

Comparative Evaluation of Preloading with Dextran, Hydroxyethyl Starch, Polygelatine and Ringer Lactate for Prevention of Hypotension Following Spinal Anaesthesia

Ravindra Singh Sisodia¹, Deepak Tiwari², Deepak Kumar³, Saurabh Bhargava^{4*}

¹Department of Anaesthesia, Mahatma Gandhi Medical College and Hospital, Jaipur, Rajasthan, India

²Department of Emergency Medicine, National Institute of Medical Sciences and Research, Jaipur, Rajasthan, India

³Department of Anaesthesia, National Institute of Medical Sciences and Research, Jaipur, Rajasthan, India

⁴Department of Emergency Medicine, National Institute of Medical Sciences and Research, Jaipur, Rajasthan, India

Received: 25-06-2020 / Revised: 28-07-2020 / Accepted: 04-08-2020

Abstract

Background: A good number of routine and emergency surgical procedures are done under spinal anaesthesia. Hypotension is the most common cardiovascular response of spinal anaesthesia which may be associated with serious patient discomfort and mortality. Preloading has proved to be the most effective method for prevention of post spinal hypotension. Preloading is rapid administration of crystalloid or colloid solution before giving spinal or epidural block. Aim: To study the effect of pre-operative infusion of Ringer Lactate, Hydroxyethyl starch, Dextran 40 and Polygelatine to prevent spinal hypotension and compare the effect of preloading with different colloids.

Material & Methods: 100 patients, ASA physical status of I and II undergoing elective surgeries between the age group of 21 to 60 years were randomized into four groups depending upon the type of fluid (Hydroxyethyl starch, Dextran-40, Polygelatine and Ringer Lactate) used for preloading the patients before the subarachnoid block. In case of hypotension, Inj. Mephentermine(3mg) was injected to maintain blood pressure. The number of boluses of Inj. Mephentermine were recorded. Results: Incidence of hypotension in group R preloaded with Ringer lactate solution is 56%, group H preloaded with HES is 24%, group D preloaded with Dextran 40 is 32% and group P Polygelatine is 36%. This was statistically found to be highly significant ($p < 0.001$). when compared between groups, it was also observed that the use of mephenteramine as vasopressor was minimum in Hydroxyethyl Starch (HES) group as compared to the Ringer Lactate, Dextran and Polygelatine groups. The use of mephentermine was found highest in the Ringer lactate group. Conclusion: Subarachnoid block is associated with significant incidence of hypotension. In prevention of post subarachnoid block hypotension preloading with Hydroxyethyl Starch (HES) is more effective than the Ringer Lactate, Dextran and Polygelatine.

Keywords: Spinal Anaesthesia, Hypotension, Preloading, Ringer Lactate, Hydroxyethyl Starch, Dextran and Polygelatine.

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Introduction

Spinal or epidural conduction block techniques are now widely used for both elective and emergency surgical procedures, particularly for caesarean section, lower abdominal, orthopaedic and urological surgeries[1].

It is easier to perform, gives profound muscle relaxation and prolonged analgesia[1]. The most common and serious problem associated with spinal anaesthesia remains the rapid onset of profound hypotension which can be detrimental[2]. Arterial Hypotension during spinal anaesthesia may be associated with significant patient discomfort and even mortality. Various theories of causation of hypotension during spinal anaesthesia have been given like; diminished cardiac output due to decreased venous return, dilatation of post arteriolar capillaries and small venules, paralysis of splanchnic

*Correspondence

Dr. Saurabh Bhargava,

Department of Emergency Medicine, National Institute of Medical Sciences and Research, Jaipur, Rajasthan, India.

nerves, effects of drugs in circulation and compression of great vessels within abdomen.

During the course of time and with evaluation of anaesthesia several methods have been used for prevention of post spinal hypotension[3-5]. such as

1. Peripherally acting Vasopressor e.g., Ephedrine, Methoxamine, Phenylephrine, Metaraminol and Dopamine, etc.
2. Preloading with crystalloids and colloids
3. Application of elastic bandages on both legs preoperatively.
4. Maintaining lateral position
5. Left uterine displacement in obstetric patients.

Among all the methods described above, preloading has proved to be the most effective method

Preloading

It is rapid administration (15-20 min) of 500-1000 ml of crystalloid or colloid solution before giving spinal or epidural block. For the prevention of hypotension, a variety of fluids have been tried.

- Preloading With Crystalloids

Crystalloids like Ringer lactate, balanced salt solutions and normal saline have been used extensively for preloading[6,7]. Crystalloid preloading may bring down the incidence of hypotension from 80% to 43-65%.

- Preloading With Colloids

Colloids are mainly confined to the intravascular space because of their high oncotic pressure that will move fluid from the interstitial space into intravascular space resulting in augmentation of the intravascular volume by a factor that is greater than the volume of colloid infused. Such colloid solutions are called plasma expanders[6,7]. Colloids maintain arterial pressure, CVP and other cardiovascular parameters for longer time (2-4 hours) due to long IV half life, less volume of fluid is required for preloading thus minimal risk of

overloading of cardiovascular system and minimize the use of vasoconstrictor drugs.

Aim and Objectives

1. To study the effect of pre-operative infusion of Ringer Lactate, Hydroxyethyl starch, dextran 40 and Polygelatine to prevent post sub arachnoid block (SAB) hypotension.
2. To compare the effect of preloading with different colloids
3. To observe the side effects, if any.

Materials and Methods

The present study was carried out at the Department of Anaesthesiology, tertiary care medical college hospital. The study was carried out on 100 healthy patients of ASA Grade I and II undergoing elective surgeries. The patients were briefed about the details of the procedure and written consent was obtained from them.

Inclusion Criteria

The patients selected for the present study were between age group of 21 to 60 years and were normotensive.

Exclusion Criteria

Patients with history of bleeding disorders, infection at the site of lumbar puncture, neurological diseases and chronic backache were excluded from the study. Patients with the history of hypertension, myocardial infarction, anaemia and other systemic disorders were also excluded from the study. All the patients enrolled in the study went through a thorough pre-anaesthetic checkup and the following examinations were carried out such as urine routine and microscopic, Blood Hb%, total and differential WBC counts, blood sugar, ESR, renal function test, liver function test, coagulation profile, ECG, X-Ray chest, etc. 100 patients were divided into four groups (25 each) depending upon the type of fluid (Ringer Lactate, Hydroxyethyl starch, Dextran-40 and Polygelatine) used for preloading the patients before the subarachnoid block.

Table 1: Type of colloid use for preloading in different groups and number of cases

| Groups | Type of colloid use for Preloading | No. of Cases |
|---------|------------------------------------|--------------|
| Group H | Hydroxyethyl Starch 10 ml/kg. B.W. | 25 |
| Group D | Dextran-40 10ml/kg. B.W. | 25 |
| Group P | Polygelatin 10ml/kg. B.W. | 25 |
| Group R | Ringer Lactate 10 ml/kg B.W. | 25 |

Anaesthesia Technique: A uniform premedication of Tab Pantoprazole 40 mg along with Tab Alprazolam 0.5 mg P.O. on the night prior to surgery were given. Upon arrival into the operation theatre baseline pulse, blood pressure, respiratory rate were recorded. A vein was cannulated with an appropriate sized intravenous cannula. The preload fluid was given by intravenous infusion within a period of 15 minutes, 1-5 minutes prior to administration of subarachnoid block (SAB). SAB was performed in left lateral position with quincke spinal needle 25 gauge at L2-3 or L 3-4 intervertebral space. After observing free flow of cerebrospinal fluid, Inj. Bupivacaine 0.5% 2 to 3 ml. was given through the spinal needle. Patient turned again to supine position. Oxygen was supplemented with face mask. After preloading, pulse rate, systolic and diastolic blood pressure and respiratory rate were recorded thrice and mean value was taken as a baseline value. Then same parameters were recorded at 0, 2, 4, 6, 8, 10, 20, 30, 40, 50, 60 minutes, at the end of operation and postoperatively. Ringer lactate and normal saline were transfused intravenously as maintenance fluids. Whenever hypotension i.e. a fall in systolic blood pressure of 20% from the baseline value or less than 90 mm Hg occurred, Inj. Mephentermine (3 mg) was injected to maintain blood pressure. The number of boluses of Inj. Mephentermine were recorded. The bradycardia i.e. a pulse rate of 60/ min. or below was treated by Inj. Atropine 0.3 mg IV. The maximum level of sensory block was assessed by pinprick method 5 minutes after the SAB. The complete

record of pulse, blood pressure (both systolic and diastolic), respiration, amount of fluids administered before and after SAB, the dose of vasopressor needed were maintained. Any other complications like skin reactions, nausea-vomiting were also recorded and treated accordingly.

Statistical Analysis

The observations recorded in all four groups were tabulated and statistical analysis carried out applying Student 't' test (paired for intra-group and unpaired for intra-group comparison). P value <0.05 was taken to be statistically significant and P value less than 0.001 was taken as highly significant.

Observations

The present study was conducted on 100 patients, of age group ranging from 21-60 years, ASA grade-I and II, scheduled for elective surgery under sub arachnoid block at tertiary level medical college hospital. The age incidence of patients was 21-60 years. Mean age group of R was 42.60 years group H was 42.88, group D was 43.00 years and group P was 41.52 years. All the groups were comparable for age. It was found that the maximum incidence of weight in both groups belonged to the group of 51-60 Kg. In group R - 48 % patients belongs to this weight group and group H - 56% patients, group D - 52%% patients and group P-48% patients belong to this weight group. Distributions of cases in all the groups were similar in different weight categories[Table 1,2]

Table 2: Changes in Pulse Rate (Mean + S.D.)/minute

| Time | Group R | | | Group H | | | Group D | | | Group P | | |
|----------------------|---------|------|---------|---------|------|---------|---------|------|---------|---------|-------|---------|
| | Mean | S.D. | p Value | Mean | S.D. | p Value | Mean | S.D. | p Value | Mean | S.D. | p Value |
| Before Spinal | | | | | | | | | | | | |
| Before preloading | 91.04 | 7.71 | | 89.04 | 8.27 | | 89.84 | 8.22 | | 88.96 | 9.29 | |
| After preloading | 90 | 7.06 | >0.05 | 90.56 | 8.11 | >0.05 | 92.28 | 6.53 | >0.05 | 90.16 | 8.25 | >0/05 |
| After Spinal | | | | | | | | | | | | |
| 2 minutes | 100 | 8.87 | <0.05 | 95.60 | 9.98 | <0.05 | 96.88 | 9.89 | <0.05 | 96.8 | 9.57 | <0.05 |
| 4 minutes | 98.6 | 8.42 | <0.05 | 94.18 | 9.22 | <0.05 | 95.68 | 9.72 | <0.05 | 92.6 | 8.9 | <0.05 |
| 6 minutes | 97.12 | 7.19 | <0.05 | 92.40 | 8.21 | <0.05 | 94.24 | 9.68 | <0.05 | 90.92 | 10.17 | >0.05 |
| 8 minutes | 92.68 | 7.06 | <0.05 | 90.68 | 8.32 | >0.05 | 92.89 | 8.76 | <0.05 | 90.68 | 9.21 | >0.05 |
| 10 minutes | 92.46 | 6.4 | >0.05 | 90.4 | 8.93 | >0.05 | 92.96 | 8.83 | <0.05 | 92.08 | 8.72 | <0.05 |

| | | | | | | | | | | | | |
|------------|-------|------|-------|------|-------|-------|-------|------|-------|-------|-------|-------|
| | | 6 | | 0 | | | | | | | | |
| 15 minutes | 98.56 | 10.3 | <0.05 | 88.8 | 11.03 | >0.05 | 91.0 | 9.38 | >0.05 | 90.48 | 9.68 | >0.05 |
| 20 minutes | 90.48 | 6.74 | >0.05 | 87.3 | 11.44 | >0.05 | 90.88 | 9.03 | >0.05 | 88.96 | 9.35 | >0.1 |
| 25 minutes | 96.16 | 6.08 | <0.05 | 87.8 | 9.36 | >0.05 | 90.16 | 9.48 | >0.05 | 88.8 | 11.29 | >0.1 |
| 30 minutes | 98.56 | 6.7 | <0.00 | 88.7 | 7.44 | >0.05 | 87.76 | 9.24 | >0.05 | 86.8 | 12.04 | >0.05 |
| 40 minutes | 96.16 | 6.48 | <0.00 | 88.7 | 7.07 | >0.05 | 83.92 | 9.09 | <0.05 | 87.90 | 11.55 | >0.05 |
| 50 minutes | 96.16 | 6.07 | <0.05 | 88.9 | 7.35 | >0.05 | 90.56 | 7.58 | >0.05 | 89.52 | 7.57 | >0.05 |
| 60 minutes | 97.50 | 5.61 | <0.05 | 88.9 | 6.74 | <0.05 | 90.4 | 7.39 | <0.05 | 88.4 | 9.60 | >0.05 |

A Statistically significant rise occurred in heart rate in group-R at 15 minutes onwards which corresponded to the fall in mean systolic blood pressure. There was no significant change in heart rate in group-H, D and P[Table 3]

Table 3: Changes in Systolic Arterial Pressure (SAP) (mmHg); Mean + S.D.

| Time | Group R | | | Group H | | | Group D | | | Group P | | |
|----------------------|---------|-------|---------|---------|-------|---------|---------|-------|---------|---------|-------|---------|
| | Mean | S.D. | p Value |
| Before Spinal | | | | | | | | | | | | |
| Before preloading | 125.6 | 10.03 | | 126.8 | 9.00 | | 126.6 | 11.86 | | 128.0 | 11.18 | |
| After preloading | 126.0 | 10.0 | >0.05 | 128.8 | 10.54 | >0.05 | 128.8 | 10.9 | >0.05 | 131.0 | 9.86 | >0.05 |
| After Spinal | | | | | | | | | | | | |
| 2 minutes | 126.0 | 10.0 | >0.05 | 130.4 | 8.89 | <0.05 | 128.4 | 10.6 | >0.05 | 130.8 | 9.96 | >0.05 |
| 4 minutes | 122.4 | 9.6 | >0.05 | 129.6 | 8.42 | >0.05 | 124.0 | 10.86 | >0.05 | 122.8 | 8.91 | <0.05 |
| 6 minutes | 120.3 | 12.35 | <0.05 | 129.4 | 8.31 | >0.05 | 123.1 | 11.73 | >0.05 | 124.4 | 10.6 | <0.05 |
| 8 minutes | 116.8 | 11.73 | <0.00 | 129.1 | 9.17 | >0.05 | 122.6 | 11.62 | <0.05 | 124.9 | 10.81 | <0.05 |
| 10 minutes | 112.4 | 13 | <0.00 | 127.2 | 10.61 | >0.05 | 119.2 | 11.87 | <0.05 | 128.0 | 11.7 | >0.05 |
| 15 minutes | 106.0 | 16.58 | <0.00 | 124.0 | 11.55 | >0.05 | 119.0 | 12.24 | <0.05 | 123.6 | 13.12 | <0.05 |
| 20 minutes | 108.8 | 11.30 | <0.00 | 124 | 10.41 | >0.05 | 118.2 | 14.37 | <0.05 | 119.2 | 15.03 | <0.05 |
| 25 minutes | 109.6 | 10.20 | <0.00 | 124.8 | 9.63 | >0.05 | 115.3 | 16.32 | <0.00 | 117.2 | 16.75 | <0.05 |
| 30 minutes | 111.2 | 7.81 | <0.00 | 126.8 | 7.48 | >0.05 | 118.2 | 12.5 | <0.05 | 120.2 | 13.14 | <0.05 |
| 40 minutes | 111.6 | 6.88 | <0.00 | 127.6 | 7.79 | >0.05 | 121.2 | 12.01 | <0.05 | 118.8 | 11.18 | <0.00 |
| 50 minutes | 112.6 | 6.89 | <0.00 | 128.0 | 8.16 | >0.05 | 122.2 | 12.01 | <0.05 | 123.6 | 8.60 | <0.05 |

| | | | | | | | | | | | | |
|------------|-------|------|--------|-------|------|-------|-------|------|-------|-------|------|-------|
| 60 minutes | 112.5 | 6.39 | <0.001 | 128.1 | 8.73 | >0.05 | 123.4 | 7.34 | <0.05 | 123.0 | 9.57 | <0.05 |
|------------|-------|------|--------|-------|------|-------|-------|------|-------|-------|------|-------|

The changing trends in mean SAP in all four groups are shown in above table. In group-R, there was significantly greater fall in SAP from 6 minutes onwards. Maximum fall was at 15 minutes (106 t 16.58). There was minimum fall in SAP in group- H. Intermediate fall in SAP was seen in group - D from 8 minutes onwards. Minimum SAP was 115.36 ± 16.32 at 25 minutes. Fall in group - P was also intermediate with minimum SAP 117.2 ± 16.75 at 25 minutes[Table 3,4]

Table 4: Changes in Diastolic Arterial Pressure (DAP) (mmHg); Mean + S.D.

| Time | Group R | | | Group H | | | Group D | | | Group P | | |
|----------------------|---------|-------|---------|---------|------|---------|---------|------|---------|---------|-------|---------|
| | Mean | S.D. | p Value | Mean | S.D. | p Value | Mean | S.D. | p Value | Mean | S.D. | p Value |
| Before Spinal | | | | | | | | | | | | |
| Before preloading | 82 | 5.77 | | 84.72 | 6.35 | | 84.4 | 7.11 | | 83.8 | 7.91 | |
| After preloading | 81.20 | 5.26 | >0.05 | 86.72 | 6.75 | >0.05 | 86.2 | 7.57 | >0.05 | 85.6 | 8.71 | >0.05 |
| After Spinal | | | | | | | | | | | | |
| 2 minutes | 81.60 | 5.54 | >0.05 | 87.12 | 6.64 | >0.05 | 86.0 | 7.63 | >0.05 | 82.0 | 8.22 | >0.05 |
| 4 minutes | 80.94 | 6.71 | >0.05 | 86.31 | 7.12 | >0.05 | 84.8 | 8.39 | >0.05 | 81.7 | 7.93 | >0.05 |
| 6 minutes | 78.80 | 7.26 | >0.05 | 84.84 | 6.55 | >0.05 | 82.0 | 9.84 | >0.05 | 81.2 | 8.0 | >0.05 |
| 8 minutes | 74.68 | 9.13 | <0.05 | 84.16 | 7.38 | >0.05 | 80.3 | 9.14 | <0.05 | 80.81 | 7.76 | >0.05 |
| 10 minutes | 74.0 | 10.0 | <0.05 | 83.2 | 7.92 | >0.05 | 80.6 | 8.75 | <0.05 | 79.6 | 10.0 | <0.05 |
| 15 minutes | 71.60 | 10.28 | <0.001 | 82.2 | 8.23 | >0.05 | 80.8 | 9.79 | <0.05 | 76.4 | 10.36 | <0.05 |
| 20 minutes | 71.76 | 8.50 | <0.001 | 81.7 | 8.21 | <0.05 | 75.2 | 9.62 | <0.05 | 72.64 | 10.04 | <0.001 |
| 25 minutes | 71.80 | 8.00 | <0.001 | 80.3 | 7.64 | <0.05 | 72.4 | 9.69 | <0.001 | 72.48 | 10.89 | <0.001 |
| 30 minutes | 73.20 | 6.9 | <0.001 | 80.4 | 6.45 | <0.05 | 74.2 | 9.16 | <0.001 | 73.6 | 9.07 | <0.001 |
| 40 minutes | 73.60 | 5.69 | <0.001 | 78.2 | 6.45 | <0.05 | 75.2 | 7.70 | <0.001 | 74.4 | 9.16 | <0.001 |
| 50 minutes | 74.35 | 5.90 | <0.05 | 78.6 | 6.9 | <0.05 | 74.36 | 6.53 | <0.001 | 75.2 | 9.18 | <0.05 |
| 60 minutes | 74.0 | 5.98 | <0.05 | 79.67 | 7.30 | <0.05 | 76.4 | 6.53 | <0.05 | 76.0 | 9.18 | <0.05 |

There was significant fall in DAP from 8 minutes onwards in group-R, 20 minutes onwards in group H, 8 minutes onwards in group D and group - P. Minimum DAP in group - R was 71.60 ± 10.28 at 15 minutes; in group - H was 78.2 ± 6.45 at 40 minutes; in group - D was 72.4 ± 9.69 at 25 minutes and in group - P was 72.48 ± 10.89 at 25 minutes. As shown in table DAP was better maintained in group - H, near the basal value. During inter group comparison of changes in heart rate (bpm), the changes in mean pulse rate of group R were compared with group H, D and P. It was

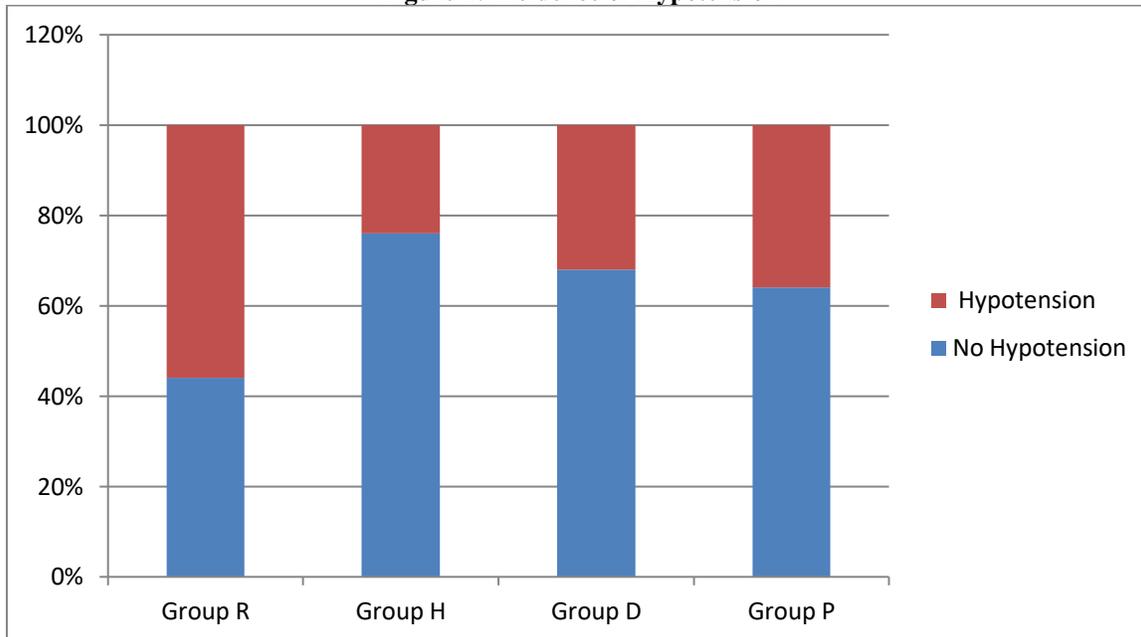
observed that after SAB there was statistically significant increase in heart rate in group R as compared to group H, D and P. During inter group comparison of changes in systolic blood pressure (mmHg), the changes in mean systolic blood pressure of group R were compared with group H, D and P. It was observed that after SAB there was statistically significant fall in SAP in group R in comparison of groups H, D and P. The results were found to be statistically significant. During inter group comparison of changes in diastolic blood pressure (mmHg), the

changes in mean diastolic blood pressure of group R were compared with group H, D and P. After preloading increase in DAP in group H and P were statistically significant when compared to group R.

After SAB diastolic blood pressure fell significantly in group R as compared to H, D and P.

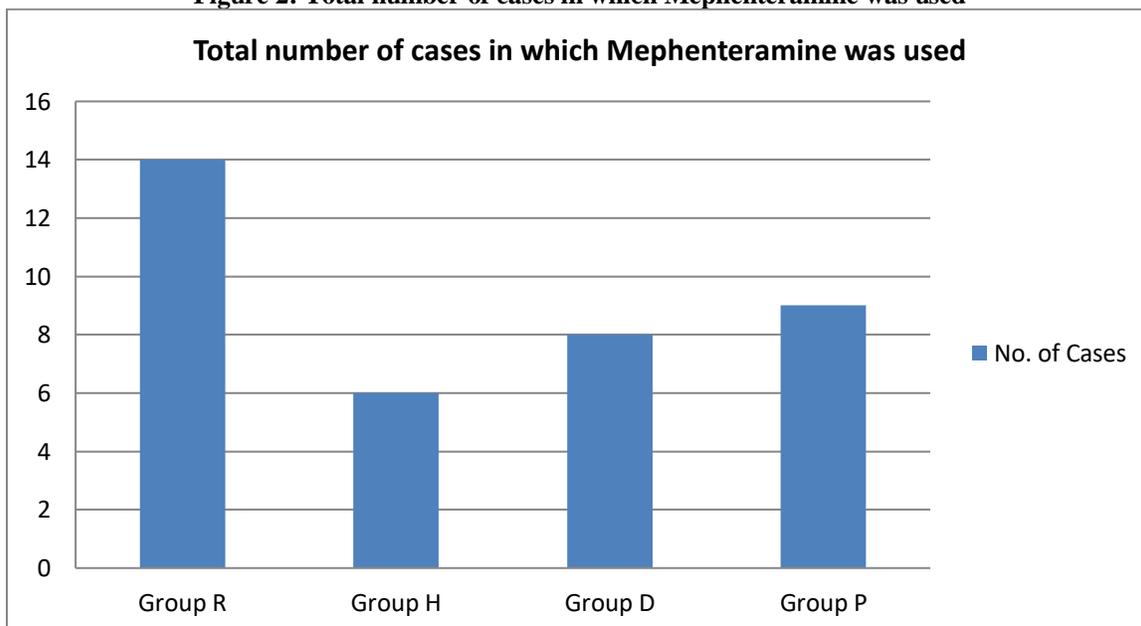
After 25 minutes values of DAP in group R was not significantly different from group D and P but were significantly lower than group H.

Figure 1: Incidence of Hypotension



The above figure displays the incidence of hypotension in all groups. As can be observed from above figure hypotension occurred in 14 cases (56%) in group R, only cases (24%) in group H, 8 cases (32%) in group D and 9 cases in group P[Figure 1]

Figure 2: Total number of cases in which Mephenteramine was used



The above figure displays the number of cases in which Mephenteramine was used for the treatment of

hypotension. Group – R required the highest number of dosages[Figure 2]

The most common side effects were shivering, nausea & vomiting and bradycardia. Shivering was observed more in Ringer Lactate group. Nausea and vomiting were more with R. L. and Dextran 40. Bradycardia was infrequent in all the groups. Other side effects like anaphylactoid reaction, pulmonary oedema, coagulation defects, pruritus, etc. were not found in any group.

Discussion

The present study was aimed at the comparison of preloading effects of Ringer lactate with hydroxyethyl starch, Dextran 40 and Polygelatine on maintaining the hemodynamic status during subarachnoid block in 100 patients of ASA grade I and II scheduled for elective surgeries. As a preload in group R ringer lactate 10 ml/kg was infused, in group H Hydroxyethyl starch 10 ml/kg, in group D Dextran-40 10 ml/kg, in group P Polygelatine 10 ml/kg was given within 15 minute just before the SAB for prevention of hypotension.

In the present study parameters studied are: Systolic arterial pressure (mmHg), Diastolic arterial pressure (mmHg) and Heart rate (per minute)

Comparison of changes in Mean heart Rate (Per Minute)

Baseline heart rate (group R - $91.04 \pm 7.71/\text{min.}$; group H $89.04 \pm 8.27/\text{min.}$; group D- $89.84 \pm 8.22/\text{min.}$ and group P - $88.96 \pm 9.29/\text{min.}$)

After preloading there was no significant change of heart rate in any group.

After SAB there was significant rise in heart rate in all four groups which correspond to fall in systolic blood pressure. After 15 mins only in group R pulse rate was still significantly higher than baseline value. In the other three groups it was not significantly different from basal value. This goes with the greater fall of SAP in group R as compared to other groups.

On inter group comparison: Baseline values and values after preloading were statistically comparable between all 4 groups. After SAB there was statistically significant increase of heart rate in group R as compared to group H, D and P while difference of changes in heart rate were not statistically significant between group H, D and P. Above readings correspond with greater fall in SAP in group R, as compared to group H, D and P.

In our study, the tendency towards an increase in heart rate was seen only in group R, otherwise in group H, D and P heart rate remains relatively unchanged.

Comparison of changes in Mean Systolic Blood pressure (mmHg)

Baseline SAP (Group R - $125.60 \pm 10.03 \text{ mmHg}$, Group H $126.80 \pm 9.00 \text{ mmHg}$; Group D- $126.6 \pm$

11.86 mmHg and Group D - $128.0 \pm 11.18 \text{ mmHg}$) were statistically not different from each other.

After preloading SAP in any group did not change significantly. After SAB in group R there was significantly greater fall of SAP which was due to sympathetic blockade. This fall was significant at 6 mins. and became highly significant after 8 mins. Maximum fall was at 15 mins. (SAP $106.0 \pm 16.58 \text{ mmHg}$). In group H there was minimum fall of SAP from baseline and mean SAP was maintained near basal values throughout the study period. Intermediate fall was seen in group D and P. In group D SAP was significantly low from basal value from 8 mins. onwards and in group P from 6 mins. onwards. Minimum mean SAP was $115.36 \pm 16.32 \text{ mmHg}$ at 25 mins. in groups D and $117.2 \pm 16.75 \text{ mmHg}$ at 25 mins. in group P. So in group D and P mean SAP was maintained nearer to basal value as compared to group R.

Inter Group Comparison

Difference in baseline values and values after preloading were statistically insignificant between all four groups. ($p > 0.05$). After SAB there was statistically significant fall in SAP in group R as compared to group H, D and P which became highly significant ($p < 0.001$) after 10 minutes. After 4 minutes of SAB and onward there was greater fall of mean SAP in group D and P which was statistically significant as compared to group H. ($p < 0.05$). Values of mean SAP between group D and P were not significantly different at most of the times ($p > 0.05$). Here all three colloids maintained mean SAP better as compared to crystalloid group.

We also found that in the group 'H' SAP was maintained nearer to Basal value throughout the observation period which was statistically significant when compared to group D and group P.

Comparison of changes in Mean Diastolic Blood Pressure (mmHg)

Baseline DAP (Group R- $82.0 \pm 5.77 \text{ mmHg}$; group H- $84.12 \pm 6.35 \text{ mmHg}$; group D- $84.4 \pm 7.11 \text{ mmHg}$ and group P - $83.8 \pm 7.91 \text{ mmHg}$) were not significantly different from each other. After preloading mean DAP in any group didn't change significantly. This finding is in agreement with Chhabra B. et al[8] and Askrog V. et al[9] while Mathru et al[6] (1980) and Karinen et al(1995) observed increase mean BP after preloading[7].

After SAB, in group R there was significant fall in mean DAP after 8 minutes onwards which became highly significant 15 minutes onwards. Maximum fall was at 15 minutes (mean DAP $71.60 \pm 10.28 \text{ mmHg}$). In group H mean DAP did not fall significantly until 20

minutes. After 20 minutes there was significant fall (mean DAP 81.7 ± 8.21 mmHg) but values were maintained nearer to basal value as compared to other groups.

In group D there was significant fall in mean DAP after 10 mins onwards, maximum fall was at 25 minutes (mean DAP 72.4 ± 9.69 mmHg). In group P there was significant fall in mean DAP from 10 minutes onwards, maximum fall was at 20 minutes (mean DAP 72.48 ± 10.89 mmHg).

On intergroup comparison it was observed that mean DAP was maintained nearer to baseline value in group H. Fall in mean DAP of group D and P was significant as compared to group H ($p < 0.05$). Mean DAP was not significantly different between group D and P most of the readings. In our study all the colloids maintained mean DAP better than crystalloid.

The hypotension is the most frequent and immediate complication of SAB. In the present study hypotension was defined as a fall in mean arterial pressure below 20% of the baseline SAP or fall below 90 mmHg.

In the present study we have taken Ringer's lactate (group R) for crystalloid and HES (group H) Dextran-40 (group D) and Polygelatine (group P) as colloid solutions. We found that incidence of hypotension in group R preloaded with Ringer lactate solution is 56%, group H preloaded with HES is 24%, group H preloaded with HES is 24%, group D preloaded with Dextran 40 is 32% and group P Polygelatine is 36%. This was statistically found to be highly significant ($p < 0.001$) when compared between group R and rest of three groups and also between group H-D and H-P. This was statistically insignificant between group D and P ($p > 0.05$).

The efficacy of intravascular colloid solution in preventing hypotension is due to its retention within the intravascular compartment for longer period. The results are similar to Davies (2006) who found that colloids are more effective hypotension than crystalloids, These results are also similar to study conducted by Alimaian et al (2014)[10,11]

As against the method of IV fluid preloading, we compared the Vasopressors for their use in the management of the post SAB hypotension by various workers and their results confirm that the use of vasopressors is not the best way to improve inadequate venous return and correct the accompanying fall in cardiac output. Deleterious effects like arrhythmia and orthostatic hypotension occur frequently and the extreme vasoconstriction may interfere with tissue perfusion. The combined effect of decreased cardiac output, marked vasoconstriction and hypotension disturb the body hemostasis.

In our study we used mephenteramine (non catecholamine sympathomimetic amine which acts as beta alpha receptor agonist) in 3mg bolus dose and in repeated dose of 3mg as required.

Mephenteramine was required in group R - 14 cases, group H - not needed in any case, group D -5 cases and in group P -7 cases. This was due to the fact that colloids were retained in the intravascular space for longer period so severity of hypotension was lesser. HES being better expander further lessened the need of vasopressors.

So it is evident that preloading with colloids is definitely better than crystalloid. HES maintained mean heart rate, mean SAP and mean DAP nearer to basal value throughout the observation period as compared to Dextran and Polygelatine. HES group required less amount of vasopressor and was associated with least incidence of hypotension and other complications. Hence it can be concluded that HES offers better prophylaxis against SAB induced hypotension. The current study is similar to study conducted by Jalandhara and Makwana¹² (2014) and Ueyama et al (1999) who found significantly lower incidence of hypotension associated with SAB in the HES group[13].

Shortcomings

Shortcoming of our study was that we used inj. bupivacaine 2 to 3 ml for SAB. Fixed doses couldn't be used due to different types of surgeries and difference in the height of patients. This dose difference could affect post SAB hemodynamics.

Conclusion

Based on the results of the current study it can be concluded that Spinal subarachnoid block is associated with significant incidence of hypotension. Maximum fall in blood pressure occurred in preloading with Ringer lactate (56%) and the result was highly significant. It was also observed that vasopressor mephenteramine had to use maximum times in the group preloaded with Ringer Lactate when compared to Dextran, Polygelatine and Hydroxyethyl Starch (HES). In prevention of post subarachnoid block hypotension preloading with Hydroxyethyl Starch (HES) was found more effective than the Ringer Lactate, Dextran and Polygelatine as it was associated with least incidence of hypotension, better maintenance of systolic BP, diastolic BP and HR, less requirement of vasopressors and least incidences of side effects.

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Source of Support: Nil

Conflict of Interest: Nil