Original Article

Indian Journal of Anaesthesia and Analgesia
Volume 3 Number 2, May - August 2016
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.3216.10

Efficacy of Combination Therapy with Reduced Volume of Crystalloid Preloading and Reduced Dose of Vasoconstrictor as an Effective Prophylaxis Against Spinal Hypotension

Balaraju Thayappa C.*, G. Amarappa*, Kiran Kumar K.S., Naveed Abrar****

Abstract

Background: Various methods have been devised to prevent hypotension, a very common complication of subarachnoid block(SAB). This study was conducted to evaluate the efficacy of combined use of crystalloid preloading and vasoconstrictor for prevention of hypotension due to SAB, when compared to crystalloid preloading. *Methods:* 100 adult patients of physical status ASA I and II scheduled to undergo elective surgical procedure on lower abdomen under SAB were divided into two groups of 50 each. *Crystalloid group:* Preloaded with Ringer's lactate: 15 ml/KBW over 20 min before SAB. *Combination group:* Preloaded with 7.5 ml/KBW of Ringer's lactate over 10 min preceding SAB, followed by IV bolus of 2.5 mg of ephedrine in the first and second minute and 0.5mg ephedrine at the end of each minute for next 18 minutes after SAB. In each patient, pulse rate and systolic blood pressure were recorded. Subsequently, the recordings were done at 5th, 10th, 15th, 20th, 25th and 30th minute after SAB. *Results:* The incidence and severity of hypotension was maximum (18%) in the crystalloid group and less (2%) in the combination group. The difference in incidence of hypotension among two groups was statistically significant(P<0.05). The incidence of reactive hypertension was more in combination group (4%) than the crystalloid group (2%) and was statistically significant (P<0.05). The incidence of nausea (4 %) and vomiting (2%) was seen in combination group whereas there were no incidence of the same in crystalloid group. *Conclusion:* Combination therapy with the reduced volume of crystalloid preloading and reduced dose of vasoconstrictor is an effective preventive measure against hypotension due to SAB and provides better haemodynamic stability when compared to the use of preloading alone.

Keywords: Subarachnoid Block; Hypotension; Crystalloid Preloading; Vasoconstrictor; Ephedrine.

Introduction

Spinal anaesthesia was introduced into clinical practice by a general surgeon Karl August Bier in 1898 [1]. More than a century has passed and even today, it is one of the most popular techniques for both elective and emergency surgical procedures particularly Caesarean Sections, lower abdominal surgeries, lower limb and urological surgeries just to name a few [2].

The most common serious problem associated with spinal anaesthesia still remains the rapid onset of profound hypotension and it can cause significant mortality and morbidity. Various studies indicate an incidence of hypotension varying from 20% to 92% [1,3].

Spinal induced hypotension is undesirable in obstetrics because it may adversely affect both maternal and neonatal outcome owing to a significant fall in uteroplacental blood flow. Even a mild drop in blood pressure must be avoided in high risk patients such as the elderly and in those with underlying organ dysfunction in whom the autoregulatory mechanism may be abnormal [4].

Considering all this, the prevention of hypotension during subarachnoid block is an important subject and there is no perfect method to prevent it. The corner stones of prevention of hypotension due to SAB for caesarean section are the use of a left lateral tilt and volume pre-loading [5]. Mechanical methods like left lateral tilt, use of sluder, leg wrapping with esmarch bandages and thrombo-embolic stockings, volume pre loading and vasopressors have been tried from time to time with variable results

Author's Affiliation:
*Associate Professor, **Post Graduate, Department of Anesthesiology, Navodaya Medical College, Raichur.

Corresponding Author:
Naveed Abrar, Post Graduate, Department of Anesthesiology, Navodaya Medical College, Raichur-584 103 Karnataka.
E-mail: drnad007@gmail.com

[4]. Several studies have shown that an adequate preload of at least 1 L of crystalloid before spinal anaesthesia reduces the incidence of hypotension to some extent [3,6]. The ideal fluid for co-prehydration is still a matter of debate. Colloid pre-loading is more reliable. At the same time, colloid co-loading appears equally effective if infused rapidly at the time of identification of cerebrospinal fluid. It needs repeated mention that both modalities are inefficient as single interventions and should be combined with timely and judicious use of vasopressors. Ephedrine has been the drug of choice for more than 30 years in the treatment of maternal hypotension in obstetric anaesthesia when conservative measures fail. Ephedrine with its long duration of action still has a role in obstetric anaesthesia in preventing or treating spinal induced hypotension when given in an appropriate dose. Other studies have shown that an infusion of Ephedrine may be an effective alternative for preblock crystalloid administration for prevention of hypotension due to SAB. Prophylactic infusion of ephedrine not only may be more effective against hypotensive episodes, but may also reduce the volume requirements of colloid [7].

Keeping all this in mind, the present study was undertaken to clinically evaluate the efficacy of pre-loading (with Ringer's Lactate) and vasoconstrictor (Ephedrine) as a combined prophylaxis for hypotension during sub arachnoid block.

Methodology

Adult patients of physical status ASA I and II scheduled to undergo elective surgical procedures on lower abdomen under subarachroid block at Tertiary care centre.

Method of Collection of Data

The patients were randomly allocated to two groups of n=50 each.

Group I: n=50 Study: **(**crystalloid group): preloaded with Ringer's Lactate only.

Group II: n=50 Study: (combination group): received pre-loading with Ringer's Lactate as well as ephedrine intravenously.

Selection of Patients

Inclusion Criteria

1. ASA grade I &II
2. 18 to *55* years of age.
3. Who gave informed, written and valid consent.
4. Those patients scheduled to undergo elective surgical procedures on the lower abdomen under sub arachnoid block.

Exclusion Criteria

1. Significant cardiovascular or renal or hepatic or respiratory disorders.
2. History of hypertension or patients on medication which have direct cardiac effects such as beta-blockers.
3. History of mental dysfunction.
4. History of diabetes mellitus
5. Patient with hemoglobin concentration less than 10rng%.
6. Morbid obesity
7. Pregnancy and Caesarean sections.
8. History of known allergy to study drugs.
9. Patients with contraindications to subrachnoid block.
10. Those patients refusing to give consent.

Methods

The patients were randomly allocated into three groups of 50 each.

Group I (Crystalloid Group)

Patients received preloading with 15 ml Kg1 of

Ringer's Lactate over 20 minutes period preceding the subarachnoid block.

Group - 11 (Combination Group)

Patients received pre loading with 7.5 ml/Kbw of Ringers Lactate over 10 minutes period preceding the subarachnoid block followed by intravenous bolus of 2.5 mg Ephedrine in the first and second minute and 0.5mg Ephedrine at the end of each minute for the next 18 minutes after the subarachnoid block.

Results

There was no statistically significant difference in

the age group of patients included in the two groups.

There was a significant increase in meanpulse rate compared to the base line at 5th and 10th minute incrystalloid group and was not significant in rest of the period. Whereas in combination group it was highly significant at 5th min, significant at 10th and 15th minute while it was not significant at 20th, 25th and 30th minute.

There was a significant fall in mean systolic pressure compared to the base line at 10th and 20th minute and highly significant fall at 25th and 30th minute incrystalloid group.While there was no significant fall in mean systolic pressure throughout the study period in combination group when compared to baseline.

Table 1: Age distribution

Age in yrs	Crystalloid Group(n=50)	Combination Group(n=50)	p-value	Remarks
Mean±SD	33.28±7.21	33.48±7.54	0.892	NS

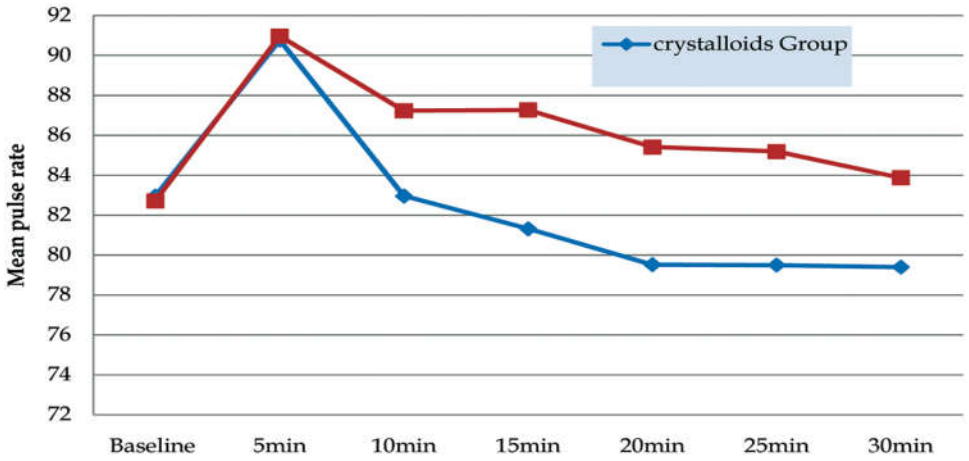

Fig. 1: Mean pulse rate

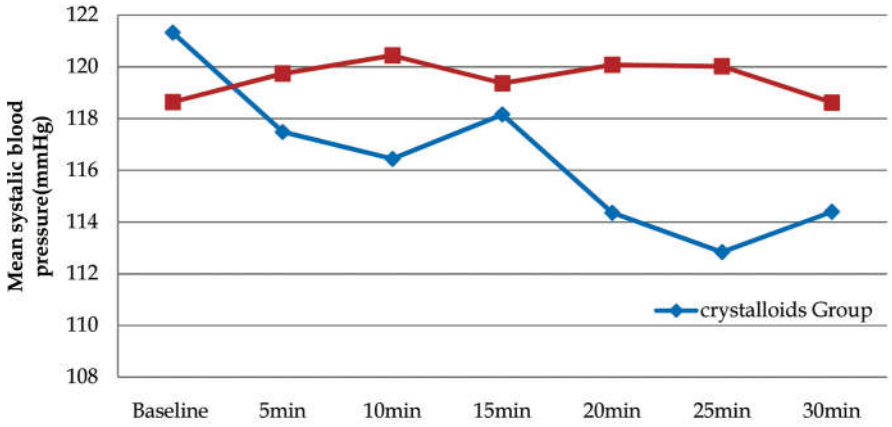

Fig. 2: Mean systolic blood pressure

Table 2: Mean Systolic blood pressure inter group comparison and their statistical significance

Time	Groups	t-value	p-value	Result
Baseline	I&II	1.596	0.91	NS
5min	I&II	0.886	0.939	NS
10min	I&II	1.523	<0.001	HS
15min	I&II	0.51	0.032	Sig
20min	I&II	2.11	0.037	Sig
25min	I&II	2.764	0.007	Sig
30min	I&II	1.968	0.052	Sig

Table 3: Hypotension and management

	Crystalloid Group	Combination Group	p-value
No.of Hypotensive patients	9	1	<0.05
No.of Episodes of Hypotension	11	1	<0.05
%of patients managed by IVF	9(81.82%)	1(100%)	--
No.of boluses of IVF	13	1	--
%patients required 6mg of Ephedrine	2(18.18%)	0	--
No.of boluses of 6mg Ephedrine given	2	0	--

Table 4: Incidence of hypertension,nausea &vomiting

	Crystalloid Group	Combination Group	p-value
Hypertension	1(2%)	2(4%)	<0.05
Nausea	0(0%)	2(4%)	--
Vomiting	0(0%)	1(2%)	--

Intergroup comparisonamong two groups reveal that the difference in mean systolic pressure at baseline and 5th minute was not significant, was highly significant at 10thminute. While it was significant throughout the rest of the study period.

Nine(18%) patients in crystalloid group and one (2%) patient in combination group had hypotension following SAB.And the difference among the groups were statistically significant. While 7 patients in crystalloid group were managed with IV fluids alone, 2 of them required Inj ephedrine boluses. In combination group the lone hypotensive patient was managed with IV fluids alone and didn't require Inj ephedrine.

One (2%) patient in crystalloid group and two (4%) patients in combination group had hypertension and these were statstically significant.

While no patient had nausea and vomiting in crystalloid group. There were two(4%) patients who had nausea and one(2%) patient had vomiting in combination group.

Discussion

Hypotension during subarachnoid block is common and can cause significant morbidity and mortality. Pre-block crystalloid administration has been recommended by some to reduce the incidence of hypotension. The use of Ephedrine may be an alternative approach [3]. The present study is based with an ideato take the advantage of both preloading and vasoconstrictor in preventing spinal hypotension, & at the same time avoiding their undesirable effects by using reduced volume & dose when compared to preloading alone.

As shown in the above table, in 1969, Marx et al [16], conducted a study on 34 parturients and found that there was a statistically significant difference in incidence of hypotension between crystalloid preloaded group and control group.

In 1976, Clark et a1 [3], conducted a study on 103 pregnant ewes who underwent elective caesarean delivery and found that, there was a statistically significant difference in the incidence of hypotension between crystalloid preloaded and control group, thus showing that crystalloid preloading reduces the incidence of post spinal hypotension. But in the present study the incidence of hypotension in crystalloid preloaded group was significantly present throughout.

In 1993, Gajrajet al [9], conducted a study on 54 females undergoing postpartum tubal ligation under spinal anaesthesia. In their study, there was a statistically significant difference in the incidence of hypotension between crystalliod and Ephedrine group. Thus showing that Ephedne infusion reduces the incidence of hypotension after spinal anaesthesia. But in the present study Ephedrine was used with reduced volume of preloading which showed the incidence of hypotension in the combination group was less when compared to the crystalloid group.

In 1993, another study was conducted by Rout et al [10] on 140 women undergoing elective Caesarean section under SAB. They found that, there was a statistically significant difference in the incidence of hypotension between crystalloid preloaded group and control group. In the present study, however the incidence of hypotension in the crystalloid group was not less.

Rielyet a1 [6], in 1995, conducted a study on 40 women undergoing elective Caesarean section under SAB. They compared crystalloid (RL) preload with colloid (6% HES) preload and found that colloid preload was better the crystalloid preload in the

Table 5: Crystalloids and incidence of hypotension due to SAB

No	References	Fluid volume (ml) crystalloid/colloid preload		Hypotension (%)		Definition of hypotension	Comments
		Ex	Co	Ex	Co		
1	Marx et al4'.,(1969)	1000 D5RL	0	0	100	Any decrease in BP	Statistically significant difference in incidence of hypotension
2	Clark et al[3]., (1976) (Elective C/D)	1000 D5RL	0	57	92	sBP<100mm Hg	Statistically significant difference in incidence of hypotension
3	Clark et al[3]., (1976) (C/D) following labour)	1000 D5RL	0	46	50	sBP<100mm Hg	No statistically significant difference in incidence of hypotension
4	Kangas et al[8], 1990	20ml/kg RL	15ml/kg RL	50	50	>10% decrease in sBP	No statistically significant difference in incidence of hypotension
5	Rout et al[5], 1992	1790 ml PL (20min)	1725 ml PL (10min)	70	60	>10% decrease in sBP	No statistically significant difference in incidence of hypotension
6	Gajraj et al[9], 1993	15ml/kg RL	Ephedrine with infusion	56	22	sBP<80% of the baseline	statistically significant difference in incidence of hypotension
7	Rout et al[10], 1993	1413 PL	0	55	71	sBP<100mmHg andsBP<80% of baseline	statistically significant difference in incidence of hypotension
8	Jackson et al[11], 1995	997 H	204 H	30	30	>30% decrease in sBP from baseline or a sBP<90mmHg	No statistically significant difference in incidence of hypotension
9	Karinen et al[12,] 1995	1000 RL	500 6% HES	62	38	sBP<90mmHg and sBP<80% baseline	No statistically significant difference in incidence of hypotension
10	Riley at al[13], 1995	1000 RL	500 6% HES	85	45	sBP<100mmHg and sBP<80% baseline	statistically significant difference in incidence of hypotension
11	Husaini et al[14], 1998	1000 RL	0	19	37	>30% decrease in sBP from baseline	No statistically significant difference in incidence of hypotension
12	Bhagath et al[4], 2004	15ml/kg RL	Ephedrine 28mg	13	5	>30% decrease in sBPfrom baseline or a sBP<90mmHg	No statistically significant difference in incidence of hypotension
13	M. Goel et al[15], 2009	15ml/kg RL	Ephedrine 25mg	30	10	>30% decrease in sBPfrom baseline or a sBP<90mmHg	Statistically significant difference in incidence of hypotension

prevention spinal hypotension. In the present study colloid was not used.

Clark et al [3], (1976) conducted a study on 57 pregnant women undergoing Caesarean delivery following labour under spinal anesthesia and found that there was no statistically significant difference in the incidence of hypotension between the crystalloid preloaded group and non-preloaded group, thus showing that crystalloid preload is not effective in the prevention of spinal hypotension. This is similar to findings of the present study that crystalloid preload is not effective in the prevention of spinal hypotension as shown in Table 6, 8 and Figure 8 where the incidence of hypotension is 18% in crystalloid group and 2% in combination group.

Kangaset a1 [8], in 1990 did a study of crystalloid preloading on 16 women undergoing Caesarean section under SAB. They found that both - a preload of 20mlkg' RL or a preload of 15m1 kg1 were equally effective in preventing spinal hypotension.

Conclusion

The combined use of both crystalloid preloading and vasoconstrictor (Ephedrine) is effectivein reducing the incidence, severity and duration of hypotension due to SAB.

The combination of decreased volume of preload with crystalloid and reduced dose of vasoconstrictor provides better haemodynamic stability when compared to preloading alone.

References

1. Parameshwara G. spinal, epidural to combined spinal epidural analgesia, the history of central neuraxial block. Indian J Anaesth. 2001; 45(6): 406- 412.
2. Dureja G.P, Jayalaxmi T.S, Colloid preloading before spinal and epidural anaesthesia. Hospital today. 2000; 5(2): 601-603.
3. Clark RB, Thompson DS, Thompson CH. Prevention of spinal hypotension associated with caesarean section. Anaesthesiology. 1976; 45: 670-674.
4. HemanthBhagat, KiranMalhotra, Sudhir K. Ghildyal, Prakash C. Srivastava. Evaluation of preloading and vasoconstrictors as a combined prophylaxis for hypotension during subarachnoid anaesthesia. Indian J Anaesth. 2004; 48(4): 299-303.
5. Rout C.C, Akoojee S.S, Rocke DA, and Gauws E. Rapid administration of crystalloid preload does not decrease the incidence of hypotension after spinal anaesthesia for elective caesarean section. Br J Anaesth. 1992; 68: 394-397.
6. Bhattacharya D, ChowdhuryM, Biswas B et al. Comparsion of an ephedrine infusion with crystalloid administration for prevention of hypotension during spinal anaesthesia for elective caesarean section. Indian J Anaesth. 2001; 45(4): 290-293.
7. Wennberg E, Frid I, Haljamae H and Noren H. Colloid (3% Dextran 70) with or without ephedrine infusion for cardiovascular stability during extradural caesarean section. Br J Anaesth. 1992; 69: 13-18.
8. KangasSareela T, Hollmen A, Tolonen U, et al. Does ephedrine influence newborn neurobehavioural responses and spectral EEG when used to prevent maternal hypotension during caesarean section? ActaAnaesthesiolScand. 1990; 34: 8-16.
9. Gajraj NM, Victory RA, Pace NA et al. Comparison of ephedrine infusion with crystalloid administration for prevention of hypotension during spinal anaesthesia. AnesthAnalg. 1993; 76: 1023-26.
10. Rout C,Rocke D, Levin J, et al. A reevaluation of the role of crystalloid preload in the prevention of hypotension associated with spinal anesthesia for elective cesarean section. Anesthesiology. 1993; 79: 262-9.
11. Jackson R, Reid J.A and Thorburn J. Volume preloading is not essential to prevent spinal induced hypotension at caesarean section. Br JAnaesth. 1995; 75: 262-265.
12. Karinen J, Rasanen J, Alahuhta 5, et al. Effect of crystalloid and colloid preloading on uteroplaental and maternal haemodynamic state during spinal anaesthesia for caesarean section. Br J Anaesth. 1995; 75: 531-5.
13. Edward T. Riley, Sheila E. Cohen., Adam J. Rubenstein, and Brendan Flanagan., Prevention of hypotension after spinal anesthesia for caesarean section: Six percent Hetastarch versus Lactated Ringer's solution: AnesthAnalg. 1995: 81: 838-42.
14. Husaini S. Russel I, Volume preloading: Lack of effect in the prevention of spinal induced hypotension at caesarean section. Int J ObstetAnesth. 1998; 7: 76-81.
15. M.Goel,M.Sharma,A.Kulshreshtra,S, Mashraqui & M.K.Goel:Haemodynamic Effects during Combined Spinal and Epidural Anaesthesia:Role of Fluid Preloading and Prophylactic Vasoconstrictors.The Internet Journal of Anaesthesiology. 2009; (22); 1
16. Marx G, Cosmi E, Wollman S. Biochemical status and clinical condition of mother and infant at cesarean section. AnesthAnalg. 1964; 48: 986-94.