotension in the co-loading group was 40% (p = 0.023) [8]. This was also consistent with the results of the study of Oh et al. in 2014, where the incidence of hypotension was significantly lower in the co-loading group compared to preloading group (p = 0.026) [9,10]. This is similar to Rao's study where the total dose of ephedrine needed in the co-loading group decreased significantly compared to the preloading group (p = 0.023).[8] Oh et al.'s research results in 2014 also showed the same thing where ephedrine requirements were significantly smaller in the co-loading group compared to the preloading group.[9, 10].

The measurements of SBP, DBP, MAP,RR and Pulse Rate exhibited an improvement ($p < 0.05$) within the groups: pre loading as well as co-loading. However, SPO_2 was consistent within pre loading as well as co-loading groups. In pre loading, there was a difference ($p < 0.05$) in SBP, DBP, MAP, SPO_2, RR, and Pulse Rate from baseline to seventy minutes. Regarding co-loading, only the SBP, DBP, MAP, and Pulse Rate exhibited a change from baseline to seventy minutes.

The pathophysiology for hypotension during spinal anesthesia includes: onset of sympatholytic due to increased sensitivity of nerve fibers to local anesthetics during pregnancy, aortocaval compression, or dominance of parasympathetic system. Bradycardia is another feature of profound circulatory collapse under neuraxial anesthesia among the cesarean cases and it can lead to cardiac arrest. Untreated hypotension associated with decrease in uteroplacental blood flow, which can leads to fetal acidosis and morbidity [7]. In this study, the comparison of number of episodes of hypotension and ephedrine usage reveals that preloading groups faced more episodes. Also, usage of ephedrine in the beginning of spinal is almost same. But at 15 minutes time interval co-loading groups uses more ephedrine than pre-loading group and at 20 minutes interval there is no more incidence of hypotension in co-loading group. At the same time at 20 minutes interval pre-loading group received the maximum dose of ephedrine.

VI. Limitations:

This study concentrated the noninvasive blood pressure monitoring, which might not be able to reflect exact blood pressure measurement of the cesarean cases. Hence, further studies with use of invasive blood pressure monitoring would help to accurately identify the role of pre loading and co-loading of spinal induced hypotension in caesarean section.

VII. Conclusion:

The incidence of hypotension was different between the groups: preloading and co-loading, there for it affects the hemodynamic stability of patients. In co-loading, the episodes of hypotension are less and hence patients are more hemodynamic stable when comparing with pre-loading by crystalloid fluid Ringer Lactate 1000ml.

References

[1] Morgan GE, Maged JR, Mikhail MS, Murray MJ. Clinical Anesthesiology, Third Edition, McGraw-Hill, Anesthesia for Cesarean Section 2006; 901-906.

[2] Bajwa S, Jindal R, Kulshrestha A. Co-loading or pre-loading for prevention of hypotension after spinal anesthesia! a therapeutic dilemma. Anesth: Essays Res. 2013; 7(2):155.

[3] Artawan I, Sarim B, Sagita S, Etty Dedi M. Comparison the effect of preloading and coloading with crystalloid fluid on the incidence of hypotension after spinal anesthesia in cesarean section. Bali J Anesthesiol. 2020; 4(1):3.

[4] Ranasinghe JS, Birnbach D. Current Status of Obstetric Anaesthesia: Improving Satisfaction and Safety. Indian J Anaesth. 2009; 53:608-16.

[5] Dyer RA, Farina Z, Joubert IA, Du Toit P, Meyer M, Torr G, et al. Crystalloid pre-load versus rapid crystalloid administration after induction of spinal anesthesia (coload) for elective cesarean section. Anaesth Intensive Care. 2004; 32:351–7.

[6] Loubert C. Fluid and vasopressor management for Cesarean delivery under spinal anesthesia: continuing professional development. Can J Anesth. 2012; 59(6):604–19.

[7] Macarthur A, Riley ET. Obstetric anesthesia controversies: Vasopressor choice for post- spinal hypotension during cesarean delivery. Int Anesthesiol Clin. 2007; 45 (1):115–32.

[8] Chooi C, Cox J, Lumb R, Middleton P, Chemali M, Emmett R et al. Techniques for preventing hypotension during spinal anaesthesia for caesarean section. 2021.

[9] IOSR Journal of Dental and Medical Sciences (IOSR - PDF document download [Internet]. Docslides.com. 2021 [cited 6 June 2021].

[10] Shnider SM, Levinson G. Anaesthesia caesarean section, chapter 12, anaesthesia for obstetrics, 3rd, william' and wilkins.

Authors

First Author – Gurulingappa I Herakal, Institution- Department of Anesthesia Technology,College of Health Science,Gulf Medical University,AJMAN,United Arab Emirates
Second Author – Dr Ellen Ghazi Safadi, Institution- Department of Anesthesia Technology,College of Health Science,Gulf Medical University,AJMAN,United Arab Emirates
Third Author – Prathima Prasad Rai, Department of Anesthesia & Operation Theatre Technology,KSHEMA,NITTE (Deemed to be) University,Mangalore,Karnataka,INDIA.

Fourth Author – Suma Ashok, Department of Anesthesia & Operation Theatre Technology, KSHEMA, NITTE (Deemed to be) University,Mangalore,Karnataka,INDIA.
Fifth Author – Ashli Shaji, Department of Anesthesia & Operation Theatre Technology, College of Health Professionals, Manipal University,Udupi,Karnataka,INDIA.
Sixth Author – Jibin Simon, Department of Anesthesia & Operation Theatre Technology, Allied Health Sciences, Yenepoya University, Mangalore, Karnataka, INDIA.