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Research Article

Comparison of Total Vasopressor Requirement in Elective Caesarean Section Under Subar--achnoid Block For Patients Preloaded With 500ml Of 6% PentastarchVersus1000ml Of Ringer's Lactate: A Randomized Clinical Trail

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ABSTRACT

Introduction: In recent times, delivery by caesarean section has become common and subarachnoid block appears to be the technique of choice as it is reliable, however it can cause hypotension which is associated with increased morbidity and mortality; thus, its prevention is important in parturients. Qualitative systematic review has shown hypotension can be better prevented with volume preloading using colloid which is consistently more effective than crystalloids in preventing hypotension. Among the commercially available colloids 6% Pentastarch in 0.9% saline has the best safety profile. ***Aim:*** To compare the efficacy of 1000ml Ringer's lactate to that of 500ml 6% Pentastarch in preventing the incidence and severity of hypotension (total usage of vasopressor ephedrine) in parturient undergoing lower segment caesarean section under subarachnoid block. ***Materials and methods:*** The present randomized clinical study was conducted in the Department of Anaesthesiology BGS GIMS from 28th July 2022 to 28th November 2022 in 60 parturient of ASA I and II aged between 20-32 years undergoing elective cesarean section under subarachnoid block who were randomly divided into two groups, Group P (n=30) who received 6% pentastarch 500ml IV and Group R (n=30) who received RINGER'S LACTATE 1000ml IV 20 minutes prior to the block. Demographic data, hemodynamic parameters like SBP, DBP, MAP and total vasopressor (ephedrine) requirement were noted. The Statistical software namely SPSS 22.0, and R environment ver.3.2.2 were used for the analysis of the data. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between groups. ***Results:*** A total of 60 parturients were studied, there were no significant differences in demographic data between the two groups. The incidence of hypotension (SBP, DBP, MAP) was significantly lesser with $p<0.001$ in patients belonging to the 6% pentastarch group (P) than in patients of ringer lactate group (R). The usage of ephedrine was significantly more in group R parturients with 28 of the 30-requiring vasopressors (93.3%) as compared to group P where in only 10 of the 30 patients (33.3%) required ephedrine. ***Conclusion:*** It can be concluded that the incidence of hypotension after SAB in parturients can be reduced by volume preloading with colloids like pentastarch as compared to crystalloids like ringer lactate. This also reduces the aggressive use of vasopressors intraoperatively to maintain haemodynamic stability in parturients.

INTRODUCTION

Subarachnoid block, a widely favored technique for caesarean section, is associated with a notable incidence of hypotension ranging from 7.1% to 74.1%. This occurrence presents a significant challenge in obstetric anesthesia, as hypotension not only poses risks to maternal health but also affects fetal well-being through a reduction in uterine blood flow. The effective management of hypotension remains a critical aspect of obstetric care[1-3].

Various approaches have been explored within the realm of a multimodal strategy to counteract maternal hypotension during caesarean sections. Among these, the common practice involves preloading or co-loading with crystalloids or colloids, coupled with the use of vasopressor drugs. Crystalloids, such as Ringer's lactate solution (RL) and Hartmann's solution, are readily available and have been conventionally employed. RL, a mixture of sodium chloride, potassium chloride, sodium lactate, and calcium chloride in water with an osmolarity of 273 mOsm L-1, is frequently used due to its accessibility and established safety profile[4-6]. Figure 1 shows the Midline approach to the subarachnoid space.

On the other hand, colloids, including pentastarch, have been considered as volume expanders. Pentastarch, derived from waxy star-

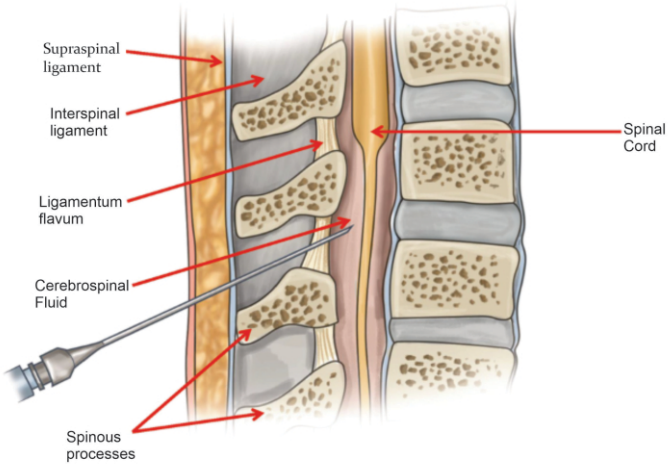

Figure 1: Approaching the subarachnoid space via the midline involves inserting a spinal needle with a slight cephalad angulation, ensuring it advances along the midline trajectory without making contact with bone.

-ch and primarily composed of amylopectin, exhibits a colloid oncotic pressure of 40 mmHg. This colloid has demonstrated the ability to improve hemodynamic status for a prolonged duration, up to 12 hours. Notably, its structural similarity to body glycogen suggests a lower antigenic potential, mitigating the risk of colloid anaphylaxis[7]. Ephedrine, recognized as a safe and efficacious vasopressor, is among the agents considered for managing spinal-induced hypotension in healthy parturients. Despite the availability of various interventions, determining the optimal fluid regimen for preventing hypotension during caesarean sections remains inconclusive, as highlighted by recent network analyses on fluid therapy[8].

In light of these considerations, the present study aimed to address the gap in knowledge by primarily assessing the total requirement of vasopressors in both crystalloid and colloid preloaded groups. Additionally, the study sought to evaluate the incidence of hypotension, thereby testing the effectiveness of colloid versus crystalloid preload administered before subarachnoid block in parturients undergoing caesarean sections. Secondarily, the investigation aimed to document any adverse effects associated with the intravenous administration of fluids during the perioperative period[9]. The choice between crystalloid and colloid preloading is a crucial decision in obstetric anesthesia, influenced by factors such as availability, safety profile, and efficacy in preventing hypotension. Crystalloids, with their widespread availability and established safety record, have been the conventional choice. However, the potential advantages offered by colloids, such as pentastarch, in terms of sustained hemodynamic stability and lower antigenic potential, make them an intriguing alternative[9, 10].

It is imperative to note that the prevention of hypotension is not only crucial for the well-being of the mother but also directly impacts fetal outcomes by ensuring an adequate uterine blood flow. Hypotension during caesarean sections has been associated with an increased risk of morbidity for both the mot-

-her and the fetus, underscoring the significance of effective preventive measures[9, 11].The use of ephedrine as a vasopressor in managing spinal-induced hypotension adds another dimension to the multifaceted approach in obstetric anesthesia. Its safety and efficacy profile position it as a valuable tool in mitigating the adverse effects of subarachnoid block-induced hypotension, particularly in healthy parturients[12, 13]. Despite the widespread use of crystalloids and colloids in obstetric anesthesia, recent network analyses on fluid therapy have failed to conclusively establish the superiority of a specific fluid regimen. This highlights the need for further research to elucidate the most effective approach in preventing hypotension during caesarean sections[14, 15].

In the context of this study, the primary focus on assessing the total vasopressor requirement in both crystalloid and colloid preloaded groups provides valuable insights into the comparative efficacy of these two approaches. The study's emphasis on evaluating the incidence of hypotension further contributes to our understanding of the preventive strategies employed during subarachnoid block in parturients[16, 17].

Additionally, the secondary objective of documenting adverse effects associated with intravenous fluids addresses the broader safety concerns surrounding fluid administration in the perioperative period. This comprehensive approach to assessing both efficacy and safety parameters enhances the clinical relevance of the study findings[18, 19].

Thus, the management of hypotension during caesarean sections, particularly with subarachnoid block, remains a complex challenge in obstetric anesthesia. The choice between crystalloid and colloid preloading, coupled with the use of vasopressors like ephedrine, requires careful consideration of factors such as availability, safety, and efficacy. This study, by focusing on the total vasopressor requirement and the incidence of hypotension, aims to contribute valuable data to guide evidence-based decision-making in obstetric anesthesia. The secondary assessment of adverse effects adds an essential layer of understanding, addressing safety concerns associated with intravenous fluid administration in this context. Ultimately, the findings of this study have the potential to inform and optimize the management of hypotension during caesarean sections, improving outcomes for both mothers and their infants[20, 21].

MATERIAL AND METHODS

This randomised double blinded clinical study was conducted in sixty parturients undergoing elective caesarean section under sub arachnoid block at BGS Global institute of medical sciences and hospital over a period of four months from 28th July 2022 to 28th November 2022. (CTRI/2022/07/044277). During the above said study period, after obtaining clearance and approval from institutional Ethical committee (BGSGIMS/IEC/App/FEB/2022/011) pregnant females belonging to age group 20-32 years, at term with uncomplicated pregnancies and ASA I and II status undergoing elective LSCS who were willing to give informed written consent were included in the study[22, 23]. Patients with complicated pregnancies, uncontrolled systemic disorders and contraindications to spinal anaesthesia were excluded from the study .

The patients were divided into two groups – Group R and Group P by

computer generated random numbers. The patient and the anaesthesiologist administering the study fluid and monitoring the parturient were blinded in this study.

Group R – 1000ml Ringer's lactate.

Group P – 500ml 6% Pentastarch.

In this study sample size estimation with two means was calculated with the following formula:

$$N = \frac{(r+1)(z_{\alpha/2}+z_{1-\square})^2\sigma^2}{rd^2}$$

With 5% level of significance, 90% of statistical power, the sample size is 30 in each group

Patients were explained about the procedure and informed written consent obtained. All patients maintained fasting for 8 hours and were pre-medicated with Inj Pantoprazole 40mg and Inj Ondansetron 4mg given intravenously after securing 18-gauge canula on the morning of surgery in the preoperative period.

On arrival of patient in the operating room, monitors (standard anaesthetic) were attached and baseline heart rate (HR), non-invasive blood pressure (NIBP) and oxygen saturation were recorded, and cardiac rate and rhythm were monitored by a continuous visual display of electrocardiogram of lead II.

Study drugs administration was completed 20minutes prior to performance of Subarachnoid block as per the following groups

Group R – 1000ml Ringer's lactate,

Group P – 500ml 6%Pentastarch.

After 20 minutes of study drug administration, Subarachnoid block was performed with patients in sitting position using the midline approach at levels L_3-L_4 or L_4-L_5 intervertebral space with a 23/25-gauge Quincke-tip spinal needle under strict aseptic precautions. Once a free flow of cerebrospinal fluid was obtained, 2 ml of 0.5% hyperbaric bupivacaine was administered intrathecally over 10 seconds, then the patient was made to lie down immediately and level of sub arachnoid block noted[23].

Monitoring of systolic blood pressure, diastolic blood pressure, mean arterial pressure, was done at every minute for first 10 minutes, after that for every 5mins till the end of surgery. In addition to vital parameters, amount of ephedrine needed was recorded, and any allergic reactions to the fluids were recorded. The fall in systolic blood pressure less than 20% of the baseline value was considered as hypotension. The hypotensive episodes were treated with intravenous Ephedrine 6mg[24].

Statistical software:

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between groups. The Statistical software namely SPSS 22.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft Word and Excel have been used to generate graphs, tables[25].

RESULTS

The demographic data between the two groups had no significant differences as shown in **Table 1.** All patients achieved a block to light touch at or above the T6 dermatome. None of them required any anesthetic supplementation.

Table 1 : Age in years – frequency distribution in two groups of patients studied

Age in Years	Group P	Group R	Total
20-25	18(60%)	20(66.7%)	38(63.3%)
26-30	12(40%)	10(33.3%)	22(36.7%)
Total	30(100%)	30(100%)	60(100%)
Mean ± SD	24.30±3.19	24.06±3.21	24.18±3.18

Samples are age matched with P=0.779, student t test

Mean age distribution as shown in **table 1,** patients in the age group between 20 to 30 years were included in the study and statistical analysis showed that differences among the two groups were statistically insignificant (p =0.779)

Table 2: Incidence of hypotension

HYPOTENSION	Group P	Group R	Total
ABSENT	20(66.7%)	2(6.7%)	22(36.7%)
PRESENT	10(33.3%)	28(93.3%)	38(63.3%)
Total	30(100%)	30(100%)	60(100%)

P≤0.001**, Significant.

Hypotension requiring treatment was seen in only 10 parturients of group P whereas 28 patients in group R had hypotension. The incidence of hypotension was lesser in group P (33.3%) than group R (93.3%%) and was found to be statistically significant with p<0.001** **(Table 2).**

The SBP of the two groups were compared at the preset intervals designed for this study. The differences in the SBP among the two groups were found to be statistically significant at 3rd min, 4th min, 6th min, 7th min, 8th min, 9th min,50th,55th, and 60th min, with group R having more fall in SBP than group P. **(Table 3).**

Table 3: Systolic BP: A comparison in two groups of patients studied

SYSTOLIC BP	Group P	Group R	Total	P Value
Baseline	**126.53±11.65**	**122.73±11.94**	**124.63±11.85**	**0.217**
1st min	116.43±11.24	113.57±7.86	115±9.72	0.257
2nd min	110.23±12	103.8±10.14	107.02±11.48	0.029
3rd min	105.07±14.23	93.37±10.75	99.22±13.83	<0.001**
4th min	107.43±14.09	94.13±10.61	100.78±14.07	<0.001**
5th min	106.67±12	98±8.33	102.33±11.13	0.002**
6th min	107.73±11.56	92.73±14.62	100.23±15.1	<0.001**
7th min	105.8±7.57	97.77±11.41	101.78±10.42	0.002**
8th min	108.33±11.28	100.93±8.4	104.63±10.54	0.006**
9th min	109.1±8.72	102.6±9.99	105.85±9.86	0.009**
10th min	108.07±7.71	106.23±9.2	107.15±8.47	0.406
15 min	110.93±9.06	109.97±7.84	110.45±8.41	0.660
20 min	114.43±7.8	113.73±7.24	114.08±7.47	0.720
25 min	114.17±7.34	115.17±7.61	114.67±7.43	0.607
30 min	113.17±7.69	116.8±8.2	114.98±8.09	0.082+
35 min	111.07±10.3	113±7.52	112.03±8.99	0.410
40 min	110.07±7.27	111.7±6.03	110.88±6.67	0.347

45 min	115±7.74	112.07±8.75	113.53±8.32	0.174
50 min	117.13±10.12	111.4±7.88	114.27±9.45	0.017*
55 min	119.17±9.06	109.97±7.7	114.57±9.54	<0.001**
60 min	122.47±12.1	113.13±8.42	117.8±11.36	<0.001**

Table 4: Diastolic BP: A comparison in two groups of patients studied

DIASTOLIC BP	**Group P**	**Group R**	**Total**	**P Value**
Baseline	**77.1±4.94**	**76.47±3.82**	**76.78±4.39**	**0.581**
1st min	70.67±10.05	68.8±7.75	69.73±8.95	0.424
2nd min	65.27±9.49	63.6±8.76	64.43±9.1	0.483
3rd min	62.37±11.89	54.7±11.28	58.53±12.12	0.013*
4th min	62.4±10.96	55.73±8.03	59.07±10.1	0.009**
5th min	63.43±12.7	58.73±9.24	61.08±11.26	0.107
6th min	61.07±11.88	54.87±9.81	57.97±11.25	0.032*
7th min	62.9±10.59	58.6±9.7	60.75±10.3	0.107
8th min	61.47±11.17	61.3±8.12	61.38±9.68	0.948
9th min	62.13±9.78	62.03±7.91	62.08±8.82	0.965
10th min	62.43±10.47	63.67±7.87	63.05±9.2	0.608
15 min	63.27±9.02	66.77±7.06	65.02±8.22	0.100
20 min	68±10.15	68.83±7.9	68.42±9.03	0.724

25 min	76.27±10.25	72.43±8.68	74.35±9.61	0.123
30 min	73.3±6.61	76.3±7.48	74.8±7.16	0.105
35 min	75.3±6.05	78.63±5.52	76.97±5.98	0.030*
40 min	77.6±3.53	79.47±5.56	78.53±4.71	0.126
45 min	74.7±6.19	74.03±6.12	74.37±6.11	0.676
50 min	73.47±8.11	74.93±6.55	74.2±7.34	0.444
55 min	73.67±8.16	74±5.44	73.83±6.87	0.853
60 min	74.1±6.96	78.57±6.22	76.33±6.92	0.011*

The DBP of the two groups were compared at the preset intervals designed for this study. The fall in DBP was statiscal-ly more significant in group R than group P at the 3rd min, 4th min, 6th min, and 35th min and at 60th minute **(Table 4).**

Table 5: Mean Arterial Pressure: A Comparison in Two Groups of Patients Studied

MEAN ARTERIAL PRESSURE	**Group P**	**Group R**	**Total**	**P Value**
Baseline	**93.58±5.48**	**91.89±4.96**	**92.73±5.25**	**0.216**
1st min	86.8±8.55	83.13±7.38	84.97±8.13	0.081+
2nd min	81±8.92	76.97±8.48	78.98±8.87	0.078+
3rd min	78.1±11.68	67.6±11.03	72.85±12.44	<0.001**
4th min	78±9.93	68.97±8.75	73.48±10.34	<0.001**
5th min	78.23±10.94	71.63±7.93	74.93±10.04	0.010*
6th min	77.53±10.66	66.93±11.45	72.23±12.2	<0.001**
7th min	78.8±8.29	71.3±9.53	75.05±9.63	0.002**
8th min	78.43±11.38	73.83±7.86	76.13±9.97	0.074+

9th min	78.07±8.17	75.77±7.46	76.92±7.84	0.260
10th min	78.47±7.68	77.63±7.35	78.05±7.46	0.669
15 min	80.33±7.91	80.4±7.15	80.37±7.47	0.973
20 min	83.67±8.41	83±7.25	83.33±7.79	0.743
25 min	87.47±9.77	85.9±8.13	86.68±8.95	0.502
30 min	86.6±5.0	89.8±7.15	88.2±6.32	0.049*
35 min	86.43±5.44	89.8±4.37	88.12±5.18	0.011*
40 min	88.1±3.85	90.47±4.44	89.28±4.29	0.031*
45 min	87.9±5.28	86.33±5.71	87.12±5.51	0.275
50 min	87.7±6.34	87.43±5.75	87.57±6	0.865
55 min	88.47±6.74	85.67±4.95	87.07±6.03	0.072+
60 min	90.83±3.76	89.63±4.26	90.23±4.03	0.252

The MAP of the two groups were compared at the preset intervals designed for this study. The differences in the MAP among the two groups were found to be statistically significant at 3rd,4th, 6th, 7th,30th, 35th,40thminute with group R having lower MAP compared to group P **(Table 5).**

Ephedrine Requirement:

The usage of ephedrine was more in group R than in group P and was statistically significant as seen from the following **table 6**.

Table 6: Ephedrine Usage: A Comparison in Two Groups of Patients Studied

EPHEDRINEUS AGE	**Group P**	**Group R**	**Total**
No	20(66.7%)	2(6.7%)	22(36.7%)
Yes	10(33.3%)	28(93.3%)	38(63.3%)
Total	30(100%)	30(100%)	60(100%)

P≤0.001**, Significant, Chi-Square Test

The total percentage ephedrine use among each group was co--mpared and greatest use was found to be in the group (93%). The difference among the groups was statistically significant with a P value of less than 0.001 (**Table 6).**

DISCUSSION

Spinal anaesthesia a common technique for caesarean delivery causes hypotension secondary to the sympathetic vasomotor block which has adverse effects on both mother and neonate. Prevention of hypotension is better than treating established hypotension[26]. American Society of Anaesthesiologists Practice guideline from 2016 states that maternal hypotension can be reduced using intravenous fluid preloading, which increases maternal blood volume, thus increase in venous return, stroke volume and blood pressure. This study assessed the incidence of hypotension and total vasopressor requirement to prevent the spinal anaesthesia-induced hypotension while using preloading with colloids versus crystalloids in healthy parturients undergoing elective cesarean delivery[27].

In this study demographic data is comparable to the study by Jackson R, who selected the parturient between 20-32 years of age to compare between ringer's lactate and pentastarch. This study demonstrated a significantly lower incidence of hypotension and total requirement of vasopressor reduction in patients who are preloaded with 500ml 6% pentastarch compared with those who received an equipotent volume of ringer lactate solution as preload[28]. In pentastarch group, 67% had no hypotension and there is no requirement of ephedrine where as in crystalloid group 93% had usage of ephedrine and incidence of hypotension. This difference was found to be statistically significant. The results in this study are similar to those obtained by other authors. Ekbote SN *et al* in 2014 compared crystalloid vs colloid as preloading solution in prevention of spinal induced hypotension during LSCS, and concluded that parturients who are preloaded with 500ml of Pentastarch 6% had less hypotension than those preloaded with 1 litre of ringer's lactate solution[29].

Wani S *et al*, evaluated the effect of colloid coloading versus crystalloid coloading for prevention of spinal anaesthesia induced hypotension and effect on foetal Apgar score in patients undergoing elective lower segment caesarean section. The incidence of hypotension was lesser with colloid co-load group (41.7%) as compared to the crystalloid coload group (58.3%)[30, 31]. Bottiger BA *et al*., hypothesized colloid preload with hydroxyethyl starch (6% in normal saline, 500 ml) would reduce hypotension when compared with a crystalloid preload of Lactated Ringer's solution (1500 ml) 30 min prior to placement of spinal anesthesia and results showed lesser consumption of vasopressor phenylephrine in the colloid group. Pentastarch is a colloid derived from waxy starch and composed mostly of amylopectin. Colloid oncotic pressure is 40 mmHg. It is a volume expander, which improves haemodynamic status for 12 hours[32]. The structural similarity to body glycogen may explain its low antigenic potential and there is no significant evidence that it significantly interferes with clotting in major surgery patients. The molecular profile of colloids and the short time to delivery of foetus after the preload probably means they do not pass to the foetal circulation in appreciable amounts, unlike crystalloids[33].

As a preloading, pentastarch may be preferable to hetastarch for several reasons. Its shorter plasma expansion effect and half -lives are more appropriate as volume loading is not necessary for prolonged periods[34]. In addition, it causes greater plasma expansion, which may allow smaller volumes to be infused rapidly to achieve the same effect. The lack of efficacy of crystalloids infusions to prevent hypotension has prompted some authors to abandon routine preloading. However, we feel that the results of this study suggest that there may still be a place of preloading in favour of the aggressive use of vasoconstrictors[35].

LIMITATIONS

Foetal outcomes in terms of acidosis and APGAR score could not be studied to substantiate deleterious effects of hypotension.

CONCLUSION

Prevention of hypotension post subarachnoid block in parturient is of utmost importance. This has been traditionally achieved by adequate preloading and the present study demonstrated colloid preload (6% pentastarch) reduces the usage of vassopressors to maintain hemodynamic stability over crystalloids. The incidence of hypotension was significantly lesser when colloid preload was given. Thus, it can be concluded that colloid preload with 6% pentastarch effectively reduces incidence of hypotension along with use of vasopressors in parturient undergoing SAB for caesarean section.

SOURCE OF FUNDING

None

CONFLICT OF INTEREST

Nil

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