

Comparison of Intravenous Colloid and Colloid-Crystalloid Combination in Hypotension Prophylaxis during Spinal Anesthesia for Cesarean Section

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Time of Study- From May 2018 To May 2019.

Abstract: *Context:* Many studies comparing different intravenous fluid types usually do not use equipotent volumes of three to one crystalloid to colloid ratio. *Aim:* This study was designed to compare the efficacy of equipotent volumes of colloid and crystalloid-colloid combination in spinal anesthesia-induced hypotension prophylaxis during cesarean section. *Materials and Methods:* pregnant women scheduled for elective cesarean section were prospectively randomized into two groups to receive either 1000ml of crystalloid/colloid (750/250ml) combination or 500ml colloid intravenous fluid preload, before spinal anesthesia. hemodynamic variables were monitored till the end of surgery.

Keywords: cesarean section, intravenous fluids, hypotension, spinal anesthesia

1. Introduction

Hypotension is a prominent side effect of spinal anesthesia. Prophylactic methods include fluid preloading, prophylactic ephedrine, Trendelenburg positioning, relieving aorto-caval compression. For effective prevention, fluid overloading must be sufficient to significantly increase cardiac output. crystalloids have a short intravascular half-life, large volumes are therefore needed. colloids stay longer in the circulation and smaller amounts are required.

2. Material and Methods

Including Criteria:

1. Elective cesarean section.
2. ASA class 1 & 2.
3. Having non- urgent cesarean section.

Exclusion Criteria:

1. Multiple pregnancy.
2. Weight over 115kg.
3. Height less than 150cm.
4. Hypertensive diseases in pregnancy.
5. Hypertensive diseases in pregnancy.
6. Intra uterine death.
7. Age less than 18years or more than 40years.
8. Patients on diuretic therapy.
9. Contraindication to central neural blockade (patients refusal, raised intracranial pressure, hypovolemic states, abnormal coagulopathy)

3. Statistical Methods

- The two groups were compared using Student's *t*-test, represented as mean \pm standard deviation (SD) (continuous data) and Chi-square for categorical data.
- The null hypothesis was rejected at $P < 0.05$.
- Data collected was analyzed with Statistical Package for Social Sciences (SPSS) version 16 and rational deductions derived.

4. Results

- The mean age, height, and weight of patients in both groups were similar. There were no differences in the upper levels of spinal blockade; the maximum block height was between T8 and T4 for each group [Table 1].
- There were no differences in the pre-induction values of the systolic and diastolic blood pressures; heart rates and SpO₂ [Table 2]. After spinal anaesthesia, mean and minimum systolic blood pressures, diastolic blood pressures, heart rates, SpO₂ were lowest in the colloid group. These were however not statistically significant [Table 2].
- In the two groups, all hemodynamic parameters were reduced with time. The combination group had less reduction in the mean arterial blood pressure.
- Comparison of ephedrine requirements showed that the number of patients that required ephedrine and the mean ephedrine dose were highest in the colloid group. The mean duration of surgery and estimated blood loss were similar in both groups [Table 3].

- Incidence of hypotension in the first 10 min after spinal anaesthesia was highest in the colloid group with (91%), versus 68% in the combination group. These differences were statistically significant. The incidence of hypotension in the latter 30 min, that is, between 10 and 40 min after spinal showed that, colloid had 76% and combination group had 62%. These differences were not statistically significant, [Table 4].
- Neonatal outcome with Apgar score less than 7 in 1 min, (those that require active resuscitation) occurred most in the combination group, with six neonates, versus four neonates in the combination group. In the colloid group one patient vomited and two others had mild nausea against one patient that vomited in the combination group. Nausea and/or vomiting coincided with episodes of maternal hypotension and were successfully treated by correcting the hypotension with IV ephedrine and rapid fluid infusion.
- Hypotension occurred earliest in the combination group with mean time of 2.39 min, while the colloid group was delayed till 3.85 min [Figure 2].

5. Discussion

- In this study, combination of intravenous fluids reduced the incidence of hypotension better than the colloid alone within the outcome measurement time frame of 10 min (average uterine delivery time and optimal effect of pharmacological sympathectomy). Within a 15 min period of preload before establishment of spinal anaesthesia, volumetric effect is more important than osmotic effect. Combination group had better efficacy in preventing hypotension because a larger amount of fluid 1000 ml (750 ml of crystalloid and 250 ml of colloid) was infused compared to 500 ml of colloid in the other group, though they were given in equipotent volumes.
- Our result is similar to that of Vercauteren et al., [8] who had better hypotension prophylaxis after subarachnoid blockade with the combination of crystalloid-colloid compared to colloid. Though there was a reduced incidence of hypotension in the combination group when compared to the colloid group in both our studies. Their study compared 1000 ml of 6% hydroxylethylstarch (HES) and 1000 ml of Ringer's lactate to 1000 ml of HES, these volumes were not equipotent, it should have been 1000 ml of Ringer's and 660 ml of HES in the combination group rather than the 1000 ml they used. This could have accounted for the much reduced incidence of hypotension of 10%, compared to the 68% in this study. Another study also showed the superiority of combination therapy, but was compared against crystalloid; interestingly they were not in equipotent volumes [4]
- Another reason that can be attributed for the reduced incidence of hypotension in the combination group compared to the colloid group in our study could be the acute hydration in about 15 min before spinal anaesthesia was established. The time to establishment of spinal anaesthesia should be less than the intravascular half-life of the crystalloid in other to prevent redistribution to interstitial space. The time for preload did not seem to affect Vercauteren's result; they had preloading from the ward before proceeding to the operating theatre for the anaesthetic technique. Although the exact interval between preload and spinal anaesthesia was not stated, the increased total volume could have been responsible for better results in the Vercauteren study compared to that obtained in this study.
- Rout et al., rapidly administered crystalloid, but did not decrease the incidence of hypotension after spinal anaesthesia for elective caesarean section [9] They compared 20 ml/kg of crystalloid infused over 10 and 20 min, and found no difference. It is possible that the 20 min infusion time which is the upper border before redistribution into interstitial space occurs, may be responsible for no difference in the incidence of hypotension in their study.
- In this study, the incidence of hypotension was 91% when 500 ml of 6% HES was used as a preloading agent. Ueyema *et al.*, had 58% incidence when same volume of colloid was used [1] It could be that there was more time for the osmotic effect of colloid in Ueyema's study, with 30 min as preloading time, as against 15 min preloading time in our study. A 6% HES is said to have no initial plasma increase unlike other colloids like 10% HES which are hyper-osmotic when first infused [10]
- Although Sharma et al., rapidly infused 500 ml of 6% HES over 15 min, as in this study, they recorded a lower incidence of hypotension of 52% was observed [11] This lower incidence would have been possible because their study group were non-parturients. So also were Buggy *et al.*, who rapidly infused 500ml of colloid (Haemaccel) in elderly patients over 5-8 min and had 39% incidence of hypotension [12] Pregnant patients at term are more prone to develop hypotension due to the occurrence of aorto-caval compression by the fetal head and higher sympathetic blockade owing to increased spread of local anaesthetic agent in the cerebrospinal fluid.
- The observation that preloading does not eliminate hypotension after spinal anaesthesia was further established by our study. Although some workers [13, 14] at various times reported no hypotension in their studies, the agents and quantity used could have been responsible for this observation. Mathru *et al.*, [14] for example, used 15 ml/kg of 5% albumin in 5% dextrose Ringer's lactate (D5RL) which is a combination of colloid and crystalloid. This result could only be possible because of albumin used, is a principal natural colloid comprising of 50-60% of all plasma proteins. It contributes to 80% of normal oncotic pressure [15] Wollman and Marx also used 1000 ml of D5RL, though not a colloid, there was no incidence of hypotension [13] These results have not been replicated by other workers because the quality may be responsible for this.
- Vasopressors like ephedrine are used in the management of spinal induced-hypotension, among others. In this study, total rescue ephedrine used was lowest in the combination group because the numbers

of hypotensive patients were least in the group. This reveals the superior effect of combination in preventing spinal induced maternal hypotension, within the time frame of 10 min outcome study. Nausea and vomiting also occurred more in the colloid group because they had a higher incidence of hypotension.

- No adverse reaction to crystalloid or colloid occurred in this study, although the incidences of allergic reaction with artificial colloid are high [15] Severe anaphylactic or anaphylactoid reaction did not occur with HES in this study.
- Common complications that occurred were headache, chest pain, shivering, and dizziness. These complications are due mainly to spinal anaesthesia or exteriorization of the uterus. Complications were unrelated to the type of fluid used for preload. It is however, not expected that significant pulmonary pathology would have occurred after 1000 ml fluid load, considering the fact that they were healthy parturients with ASA I and II fitness.

References

[1] Ueyema H, He YL, Tanigami H, Moshimo T, Yoshiya I. Effects of crystalloid and colloid preload on blood volume in the parturient undergoing spinal anaesthesia for elective Caesarean section. *Anesthesiology*1999;91:1571-6.

[2] Keith G, Iaian H. *Obstetric Anaesthesia (preload)*. Oxford Handbook of Anaesthesia, 2nd ed. Ch. 32, Oxford: Oxford Med Publication, P 721.

[3] Weeks S. Reflection on hypotension during Caesarean section under spinal anaesthesia: Do we need to use colloid? *Can J Anaesth*2000;47:607-10.

[4] Riley ET, Cohen SE, Rubenstein AJ, Flanagan B. Prevention of hypotension after spinal anesthesia for cesarean section: Six percent hetastarch versus lactated Ringer’s solution. *AnesthAnalg*1995;81:838-42.

[5] Siddik SM, Aouad MT, Kai GE, Sfeir MM, Baraka AS. Hydroxyethylstarch 10% is superior to Ringer solution for preloading before spinal anaesthesia for Caesarean section. *Can J Anaesth*2000;47:616-21.

[6] Dahlgren G, Granath F, Pregner K, Rosblad PG, Wessel H, Irestedt L. Colloid vs. crystalloid preloading to prevent maternal hypotension during spinal anaesthesia for elective caesarean section. *Acta AnaesthesiolScand*2005;49:1200-6.

[7] French GW, White JB, Howell SJ, Popat M. Comparison of pentastarch and Hartman’s solution for volume preloading in spinal anaesthesia for caesarean section. *Br J Anaesth*1999;83:475-7.

[8] Vercauteren MP, Hoffmann V, Coppejans HC, Van Steenberge AL, Adriaensen HA. Hydroxyethylstarch compared with modified gelatine as volume preload before spinal anaesthesia for Caesarean section. *Br J Anaesth*1996;76:731-3.

[9] Rout CC, Akoojee SS, Rocke DA, Gouws E. Rapid administration of crystalloid preload does not decrease the incidence of hypotension after spinal anesthesia for elective caesarean section. *Br J Anaesth*1992;68:394-7.

[10] Wennberg E, Frid I, Haljamae H, Wennergren M, Kjellmer I. Comparison of Ringers acetate with 3% dextran 70 for volume loading before extradural caesarean section. *Br J Anaesth*1990;65:654-60.

[11] Sharma SK, Gajraj NM, Sidawi JE. Prevention of hypotension during spinal anaesthesia. A comparison of intravenous administration of hetastarch versus lactated Ringer’s solution. *AnesthAnalg*1997;84:111-4.

[12] Buggy D, Higgins P, Moran C, Brien DO, Frances O, McCarroll M. Prevention of spinal anesthesia-induced hypotension in the elderly: Comparison between preanesthetic administration of crystalloid, colloids, and no prehydration. *AnesthAnalg*1997;84:106-10.

[13] Wollman SB, Marx GF. Acute hydration for prevention of hypotension of spinal anesthesia in parturients. *Anesthesiology* 1968; 29:374-80.

[14] Mathru M, Rao TL, Kartha RK, Shanmugham M, Jacobs HK. Intravenous albumin administration for prevention of spinal hypotension during caesarean section. *AnesthAnalg*1980;59:655-8.

[15] Mitra S, Khandelwal P. Are all colloid same? How to select the right colloid? *Indian J Anaesth*2009;53:592-607

Table 1: Demographic data/clinical characteristics

	Colloid group		Combination group		P value
	mean	SD	mean	SD	
Age (years)	34.03	±4.82	32.74	±5.09	0.285
Height (m)	1.59	±0.09	1.63	±0.06	0.027
Weight (kg)	79.51	±12.55	80.13	±12.01	0.836
Level of block	T8-T4		T8-T4		

Hemodynamic parameters	Colloid		Combination		P value
	MEAN	SD	MEAN	SD	
Pre-induction Values	138.47	±14.84	137.14	±18.00	0.740
Systolic (mmHg)	80.97	±8.93	78.97	±8.96	0.357
Diastolic (mmHg)	97.09	±12.23	97.14	±10.75	0.984
Heart rate (/min)	97.97	±0.72	97.97	±1.07	0.997
Mean intraoperative values					
Systolic (mmHg)	114.18	±15.61	116.97	±17.71	0.490
Diastolic (mmHg)	60.47	±9.81	63.06	±11.12	0.310
Heart rate (/min)	97.65	±12.24	99.91	±15.36	0.501
SpO2	97.82	±0.94	97.94	±1.41	0.681

Minimum values after spinal (10 min after spinal)					
Systolic (mmHg)	95.44	±15.35	97.94	±20.58	0.570
Diastolic (mmHg)	47.00	±9.17	50.43	±12.45	0.198
Heart rate (/min)	81.62	±15.27	86.51	±15.17	0.186
SpO2	96.74	±1.24	96.00	±3.66	0.271

Table 3: Intraoperative clinical values

	Colloid		Combination		P value
	MEAN	SD	MEAN	SD	
Level of sensory block	T8-T4		T8-T4		
Mean duration of surgery (min)	52.82	±17.99	57.37	±22.06	
Mean blood loss (ml)	625.15	±300.81	607.14	±202.61	0.352
Mean ephedrine dose (mg)	5.76	±9.61	3.66	±7.23	0.771
No. of patient requiring ephedrine	13.00		10.00		0.306
Total amount of ephedrine (mg)	166		128		

Table 4: Incidence of hypotension

Incidence of hypotension	Identification		P value
	Colloid (%) n=34	Combination (%) n=35	
First 10 min	31 (91)	24 (68)	0.0419
10-40 min	26 (76)	22 (62)	0.3335