Hemodynamic Effects during Combined Spinal and Epidural Anesthesia: Role of Fluid Preloading and Prophylactic Vasoconstrictors

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Citation

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Abstract

The most common complication encountered with combined spinal and epidural anaesthesia is hypotension. Several interventions can be planned for prevention of hypotension after combined spinal and epidural anaesthesia. We compare fluid preloading with prophylactic vasoconstrictors (Ephedrine) in reducing the hemodynamic side effects of combined spinal and epidural anaesthesia. The study was carried out randomly on 60 patients in age group of 20 –65 yrs. Patients classified under class 1-3 as per ASA classification. Patients were randomly allocated to the two groups. GROUP-1 patients had received crystalloid preloading (Ringer Lactate) 20 minute before procedure at a rate of 15ml /kg and GROUP-2 patients had received prophylactic ephedrine intravenously 5mg, 5mg at 1st and 2nd minute and 1mg at every minute thereafter for 15 minutes after block. HR, BP were recorded immediately after placing patient in supine position and then at 5, 10, 15, 20, 25, 30, 45, 60, 90, 120 minutes. Minute to minute monitoring was done to assess any haemo-dynamic changes and early institution of corrective therapy. In both Group 1 and Group 2 sustained fall in systolic blood pressure was observed from baseline. In Group 1 the fall in BP was more and the difference was also statistically significant. There were comparable sequential rise in mean pulse rate in both the groups, although this was statistically non-significant. In Group 1 nine patients showed hypotension out of which four (44.5%) were managed with fluid challenge alone and rest five patients needed ephedrine. There were three hypotensive patients in Group 2; two out of them (66%) were managed by i.v. fluid boluses alone. Study showed that vasoconstrictor (ephedrine) is a more effective method in reducing the incidence and severity of fall in systolic blood pressure as compared to volume preloading.

INTRODUCTION

Spinal & epidural anaesthesia is being widely utilized in orthopaedics, obstetric & lower limbs and lower abdominal surgeries. Spinal anaesthesia, introduced by August Bier 1898, was first major regional technique in clinical practice [1]. It is simple to institute, rapid in its effect and produces excellent operating conditions. Spinal block is usually a single shot technique so; there is tendency to overdose the drug. Moreover if block is inadequate, there is little possibility to increase the effectiveness of the block.

With introduction of epidural block, options are there to supplement the block. But, because of need of large doses of local anesthetic drugs, potential risk of systemic toxicity and hypotension is there with this technique. The combined spinal and epidural anaesthesia (CSEA) technique is gaining popularity day by day in obstetric analgesia, major lower limb and lower abdominal surgeries, total hip replacement and total knee replacements.

The most common complication encountered with combined spinal and epidural anaesthesia is hypotension [2], which is due to sympathetic nervous system blockade. As a result, decreased systemic vascular resistance and peripheral pooling of blood occurs which decreases cardiac output. In some cases, these cardiovascular effects may manifest as profound hypotension & bradycardia. Even a mild drop in blood pressure is significant in high risk patients such as the elderly and in those with underlying organ dysfunction in whom the auto-regulatory mechanism may be abnormal [3]. Several interventions can be planned for prevention of hypotension after combined spinal and epidural anaesthesia [4,5,6]. Here, in our study, we are trying to compare fluid preloading with prophylactic vasoconstrictors (Ephedrine) in reducing the hemodynamic side effects of combined spinal and epidural anaesthesia.

MATERIAL AND METHODS

The study was carried out on 60 patients in age group of 20 ¬¬–65 yrs of either sex, undergoing lower abdomen and lower limbs surgeries in department of anaesthesia SMS Hospital & Medical College, Jaipur with prior permission of ethical committee of the institute. The study was double blind and the 60 patients were randomly allocated in two groups using opaque envelope method.

Absolute aseptic condition & equipments to manage forthcoming events were prime necessity for conduction of combined spinal & epidural (CSE) block. A separate theatre was arranged for this which was well equipped with all the resuscitation measures.

Patients classified under class 1-3 as per ASA (American Society of Anesthesiologists) classification, were included in this study. Preoperative assessment of the patients was done a day before surgery. Patients with history of diabetes mellitus, hypertension, low BP, respiratory diseases, epilepsy, cardiac patients, spinal injuries, or spinal defects were excluded.

Special investigations were done in patients as deemed necessary. The nursing staff of the ward asked to prepare the back of the patient for CSE analgesia. A written informed consent was taken from patients for CSE block and procedure was explained to the patients.

As the patients were brought to the operation theater the blood pressure, pulse rate, ECG and Sp O_2 were checked and recorded.

The patients were randomly divided in 2 groups of 30 pts each;

GROUP-1: Those patients who had received crystalloid preloading (Ringer Lactate) 20 minutes before procedure at a rate of 15ml /kg.

GROUP-2:Those patients who had received prophylactic ephedrine intravenously 5mg, 5mg at 1 [[[st]]] and 2 [[[nd]]] minute and 1mg at every minute thereafter for 15 minutes after block.

Two (18 G) intravenous line were secured. No premedication were given to the patients. Baseline heart rate and blood pressure were monitored before preloading in group 1& group 2 subjects. Aspiration with small syringe for the presence of spinal fluid and blood were carried out in all the cases. Parameters (HR, BP) were recorded immediately after placing patient in supine position and then at 5, 10, 15, 20, 25, 30, 45, 60, 90, 120 minutes. An infusion of Ringer lactate at rate of 2ml \kg \hr was given during whole study period (surgical procedure) and rate was not be altered during study period. However, minute to minute monitoring was done to assess any haemo-dynamic changes and early institution of corrective therapy.

Hypotension was defined as any decreased of systolic blood pressure >30 % of baseline or less than90 mm of Hg.

The patients were monitored for spO_2, ECG, any reactive hypertension [SAP>30% of baseline] nausea, vomiting, any discomfort, respiratory depression etc. Supplement O_2 was given by venti-mask.

Unpaired‘t’ test and chi square test were used to analyze the data recorded from the subjects.

RESULTS

Mean age in the ringer lactate preloaded group (Gp1) was 43.45±15.52 and the ephedrine group (Gp2) was 40.30±13.95. Mean weight in Group1 was 61.50±8.45 and in Group 2 was 63.70±6.04. Both the groups were comparable with respect to age and weight of the patients (table 1).

Similarly, in Group 1 and Group 2 the mean onset of analgesia was 9.42.45 and 9.5±2.58 and the mean duration of surgery was 123.75 ±38.14 and 129.00±36.40 respectively. Both the groups were also comparable in respect of these two parameters (table 2).

In Group 1 the fall in systolic blood pressure was observed after 5 minute to 115.1 ± 8.14 mmHg, from baseline value of 123.6 ± 5.6 with mean change of 8.5 mmHg. Sustained maximum decrease in SBP was noticed till 15 minutes as 103.90 ± 8.2 with mean change of 19.7 mmHg. After 20th min onwards a less decrease from baseline value was recorded. In Group II the fall in systolic blood pressure observed after 5 minute of CSEA was 2.2 mmHg. Maximum fall was recorded as 9.3 mmHg at 15 minute from baseline value. The decline in the blood pressure values at different time intervals in group1 was more than in group 2 and the difference was also statistically significant (i.e. p value < 0.05), (table 3).

In Group I, mean pulse rate changed form baseline of 81.9 ± 10.9 to a maximum of 96.5 ± 13.5 at 45 minute. In Group II (ephedrine group) mean pulse rate increased from baseline

of 89.4 ± 12.5 to maximum of 103.3 ± 11.5 at 25 minute after CSEA. The difference in pulse rate among two groups was statistically non-significant (i.e. p value > 0.05) at most of the time intervals at which recording was done, (table 4).

In Group 1 Nine patients showed hypotension out of which 4 (44.5%) were managed with fluid challenge alone that is i.e. 2ml/kg i.v. bolus of Ringer Lactate stat, and repeated up to 3 times. Rest five patients needed ephedrine 6mg for management of episodes of hypotension.

There were 3 hypotensive patients in Group 2, 2 out of them (66%) were manage by i.v. fluid boluses alone. Only one patients (33%) required ephedrine 6mg for treatment of hypotension.

Nausea was complained by 3 and 1 patients in group I, II respectively. Other minor untoward reactions like vomiting, rigor, restlessness were complained by in a very few patients. None of late post operative complication reported.

Figure 1

Table 1: Comparison of ringer lactate preloading group (Gp1) and ephedrine group (Gp2) with respect to age and weight

Parameters		Mean	Std. Deviation	Unpaired 't' test (p Value)
Age(in years)	Group 1.00	43.45	15.52	0.504
	Group 2.00	40.30	13.95	
Weight (in kg.)	Group 1.00	61.50	8.45	0.349
	Group 2.00	63.70	6.04	

Figure 2

Table 2: Comparison of ringer lactate preloading group (Gp1) and ephedrine group (Gp2) with respect to onset of analgesia and duration of surgery

Parameters		Mean	Std. Deviation	Unpaired 't' test (p Value)
Onset of analgesia (in minutes)	Group 1.00	9.40	2.45	0.901
	Group 2.00	9.50	2.58	
Duration of Surgery (in minutes)	Group 1.00	123.75	38.14	0.659
	Group 2.00	129.00	36.40	

Figure 3

Table 3: Distribution of Systolic blood pressure among ringer lactate preloading group (Gp1) and ephedrine group (Gp2) subjects

Systolic blood pressure	Group 1		Group2		Unpaired 't' test (p Value)
	Mean	S.D.	Mean	S.D.	
Base line	123.60	5.64	126.10	7.49	0.241
At 5 min.	115.10	8.14	123.90	8.34	0.002
At 10 min.	107.90	8.22	120.50	12.14	0.000
At 15 min.	103.90	8.27	116.80	12.37	0.000
At 20 min.	107.70	6.97	119.40	9.99	0.000
At 25 min.	109.60	3.82	118.90	5.86	0.000
At 30 min.	110.20	6.42	117.20	7.72	0.003
At 45 min.	108.10	3.97	115.50	6.19	0.000
At 60 min.	106.40	4.88	114.50	5.39	0.000
At 90 min.	103.00	5.15	113.71	4.89	0.000
At 120 min.	100.00	1.63	108.66	1.15	0.001

Figure 4

Figure1: Mean systolic blood pressure in Group 1 and Group 2 subjects.

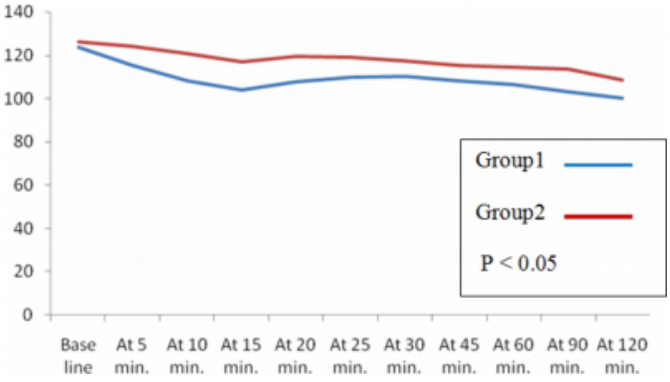

Figure 5

Table 4: Distribution of Pulse rate among ringer lactate preloading group (Gp1) and ephedrine group (Gp2) subjects

Pulse rate	Group 1		Group2		Unpaired 't' test (p Value)
	Mean	S.D.	Mean	S.D.	
Base line	81.90	10.91	89.40	12.50	0.051
At 5 min.	85.30	13.20	94.90	11.53	0.019
At 10 min.	88.50	17.84	96.00	14.81	0.156
At 15 min.	91.50	19.39	98.60	15.97	0.214
At 20 min.	91.60	17.11	101.25	13.75	0.051
At 25 min.	92.65	15.80	103.35	11.53	0.019
At 30 min.	95.75	14.80	102.35	11.57	0.124
At 45 min.	96.50	13.53	100.90	11.77	0.280
At 60 min.	95.70	13.49	100.37	9.60	0.223
At 90 min.	94.92	10.82	99.14	5.79	0.217
At 120 min.	101.50	4.80	97.33	4.16	0.285

Figure 6

Figure 2: Mean pulse rate in Group 1 and Group 2 subjects

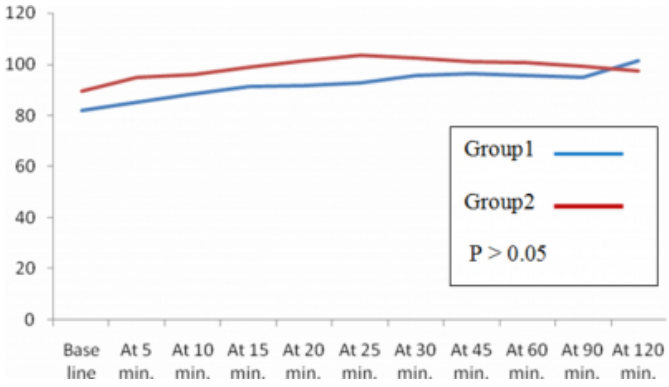

Figure 7

Table 5: Problems suffered by ringer lactate preloading group (Gp1) and ephedrine group (Gp2) subjects

Complications	Group 1	Group 2
Hypotension	9	4
Required i.v. fluid bolus	4	2
Required ephedrine	5	1
Nausea	3	1

DISCUSSION

EFFECT ON SYSTOLIC BLOOD PRESSURE

Hypotension during spinal anaesthesia is the result of sympathetic blockade leading to decreased venous return, as cardiac output must be maintained at much higher levels than normal to compensate for decrease in SVR [7].

In both Group 1 and Group 2 sustained fall in systolic blood pressure was observed from baseline. In Group 1 nine patients showed hypotension out of which four (44.5%) were managed with fluid challenge alone and rest five patients needed ephedrine. There were three hypotensive patients in Group 2, two out of them (66%) were manage by i.v. fluid boluses alone.

Intravenous pre loading is the most popular non-pharmacological method. Early studies had impressive results [8] and it became established as an accepted standard of care. However, more recent controlled studies have questioned the efficacy of pre loading. Some had shown that it reduced the severity of hypotension [9] and some showed that preloading have minimal effect on the incidence of hypotension [10].

The study conducted by Datta et al also showed that incidences of hypotension and hypoxemia were significantly lower in group of patients where intravenous ephedrine was given [11]. The incidence of hypotension in the crystalloid and ephedrine infusion groups in the study conducted by Gajraj et al [5] and Bhagat et al [3] was higher than our study.

The changes in SAP are related to the level of block, and the risk of hypotension increase with height of block [12]. In this study, there was no significant difference in the distributions by dermatome levels for groups ranged between T6 – T10, most commonly T8 level. So patients were treated was having similar degrees of sympathetic block. Therefore, the differences in hypotension incidence observed between groups to have been due to presence or absence of preventive measures only.

PULSE

There were comparable sequential rise in mean pulse rate in corresponding readings till 25 minutes in both the groups, although this was statistically non-significant.

Critchley et al observed significant (12%) increase in heart rate and (10%) increase in stroke index and CVP in a similar study in ephedrine group [6]. That represented predominant effect of ephedrine on beta 1 receptor resulted in increased heart rate. Alpha receptor effect of ephedrine was insufficient to maintain CVP and systemic vascular resistance index, which were indices of venous and arterial vasoconstriction.

CONCLUSION

As matching was done between the lactate preloading group (Gp1) and ephedrine group (Gp2) with respect to age, weight, duration on anaesthesia, onset on analgesia and height of block, the study concludes that the use of vasoconstrictors (ephedrine) is a more effective method in reducing the incidence and severity of fall in systolic blood pressure as compared to volume preloading.

Ephedrine may cause tachycardia and hypertension [13] and should be used cautiously in patients with ischemic heart disease. [5]

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