

ORIGINAL RESEARCH ARTICLE

Comparison of Ringer's Lactate and 6% Pentastarch as a Preload for Subarachnoid Block in Parturient undergoing Lower Segment Caesarean Section

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ABSTRACT

BACKGROUND

Delivery by caesarean section is common in recent times and subarachnoid block is the technique of choice due to its simplicity and reliability. However, it can cause hypotension which is associated with increased morbidity and mortality. Preloading the parturient with colloid is more effective than crystalloid in preventing the hypotension. Among the commercially available colloids 6% Pentastarch in 0.9% saline has the best safety profile. In this study, we compared the efficacy of 10ml/kg Ringer's lactate to that of 10ml/kg 6% Pentastarch in preventing the incidence and severity of hypotension in parturients undergoing LSCS under SAB.

MATERIAL AND METHODS

After the ethical committee's approval, a randomized study was conducted on 114 parturients (aged between 20 -32 years) and divided into two groups. Group P - 6% Pentastarch 10ml/kg IV and Group R - Ringer's Lactate 10ml/kg IV. Study drugs were administered intravenously over 20 minutes before the performance of the subarachnoid block. HR, SBP, DBP, MAP and SPO2 were noted every minute for the first 10 minutes, thereafter for every 5 mins till the end of surgery.

RESULTS

The mean HR of group P was better maintained than that of group R. A statistically significant fall in SBP was seen with group R more than group P at the 2nd, 4th, 6th, 7th, 10th and 40th minute. Group P had significantly less fall in DBP and MAP than group R.

CONCLUSION

Our study demonstrates that 6% Pentastarch is better preloading fluid than Ringer's lactate in

preventing hypotension in parturients undergoing elective caesarean section under subarachnoid block.

KEYWORDS

Subarachnoid Block, Hypotension, Pentastarch, Ringer's Lactate, Parturient.

INTRODUCTION

In recent times, delivery by caesarean section has become increasingly common. Subarachnoid block appears to be the preferred technique of choice.^[1] It is preferred over general anaesthesia due to its simplicity and reliability but can cause hypotension due to a higher level of sympathetic blockage. As hypotension is associated with increased morbidity and mortality, its prevention is of at most importance especially in parturients, as the life of the mother as well as the foetus is at risk.^[2] Prophylactic methods include fluid preloading, pre-emptive ephedrine, Trendelenburg positioning, and relieving aorto-caval compression. For effective prevention, fluid preloading must be sufficient to significantly increase cardiac output. Crystalloids have short intravascular half-life; therefore, large volumes are needed. Colloids stay longer in circulation and smaller amounts are required.^[3] Crystalloid volume preload started being used traditionally in patients undergoing subarachnoid block, to prevent hypotension.^[4,5] However, the positive results could not be consistently replicated in these studies. Despite crystalloid preload, 85% of patients undergoing lower segment caesarean section after subarachnoid block developed hypotension leading to the methodology being questioned.^[6]

By qualitative systematic review volume preload with colloid has consistently shown to be more effective than crystalloid in preventing hypotension.^[7] Among the commercially available colloids 6% pentastarch in 0.9% saline has the best safety and time profile.^[8]

This study aims to compare the efficacy of 10ml/kg Ringer's lactate to that of 10ml/kg 6% pentastarch in preventing the incidence and severity of hypotension and maintain haemodynamic status in patients undergoing lower segment caesarean section under subarachnoid block.

METHODOLOGY

During the above-said study period, after obtaining clearance and approval from the institutional Ethical committee, patients posted for caesarean sections under subarachnoid block were randomly selected and allotted to one of the two groups. The study drug was prepared by the anaesthesiologist not involved in the study.

Group R – 10ml/kg Ringer's lactate.

Group P – 10ml/kg 6% Pentastarch.

Patients were explained about the procedure and informed written consent was obtained.

All patients were kept fasting for 8 hours and premedicated with Inj Pantoprazole 40mg and Inj Ondansetron 4mg intravenously after securing an 18-gauge cannula on the morning of surgery in the preoperative area. On arrival of patient in the operating room, standard anaesthesia monitors were attached and baseline non-invasive blood pressure (NIBP), heart rate (HR) and oxygen saturation (SpO₂) were recorded, and cardiac rate and rhythm were also monitored from a continuous visual display of electrocardiogram from lead II.

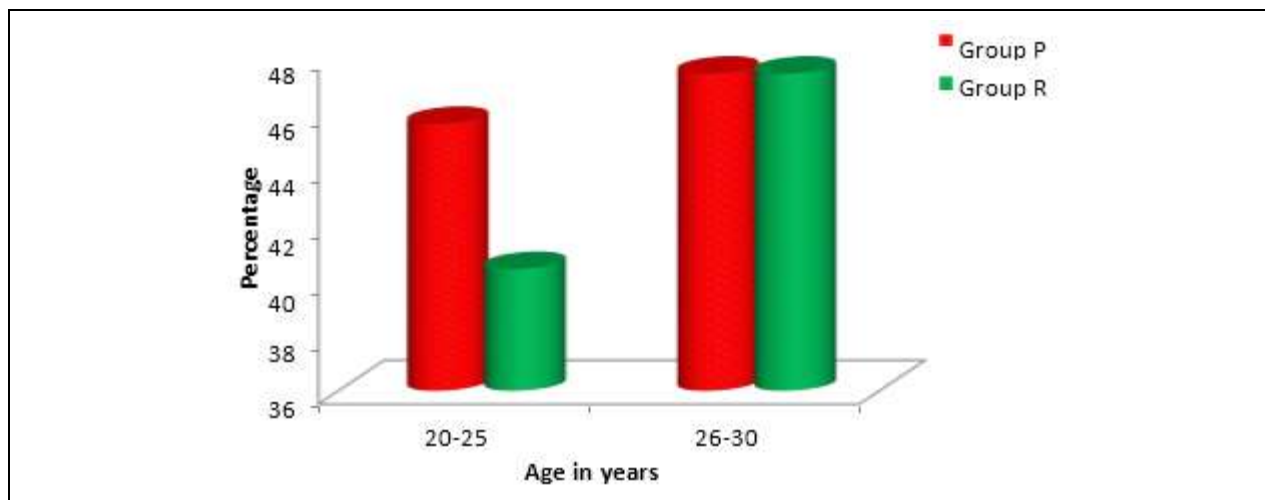
Study drugs were administered intravenously over 20 minutes before the performance of the subarachnoid block as per the groups divided.

After 20 minutes of administration of the study drugs, the subarachnoid block was performed under strict asepsis with patients in a sitting position using the midline approach at levels L3-L4 or L4-L5 intervertebral space with a 23/25-gauge Quincke-tip spinal needle. Once a free flow of cerebrospinal fluid was obtained, 2 ml (10mg) of 0.5% hyperbaric bupivacaine was administered intrathecally over 10 seconds, and the patient was made to lie down immediately and monitored for the level of block achieved. Monitoring of maternal heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and oxygen saturation was done every minute for the first 10 minutes, thereafter for every 5mins till the end of surgery. The amount of ephedrine used was measured in both the groups.

RESULTS

Mean Age in Years	Group P	Group R	Total
20-25	45.6	40.4	43
26-30	47.4	47.4	47.4
Total	100	100	100
Mean \pm SD	24.98	24.92	24.95

Table 1: Age in years – frequency distribution in two groups

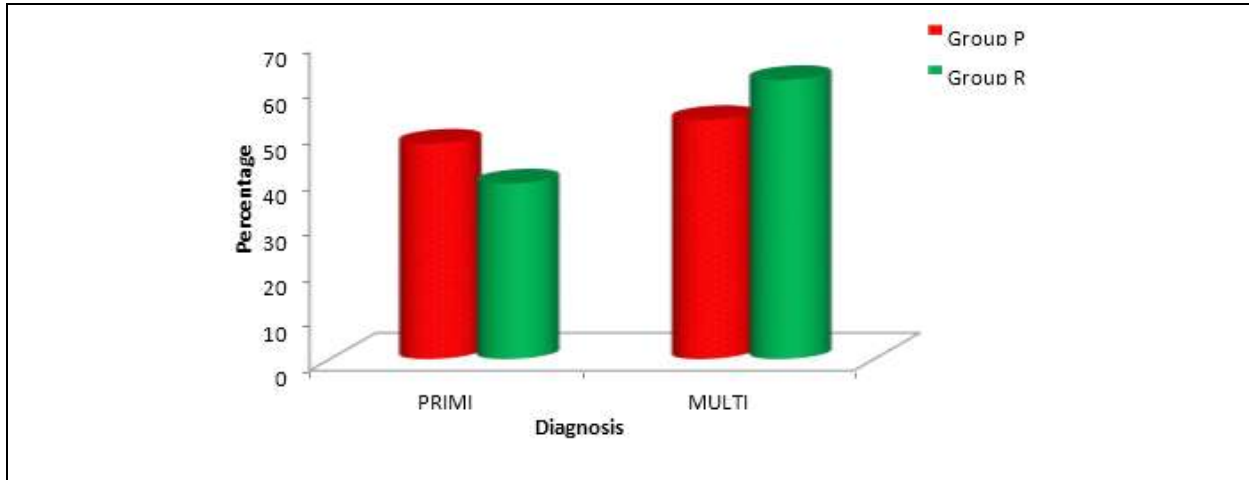


Graph 1 : Age in years – frequency distribution in two groups

The mean age was 24.98 \pm 3.07 in Group P and 24.92 \pm 2.56 in Group R.

Diagnosis	Group P	Group R	Total
Primigravida	27(47.4%)	22(38.6%)	49(43%)
Multigravida	30(52.6%)	35(61.4%)	65(57%)
Total	57(100%)	57(100%)	114(100%)

Table 2: Frequency distribution of patients in two groups studied

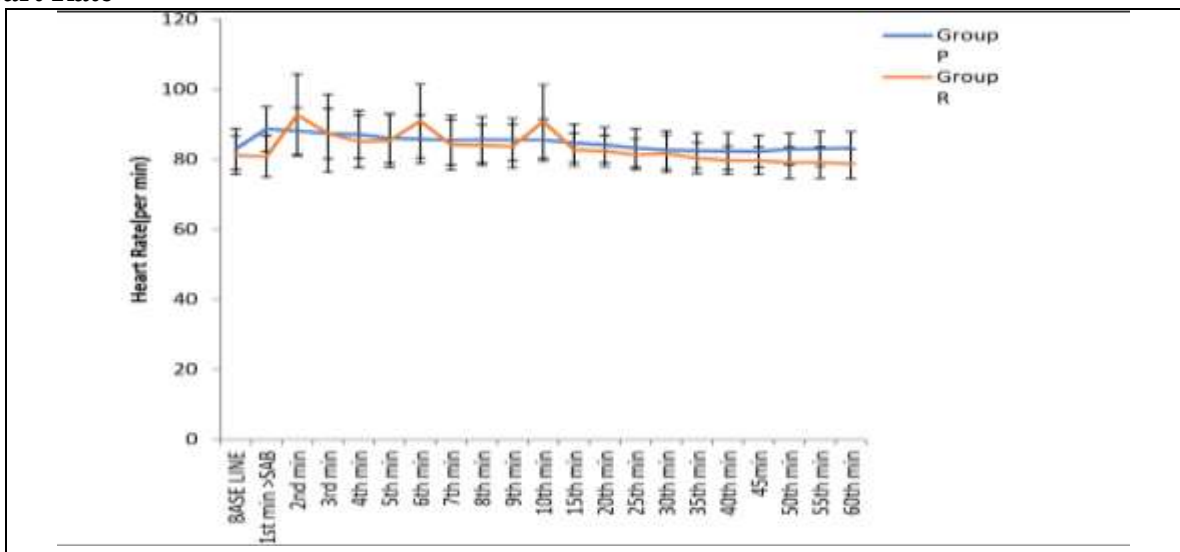


Graph 2 : Frequency distribution of patients in two groups studied

Level of Sensory and Motor Block	Group P	Group R	Total
T4	46%	52%	100%
T6	54%	48%	100%
Total	57(100%)	57(100%)	114(100%)

Table 3: Maximal Dermatomal level of Sensory block

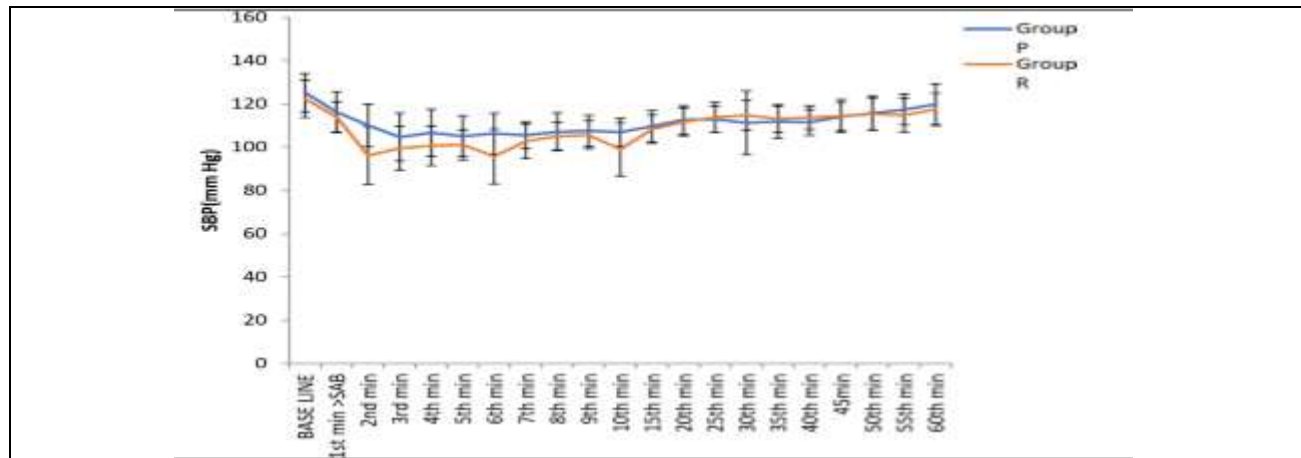
Heart Rate



Graph 3 : Heart Rate

The mean heart rate of the two groups were compared at the preset intervals designed for this study. The differences in the mean heart rate among the two groups were found to be statistically significant at 1 min ($P=0.001$), 2 min ($P=0.012$), 6 min ($P=0.002$), 10 min ($P=0.001$), 15 min ($P=0.044$), 25 min ($P=0.047$), 40 min ($P=0.003$). The changes in heart rate in group P were lesser compared to group R.

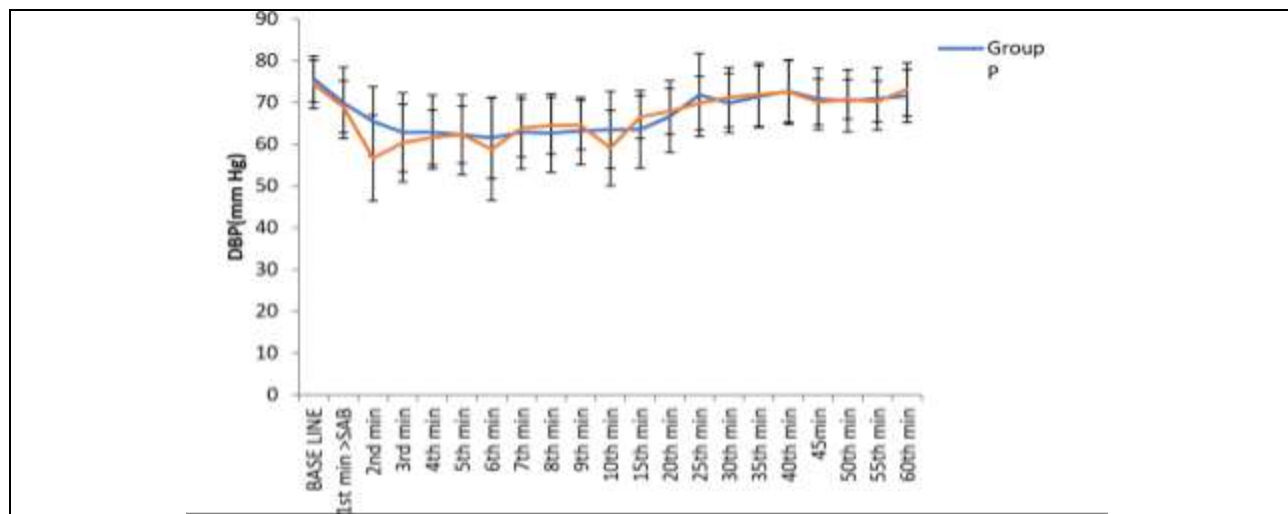
Systolic Blood Pressure



Graph 4: Systolic Blood Pressure

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 2 min (P=0.001), 4 min (P=0.002), 6 min (P=0.001), 10 min (P=0.001), 40 min (P=0.042), with group R showing more fall in SBP than group P

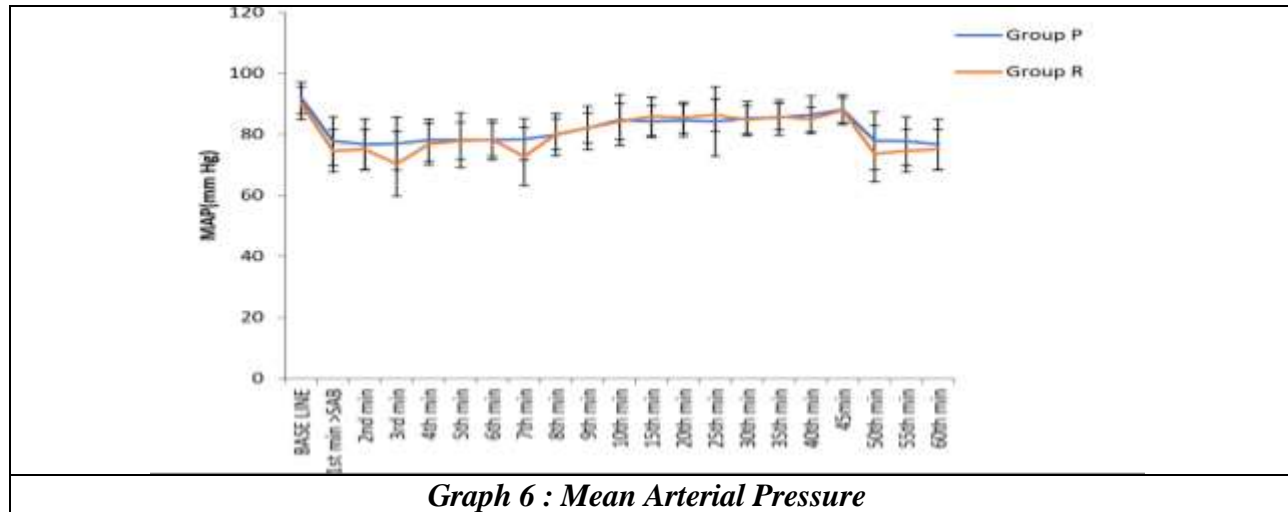
Diastolic Blood Pressure



Graph 5 : Diastolic Blood Pressure

The DBP of the two groups were compared at the preset intervals designed for this study. The fall in DBP was statistically more significant in group R than group P at 2 min (P=0.001), 10 min (P=0.011), 15 min (P=0.039).

Mean Arterial Pressure



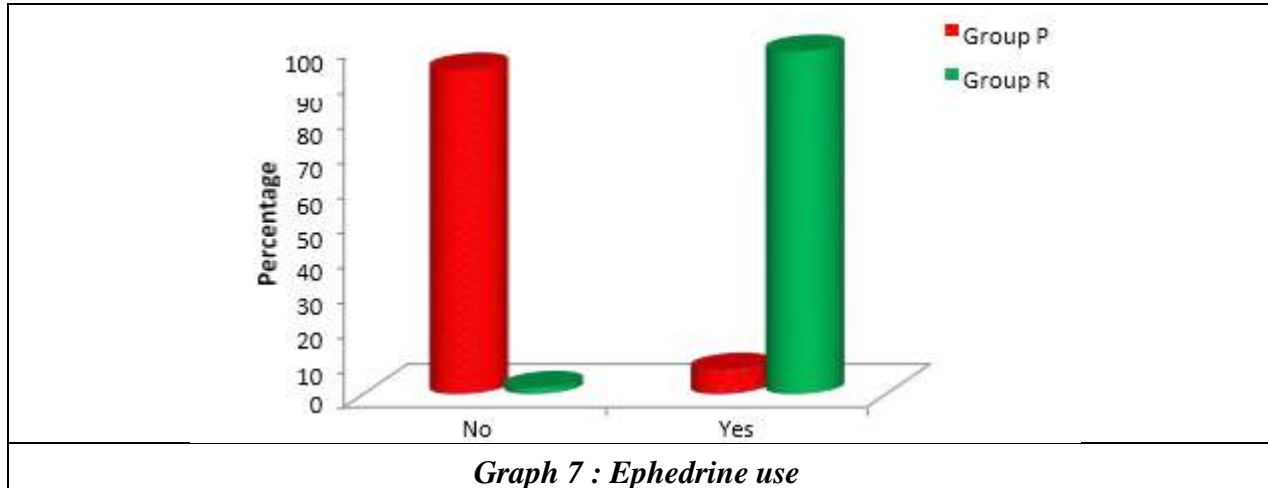
Graph 6 : Mean Arterial Pressure

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 2 min (P=0.001), 3 min (P=0.017), 4 min (P=0.023), 6 min (P=0.001), 10 min (P=0.001), with group R having lower MAP compared to group P.

Ephedrine Use

Drug Used	Group P	Group R	Total
No	53(93%)	1(1.8%)	54(47.4%)
Yes	4(7%)	56(98.2%)	60(52.6%)
• 6mg	3(5.3%)	19(33.3%)	22(19.3%)
• 6mg+6mg	1(1.8%)	23(40.4%)	24(21.1%)
• 6mg+6mg+6mg	0(0%)	14(24.6%)	14(12.3%)
Total	57(100%)	57(100%)	114(100%)
Mean ± SD	7.5±3.0	11.46±4.62	11.2±4.62

Table 4: Ephedrine use



The total percentage ephedrine use among each group was compared and greatest use was found to be in the group R (98%). The difference among the groups were statistically significant with a P value of 0.045.

DISCUSSION

Spinal anaesthesia is the most common technique of choice for caesarean section due to its rapid onset, dense neuraxial blockade and minimum transfer of drug to the foetus. Maternal hypotension is a recognized complication of spinal anaesthesia, which may compromise the welfare of both mother and foetus if not treated appropriately.^[9]

Hypotension is due to a greater level of sympathetic blockade, leading to vasodilatation and peripheral pooling of blood causing decreased venous return and cardiac output.^[2] Traditionally, preloading of fluids was recommended for the prevention of hypotension after spinal anaesthesia.

French and his colleagues compared Pentastarch and Hartmann's solution (15ml/kg) for volume preloading in spinal anaesthesia for elective caesarean section and concluded that starches may be suitable for preloading and significantly more patients in Hartmann's group developed hypotension compared with the pentastarch group.^[10]

Davis and colleagues compared pentastarch (5ml/kg and 10ml/kg) and showed that 10ml/kg is more effective than 5ml/kg at preventing hypotension following spinal anaesthesia for caesarean section.^[8]

In the above studies, large volumes of fluid were used as preloading. This raises concerns about hemodilution in pregnancy especially when associated with anemia, resulting in reduced oxygen to the placenta. In addition, the maternal lung is known to be susceptible to pulmonary oedema, if large volumes are infused. It would therefore seem logical to infuse 10ml/kg, the effective volume possible for good compromise. Conversely 500ml of 6% HES increased the blood volume by 10%, with 100% remaining in the circulation at 30min.^[8]

Comparable to the study by French G W G et al, we have used equipotent volumes of 6% pentastarch and ringer's lactate in our study.^[10]

Previous studies states that colloid preloading offsets hypotension and hypervolemia more effectively than in the crystalloid solutions. The colloid is more effective since it contains larger

molecules that stay in vascular compartment for longer duration and help to maintain stable hemodynamics. The plasma oncotic pressure remains stable with colloid preloading. This is evident from a study conducted by Wennberg et al which states that plasma oncotic pressure decreased by 1.7mm hg after preloading with 3% dextran 70, compared with 5.6mm hg decrease following preloading with RL.^[11]

In our study, the incidence of hypotension was found to be low in pentastarch group compared with ringer lactate group. In pentastarch group, 93% had no hypotension compared to RL. This difference was found to be statistically significant.

The results of our study were similar to the study conducted by Karinen et al 1995, in his study compared the effect of 1 L of crystalloid and 500ml of colloid preloading in elective caesarean section under spinal anaesthesia^[12]. They found the incidence of hypotension in crystalloid group is 62% whereas in the colloid group is 38%.

In our study, the age group of pregnant women considered was 20-32 years old to compare the effects of pentastarch with ringer's lactate.

In the present study mean age was 24.98 \pm 3.07 in Group P and 24.92 \pm 2.56 in Group R and were comparable.

In the present study, 47.4% of parturients were primigravida and 52.6% of multigravida in group P and 38.6% were primigravida and 61.4% multigravida in group R and they were comparable with a p value of 1.000.

There were no significant differences between the 2 groups regarding gestational age, foetal lie, presentation, and the incidences of contracted pelvis and cephalopelvic disproportion during the current pregnancy.

In the present study level of sensory and motor blockage at T4 is seen in 46% cases and T6 seen in 54 cases in group P, and in Group R 52% cases achieved T4 level and 48% cases achieved T6 level. There was no significant difference motor and sensory blockade in both groups at T4 and T6 Levels.

In this study, the baseline heart rate was statistically similar in the two groups with p-value of 0.100 ($p > 0.05$). Mean heart rate was higher in the group R compared with the group P at 2min, 6th min and 10th min. This increase in heart rate might be either due to hypotension induced tachycardia and or due to increased usage of ephedrine in group R, which tends to increase the heart rate. Similar results were obtained by Poonam arora et al^[13] comparing the efficacy of preloading with RL, 6% HES over co-loading with 6% HES. Karinen et al, who compared the haemodynamic changes during crystalloid and colloid preloading in elective caesarean section during spinal anaesthesia showed mean maternal HR was not statistically significant and the tendency was similar in both groups, contrary to our results.^[12]

In the present study there is a fall in blood pressure in both the groups, but the fall is more in Group R compared with the Group P.

In Group P steady fall in the systolic blood pressure was noted from 2nd minute and maximum fall in 10th minute. This is followed by rise in systolic blood pressure at 60th minute, whereas in Group R the steady falling SBP was noted from 2nd min and maximum fall was noted in 6th min, followed by rise in systolic BP at 60th minute was.

In this study, the baseline systolic BP was statistically similar in the two groups. Mean SBP was lower in the group R compared with the group P at 2min, 6th min and 10th min.

Overall, the systolic blood pressure fall was more with group R compared with Group P and p value was < 0.001 which was significant from 2nd to 10th minute.

Ngan Kee et al^[14] demonstrated that SBP was significantly lower among patients in the

control group than patients receiving colloid. [90(51-109) vs 101 (75-127) mmHg, 95% confidence interval of the difference 3-16 mmHg, $P=0.006$]. The systolic blood pressure trends in the study were comparable with our study with respect to both Groups P and R.

In this study, the baseline diastolic BP was statistically similar in the two groups. Mean DBP was lower in the group R compared with the group P at 2min, 6th min and 10th min which was statistically significant with p value of less than 0.001 for 2nd min. In the 10th and 15th min, it has moderately significant with a p value of 0.011 and 0.039 respectively.

In the present study, diastolic blood pressure was comparable to the study conducted by Mahzad Alimian et al^[15] which showed diastolic mean BP was lower in the crystalloid group than in the HES group.

In our study, the baseline Mean arterial pressure was statistically similar in the two groups with p value of 0.093 ($P>0.05$). Mean MAP was lower in the group R compared with the group P at 2 min, 6th min and 10th min which was statistically significant with p value of less than 0.001.

In Group R mean arterial pressure was lowest at 3rd minute and at 2nd minute in Group P. Throughout the monitoring period mean arterial pressure was lower in group R than Group P. On comparison between the groups P value was significant at 2nd, 3rd, 4th, 6th, 10th minute. It similar to the study done by Mahzad alimian et al^[15]

The present study there was need for ephedrine use in 7% of Group P and 98% of Group R patients. In Group R 12mg was needed in 40% cases and 18 mg was needed in 24% cases. This was statistically significant among the two groups with p value of 0.045 Our results were comparable with the study conducted by French^[10] et al in 1999, which states that mean dose requirement of ephedrine was higher in those receiving ringer's lactate solution($P<0.0001$)

It was revealed from a study by Lin et al in 1999 that the incidence of hypotension and requirement of ephedrine was significantly more in RL group than in dextran group.^[16]

In our study, 56 patients in group R and only 4 patients in group P developed hypotension. The difference was statistically significant with p value (<0.05). During the study, hypotension was initially treated with head low tilt and additional use of I.V. Fluids. Later, vasopressor (Ephedrine in 6mg boluses) was used if hypotension persisted.

Other parameters like age of the patient, height of the patient, weight of the patient, dosage of local anaesthetic used for spinal block and level of sensory block obtained were intentionally kept comparable to avoid these factors influencing our study.

CONCLUSION

We conclude that prevention of hypotension in parturients, to avoid harmful effects on both mother and foetus can be achieved using safer and simpler methods like volume preloading with pentastarch which is superior to crystalloids with respect to maintenance of the haemodynamic parameters.

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