# To Study Preloading and Relative Efficacy of Ringer's Lactate and Pentastarch 6% Prior to Spinal Anaesthesia in Lower Abdominal and Lower Limb Surgeries

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## Abstract

**Background and Objectives:** Hypotension after spinal anaesthesia remains a common and a serious complication. Various method have been recommended for the prevention and treatment of this problem. Preloading has become the cornerstone for prophylaxis of hypotension post spinal anaesthesia. This current study reassessed the efficacy of this volume preloading and also compared the efficacy between Ringer's lactate and Pentastarch 6%.

**Method:** In this study, 60 patients (ASA I & II) presenting for elective lower abdominal and lower limb surgeries under spinal anaesthesia were allocated into two groups, group P and group R to receive 5 ml/kg of 6% Pentastarch and 10 ml/kg of Ringer's lactate preload respectively. After institution of spinal anaesthesia in a sitting position with 3.8 ml of Bupivacaine 0.5% (heavy) using 23G Quincke spinal needle, patients were made to assume supine position. The heart rate(HR), systolic blood pressure(SBP) and diastolic blood pressure(DBP) were monitored intra-operatively every 2 minutes for first 10 minutes and every 5 minutes for next one hour and every 15 minutes thereafter. Electrocardiogram (ECG) and oxygen saturation($SpO_2$) were monitored continuously. The amount of ephedrine, used intra-operatively were noted and compared among the different groups.

**Results:** The incidence of hypotension in group R was more than that in group P. There were no significant difference in HR and the $SpO_2$ between the groups. The difference in mean basal SBP and DBP were statistically insignificant in both groups. Thereafter, the fall in SBP and DBP was more prominent in group R at all time intervals with a statistically highly significant difference between the two groups (p value <0.001). The amount of ephedrine used in group R was more than that used in group P. There were minimal complications like shivering and vomiting which were statistically non–significant . There were no allergic reactions to the fluids used.

**Conclusion:** Volume preloading, still has a substantial role in reducing the incidence and severity of hypotension in patients operated under spinal anaesthesia. Pentastarch 6% is found to be a better agent for preloading, as it is safe and effective in preventing spinal-induced hypotension in patients.

***Keywords:*** *Spinal anaesthesia, Hypotension, Crystalloids, Colloids.*

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## Introduction

Spinal anaesthesia is most commonly associated with hypotension and bradycardia due to anaesthetised spinal sympathetic nerve fibres.(1) One of the most common method of preventing spinal anaesthesia

induced hypotension is by the "pre-loading" technique described by wollman and marx. Preloading decreases the incidence of hypotension associated with spinal anaesthesia in the first 15 minutes following sub arachnoid injection as compared to patients who did not receive any pre-load.[2,3] It has been suggested that pre-loading with colloids is beneficial in preventing spinal anaesthesia induced hypotension as colloids remains in the intra-vascular space for a longer duration so they resist any decrease in intra- vascular volume following spinal anaesthesia. However prophylactic use of colloids is not routinely done due to increased cost, possible de-arrangement of coagulation and risk of anaphylaxis[4,5].

Crystalloids are fluids that contain mainly water and electrolytes. They are used to provide maintenance of water and electrolytes and expand intravascular fluid. Ringer's lactate is one of the crystalloids that is isotonic with blood, The by- products of the metabolism of Ringer's lactate in the liver counteract acidosis which is a common complication in fluid loss. Colloids are solutions, which, because of their oncotic pressure are confined mainly to the intravascular space. A colloid will usually expand the intravascular space, Pentastarch 6% is a sub group of hydroxyethyl starch sold under the name of pentaspan. Hydoxy ethyl starch is an artificial colloid obtained from starch, it is composed almost entirely of amylo-pectin, which is a highly branched and more stable component of starch.



**Aims:** To study the effect of preloading and relative efficacy of Ringer's lactate and pentastarch 6% as preloading solution prior to spinal anaesthesia in lower abdominal and lower limb surgeries.

**Objectives:**

1. To compare the efficacy in terms of haemodynamic response to spinal anaesthesia after administration of Ringer's lactate and Pentastarch 6% as preloading fluid.
2. To compare complication or side effects if any of both the fluids used for preloading.

## Methodology

This observational study was undertaken after obtaining approval of the Hospital Ethics committee and written and informed consent from the patients. 60 patients admitted at Dhiraj hospital S.B.K.S M.I and R.C, Piparia, Vadodara, for elective orthopaedics or general surgery cases, meeting the inclusion and exclusion criteria were taken up for this study.

**Inclusion Criteria:**

- The patients belonging to ASA-I and ASA-II
- Age group from 18 to 60 years.

- Only elective Cases.
- Duration of surgery from 2 to 2 .5 hours.

**Exclusion Criteria:**

- All contraindications for spinal anaesthesia
- Age less than 18 years or more than 60 years
- Concomitant diseases - diabetes mellitus, hypertension, heart diseases, obesity
- Height less than 150 cms
- ASA III, IV and V.

All patients were examined and a pre –anaesthetic check up was performed a day before the surgery. All investigations were studied and the patients meeting all the inclusion and exclusion criteria were taken for study. All patients had overnight fasting.

After receiving the patient inside the pre-operative room baseline vital signs were recorded using BPL Ultima multiparameter monitor. IV line was secured with 18 gauze cannula. Patients in group R was preloaded with 10ml/kg of Ringer's lactate solution and in group Pwith 5ml/kg of Pentastarch 6% solution respectively over a period of 20 minutes just prior to the administration of spinal anaesthesia. All were premedicated with inj. Glycopyrrolate 0.2 mg and inj. Ondansetron 4 mg i.v.

After 10 minutes of preloading period, subarachnoid block was performed with 3.8 ml of bupivacaine 0.5% (heavy) at L3-L4 or L4-L5 interspace using 23 Gauge Quinke's spinal needle in sitting position. The patient was then positioned supine. Adequate block was obtained and height of block was tested by pinprick method using blunt needle. Hypotension (A decrease in systolic BP by 20% of the baseline value) following spinal anaesthesia was treated with 6 mg bolus dose of ephedrine and additional rapid infusion of Ringer's lactate solution. All patients were administered $O_2$ 4 L/ min by ventimask throughout the period of surgery.

**Following observations were made:** Electrocardiogram (ECG), heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and oxygen saturation ($SpO_2$) were monitored every 2 minutes for the first 10 minutes and every 5 minutes till next 1 hour then every 15 minutes till end of surgery.In addition height of the block, and amount of ephedrine used intra-operatively andany allergic reactions to i.v. fluids were noted.

These observations were analyzed to get information on: Degree of hypotension (decrease in the SBP 20% of the baseline value), bradycardia (HR<60 beats/min), requirement of vasopressor, incidence of nausea and vomiting and allergic reactions.

## Observation And Results

**Figure 1: Level of Sensory Blockade**

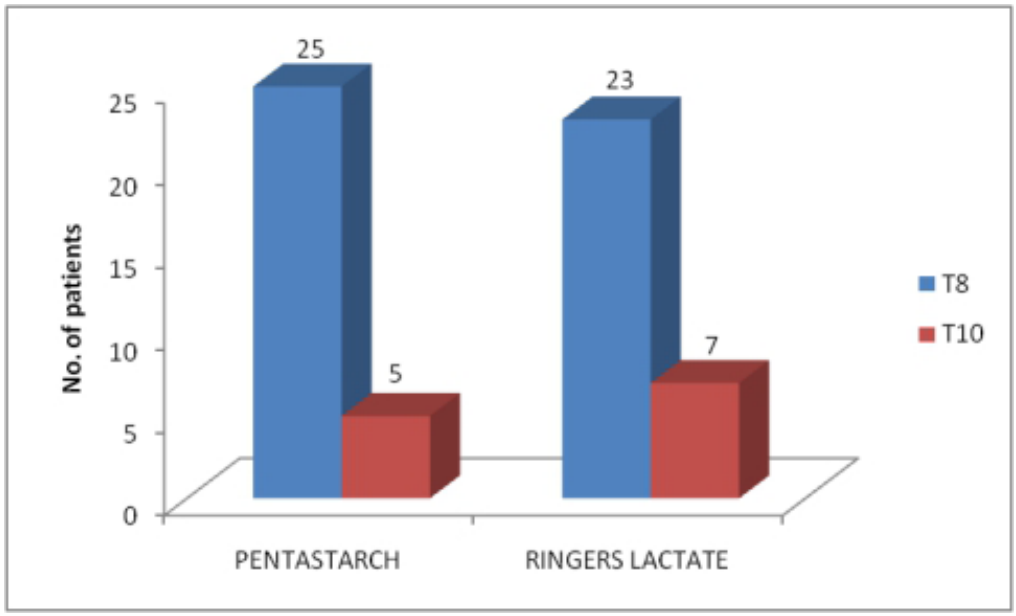


**Figure 1: Level of sensory block achieved in both groups**

Sensory level was tested by needle - prick method, a sensory level of T8 was achieved in 25 patients in group P and in 23 patients in group R, a sensory level of T10 was achieved in 5 patients in group P and in 7 patients in the group R the difference being statistically non – significant (p value >0.05).

**Figure 2: Mean heart rate (bpm) over various time intervals in both the group**

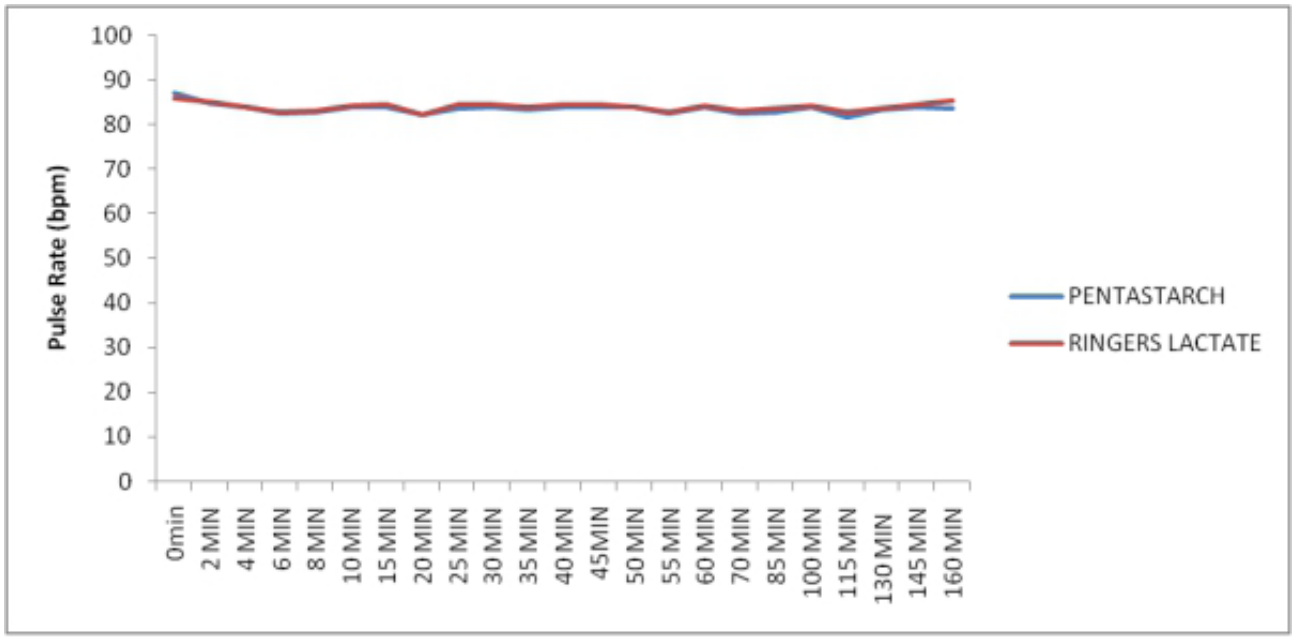


**Figure 2: Mean heart rate over various time intervals in both groups**

Mean HR variations during the study reveal no statistically significant difference between the two groups with a p value > 0.05 during all time intervals.

**Figure 3: Mean systolic blood pressure (mm Hg) over various time intervals in both the groups.**

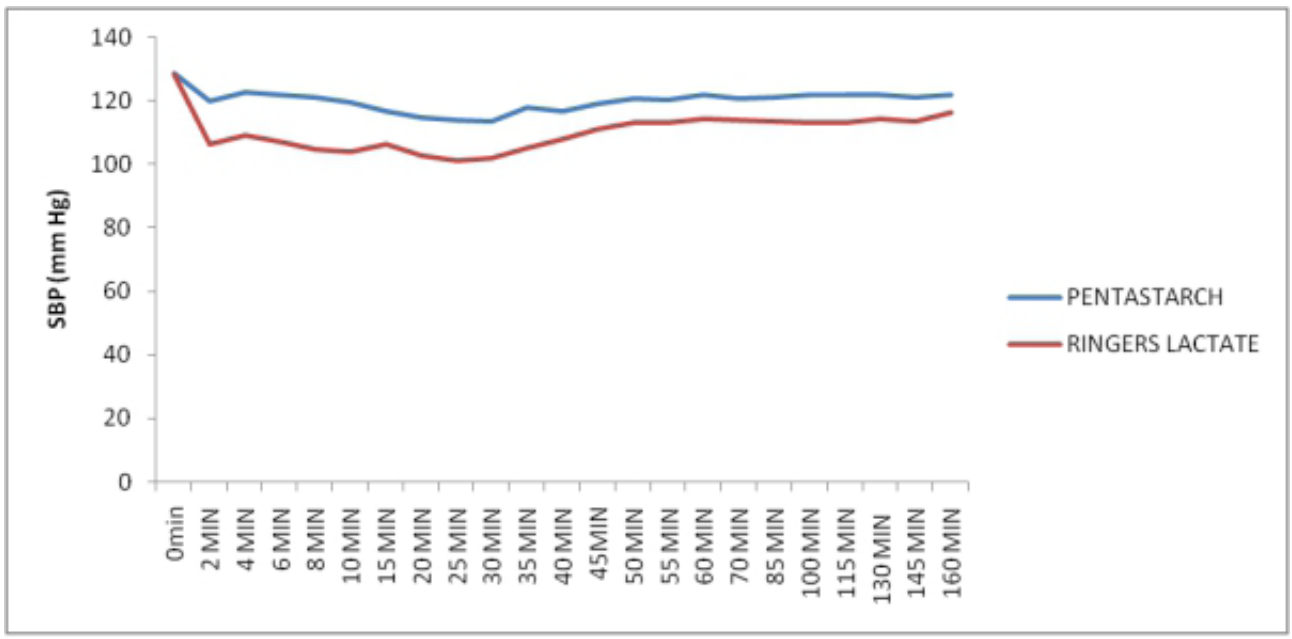


**Figure 3: Mean SBP over various time intervals in both groups**

The mean basal SBP was 128.73 mm Hg in group P and 128.40 mm Hg in group R, the difference between the two groups being statistically non- significant . Thereafter the fall in SBP was more prominent in group R at all time intervals with a statistically highly significant difference between the two groups as shown in the table. (p value < 0.001). The lowest mean SBP in group R was 101.27 mm Hg at 25 minutes and that in group P was 113.47 mm Hg at 30 minutes, corresponding to a fall in SBP of 21.129 % in group R and a fall of 11.854 % in group P.

**Figure 4: Mean diastolic blood pressure (mm Hg)over various time intervals in both the groups.**

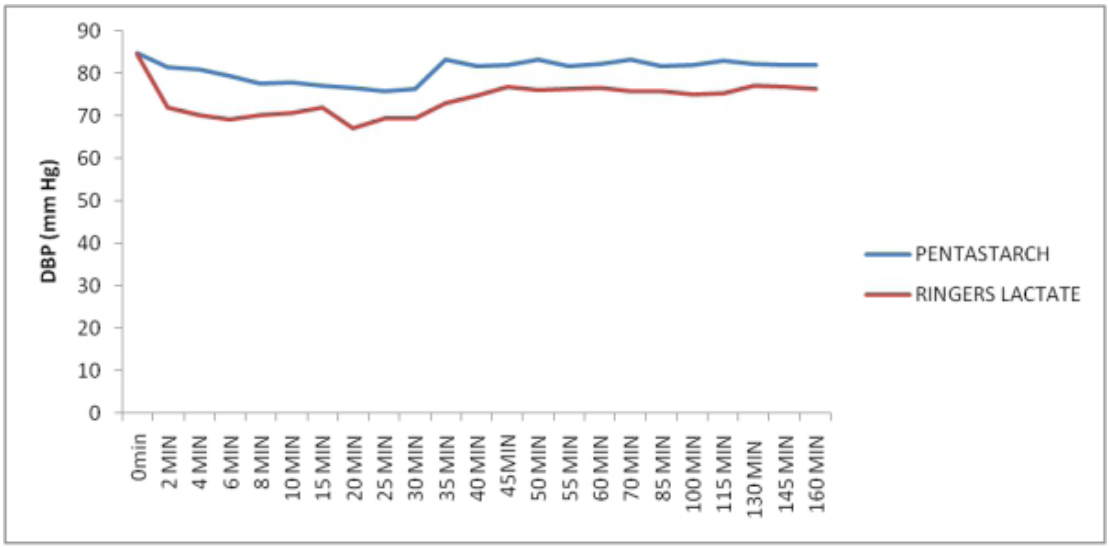


**Figure 4: Mean DBP over various time intervals in both groups**

The mean basal DBP for group P was 84.73mm Hg and that in group R was 84.47mm Hg the difference being statistically non – significant . Thereafter the fall in DBP was more prominent in group R at all time intervals with a statistically highly significant difference between the two groups as shown in the table.(p value <0.001) The lowest mean DBP was 67mm Hg at 20 minutes in group R and in group P was 75.87mm Hg at 25 minutes, corresponding to a fall in DBP of 20.68% in group R and a fall of 10.45 % in group P.

**Figure 5: Mean oxygen saturation (%) over various time intervals in both groups:**

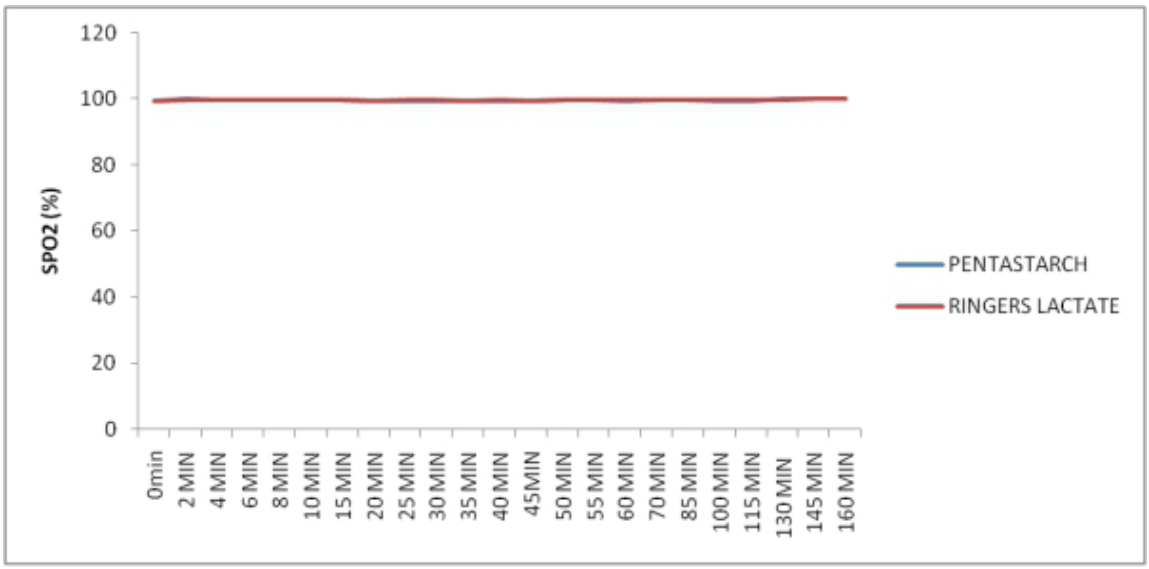


**Figure 5: Mean $SpO_2$ over various time intervals in both groups**

Mean $SpO_2$ variations during the study reveal no statistically significant difference between the two groups with a p value > 0.05 during all times.

**Figure 6: Ephedrine Used:**

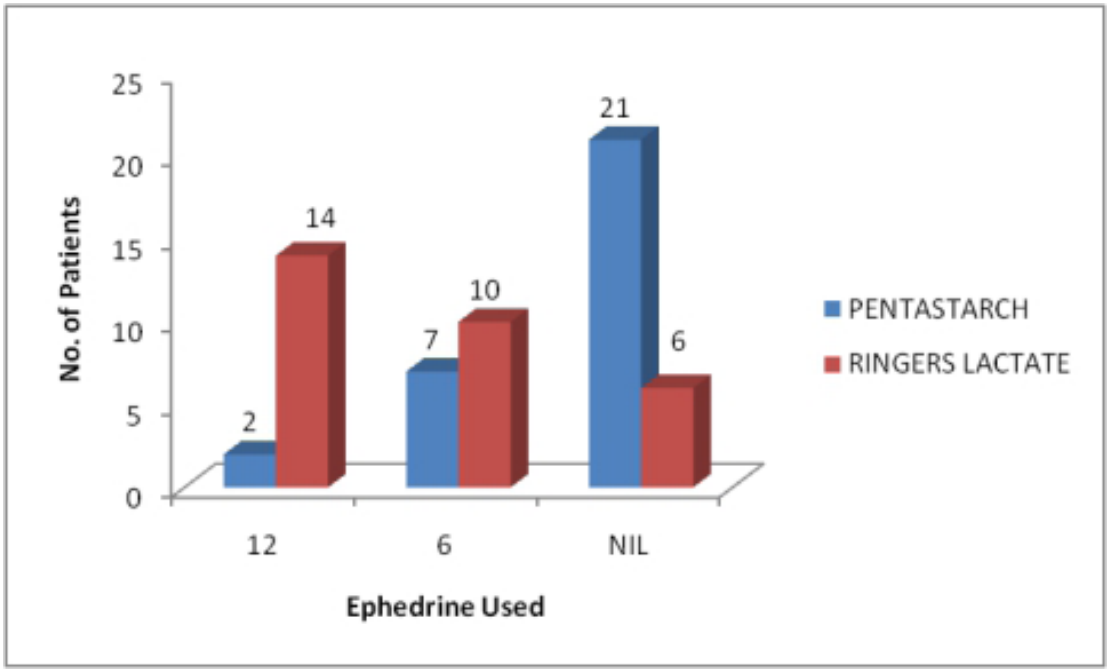


**Figure 6: Amount of ephedrine used in both groups**

The amount of ephedrine used was more in group R as compared to group P. Ephedrine was not at all required in 21 patients in group P(70%) as compared to 6 patients in group R (20%) the difference being statistically highly significant with a p value< 0.001. The amount of cumulative ephedrine used in group P was 66mg as against a use of 228 mg in group R.

**Figure 7: Complications:**

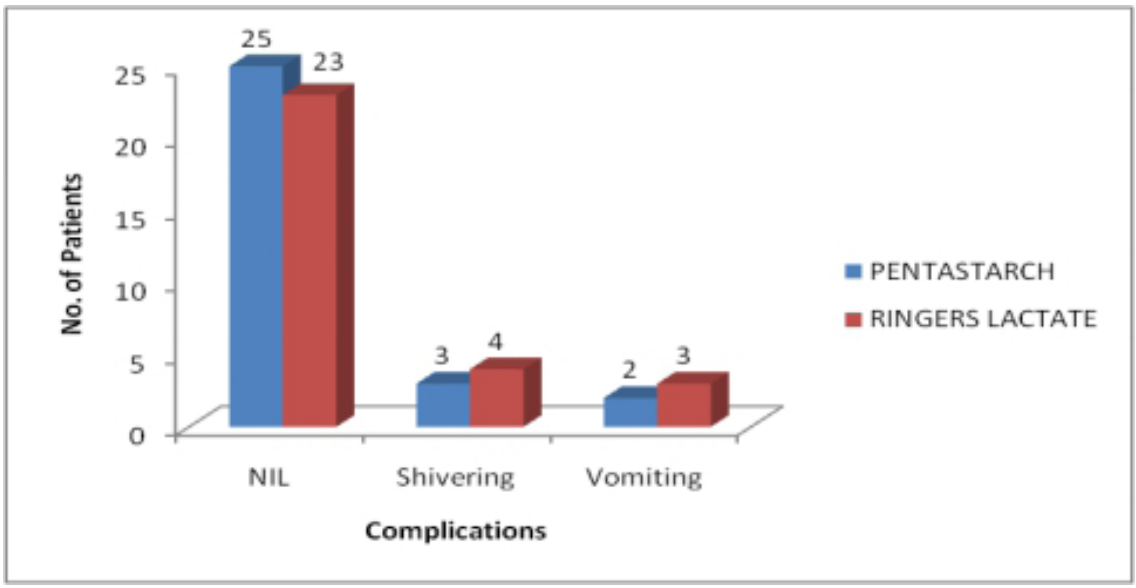


**Figure 7. Incidence of complications in both groups**

There were similar incidences of shivering and vomiting between the two groups.

## Discussion

Hypotension is the commonest problem following spinal anaesthesia for lower abdominal and lower limb surgeries.Blood pressure is usually maintained inspite of vasodilation, by a reflex increase in cardiac output. However, in the presence of spinal anaesthesia induced venodilation, venous return is reduced and so is cardiac output thus causing severe hypotension . Therefore, increase cardiac preload is done before institution of spinal blockade to prevent hypotension. (6)

Rout et al, Jackson et al 1994 recommended 1000 ml of a balanced electrolyte solution for prehydration before regional anaesthesia. Although, preloading with 1000 ml of crystalloid decreases the incidence of hypotension but it still remained a frequent event. Some researchers even increased the volume of crystalloid to 2000 ml, but use of large volumes of crystalloid fluid has risk of haemodilution along with decreased oxygen-carrying capacity, and pulmonary oedema in patients with a reduced pulmonary interstitial safety margin, due to a fall in oncotic pressure and an increase in the plasma volume. (6,7)Since colloids remain in the vascular compartment for a longer time period than the crystalloids, it is said to require only about one-third to one-fourth as much colloid as crystalloid,for an equivalent amount of venous expansion. Colloid solutions are more expensive than crystalloids and, have other disadvantages, including anaphylaxis.(6,7)

Siddik et al, 2000, compared the preloading effect of 500 ml of Heta starch (HES) with 1000 ml of Ringer's lactate in patients undergoing elective caesarean section, they found that the incidence of hypotension was 20% in HES group as against 40% in Ringer's lactate group. (8)

Xie et al, 2014, studied crystalloid and colloid preload for maintenance of cardiac output (CO) in patients undergoing total hip replacement and observed that preload with colloid was more effective than crystalloid in maintaining CO which might improve haemodynamic stability.(9)

Mandal et al, 2016, compared effects of crystalloid and colloid preload on maternal haemodynamics in elective caesarean section under spinal anaesthesia and found out that the fall of blood pressure was higher in Ringer's lactate group than 6% HES group.(10)

In our study, the incidence of hypotension was found to be lower in patients who received 6% Pentastarch solution as compared to those who were preloaded with Ringer's lactate solution. The results of our study correlate well with the other studies conducted to know the effectiveness of crystalloid and colloids in preventing hypotension post spinal anaesthesia.

Colloids contain larger molecules that did not immediately redistribute, through the extracellular fluid compartment.Hence, they did not decrease plasma colloid oncotic pressure (COP) as much as crystalloid solutions and intravascular volume would be better maintained. Colloid solutions, due to their longer presence in the vascular compartments, maintain a stable haemodynamics where as crystalloid solutions, in larger doses, dilute the plasma proteins resulting in a greater extra-vasation of fluid into the extracellular fluid compartment secondary to the fall of plasma colloid oncotic pressure.(11,12)

The amount of vasopressor (Ephedrine 6mg boluses) required to treat hypotension was found to be more in group R as compared to group P.

The other important parameters like the age of the patient, height of the patient, weight of the patient, the dose of local anaesthetic used for the subarachnoid block and the level of sensory blockade obtained,were intentionally kept comparable in all the groups as much as possible, to avoid these factors influencing our study.

There were no significant difference in heart rate and the oxygen saturation ($SpO_2$) between the groups. The difference in mean basal SBP and DBP were statistically non- significant in both groups. Thereafter, the fall in SBP and DBPwas more prominent in group Rat all time intervals with a statistically highly significant difference than group P.(pvalue <0.001)

Incidence of nausea, vomiting and shivering were comparable in both the groups.

In this present study, Pentastarch 6% did not produced any allergic reactions. Pentastarch is derived from waxy starch and composed chiefly of amylo-pectine. The structural similarity to our body glycogen explained its lower antigenic potential, and there was no evidence that it interferes with the clotting in trauma or major surgery patients.

## Conclusion

Pentastarch 6% was better than Ringer's lactate in reducing the incidence of spinal anaesthesia induced

hypotension in lower abdominal and lower limb surgeries with similar incidences of complications like vomiting and shivering.

**Ethical Clearance:** Taken from Sumandeep Vidyapeeth Institutional Ethics Committee (SVIEC).

**Source of Funding:** Self

**Conflict of Interest:** Nil

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