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Original Research Article

Comparative study of Ringer's lactate solution and 6% hydroxyethyl starch solution as pre-loading fluid for prevention of hypotension following spinal anesthesia

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ABSTRACT

Background: Arterial hypotension following spinal anesthesia still remains the leading cause for maternal mortality and morbidity. Active management of hypotension and more so its prevention of its ads more safety value to spinal anesthesia, which is widely practiced worldwide. Preloading of patients with either crystalloid or colloid prevents the severity of hypotension. Objectives of the study was to compare the preloading efficacy of Ringers lactate solution (20 ml/kg) and 6% hydroxyl ethyl starch at 10 ml/kg in prevention of hypotension following spinal anesthesia in elective caesarean section.
Methods: 100 ASA grade I and grade II subjects for elective caesarean section were studied in two groups. Group A (Ringer lactate group) 50 subjects and Group B (hydroxyl ethyl starch group) 50 subjects. Each group was preloaded over a period of 20 minutes before spinal anesthesia with either ringer lactate solution (Group A) at 20 ml/kg or 6% hydroxyl ethyl starch group at 10 ml/kg body weight. Main outcome measures were mean systolic blood pressure, mean diastolic blood pressure, mean arterial blood pressure and mean heart rate.
Results: Demographic characteristics of both groups were comparable. Incidence of hypotension was significantly more in ringer lactate group. There was no significant difference of heart rate in both the groups. No allergic reaction was noted to hydroxyl ethyl starch. Vasopressor requirement was also low in hydroxyl ethyl starch group compared to ringer lactate group.
Conclusions: Preloading subjects with 6% hydroxyl ethyl starch is beneficial than preloading with ringer lactate solution as it produces better hemodynamic stability to subjects.

Keywords: Heart rate, Hydroxyl ethyl starch, Mean systolic blood pressure

INTRODUCTION

Spinal anesthesia is the regional anesthesia obtained by blocking the spinal nerves in the subarachnoid space. It is the most widely practiced anesthetic technique and has become immensely popular in the last century. Particularly for lower abdominal and lower limb surgeries due to the fact that it is simple to perform, offers rapid onset of action, provides reliable surgical analgesia and good muscle relaxation. This technique may be safely practiced with knowledge of its physiological consequences and in many instances is method of choice in view of patient condition and production of ideal operative conditions. In developing countries like India, spinal anesthesia assumes special importance chiefly because of economic reasons, lack of availability of sophisticated anesthetic apparatus and compressed gases in the remote areas.[1]

Till date, the potential hazard with spinal anesthesia remains arterial hypotension and it contributes to significant maternal mortality and morbidity.

To reduce the incidence and severity of spinal hypotension various maneuvers have been used which include Trendelenberg (head down) position, prophylactic vasopressors, leg elevation and strapping, use of inflatable boots znd preloading the patients with intravenous fluids with either crystalloid or colloid solution.[2] Crystalloid solutions, being of lower molecular weight, enters the interstitial space due to lack of intrinsic colloid osmotic pressure and may result in pulmonary edema which interferes with tissue oxygen exchange. On the contrary, colloids having higher molecular weight than crystalloids, have similar osmolality as plasma remain confined to intravascular space with little expansion of interstitial space. [3]

Hence present study was conducted with the objective to compare the preloading efficacy of Ringers lactate solution (20 ml/kg) and 6% hydroxyl ethyl starch at 10 ml/kg in prevention of hypotension following spinal anesthesia in elective caesarean section.

METHODS

A hospital based cohort study was carried out over a period of two years. The study subjects were female aged 20-35 years of age belonging to ASA grade I scheduled for elective caesarean section involving minimal blood loss under spinal anesthesia. After Institutional approval and ethical clearance from college ethical committee, informed consent was taken from all patients.

Inclusion criteria

- Patients belonging to ASA grade I
- Weight 40-80 kg
- Age: 20-35 years
- Subjects scheduled for elective caesarean section involving minimal blood loss under spinal anesthesia.

Exclusion criteria

- Any patient where spinal anesthesia was contraindicated
- Patients with cardiovascular, respiratory and central nervous system disorders

Total sample size was 100. These 100 eligible subjects were divided into two groups. Group A (Ringer lactate group) 50 subjects and Group B (hydroxyl ethyl starch group) 50 subjects. Each group was preloaded over a period of 20 minutes before spinal anesthesia with either ringer lactate solution (Group A) at 20 ml/kg or 6% hydroxyl ethyl starch group at 10 ml/kg body weight. Main outcome measures studied were mean systolic blood pressure, mean diastolic blood pressure, mean arterial blood pressure and mean heart rate. Routine investigations for all cases like complete Hemogram, urine analysis, blood grouping and Rh typing, electrogram (for patients over 40 years of age), chest X ray, random blood sugar was carried out.

Pre-anesthetic evaluation was done on the previous day of surgery. The procedure was explained to each patient. Written informed written consent and cooperation was sought from all of them. All patients were pre-medicated with injection diazepam at 0.2 mg/kg body weight dose and injection atropine 0.6 mg IM was given 30 minutes before surgery. Basal parameters like heart rate and blood pressure were recorded using conventional methods. A peripheral IV line with 18 gauze cannula was secured in one of the upper limb. Volume infusion was determined according to body weight. Patients in group A received Ringer's lactate at 20 ml/kg and patients in group B received 6% hydroxyl ethyl starch at 10 ml/kg body weight. Both these solutions were infused over a period of 20 minutes before performance of subarachnoid block. After pre-loading, all patients received Ringer's lactate solution for fluid maintenance.

Under aseptic precautions, lumbar puncture was performed with 23 gauze spinal needle (Quincke's needle) through midline approach with patient in right lateral or left lateral decubitus position with 10^0 head-down tilt. After free flow of CSF, 3-3.5 ml of 0.5% injection bupivacaine was injected. Immediately after the injection, the spinal needle was withdrawn and patient turned to supine position. Blood pressure and heart rate were recorded at an interval of 1, 2, 5, 10, 15, 20, 25, 30, 45, 60, 75 and 90 minutes following subarachnoid blockade.

Hypotension was defined as a decrease in the systolic blood pressure by more than 25% from the initial baseline level. Hypotension was managed with Trendelenberg position, increase in fluid infusion rate and administering 100% oxygen by mask. If it still persisted, despite the above measures, injection mephenteramine sulphate was administered IV 3 mg bolus at 1 minute interval until the blood pressure increased to acceptable levels. Bradycardia was treated with IV injection atropine 0.6 mg.

Data was entered in Microsoft excel sheet. Data was analyzed using students t test chi square test wherever appropriate. P value of less than 0.05 was considered statistically significant.

RESULTS

100 ASA grade I and grade II subjects for elective caesarean section were studied in two groups. Group A (Ringer lactate group) 50 subjects and Group B (hydroxyl ethyl starch group) 50 subjects.

Each group was preloaded over a period of 20 minutes before spinal anesthesia with either ringer lactate solution (Group A) at 20 ml/kg or 6% hydroxyl ethyl starch group at 10 ml/kg body weight.

Main outcome measures were mean systolic blood pressure, mean diastolic blood pressure, mean arterial blood pressure and mean heart rate.

Table 1: Mean systolic blood pressure at different intervals of time after spinal anesthesia.

Time (minutes)	Group A (mmHg)	Group B (mmHg)	P value
0 (baseline)	120	120	>0.05
1	119	121	>0.05
2	113	118	<0.05
5	107	118	<0.05
10	103	116	<0.05
15	100	115	<0.05
20	98	115	<0.05
25	96	115	<0.05
30	98	114	<0.05
45	99	117	<0.05
60	101	117	<0.05
75	100	118	<0.05
90	104	119	<0.05
120	104	118	<0.05
240	98	120	<0.05

Mean systolic blood pressure was significantly lower in group A subjects compared to group B subjects from 5th minute onwards. And it was found to be statistically significant. ($p<0.05$) Till 5th minute the mean systolic blood pressure was found to be similar in both the groups as it was not found to be statistically significant ($p>0.05$).

Table 2: Mean diastolic blood pressure at different intervals of time after spinal anesthesia.

Time (minutes)	Group A (mmHg)	Group B (mmHg)	P value
0 (baseline)	75	78	>0.05
1	76	78	>0.05
2	73	77	>0.05
5	70	75	>0.05
10	68	74	<0.05
15	69	74	<0.05
20	65	72	<0.05
25	63	73	<0.05
30	64	76	<0.05
45	65	75	<0.05
60	66	74	<0.05
75	66	76	<0.05
90	67	75	<0.05
120	64	75	<0.05
240	68	76	<0.05

Mean diastolic blood pressure was significantly lower in group A subjects compared to group B subjects from 10th minute onwards. And it was found to be statistically significant. ($p<0.05$) Till 10th minute the mean diastolic blood pressure was found to be similar in both the groups as it was not found to be statistically significant ($p>0.05$).

Table 3: Mean arterial pressure at different intervals of time after spinal anesthesia.

Time (minutes)	Group A (mmHg)	Group B (mmHg)	P value
0 (baseline)	90	92	>0.05
1	90	92	>0.05
2	84	90	>0.05
5	81	89	<0.05
10	78	87	<0.05
15	77	87	<0.05
20	74	87	<0.05
25	74	87	<0.05
30	76	89	<0.05
45	77	87	<0.05
60	77	88	<0.05
75	77	89	<0.05
90	80	89	<0.05
120	81	88	<0.05
240	78	93	<0.05

Mean arterial pressure was significantly lower in group A subjects compared to group B subjects from 10th minute onwards.

And it was found to be statistically significant. ($p<0.05$) Till 10th minute the mean arterial pressure was found to be similar in both the groups as it was not found to be statistically significant ($p>0.05$).

Table 4: Mean heart rate at different intervals of time after spinal anesthesia.

Time (minutes)	Group A (per minute)	Group B (per minute)	P value
0 (baseline)	89	85	>0.05
1	88	85	>0.05
2	88	85	>0.05
5	87	85	>0.05
10	84	84	>0.05
15	86	83	>0.05
20	86	83	>0.05
25	89	83	>0.05
30	87	82	>0.05
45	89	83	>0.05
60	88	83	>0.05
75	86	82	>0.05
90	85	83	>0.05
120	84	84	>0.05
240	81	84	>0.05

At all intervals, the mean heart rate did not differ in both the groups. Mean heart rate was found to be similar in both the groups. There was no significant difference of mean heart rate in two groups (p>0.05).

Table 5: Incidence and severity of hypotension.

Maximum percentage fall in systolic blood pressure	Group A		Group B	
	Number	Percentage	Number	Percentage
0-5	0	0	0	0
6-10	0	0	16	32
11-15	05	10	12	24
16-20	06	12	07	14
21-25	10	20	03	06
26-30	21	42	03	06
31-35	07	14	07	14
36-40	01	02	01	02

X^2=33.4353, p=0.00001, Significant at p<0.05

Above table shows the incidence and severity of hypotension. It can be noted from above table that the incidence and severity of hypotension was more in group A as compared to group B. This was found to be statistically significant.

DISCUSSION

A prospective hospital based study was carried among 100 subjects undergoing elective caesarean section to study the effectiveness of hydroxyl ethyl starch solution in reducing the incidence of hypotension. It was observed that the mean systolic blood pressure, mean diastolic blood pressure and mean arterial pressure was significantly lower in subjects receiving Ringer's lactate solution compared to subjects receiving hydroxyl ethyl starch solution. But there was no significant difference in the mean heart rate among the two groups. The incidence and severity of hypotension was more in group A as compared to group B.

Similar findings were reported by Shiv K Sharma et al who compared efficacy of 6% hetastarch and Ringer's lactate solution in patients scheduled for postpartum tubal ligation. The incidence of hypotension was 52% in Ringer's lactate group compared to only 16% in hetastarch group.[4]

Edward Riley et al compared 6% hetastarch with Ringer's lactate solution alone. The incidence of hypotension was 45% in hetastarch group and 85% in Ringer's lactate solution group.[5] This study reported a higher incidence of hypotension in both the groups compared to the findings of the present study.

Mathur et al compared 5% albumin solution with Ringer's lactate solution during spinal anesthesia for patients undergoing caesarean section. There was no hypotension in albumin group compared to 29% in the crystalloid group.[6] We found an incidence of 18% in hydroxyl ethyl starch group.

Route et al noticed that the incidence of hypotension was reduced from 71% in patients without pre-hydration to 55% in patients who received 20 ml/kg of Ringer's lactate solution.[7] However same study showed that using 10-30 ml/kg of Ringer's lactate solution for acute volume expansion before induction of spinal anesthesia, there was no difference in the indices of maternal hypotension or the dosage of ephedrine. Both the rate and volume of crystalloid was shown to be unimportant. Studies of this kind have led to an appraisal of the role of fluid pre-loading. It is still reasonable to administer a modest amount of crystalloid pre-load before spinal injection as patients for elective surgeries are often relatively dehydrated.

Gajraj NM et al studied efficacy of ephedrine administration with crystalloid administration for reducing the incidence and severity of hypotension during spinal anesthesia.[8] The incidence of hypotension was 55% in crystalloid infusion group compared to only 22% in ephedrine infusion. They concluded that a prophylactic ephedrine infusion was effective for minimizing and managing hypotension associated with spinal anesthesia.

Baraka A et al compared crystalloid (isotonic saline 0.9%; 7 ml/kg) and colloid (3% gelatin in electrolyte solution; 7 ml/kg) in 34 male patients.[9]

Results showed that prophylactic administration is much more effective in attenuating hypotension following spinal anesthesia, when IM administration of either crystalloid or colloid produces equally satisfactory results. Epidural block develops slowly, which may result in moderate decrease in blood volume, which can be offered by either crystalloid or colloid.

Kumle B et al studied influence of three different IV volume replacement regimens, using either 6% low molecular weight hydroxyl ethyl starch solution, 6% medium molecular weight hydroxyl ethyl starch solution, or modified gelatin in assessing renal function of elderly patients.[10] He observed that all the three regimen can be used safely for volume replacement without risk to the renal dysfunction.

Joshi GP et al noticed that judicious peri-operative fluid therapy improves outcome after major gastrointestinal surgery.[11]

Moretti EW et al concluded that they're both 6% hetastarch in saline group and 6% hetastarch in balanced salt solution groups had significantly less incidence of nausea and vomiting, use of rescue antiemetics, severe pain, peri-orbital edema, double vision as compared to Ringer's lactate solution group.[12]

CONCLUSION

Preloading subjects with 6% hydroxyl ethyl starch is beneficial than preloading with ringer lactate solution as it produces better hemodynamic stability to subjects.

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