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Original Research Article

The Effect of Preload Fluid for the Prevention of Spinal Hypotension in Abdominal Surgery a Comparative Study of Ringer's Lactate with Haemaccel

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Abstract:

Objective: To study the effect of preoperative infusion of ringer's lactate and haemaccel solution for the prevention of spinal hypotension.

Methods: The 100 cases studied were divided randomly into two groups of 50 each depending upon the fluid given as preload to each patient. Group-A received Ringer's lactate solution as preload and Group-B received Haemaccel as preload. Careful screening of all patients in the pre-operative state was done, a meticulous attention was paid in excluding all patients with a known history of heart or lung disease or any other patient having contraindications for spinal anaesthesia. Both the groups were comparable with respect to age, sex, weight incidence and duration of pre-operative fasting. Equal number of types of surgeries were performed in both the groups.

Results: Hypotension was found in 58% of cases in Ringer's lactate group and 22% of cases in Haemaccel group. The total number of patients in whom mephentermine was used as vasopressor was higher in Ringer's lactate group 18, as compared to 6 in Haemaccel group. Incidence of hypo-tension observed in this study was highly significant statistically. There appears a definite difference in the incidence of hypo- tension between the older and younger age levels. The higher incidence of hypotension in the elderly patients may be related to the diminished residual vascular tone in elderly patients following sympathetic denervation. The usefulness of fluids in preventing hypotension after spinal anaesthesia was also observed in elderly patients. Further preloading with Haemaccel was found to be more effective as compared to Ringer's lactate solution.

Conclusion: Administration of IV fluids either crystalloids or colloids before spinal anaesthesia does reduce the incidence of spinal hypotension significantly. In the prevention of spinal hypotension administration of Haemaccel as preload appears to be the most physiological technique and requires less ionotropic mephentermine support.

Keywords: Spinal Anaesthesia, Spinal Hypotension, Haemaccel, Mephentermine.

Introduction

Spinal anaesthesia both intradural and extradural are the techniques of pain relief. A well conducted and skilfully applied spinal analgesia when indicated give results just as satisfactory from the point of view of the patient, surgeon and anaesthetist. These blocks provide profound muscular relaxation and analgesia while in addition they are usually associated with some degree of ischaemia and contraction of bowel which gives the abdominal surgeon more space for manoeuvre.

Since its introduction in clinical practice spinal anaesthesia has undergone many trials and tribulations. There were many ups and down varying from widely overenthusiastic acceptance to complete rejection. It has experienced more waves of popularity and unpopularity than any other anaesthetic method and it's safety in clinical practice has been questioned from time to time. This was chiefly because of complications produced by administration of spinal analgesia by rather not very well trained administrator in those days.

During last 25 years or so an increasing number of articles have appeared which point that spinal anaesthesia is exceedingly safe and post operative complications are minimal when it is correctly administered and supervised. Disadvantages are few and advantages are many. Spinal anaesthesia has many advantages over general anaesthesia which may be regarded as strong indication for its use. These include profound muscular relaxation which provides ideal operating conditions for intra-abdominal surgery and decreased operative blood

loss either with or without arterial hypotension which offers considerable advantages in reducing the need for donor blood. For patients with impaired ventillatory performance this technique is the best method of anaesthesia for lower abdominal and leg surgery.

Despite the rapid strides in the field of general anaesthesia spinal anaesthesia has still maintained its popularity specially in underdeveloped countries and developing countries. Practice of spinal anaesthesia for routine surgical operations assumes special importance in our country. This is chiefly because of economic reasons and for reasons of lack of sophisticated anaesthetic apparatus and compressed gases in areas remote from centres. Above peripheral resistance or the use of drugs with an ionotropic and chronotropic cardiac action to augment the output of the heart. Many of them have measurable effects on other systems of the body and their mode of action are not always ideal and not in the best interest of the situation. Another method of enhancing cardiac output is to augment venous return by temporary expansion of blood volume.

Spinal preloading is an established method to treat hypotension caused by sympathetic blockade because of spinal anaesthesia. In most hospitals the patients are preloaded with crystalloids. Colloids can be used for the same purpose. In this study the incidence, severity and length of hypotension and volume of each colloid vs crystalloid solution required to maintain a stable blood pressure were investigated.

Materials and Methods

The present study was carried out on a total of 100 patients admitted for various surgical procedures .The patients were of either sex belonging to ASA grade-I and IE, with the age ranging from 15 yrs to 65 yrs undergoing routine and emergency lower abdominal surgery under hyperbaric spinal anaesthesia. A careful screening and preoperative assessment of all patients was done prior to selection of individuals for suitability for spinal anaesthesia. The nature of anaesthesia was explained to the patient, viz that the procedure was a regional anaesthesia without affecting their consciousness. Written consent was taken from the patients and they were examined through detailed history and clinical examination regarding patients' general condition, pulse rate per minute B.P. in mmHg. Systemic examination was done to exclude any cardiovascular, respiratory, renal, gastrointestinal or C.N.S. disorder.

Patients with the history of following diseases were excluded from the study:

1. Any neurological disease.
2. Severe or chronic backache.
3. Quiscent or active headache.
4. Any unhygienic skin condition of back which preclude aseptic and atraumatic lumbar puncture.
5. Any vertebral coloumn deformity.
6. History of cardiovascular disease viz hypotension, hyper- tension, myocardial ischaemia.
7. Cases with history of bleeding tendencies or haemorrhagic disorders.

The types of operations performed were abdominal surgeries including appendicectomy, total abdominal hysterectomy, LSCS, suprapubic prostectomy, exploratory laparotomy, herniorraphy and lumbar sympathectomy. There were no upper abdominal intraperitoneal procedures. None of the surgical procedures resulted any operative blood loss requiring therapy for maintaining homeostasis.

Investigations: Laboratory investigations of all the patients were done like blood for haemoglobin estimation, urine routine and microscopic examination, ECG in elderly individuals and other relevant investigations were done considered necessary such as chest x-ray to exclude lung disease, fasting blood sugar, blood urea, bleeding, and clotting time etc. As the patient was brought to the operation theatre base line measurements of pulse and blood pressure were checked and recorded in the proforma specially prepared for the study. A suitable vein was cannulated with 18 gauge cannula.

The hundred patients were divided into two groups of fifty patient each. Group-I or control group received 500 ml of Ringer's lactate solution as preload fluid infusion. Group-II or experimental group received similar amount i.e. 500 ml of Haemaccel solution as preload. The preload fluid was given by intravenous infusion within a period of 15 minutes. After that spinal anaesthesia was usually administered with the patient in the lateral position.

The patient was brought to the edge of the table and parallel to it with the knees flexed on the abdomen and head brought down to knees. Hands were scrubbed up and sterile towels and gloves were donned. The back of the patient was painted over a large area with antiseptic and towels arranged suitably. The highest point in the iliac crests were felt through the sterile towel already placed, and the line joining them was defined. This usually crosses either the spine of the fourth lumbar vertebra or the interspace between L4 and L5. The space above this was usually chosen for the site of puncture, and a 25 gauge lumbar puncture needle was pushed forward and lumbar puncture was performed. The stillete was then withdrawn and a free flow of cerebrospinal fluid ensured.

Suitable amount of anaesthetic solution was then introduced into the subarachnoid space. Proper positioning was done depending on the nature of operation. The level of anaesthesia was determined

by pin prick sensation and when analgesia reached T6 level the operation was started.

Arterial pulse and blood pressure were recorded during pre- operative assessment, during and after preloading of fluid and before administering spinal anesthesia. Once spinal anesthesia was administered blood pressure and pulse were recorded at every 5 minutes intervals throughout the course of surgery. Rate and amount of fluid administered, patient complaints, medications given and other pertinent data were noted on the record maintained for the purpose of maintaining blood pressure at the appropriate time.

Hypotension was defined as a fall in mean arterial pressure of more than 20% from the baseline recording and was treated immediately with intravenous mephentermine 7.5 mg, and repeated if necessary. Any patient whose regularly scheduled treatment was not satisfactory in alleviating hypotension was subsequently treated in a way that was best indicated.

Post-Operative Observations: Immediately after operation pulse and blood pressure were noted and patient shifted to recovery room. The patient was visited in between for any post operative hypotension and pulse and B.P. were noted at the interval of 15 minutes. Necessary remedial measures were given if there was any complication

Observation Chart

The present study was carried out on one hundred patients who were allocated randomly into two groups -

Group-A: Those receiving 500 ml of Ringer's lactate solution as preload just before spinal anesthesia. This group included 50 patients.

Group-B: Those receiving 500 ml of Haemaccel as preload just before spinal anesthesia. This group also included 50 patients.

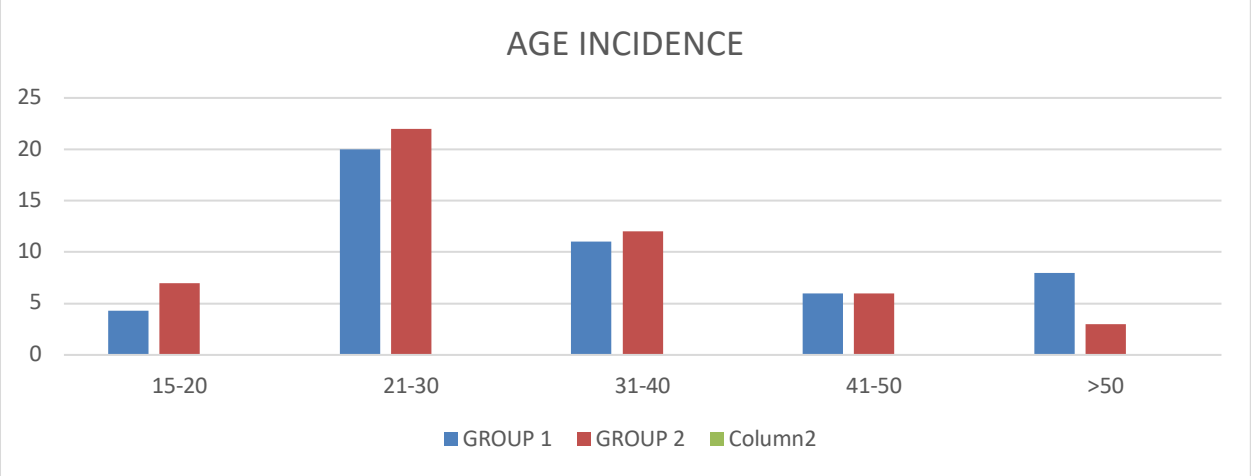

Figure 1: Age Incidence In Both Groups

Mean Age 35.54 ± 13.52 Range = 18-65 yrs.

Table 1: Types Of Surgery In Both The Groups

Serial No.	Types Of Surgery	Group 1	Group 2
1	Total Abdominal Hystrectomy	12	11
2	LSCS	10	10
3	Appendicectomy	8	9
4	Suprapubic Prostectomy	6	5
5	Herniorraphy	8	8
6	Lumber Sympathectomy	3	4
7	Exploratory Laprotomy	3	3

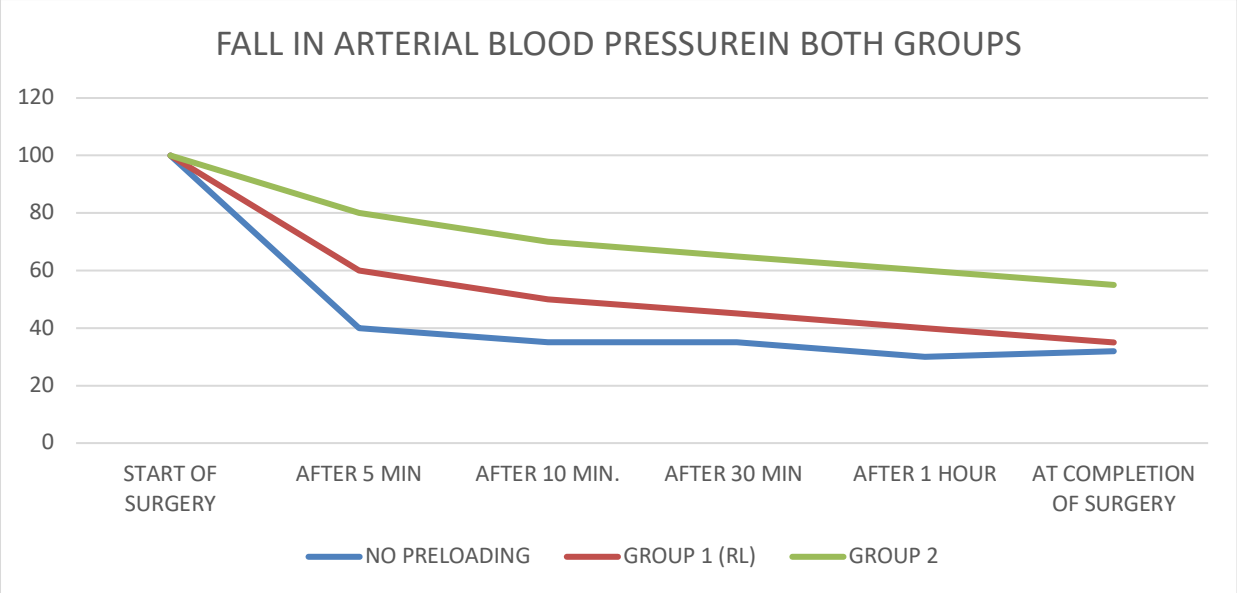

Figure 2: Fall In Arterial Blood Pressure After Spinal

Hypotension was defined as fall in mean arterial pressure more than 20%. As can be observed from above table hypotension occurred in 29 cases (58%) in Ringer's lactate group and only in 11 cases (22%) in Haemaccel group. The P value obtained was less than 0.001 which was found to be highly significant.

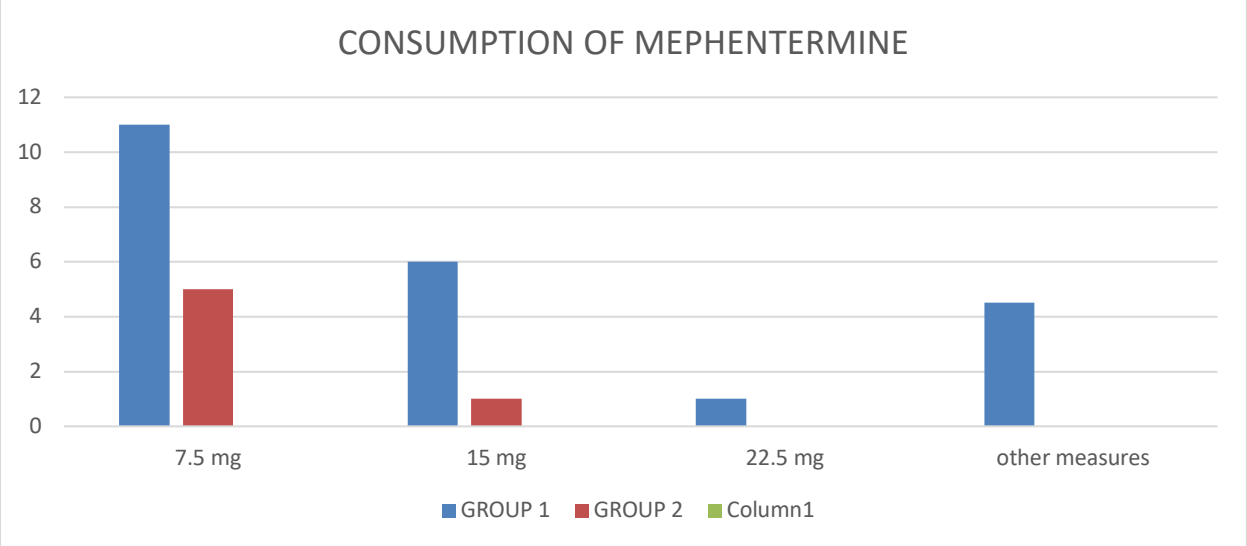

Figure 3: Consumption of Mephentermine in Both the Groups

Average consumption of mephentermine ringer's lactage group was10.83 mg. In haemaccel group it was 8.75 mg. The average consumption of mephentermine was higher in the group receiving ringer's lactate solution as preload.

Table 2: Complications Seen In Both Groups

Factors	Ringer Lactate Group		Haemaccel Group	
	CASE	%	CASE	%
Nausea	3	6	1	2
Shivering	9	18	1	2
Bradycardia	4	8	3	6

As outlined in the above table, shivering was observed more in Ringer's lactate group. Other side effects were nausea and bradycardia which were infrequent in both groups.

Results

Hypotension was found in 58% of cases in Ringer's lactate group and 22% of cases in Haemaccel group. The total number of patients in whom mephentermine was used as vasopressor was higher in Ringer's lactate group 18, as compared to 6 in Haemaccel group also the average consumption of mephentermine was higher in Ringer's lactate group (10.83mg) than in Haemaccel group (8.75%). The results obtained are correlated with observations made by various workers during spinal anesthesia. Incidence of hypo-tension observed in this study was highly significant statistically. There appears a definite difference in the incidence of hypo- tension between the older and younger age levels. The higher incidence of hypotension in the elderly patients may be related to the diminished residual vascular tone in elderly patients following sympathetic denervation.

Preloading with intravenous fluids as a means of preventing or treating hypotension was successful in majority of patients. The usefulness of fluids in preventing hypotension after spinal anesthesia was also observed in elderly patients. Further preloading with Haemaccel was found to be more effective as compared to Ringer's lactate solution.

Statistical Analysis

The collected data was summarized by using frequency, percentage, mean & S.D. To compare the qualitative outcome measures Chi-square test or Fisher's exact test was used. To compare the quantitative outcome measures independent t test was used. If data was not following normal distribution, Mann Whitney U test was used. SPSS version 22 software was used to analyze the collected data. p value of <0.05 was statistically significant.

Discussion

The present study was undertaken to compare the efficacy of IV infusion of crystalloid and colloid solution in prevention of spinal hypotension. In our study we did not find any major side effect of fluid overloading in the patients treated with fluids; such as tachyapnoea, dyspnoea, pulmonary oedema or anaphylaxis. There was no significant change in pulse rate or blood pressure after preloading the patients, with fluids. B Chhabra et al, V.Askrog et al and A.Smessart have found no change in blood pressure and pulse rate and no significant side effects after prophylactic balanced electrolyte fluid therapy while Mathru M. et al Murray M. and Anis Daraka et al found a marginal increase in blood pressure and a little or no rise in heart rate, after prophylactic colloid infusion and our results are similar to their observations.

Hypotension in the present study was defined as a fall in mean arterial pressure below 20% of the preoperative value. Graves et al found 31% incidence of hypotension in pretreatment group with IV fluids. C'ucchiara et al found 44% incidence of hypotension in their study. Wollman SB et al demonstrated the use of acute hydration to prevent hypotension in parturient patients. They observed 100% incidence of hypotension in non-hydrated patients. Clark R.B. et al have observed that hydration reduces the incidence of hypotension to 14%. Chhabra B. et al have observed only 4% incidence of fall in B.P. in the groups which were pretreated with IV fluids Rout C.C. et al found incidence of hypertension 55% in preloaded patients as against 71% in unpreloaded. Dohi et al demonstrated that the younger patients usually show less severe decrease in blood pressure than the older age group patients of equal heights of spinal anaesthesia

In the present study we found that the overall incidence of hypotension in both groups is 40% which matches with the observations of above authors.I n present study out of total 100 patients 40 developed hypotension. Out of these 40 cases, 18 patients were above 35 years ie 45% cases. Graves et al also have found that out of 32 patients examined by them for spinal hypotension 23 patients were from age group above 50 years. The explanation given for the higher incidence of hypotension in patients of older age group is correlated to higher residual autonomous vascular tone which persists in young age group patients following spinal anaesthesia.

Critchley LAH et al showed that the older age patients actually show more significant decrease in blood pressure than younger patients with same height of spinal anaesthesia Defalque in his study claimed that the degree of arterial hypotension is related to the level of spinal block. Higher the level of spinal block more will be the incidence of hypotension. Melrae A.F. et al studied treatment and prevention of spinal hypotension control neural blockade. Their results were same suggesting that with higher level of block there will be greater incidence of hypotension. Similar results were obtained in our study. Many authors have compared the efficacy of crystalloid and colloids in the preloading for prevention of hypotension after spinal anaesthesia. Mathru M. et al found 7% incidence of hypotension in patients treated with crystalloid solution and 0% incidence of hypotension in patients treated with colloid solution preloading. Murray AM et al found 10% incidence of hypotension in patients treated with crystalloids and 6% incidence in patients treated with colloid solution preloading. Anis Daraka et al have observed 45% incidence of hypotension in patients treated with crystalloid and 15% incidence of hypotension in patients treated with colloid solution preloading.

Karinen J. et al demonstrated the incidence of hypotension in patients preloaded with crystalloids as 62% and those preloaded with colloids as 38%.Satproedprai A. et al have shown that the incidence of hypotension in parturient undergoing caesarean section under spinal anaesthesia was more in those treated with crystalloids (58%) than those treated with colloids (25%).Sathe U. and Shah B.N. have also reported increased incidence of hypotension in group treated with crystalloids than with colloids. In the present study we have taken Ringer's lactate for crystalloid and Haemaccel as colloid solution. We find that Haemaccel is better solution for preloading than Ringer's lactate. The incidence of hypotension in the group preloaded with Haemaccel was lower (22%) as against the group preloaded with Ringer's lactate solution (58%). This was found to be "highly significant" statistically ($p < 0.001$).As hypotension is prevented by preloading of fluids just before spinal anaesthesia thus the consumption of vasopressors is also reduced.

Satproedprai A. et al in their study demonstrated that average consumption of vasopressor (ephedrine) was significantly higher in crystalloid group 5.1 mg than in colloid group 1.8 mg. Sathe U. and Shah B.N. observed in their study that 10 patients in group preloaded with crystalloids needed mephentine as vasopressor to support blood pressure whereas none of the patients in group preloaded with colloid needed mephentine. In the present study we have also found that 18 patients in Ringer's lactate group needed mephentine whereas only 6 patients in Haemaccel group needed mephentine in order to support the blood pressure. This was found to be statistically significant ($p<0.02$). Further the average consumption of mephentine was also found to be higher in group preloaded with Ringer's lactate solution (10.83 mg) than in group preloaded with Haemaccel solution (8.75 mg).

Theoretically colloids are the more logical choice to preload the circulation since they remain in circulation for a longer time. IV administration of crystalloid solution in the volumes commonly used before spinal anaesthesia may not be an effective expander of plasma volume since about 75% of any crystalloid rapidly diffuses into interstitial space. AM Murray et al have shown that the volume of blood needed to restore the blood volume during hypovolumic states in 3-4 times more than the volume of blood required to restore the fluid volume. Wollman SB have suggested that in regard to the extent and duration of blood volume expansion the infusion of balanced electrolyte solution such as Ringer's lactate has been shown to elevate circulating blood volume to a much smaller degree than the actual volume infused owing ne rapid distribution throughout the extracellular space. In contrast with the short intravascular half-life of crystalloids, colloids are retained in the vascular space for a longer time and hence can be more effective than crystalloids in restoring blood volume.

Firstly, owing to their globular molecular configuration the cross linked peptides have similar kinetics as albumin in surgical patients with varying degree of blood loss and renal efficiency half-life of 4 to 6 hrs. has been consistently found by a number of different workers. After infusion of 500 ml of Haemaccel 50% of polypeptides are excreted in the urine in 48 hrs. About 27-30% of the solution is still present in circulation after 12 hours. Secondly Haemaccel has an oncotic pressure of 3.4-3.9 kPa which is close to the physiological oncotic pressure of plasma and is thus a true plasma substitute and/or expander and it raises the blood pressure by virtue of the volume infused.

In our present study there was slightly increased incidence of shivering in Ringer's lactate group. But there was no significant incidence of complications associated with preloading in both the groups.

Conclusion

- Administration of IV fluids either crystalloids or colloids before spinal anaesthesia does reduce the incidence of spinal hypotension significantly.
- In comparing the efficacy of prophylactic preloading of Ringer's lactate with Haemaccel the incidence of spinal hypotension with Haemaccel preloading was less than 50% that with Ringer's lactate preloading which was a highly significant result.
- The number of cases in which vasopressor mephentermine was used were also significantly less in the group preloaded with Haemaccel than that preloaded with Ringer's lactate solution.
- The average consumption of Mephentermineu sed in Haemaccel group was lower than in Ringer's lactate group.
- There was no significant intraoperative or postoperative complication observed in patients undergoing spinal anesthesia in present study.

Hence in the prevention of spinal hypotension administration of haemaccel as preload appears to be the most physiological technique from the present study."

Declarations

Funding: None

Availability of data and material: Department of Anaesthesiology RKDF Medical College. Bhopal

Code availability: Not applicable

Consent to participate: Consent taken

Ethical Consideration: There are no ethical conflicts related to this study.

Consent for publication: Consent taken

References

1. Hetreed M, Sen A. Large volume blood loss replaced with plasma expanders. Anaesthesia. 1980 Jan;35(1):76-7.
2. Kunwar BR, Bhattacharyya P, KC N. Efficacy of Equal Volume of Ringer Lactate Versus 3.5% Polymer of Degraded Gelatine Solution (Haemaccel) as Preloading Fluid for Prevention of Hypotension after Spinal Anaesthesia for Lower Segment Cesarean Section. Medical Journal of Shree Birendra Hospital. 2011;10(1):1-5.
3. Jawaid Z, Gul Bano Tariq RA, ul Haq I, Saeed S, Bahadur S. Prevention of hypotension in Patients Undergoing Elective Caesarean Section under Spinal Anesthesia: Effect of Preloading with Crystalloid versus Colloid Infusion. In Medical Forum Monthly 2019 (Vol. 30, No. 11).
4. Ghafourifard M, Zirak M, Broojerdi MH, Bayendor A, Moradi A. The effect of ringer versus haemaccel preload on incidence of postoperative nausea and vomiting. Journal of caring sciences. 2015 Jun;4(2):105.
5. Yatish B. A comparative study of volume preloading Prior to subarachnoid block in lower Abdominal surgery with hetastarch (6%), Polygelatin, ringers lactate solution (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)).
6. Jude FA. Comparative Evaluation of Hemodynamic Parameters in Patients Preloaded with Ringer's Lactate Versus Succinylated Gelatin Following Subarachnoid Block (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)).
7. Bevinaguddaiah Y, Pujari VS, Tejesh CA, Manjunath AC. Volume preloading prior to subarachnoid block: comparison between hetastarch (6%), polygelatin, ringers lactate solution. Journal of Evolution of Medical and Dental Sciences. 2013 Nov 25;2(47):9220-8.
8. Buggy D, Higgins P, Moran C, O'Brien D, O'Donovan F, McCarroll M. Prevention of spinal anesthesia-induced hypotension in the elderly: comparison between preanesthetic administration of crystalloids, colloids, and no prehydration. Anesthesia & Analgesia. 1997 Jan 1;84(1):106-10.
9. Kumar K. Hydroxyethyl starch vs Haemaccel in subarachnoid block-Let's kill the tension of hypotension.
10. Prasad S, Kumar OS, Priyadarshini TS, Raghupraveen M. Comparative study of 6% hetastarch solution and polygeline solution as preloading fluid for the prevention of hypotension following spinal anesthesia in lower limb surgeries. International Journal of Medicine & Public Health. 2024 Jan 1;14(1).
11. SREEKANTH C, GURUMURTHY T. Intravascular Administration of Isotonic Saline versus Polymerised Gelatin in the Prevention of Spinal Induced Hypotension: A Randomised Clinical Trial. Journal of Clinical & Diagnostic Research. 2021 Jun 1;15(6).
12. Fischer SR, Burnet M, Traber DL, Prough DS, Kramer GC. Plasma volume expansion with solutions of hemoglobin, albumin, and Ringer lactate in sheep. American Journal of Physiology-Heart and Circulatory Physiology. 1999 Jun 1;276(6):H2194-203.
13. Riaz A, Munzar Z. Preloading before spinal anaesthesia for caesarian section. A comparison between colloid and crystalloid preload. Anaesthesia, Pain & Intensive Care. 2006;10(1).
14. Priyanka VN. Preloading with Intravenous Colloids-A Comparative Study in Patients Undergoing Subarachnoid Block (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)).
15. Crowhurst JA. Intravenous fluid administration in pregnancy: maintenance and acute hydration. Emergency Medicine. 1996 Mar;8:63-8.
16. Drobin D. 24 Spinal Anesthesia and Fluid Therapy. Perioperative Fluid Therapy. 2016 Apr 19:333.
17. Saleem HU, Butt TA, Akhtar N, Ashraf Z. Efficacy of crystalloids and colloids as preloading fluids to prevent hypotension in spinal aAnesthesia in elective C-sections. PJMHS. 2016 Oct 1;10:1177-81.
18. Rassam SS, Counsell DJ. Perioperative fluid therapy. Continuing Education in Anaesthesia, Critical Care & Pain. 2005 Oct 1;5(5):161-5.
19. Cortés DO, Barros TG, Njimi H, Vincent JL. Crystalloids versus colloids: exploring differences in fluid requirements by systematic review and meta-regression. Anesthesia & Analgesia. 2015 Feb 1;120(2):389-402.
20. Baron JF. Crystalloids versus colloids in the treatment of hypovolemic shock. InYearbook of Intensive Care and Emergency Medicine 2000 2000 (pp. 443-466). Berlin, Heidelberg: Springer Berlin Heidelberg.
21. Adamik KN, Yozova ID. Colloids yes or no?-a "Gretchen question" answered. Frontiers in Veterinary Science. 2021 Jul 2; 8:624049.