International Journal of Research and Review
www.ijrrjournal.com E-ISSN: 2349-9788; P-ISSN: 2454-2237

Original Research Article

Effect of Crystalloid and Colloid Preloading on Spinal Induced Haemodynamic Status

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ABSTRACT

The present study was designed to evaluate the haemodynamic changes after pre-loading with crystalloids (Hartmann's solution) and colloids; (Polygelatin and 6% hydroxy-ethyl starch) during spinal anaesthesia. The patients were randomly divided into two groups according to the intravenous infusion they received. In Group - I, patients preloaded intravenously with 1000 ml of crystalloids (Ringer's lactate) while in Group - II, patients inrtravenously preloaded with 500 ml of hydroxy ethyl starch (Expan 6%) or 500m1 of polygeline. There was no significant changed in pulse rate at different time intervals from baseline in Group II as compared to control group (Group I) ($p>0.05$). There is significant decrease in mean Systolic Blood Pressure from baseline value in the patients of Group I at different time intervals which was statistically significant ($p<0.0001$) at 5 minutes (87.89 ± 14.75), at ($p<0.01$) 15 minutes (77.37 ± 13.27), at ($p<0.05$) 30 minutes (69.68 ± 12.09). And statistically non significant ($p>0.05$) at 45 minutes (68.53± 14.12) and at 60 minutes (75.89± 11.57). In patients of Group II the mean Systolic Blood Pressure was found to be descreased during the late hours of the study as compared to baseline values. The hypotension was maximum at 30 minutes (115.2 ± 11.67) than at 60 minutes (117.40 ± 9.21) and statistically significant ($p<0.05$) and was minimum ($p>0.05$) at 15 minutes (120.00 ± 10.04) but at 5 minutes the mean Systolic Blood Pressure was increased by (1.70 ± 10.10 mm Hg) from baseline values insignificantly ($p>0.05$). The change in Diastolic Blood Pressure among the patients of both groups ever one hour period was not found to be statistically significant ($p>0.05$). Average decrease in Systolic Blood Pressure was 8 mm Hg in the Group II receiving colloid solution (H.E.S 6%, Polygeline). The crystalloid Group I experienced a drop in Systolic Blood Pressure of >25mm Hg. The Blood Pressure decrease was significantly greater in the crystalloid group. The Mean intravenous fluid infused during spinal anaesthesia in control Group I was 1021.67 ± 296.15 ml. This supplemented fluid was less (673.34 ± 176.04) in Group II from control group which was statistically significant ($p<0.001$). Infusion of 1000 ml of crystalloid fluid, PCV was decreased more in colloid Group II than the control Group I and it was statistically significant. ($p<0.001$). Colloids especially Hydroxyethyl starch appears to be the best intravenous preloading agent to overcome the problem of hypotension during spinal anaesthesia.

Keywords: Spinal anaesthesia, Crystalloid and Colloid Preloading, Spinal Induced Haemodynamic Status

INTRODUCTION

Spinal anaesthesia is a frequently used technique in anaesthetic field since 1998 when Bier of Griefswald, Germany first produced true spinal anaesthesia in man.

In recent years, there has been a steady increase in the popularity of spinal block and has been technique of choice in many lower abdominal surgeries, elective and emergency cesarean section. Its advantages include more rapid onset of action, better quality of sensory and motor block and ease of use compared with extradural anaesthesia. Satisfactory analgesia for pelvic and abdominal surgeries under spinal, anaesthesia usually requires the sensory block from T10 to S5. A significant number of patients suffer from hypotension and a relative hypovolemia.

One of its important and predicted complications is Hypotension which is a matter of concern in cesarean section and in lower abdominal or lower limb surgery and elderly patients. Incidence of this complication has been reported to be very high and documented upto 92% following spinal anaesthesia for cesarean section.

Acute administration of crystalloid solution to parturients undergoing spinal anesthesia for cesarean section has been recommended to reduce the incidence and severity of hypotension before the induction of spinal anesthesia. [1–3]

Spinal hypotension is mainly because of preganglionic sympathetic block that persists for one to five hours. During this period, there is an increase in the capacity of the intravascular space due to vasodilatation. This causes relative hypovolaemia and hypotension. Also there is decreased vascular resistance as well as increased compliance of capacitance vessels. The decrease in blood pressure following spinal anaesthesia can be minimized by various preventive measures, most commonly used technique are prophylactic Vasopressor therapy and prophylactic intravenous fluid administration.

A reduction in blood pressure is an invariable accompaniment of spinal anaesthesia. The mean brachial artery pressure in low spinal falls by about 21%, while in higher spinal it average a 44% drop (Sancetta et al, 1952). [4] The systolic pressure falls and there is no proportional fall in diastolic pressure. For clinical and experimental purposes, the diagnosis of hypotension is established arbitrarily when a 25 % fall in systolic blood pressure occurs (Collins, 1980). [5,6] Symptoms are related to the tissue hypoxia that results from diminished pressure. First effects are of stimulation with apprehension, restlessness, dizziness, tinnitus and headache accompanied by retching and vomiting. Later effects are of depression, with drowsiness, disorientation and coma; eventually shock may supervene with death. Hetland et. al. (1989) [7] highlighted the severity of hypotension during spinal anaesthesia for caesarean section by noticing three patients, developing severe hypotension, circulatory collapse during the study.

Many theories have been proposed to explain this hypotension. The view that paralysis of sympathetic vasoconstrictor fibers to blood vessels occurs during spinal anaesthesia is the one, best explaining the haemodynamic changes and the hypotension (Burch and Harrison, 1931; Sancetta et al., 1952). [8,4]

Among the neural structures in the sub-arachnoid space, affected by local anaesthetic agent introduced, are the preganglionic fibers in the thoracolumbar segment going to the sympathetic ganglia and chain. This preganglionic sympathetic block produces paralysis of vaso-constrictor fibers contained in the arterioles, capillaries and veins. The extent of segmental vasodilation and the consequent haemodynamic changes are dependent on the extent of sympathetic paralysis (Collins, 1980). [5,6]

Major circulatory changes occur on venous side - there is actual dilatation of peripheral veins and venules-leading to ‘increased venous compliance’ (Rovenstein et al., 1943). [9] Arteriolar dilatation with ‘decreased systemic vascular resistance’ due to paralysis of sympathetic vasoconstrictor fibers to arteriolar side, also contribute to this hypotension (Kennedy et al., 1969; Malmquist et al., 1987). [10] These combined with paralysis of skeletal muscles and the loss thereby of muscular milking action plus the interference with thoracic respiratory pump decreases the venous return (Gordh, 1945). [11] Thus cardiac output reduces and blood pressure falls.

To overcome the increased compliance of capacitance vessels administration of intravenous fluids prior to the block has been tried successfully during the last three decades. The beneficial effects of such a volume preloading prior to/during spinal anaesthesia have been highlighted by numerous workers. Thus volume preload has become the routine practice before spinal block, but there is no general agreement regarding the amount, type and rate of intravenous infusion to be given to such patients.

The generally recommended prophylactic measure are the infusion of a crystalloid solution (Ringer's Lactate, 5% DNS) but its stay in the circulation is short. There is a evidence that colloid (Hydroxy ethyl starch, polygeline) preloading prevent hypotension and hypovolaemia more effectively than crystalloid solutions in patients scheduled for elective or emergency surgery under spinal anaesthesia on account of its comparative longer stay in circulation.

The present study was therefore, conducted to evaluate the haemodynamic changes during spinal anaesthesia after preloading with different infusion fluids, as follows.

A) 1000 ml. of Ringer's Lactate (crystalloid solution)

B) 500ml. of Hydroxyethyl starch or 500rn1 of polygeline (Colloid solution).

MATERIALS AND METHODS

This study was designed to evaluate the haemodynamic changes after pre-loading with crystalloids (Hartmann's solution) and colloids; (Polygelatin and 6% hydroxyethyl starch) during spinal anaesthesia.

CASE SELECTION

The cases for this study were selected from the indoor patients of L. L. R. and Associated Hospitals at G. S.V. M. Medical College, Kanpur. The age of the adult subjects ranged from 20 to 60 years. Both males, as well as females were included in this study. Those patients, who were to be operated upon for lower abdominal and/or lower limb surgical problems under spinal anaesthesia, were included in our study. A thorugh clinical evaluation of all the subjects was carried out prior to the selection of cases and only ASA grade I and II patients were included in this study. Appropriate laboratory investigations were done in all the patients. Patients with hypertension, diabetes mellitus, systolic arterial pressure<l00 mm Hg, PCV values less than 35% and haemoglobin less than 10% gm were excluded from the study.

PREPARATION OF PATIENTS

After explaining the details of the proposed procedure an informed consent was obtained from all the patients and their relatives. All patients were premedicated with oral diazepam (0.2 mg/kg) at bed time on the previous night.

On arrival in the operating theatre an I.V. line was established with 18-gauge LV. catheter, inserted into a peripheral vein for infusion of intravenous fluid.

STUDY DESIGN

The patients were randomly divided into two groups according to the intravenous infusion they received.

Group - I : Patients preloaded intravenously with 1000 ml of crystalloids (Ringer's lactate)

Group - II : Patients inrtravenously preloaded with 500 ml of hydroxy ethyl starch (Expan 6%) or 500m1 of polygeline

ADMINISTRATION OF VOLUME PRELOAD

The study infusion fluids (Ringers Lactate; polygelatin or hydroxyethyl starch 6%) were administered intravenously within a period of 45 minutes preceding spinal block. Patients of group I received 1000 ml of Ringer's lactate but at a slower rate adequate only to maintain the patency of the cannula.

ANAESTHESIA

Premedication: All the patients were premedicated with inj. Atropine 0.6 mg. intramuscularly, 45 minutes prior to the surgery.

Spinal anaesthesia was given under strict aseptic conditions, using a 23- gauge short bevelled disposable spinal needle. Spinal block was performed with intrathecal deposition of 0.5% bupivacaine (heavy, 2m1) through spinal needle inserted at L3..4 inter-spinal space in lateral position. The patients were then turned rapidly to the supine position. Both groups were compared on the same criteria and were then managed identically.

MONITORING

The patients were monitored continuously and recording of various parameters were made at the time of start of intravenous infusion (baseline measurement), at the time of start of spinal anaesthesia procedure (zero time), then at 5 minutes intervals for the first 30 minute, at 10 minute intervals for the next 30 minute and every 15 minute for the remaining period of anaesthesia. The following parameters were recorded:

1. Blood pressure (Systolic/Diastolic/Pulse Pressure).
2. Pulse rate
3. Packed cell volume (PCV) before and after infusion of 1000 ml of fluid.
4. Supplement of further intravenous fluids.
5. Use of Vasopressor (Mephentermine) to maintain the blood pressure, if required.
6. Episodes of nausea and vomiting.
7. The patients were also observed for any hypersensitivity reaction.

BLOOD PRESSURE

Using a manual sphygmomanometer cuffed around the upper arm, brachial arterial pressure was recorded in form of systolic and diastolic pressure. The pulse pressure was calculated by subtracting the diastolic pressure from the systolic pressure.

HYPOTENSION

Hypotension was defined as a drop in systolic blood pressure greater that 25% as compared to baseline value or at values less than 90mm Hg.

If hypotension was noticed, it was managed as described in the following lines:

(A) Supplement of Further IV Fluids

After preloading selected fluids to the patients of respective groups further, randomly selected fluid was administered continuously just to maintain the patency of IV cannula. But when hypotension noticed it was tried to correct first administering Ringer's lactate upto a rate of 50 mI/minute in order to maintain the systolic blood pressure within 10% of the baseline readings.

(B) Mephentermine

Intravenously 15-30 mg was given if hypotension was not corrected by administration of intravenous fluid alone.

The results were evaluated statistically.

STATISTICS

In comparing the crystalloid versus colloid preload, the most important measurement of efficacy was percentage fall in systolic blood pressure.

The observations were compared using student 't' test and analysis of variance (one way/two way) for their significance of difference.

RESULTS

Present study was undertaken in 60 patients undergoing lower abdominal and lower limb surgical procedures under spinal anaesthesia, in L. L. R. and Associated Hospitals at G. S. V. M. Medical College, Kanpur. The study was conducted to compare the effectiveness of crystalloid (Ringer's lactate) with colloids (Hydroxy ethyl starch 6% or polygelatin) as a volume preload in prevention of spinal hypotension. Patients were randomly divided into two groups according to the type of infusion fluids used for preloading.

Group I = 1000 ml of Ringer's lactate preload

Group II = 500 ml of Hydroxy ethyl starch (HES 6% or 500 ml of polygeline)

The following observations were made:

Table I: Shows the distribution of patients according to their age.

Table : I Statistical Analysis of Age Distribution in Patients

S. No.	Age (years)	Group I		Group II		Total	%
		Male	Female	Male	Female		
1.	20 - 30	3	5	4	6	18	30
2.	31 - 40	4	5	6	7	22	36.7
3.	41 - 50	3	2	5	3	13	21.6
4.	51 - 60	1	1	2	2	7	11.7
		11	14	17	18	60	

Mean=38.58; SD ± 3.41

It is evident from the Table that maximum numbers of patients belong to 31 to 40 years of age group. Out of 60 patients 28 (46.5%) were male whereas 32 (53.5%) were female.

Table II : Shows the distribution of the patients according to their body weight in both group of Table II.

S. No.	Age (years)	Group I		Group II		Total	%
		Male	Female	Male	Female		
1.	30 - 40	3	5	3	5	16	26.6
2.	41 - 50	5	5	4	6	20	33.4
3.	51 - 60	4	3	5	3	15	25.0
4.	61 - 70	2	2	3	2	9	15.0
		14	15	15	16	60	

Mean = 48.56; SD ± 3.31

It is evident from the Table that maximum numbers of patients belong to 41 to 50 kgs. of body weight. Out of 60 patients 29 (48.3%) were male whereas 31 (51.7%) were female.

Table III: Shows the types of surgery performed in the two study groups and their groupwise distribution.

Out of 60 patients included in this study, 9 patients were given spinal anaesthesia for vaginal surgical procedures, 21 patients for caesarean section, 17 patients for lower limb surgeries, 11 patients for lower abdominal surgical procedures whereas 3 patients received it for urethral surgery.

Table III: Surgical Procedure and their Distribution Among Groups.

Type of Surgery	Group I (N = 30)	Group II (N = 30)
Vaginal surgery	5	4
Caesarean section	10	11
Lower limb surgery	8	9
Lower abdominal surgery	5	6
Urethral surgery	2	1
Total 60	30	30

The pulse rate of patients at different time intervals and its statistical analysis are summarised in Table IV.

Table IV: Statistical analysis of Mean pulse rate (beats/minute) Among the Groups.

Group	Mean Pulse rate (beats/minute)						
		Baseline	5 minute	15 minute	30 minute	45 minute	60 minute
Group I	Mean	100.6	97.5	94.7	94.6	92.7	91.4
	± S.D.	± 5.51	±5.46	±5.69	±5.59	±5.28	±5.28
	t	–	2.14	1.92	1.39	1.46	0.928
	p	–	p>0.05	p>0.05	p>0.05	p>0.05	p>0.05
Group II	Mean	93.8	92.7	90.5	91.6	89.5	88.5
	± S.D.	5.68	± 5.56	± 5.36	± 5.27	± 5.34	± 5.36
	t	-	0.758	1.53	1.38	0.771	0.669
	p	-	p>0.05	p>0.05	p>0.05	p>0.05	p>0.05

The baseline pulse rate among the groups were similar and towards higher side of normal range. There was no significant changed in pulse rate at different time intervals from baseline in Group II as compared to control group (Group I) (p>0.05).

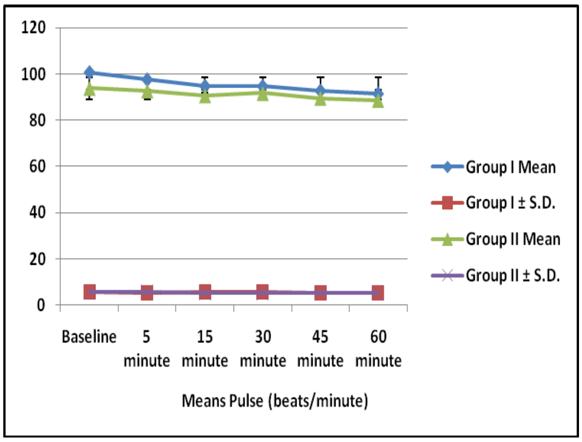

Figure 1: Comparison of mean pulse rate among groups.

BLOOD PRESSURE

A. Systolic Blood Pressure

Table V shows the statistical analysis of mean systolic blood pressure observed at different time intervals of the study and a comparative study of change in systolic blood pressure at different time intervals from baseline value.

Table V: Statistical analysis of Mean Systolic Blood Pressure (In mm Hg) among the Groups at Different timeintervals.

Group	Mean Pulse rate (beats/minute)						
		Baseline	5 minute	15 minute	30 minute	45 minute	60 minute
Group I	Mean	122.31	87.89	77.37	69.68	68.53	75.89
	± S.D.	± 18.67	± 14.75	± 13.27	± 12.09	± 14.12	± 11.57
	t	–	6.31	2.32	1.87	0.271	1.75
	p	–	p<0.0001	p<0.01	p<0.05	p>0.05	p>0.05
Group II	Mean	122.80	124.53	120.00	115.2	119.74	117.4
	± S.D.	±17.13	±10.10	± 10.04	± 11.67	+7.18	±9.21
	t	–	1.19	0.204	0345	0.68	1.19
	p	–	p>0.05	p>0.05	p<0.05	p>0.05	p<0.0S

It is evident from the Table that there is significant decrease in mean Systolic Blood Pressure from baseline value in the patients of Group I at different time intervals which was statistically significant (p<0.0001) at 5 minutes (87.89 ± 14.75), at (p<0.01) 15 minutes (77.37 ± 13.27), at (p<0.05) 30 minutes (69.68 ± 12.09). And statistically non significant (p>0.05) at 45 minutes (68.53± 14.12) and at 60minutes (75.89± 11.57).

In patients of Group II the mean Systolic Blood Pressure was found to be decreased during the late hours of the study as compared to baseline values. The hypotension was maximum at 30 minutes (115.2 ± 11.67) than at 60 minutes (117.40 ± 9.21) and statistically significant (p<0.05) and was minimum (p>0.05) at 15 minutes (120.00 ± 10.04) but at 5 minutes the mean Systolic Blood Pressure was increased by (1.70 ± 10.10 mm Hg) from baseline values in significantly (p>0.05).

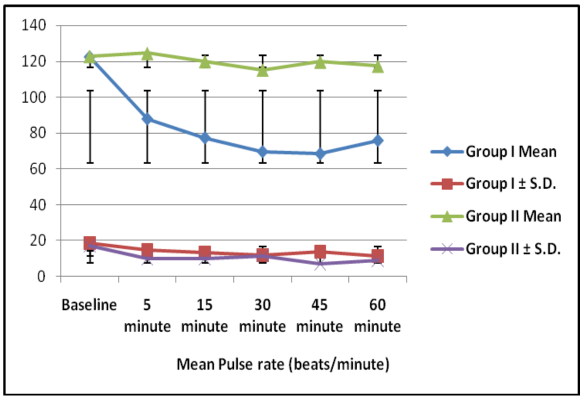

Figure 2: Comparison of mean systolic blood pressure among groups.

B. Diastolic Blood Pressure

Table 6 has shown the analysis of Diastolic Blood Pressure at different time intervals of the study among the groups.

Table VI: Statisticals analysis of Mean Diastolic Blood Pressure (In mm Hg) among the Groups at Different time intervals.

Group	Mean Pulse rate (beats/minute)						
		Baseline	5 minute	15 minute	30 minute	45 minute	60 minute
Group I	Mean	80.3	77.8	79.1	78.9	79.4	80.6
	± S.D.	± 7.25	± 6.71	± 6.40	* 6.59	± 5.36	± 5.74
	t	–	1.42	0.120	0.322	0.836	1.32
	p	–	p>0.05	p>0.05	p>0.05.	p>0.05	p>0.05
Group II	Mean	81.06	80.1	80.2	80.26	80.40	79.33
	± S.D.	± 6.59	± 6.01	+ 5.99	± 4.77	± 4.70	± 4.90
	t	–	± 6.59	± 6.01	+ 5.99	± 4.77	± 4.70
	p	–	p>0.05	p>0.05	p>0.05	p>0.05	p>0.05

The change in Diastolic Blood Pressure among the patients of both groups ever one hour period was not found to be statistically significant (p>0.05).

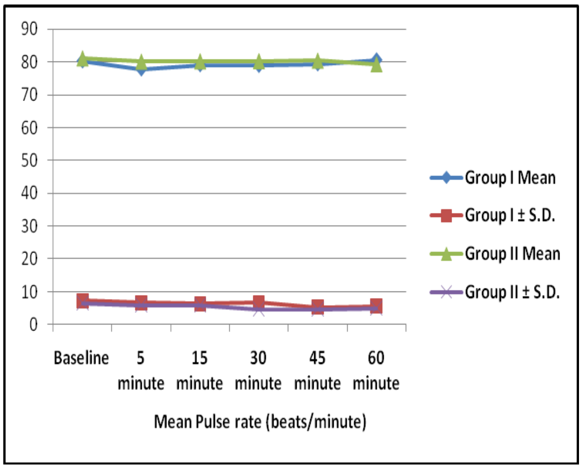

Figure 3: Comparison of mean diastolic blood pressure among groups.

Episodes of hypotension and their analysis have been shown in Table VII and Table VIII.

Table VII: Incidence of Hypotension Among the Groups.

	Group I (N=30)	Group II (N=30)
Number of patients with Hypotension	18	5
Percentage of Hypotensive patients	60 %	16.6 %

$X^2_3 = 18.409$ (p<0.01)

Table VIII: Analysis of Hypotension Observed Among the Groups.

Percentage Decrease in Blood Pressure	Group I (N=30)	Group II (N=30)
No change	12	25
0 – 10	2	4
11 – 20	4	1
21 – 30	10	0

In our study, Hypotension has been taken as a fall in Systolic Blood Pressure 30 % or Systolic Blood Pressure <90 mm Hg. It was noticed in most of the patients of control group which was 60 %. In Group II (Colloid Group), Hypotension was observed in 5 out of 30 patients which were 16.6 %.

It is evident from the Table VIII that average decrease in Systolic Blood Pressure was 8 mm Hg in the Group II receiving colloid solution (H.E.S 6%, Polygeline). The crystalloid Group I experienced a drop in Systolic Blood Pressure of >25mm Hg. The Blood Pressure decrease was significantly greater in the crystalloid group.

During spinal anaesthesia, supplemented intravenous fluid infused other than preloaded fluid has been shown in Table No. IX as follows:

Table IX: Analysis of Mean Intravenous Fluids Given During the Study among the groups.

Supplemented fluid in ml	Group I (N=30)	Group II (N=30)
Mean	1021.67	673.34
± S.D.	± 296.15	±176.04
t	–	5.54
p	–	p<0.001

The Mean intravenous fluid infused during spinal anaesthesia in control Group I was 1021.67±296.15 ml. This supplemented fluid was less (673.34±176.04) in Group II from control group. Which was statistically significant (p<0.001).

The change in PCV after infusion of one litre of preload in experimental groups has been analysed and compared with control Group in Table X.

Table X: Statistical Analysis of Change in PCV among the Groups.

Supplemented fluid in ml	Group I (N=30)	Group II (N=30)
Preoperative PCV Mean ± S .D.)	35.00 ± 2.828	41.00 ± 1.418
Decrease in PCV after infusion of 1000 ml fluid (Mean ± S.D.)	2.59 ± 1.707	4.65 ± 1.502
% Decrease in PCV	7.4	11.8
t		3.2704
p		p<0.001

In our study, we observed that infusion of 1000 ml of crystalloid fluid, PCV was decreased more in colloid Group II than the control Group I and it was statistically significant (p<0.001).

Twelve patients of control Group developed severe hypotension which was not managed by intravenous fluid alone, so mephentermine was given to such patients. Only two patients of Group II developed severe hypotension and required Mephentermine.

	Group I (N=30)	Group II (N=30)
No. of patients who needed Mephentine	12	2
Percentage of Patients needed Mephentine	40%	6.66%

In our study, we noticed 23.3% incidence of nausea/vomiting in Control Group I while there was no incidence of nausea/vomiting with patients of Group II as shown in Table 12.

Table 12: Incidence of Nausea/Vomiting among groups.

	Group I (N=30)	Group II (N=30)
No. of patients with episodes of nausea/vomiting	7	0
Incidence of nausea/ vomiting	23.3%	0%

DISCUSSION

Spinal anaesthesia is accompanied by sympathetic block with its attendant vasodilation and blockade of cardio-accelerator fibers, which leads to hypovolemia and the predictable decrease in arterial blood pressure and heart rate (Brown and Wedel, 1990). [12] Mild decrease in arterial blood pressure may be worthful with normal patients as it will decrease the blood loss during high surgical procedure (Griffiths and Gfflies 1948; Greene, 1952; Rosberg et al., 1982). [13-15] But moderate to severe hypotension, which occurs most of the time during spinal anaesthesia, must be watched for and must be corrected immediately with administration of vasoactive drugs and rapid intravenous fluids. Even a mild drop in blood pressure should be avoided in high risk patients such as the elderly and those with underlying organ dysfunction, in whom auto-regulatory mechanism may be abnormal (Baron eta!., 1986; Greene, 1981) [16,17]

Prophylactic fluid pre-loading before spinal anaesthesia has been established as routine and considered to be a safe and effective method of reducing the incidence of hypotension (Clark et al., 1976). [3] A major objective in spinal anaesthesia research has been to obtain a regimen, which may be best suited in prevention of spinal hypotension, regarding the type, volume and rate of intravenous preload to be administered before spinal anaesthesia, with its least side effects.

The present study compares the effectiveness of crystalloid (Ringer's lactate) solution with colloid solution (Polygelatin and hydroxyethyl starch 6%) in prevention of spinal hypotension. The crystalloid group I patients were preloaded with 1000 ml of Hartmann's solution, while colloid group II patients received 500 ml of hydroxyethyl starch or Polygelatin before spinal anaesthesia.

Mean age of patients in our study was 38.58 years (Table I). The mean weight of patients was 48.56 kg (Table II). The patients of this study were normotensive; the mean blood pressures of patients at the time of start of spinal anaesthesia were: 122.3 1/80.3 mm Hg in Hartmann's group 120.80/81.06 mm, Hg in HES group (Table V & Table VI).

All the patients of this study received the study infusion fluids 45 minutes before spinal anaesthesia. Both groups were comparable with respect to age, weight and Baseline Blood pressure (both systolic and diastolic). The spinal anaesthesia was given to perform the surgical procedures upon lower abdomen, perineum and lower limb (Table VII).

In our study the incidence of hypotension during spinal anaesthesia in patients with colloid group was 16.6% in patients, as compared to 60% in patients of control group. (Table VII).

Role of crystalloid preload has been questioned by various studies. In this respect our study is comparable with the study of Rout et al. (1993), where they observed 55% incidence of hypotension in crystalloid preloaded group, as compared to 60% in our study. The causes of this difference (5%) may be that they have studied on elective cesarean section whereas we have included the operations upon lower abdomen, perineum and lower limb, elective and emergency cesarean section where there may be more blood loss (Table VII).

Recently, Jackson et al (1995) [18] have abandoned the routine use of formal crystalloid preloading in women undergoing cesarean section under regional anaesthesia.

Prevention of spinal hypotension with crystalloid fluid preloading remained unsatisfactory, because it leaks into the interstitial space (Twigley and Hilmann 1985), [19] not allowing sufficient restoration of the intravascular volume. Thus it requires increasing volume of crystalloids in an effort to be hazardous with increasing susceptibility of pulmonary oedema (Maclennan et al. 1987). Then the attention was focused on colloid solutions as volume preload before spinal anaesthesia. Albumin 5% is probably the most effective solution but it is expensive and not universally available Mathru et al 1980).

Therefore, synthetic colloids were tried and various studies were made to compare the effectiveness of volume preload among the colloids and from the crystalloid solution. In our study the incidence of hypotension was 16.6% in Polygelatin group as compared to 33.33% in crystalloid groups (Table VII).

(Hallworth et al, 1982) [20] investigated the incidence of hypotension and found it to be 45% in crystalloid group and 5% in crystalloid-Polygelatin group. Here the reduction in the incidence of hypotension among Polygelatin group was more i.e. 40% as compared to 16.6% in our study. The difference may be due to the difference in the nature of surgery (cesarean versus non-cesarean section) and type of anaesthesia (epidural versus spinal). Likewise the study of Shapira et al, (1991) [21] have shown the incidence of hypotension among Polygelatin to be 20.45% and 53.8% among crystalloid (Ringer Lactate) group. These observations were approximately similar to our study, though the case selected in their study were of ASA il-ifi grades whereas in our study the cases were of ASA I & II, with same types of surgical procedure in both the studies, Thus Polygelatin solution was found to offer better protection against hypotension during epidural as well as spinal anaesthesia than crystalloid solutions.

Hydroxyethyl starch, another synthetic colloid solution compared crystalloid preloading in parturients undergoing elective cesarean section under spinal anaesthesia by Karinen et al., (1995). [22] The incidence of hypotension was 62% in crystalloid group and 38% in HES group. These observations were higher than our findings, which was 60% in crystalloid group and 16.6% incidence of hypotension in HES group. The reason of this difference may be the difference in nature of surgical procedure and ‘their respective blood, loss. Though preloading with HES was superior than crystalloid preload to prevent spinal hypotension, was not as effective as to be recommended as a routine practice. Same suggestions were made by Murray et al., (1989) and more recently by Buggy et al., (1997); [23] they observed that both crystalloid as well as colloid (HES 6%) volume preload before regional anaesthesia have no significant difference in the incidence of hypotension (Table VII).

In our study the average fluid required was 1021.67±296.15 ml in crystalloid (control) group 673.34±176.04 ml in Polygelatin group (II) (Table IX). The fluid required was more in crystalloid group I than in group (II).

Shapira et al., (1991) [21] observed a significant difference in volumes required to maintain a stable blood pressure, 297±202 ml of Polygelatin group as compared to 1962±522 ml of Hartmann’s group ($p<0.005$). These results were higher than our results. The reason of this difference may be the nature of regional anaesthesia (if was epidural in their study while we used subarachnoid technique) as well as the ASA grading of the case selected (their cases were of ASA grade II and ifi while we included the ASA grade I and II patients).

In our study, we observed that there was 7.4% reduction in PCV after infusion of one litre fluid in group I crystalloid group while it was 11.8% in Polygelatin colloid group (Table X).

Vercauteren et al. (1996) [24] observed that the decrease in PCV was 20.3% in crystalloid group, 21.9% in Polygelatin group after infusion of 2000 ml of preload in respective groups. These values were higher than our observations.

The reason of this higher change in PCV may be that they have preload with double the volume of our study. Secondly, the patients of their study were the parturient while we have included the other patients of normal haematocrit (Table X).

In our study 12 patient of preload group (control) developed severe hypotension which was not managed by intravenous fluid alone, so Mephentermine was given while in colloid group only two patients developed severe hypotension & required Mephentermine, which was statistically significant (Table XI).

Shapira et al., (1991) [21] found that three patients of Polygelatin group required ephedrine iv. to treat a systolic blood pressure 80 mm of Hg Jackson et al., (1995) [18] observed that vasopressor (Ephedrine) was needed in 5 out of 30 patients of 1000 ml preload group and 6 out of 30 patients of 200 ml preload group. This difference was non-significant.

Vercauteren et al., (1961) [24] found that ephedrine requirement was less frequent p<0.05) in HES group i.e., 11 patients versus 20 patients in HES group and 22 patients in Polygelatin group. These values were higher than our findings because there may be the difference in the management protocol of hypotension. They have used vasopressor (ephedrine) and were given immediately without further fluid therapy. In our study we have managed the hypotension by rapid i.v. fluid first, then vasopressor (Mephentermine) was given, if not controlled by fluid alone (Table Xl).

In our study seven patient of control group developed nausea followed by vomiting and required the antiemetic treatment while there was no incidence of nausea and vomiting in colloid group which was statistically significant (Table XII).

Jackson et al., (1995) [18] observed the incidence of nausea and vomiting of 53% in both groups and was related to hypotension in 50% of these cases. Only one woman required administration of a systemic antiemetic treatment, all other were resolved by reversing the hypotension and reassurance. These findings were higher than observations of our study. The reason may be the potentially full stomach in pregnant women for cesarean section, which further gets stimulated by methyl-ergometrine given after delivery of baby. The manipulation of bowels and stomach during the delivery of baby further potentiate the matter (Table XII).

In our study, no incidence of any hypersensitivity reaction was observed and pulse rate, respiration were maintained throughout the study procedure.

CONCLUSION

The present study was undertaken to evaluate the effect of volume preload on spinal hypotension. In prevention of spinal hypotension, the various researches are still being conducted in order to obtain an appropriate and most suitable method. Here we have searched out a better type of intravenous fluid to be used as a volume preload. Our study compares the role of intravenous crystalloid solution (Hartmann's solution) with colloid solutions (polygelatin and hydroxyethyl starch 6%) administered as fluid preload before spinal anaesthesia. Spinal anaesthesia was given after infusion of 1000 ml of Hartmann's solution in crystalloid group, 500 ml of hydroxyethyl starch or polygelatin in group II. The following conclusions were drawn from our study.

1. There was a positive role of volume preload in prevention of hypotension during spinal anaesthesia.
2. Hydroxyethyl starch or polygeline appears to be highly effective to maintain a stable blood pressure during spinal anesthesia as compared to crystalloids. (Ringer lactate). Least protection was observed with Ringer lactate solution.
3. The fluid requirement to maintain haemodynamic stability was lesser in colloid group.
4. Decrease in PCV was more with colloids, which was statistically significant.

5. Requirement of vasopressor drug (Mephentermine) was more in crystalloid group as compared to colloid group which was statistically significant.
6. The patients of crystalloid group had more incidences of nausea and vomiting. While there was no incidence of nausea/vomiting in colloid group.
7. Colloids especially Hydroxyethyl starch therefore appears to be the best intravenous preloading agent to overcome the problem of hypotension during spinal anaesthesia.

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How to cite this article: Ahuja S, Gahlot SK. Effect of crystalloid and colloid preloading on spinal induced haemodynamic status. International Journal of Research and Review. 2019; 6(5):341-352.

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