ARTICLE

A COMPARATIVE STUDY OF THE EFFECTS OF NORMAL SALINE AND HYDROXYETHYL STARCH 6% ON MOTHERS' BLOOD PRESSURE DURING SPINAL ANESTHESIA IN ELECTIVE CESAREAN SECTION

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ABSTRACT

Introduction: *Hypotension is the most common problem after spinal anesthesia in women volunteered for cesarean section. This complication can be prevented by hydrating the patient with a suitable and stable serum. The present study intended to compare the effects of normal saline and hydroxyethyl starch 6% on reducing hypotension in women volunteered for cesarean section after spinal anesthesia.* ***Methodology:*** *To this end, a clinical trial was conducted on 72 pregnant women who were volunteered for cesarean section in Shahid Motahari Hospital in Jahrom, Shiraz. The eligible patients were randomly divided into two groups of 36. Both the blood pressure and heart rate of patients were measured after entering the operating room and before spinal anesthesia. An amount of 15-20 cc normal saline per kilogram of body weight was injected intravenously to the patients of the first group about 15 minutes prior to spinal anesthesia while 5-10 cc of hydroxyethyl starch per kilogram of body weight was injected intravenously to the second group. Systolic and diastolic blood pressure as well as heart rate of the patients were measured within 5, 10 and 15 minutes after anesthesia and then every 10 minutes until the end of C-section operation. Data were analyzed in SPSS$_{11}$ using Mauchly's Sphericity Test and Greenhouse-Geisser test.*

Results: *Over time there was a statistically significant difference in the systolic and diastolic blood pressure between both groups and between the time and type serum (P<0.001). In case group (HES), the mean of baseline systolic blood pressure was 124.9 mmHg as well as 123.7 and 112.2 mmHg respectively 15 and 30 minutes after the operation. On the contrary, the mean of baseline blood pressure was 123.9 mmHg as well as 94.3 and 103 mmHg respectively 15 and 30 minutes after the operation in control group (NS). The incidence of hypotension was 11% in HES group and 25% in NS group.* ***Conclusion:*** *In addition to hypotension reduction, homodynamic instability was also lower in HES than NS group. However, there was not any significant difference in the heart rate and neonatal Apgar between both groups. Consequently, hydroxyethyl starch may be effective in preventing hypotension.*

KEY WORDS
Spinal Anesthesia; Blood Pressure; Elective C-section; Neonatal Apgar; Hydroxyethyl Starch (HES) 6%; Normal Saline (NS).

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INTRODUCTION

Nowadays, cesarean is done using different types of anesthesia and general anesthesia. One of the preferred methods is spinal anesthesia [1] which is more applicable since it not only reduces difficult intubation and bleeding during the operation but also inhibits the use of respiratory neuro-suppressive drugs which are transferred through placenta to the fetus [2]. Nevertheless, this method causes some complications including nausea, vomiting and headache; its most important and prevalent complication is hypotension due to the spinal cord sympathectomy, peripheral vascular vasodilatation, reduction of venous return to the heart and reduction of cardiac output[3]. Studies has found that pregnant women who are lying position undergo a considerable reduction in placental bloodstream despite having a normal brachial blood pressure (4). Since there is not any self-regulation in uterine bloodstream, mother's hypotension, especially with a systolic blood pressure below 90 mm Hg, reduces blood supply to placenta and causes neonatal asphyxia and decreases neonatal Apgar [5].

Hypotension, caused by spinal anesthesia, is treated through two main treatment methods due to its physiological causes i.e. increased systematic vascular resistance and increased intravascular fluid volume (6); Ephedrine is a preferred medication for the former method. Nevertheless, Ephedrine causes Acidemia in fetus and neonatal nervous system abnormalities [7].

Pre-hydration is the infusion of intravenous fluid within 15 – 20 minutes before spinal block to fill the vascular capacity. The fluids used for pre-hydration are Crystalloids and Colloids [8]. Like Ringers, Crystalloids have a short half-life in bloodstream and are not good vasodilators. Several studies showed that the prescription of crystalloids could not maintain a safe and steady blood pressure level in patients during the operation [9]. Pre-hydration with high doses of fluid may increase central venous pressure and pulmonary edema [10 & 11]. Colloid fluids have a longer stay in the vessel and require less fluid to increase blood pressure [12]. Hydroxyethyl Starch 6% solution is a kind of colloid fluids which is used to treat hypotension in trauma and shock[13]. This solution can be a good choice used for pre-hydration in

spinal anesthesia. One of the complications of colloids is their effects on coagulation system which decrease the levels of Factor 8 and Von Willebrand. However, these effects are much less influential in solutions with average molecular weight than in solutions with high molecular weight (14).
According to the studies reporting the success of this solution in reducing the incidence of hypotension and spinal anesthesia complications as well as the significance of spinal anesthesia in pregnant women and its effect on their infants, and in order to compare the effect of intravenous solutions including hydroxyethyl starch 6% and normal saline on preventing hypotension, the current study was conducted on women volunteering for C-section operation [15].

The present project requires more investigation with regard to the spinal anesthesia complications and its resulting hypotension and due to observation of different results obtained from previous studies using different serums. Furthermore, the current study was conducted since hypotension reduction has significant effects, including Asphyxia and neonatal Apgar decrease, on infants which may bring about negative effects on infants' growth and their life quality[16].

MATERIALS AND METHODS

The current study is a clinical trial research. The research was instigated after it was approved by the Research council of Jahrom University of Medical Sciences and Ethics Committee and once written consent was reached from patients. Patients with blood pressure, respiratory problems, asthma, allergy and cardiovascular disease were excluded from the study. The present study was conducted on 72 pregnant women, aging 15 – 40, who were volunteered for elective cesarean section with spinal anesthesia class ASAI, II. The eligible patients were randomly divided into two groups of 36 recipients of normal saline and hydroxyethyl starch 6%. Both the blood pressure and heart rate of patients were measured after entering the operating room and before spinal anesthesia. An amount of 15-20 cc normal saline per kilogram of body weight was injected intravenously to the patients of the first group about 15 minutes prior to spinal anesthesia while 5-10 cc of hydroxyethyl starch per kilogram of body weight was injected intravenously to the second group**.** The temperature was maintained at 23 – 25 ˚C during the presence of patient in the operating room and recovery room. The spinal anesthesia, in both groups, was done under sterile condition by a trained anesthesiologist in L4 – L5 space using needle number 25 containing 2.5 cc (12.5 mg) of Marcaine 0.5%.Systolic and diastolic blood pressure as well as heart rate of the patients were measured within 5, 10 and 15 minutes after anesthesia and then every 10 minutes until the end of C-section operation by a monitoring device and were recorded by a technician, who was not aware of the type of venous solution. Data were analyzed in $SPSS_{11}$ using velvet tests and greenhouse grazer tests. Patients were examined in terms of arrhythmia during cardiac monitoring. Data were analyzed in $SPSS_{11}$ using Mauchly's Sphericity Test and Greenhouse-Geisser test**.**

RESULTS

In order to measure the adherence of data to normal distribution, all the research variables were examined with Kolmogorov-Smirnov test; it was, therefore, found that all the variables with a statistical value larger than 0.05 (P>0.05) have a normal distribution. Regarding the inevitable effect of age variable, independent T-test was used in order to determine the effect of age on research results. With respect to the mean age of both groups (29.09±4.27 & 28.19±4.13), the other values i.e. P:0.39, T:865 and DF:68 were estimated accordingly. Then, it was measured as a covariate with each individual variable and separately through ANCOVA. Subsequently, there was not any correlation between groups and age (P<0.05). Hence, in further analyses, the changes in systolic blood pressure, diastolic blood pressure and heart rate between both groups were respectively measured through ANOVA with repeated measures. Below are the results:

Systolic Blood Pressure: once the mean and standard deviation of this variable was measured (Table 1), the results of Mauchly's Sphericity Test were evaluated to determine whether it meets compound symmetry condition; since P:0.001, Epsilon Correction Factor was used and, subsequently, Greenhouse-Geisser test was used instead of Sphericity Test. In this regard, three questions were answered:

1. Was there any significant difference in systolic blood pressure between both groups in five periods of time? Yes, there was. according to P:0.001, there was a significant difference in systolic blood pressure between the five periods of time[Table 1].
2. Did the passage of time have any significant difference in systolic blood pressure between both groups? Yes, it did. The statistical value of P:0.001 showed that it was significant.
3. Was there any correlation between time and type serum? Yes, there was. The value of P:0.001 showed that there was a significant correlation between time and type of serum.

Table 1: Mean of Systolic Blood Pressure between both groups in different minutes

Variable	Group	Mean	SD
Systolic Blood Pressure 1	HES	124.94	11.00519
	NS	123.92	12.71079
	Total	124.42	11.82692
Systolic Blood Pressure 2	HES	114.31	13.83468
	NS	99.1667	15.99196
	Total	106.63	16.70350
Systolic Blood Pressure 3	HES	113.77	13.85022
	NS	94.3333	13.16055
	Total	103.92	16.60013
Systolic Blood Pressure 4	HES	114.06	13.96201
	NS	97.3056	9.82655
	Total	105.56	14.63238
Systolic Blood Pressure 5	HES	112.29	11.68853
	NS	103.00	7.19126
	Total	107.58	10.68064

Diastolic Blood Pressure: once the mean and standard deviation of this variable was measured, the results of Mauchly's Sphericity Test were evaluated to determine whether it meets compound symmetry condition; since P:0.003, Epsilon Correction Factor was used and, subsequently, Greenhouse-Geisser test was used instead of Sphericity Test. In this regard, three questions were answered:

1. Was there any significant difference in diastolic blood pressure between both groups in five periods of time? Yes, there was. according to P:0.001, there was a significant difference in diastolic blood pressure between both groups in the five periods of time (Table 2).
2. Did the passage of time have any significant difference in diastolic blood pressure between both groups? Yes, it did. The statistical value of P:0.001 showed that it was significant.
3. Was there any correlation between time and type serum? Yes, there was. The value of P:0.001 showed that there was a significant correlation between time and type of serum.
4.

Table 2: Mean of Diastolic Blood Pressure between both groups in different minutes

Variable	Group	Mean	SD	Number
Diastolic Blood Pressure 1	HES	78.3143	9.02862	35
	NS	78.8056	12.13453	36
	Total	78.5634	10.64322	71
Diastolic Blood Pressure 2	HES	70.7714	11.74255	35
	NS	59.9722	13.60144	36
	Total	65.2958	13.74918	71
Diastolic Blood Pressure 3	HES	66.9143	10.39053	35
	NS	56.1111	9.87284	36
	Total	61/4366	11.43520	71
Diastolic Blood Pressure 4	HES	66.0000	11.39143	35
	NS	57.3056	6.80260	36
	Total	61.5915	10.26308	71
Diastolic Blood Pressure 5	HES	64.6571	7.91478	35
	NS	60.0000	12.03566	36
	Total	62.2958	10.40933	71

Heart Rate: once the mean and standard deviation of this variable was measured (Table 3), the results of Mauchly's Sphericity Test were evaluated to determine whether it meets compound symmetry condition; since P:0.001, Epsilon Correction Factor was used and, subsequently, Greenhouse-Geisser test was used instead of Spheri2city Test. In this regard, three questions were answered:

1. Was there any significant difference in heart rate between both groups in five periods of time? No, there wasn't. according to P:0.52, there was not any significant difference in the heart rate between both groups in the five periods of time (Table 3).

2. Did the passage of time have any significant difference in heart rate between both groups? Yes, it did. The statistical value of P:0.001 showed that it was significant.
3. Was there any correlation between time and type serum? No, there wasn't. The value of P:0.364 showed that there was not any significant correlation between time and type of serum.

Table 3: Mean of patients' heart rate between both groups in different minutes

Variable	Group	Mean	SD	Number
Heart Rate 1	HES	96.0857	14.28568	35
	NS	100.42	14.78875	36
	Total	98.2817	14.60253	71
Heart Rate 2	HES	95.0286	16.12540	35
	NS	105.08	17.49020	36
	Total	100.13	17.46092	71
Heart Rate 3	HES	94.2000	13.79642	35
	NS	104.78	13.83807	36
	Total	99.5634	14.71611	71
Heart Rate 4	HES	97.0286	13.76801	35
	NS	104.78	14.48962	36
	Total	100.96	14.56948	71
Heart Rate 5	HES	93.1714	11.48781	35
	NS	103.61	14.10629	36
	Total	98.4648	13.82837	71

In present study, the level of hypotension, systolic and diastolic hypotension were described as 20% of the baseline blood pressure after 30 minutes.

Table 4: The incidence of hypotension in both groups

			Systolic Blood Pressure		Total
			<80	>80	
Group	HES	Number	4	31	35
		Group	11.0%	88.0%	100.0%
		Systolic Blood Pressure	30.0%	53.0%	49.0%
		Total	5.0%	43.0%	49.0%
	NS	Number	9	27	36
		Group	25.0%	75.0%	100.0%
		Systolic Blood Pressure	69.0%	46.0%	50.0%
		Total	12.0%	38.0%	50.0%
Total		Number	13	58	71
		Group	18.0%	81.0%	100.0%
		Systolic Blood Pressure	100.0%	100.0%	100.0%
		Total	18.0%	81.0%	100.0%

DISCUSSION

The current study aimed at investigating the effects of two different solutions on preventing spinal anesthesia complications.

1. Hypotension

Hypotension in pregnant women after spinal anesthesia is mainly due to the spinal cord sympathectomy, peripheral vascular vasodilatation, reduction of venous return to the heart and reduction of cardiac output. The variables, measured for this end, were systolic and diastolic blood pressure in different minutes during the operation.

On the one hand, the mean of baseline systolic blood pressure in the recipient group of normal saline was 123.9 which dropped to 99 after 5 minutes, 9.3 after 10 minutes and 103 after 20 minutes. On the contrary, the mean of baseline systolic blood pressure in the recipient group of Hydroxyethyl starch was 124.9 which descended to 114.3, 113.7 and 112.2 respectively after 5 minutes, 10 minutes and 20 minutes.

On the other hand, the mean of baseline diastolic blood pressure in NS recipients was 78.8 which dropped to 59.9, 56.1 and 60 correspondingly 5, 10 and 20 minutes after spinal anesthesia. Whereas, it was 78.8 in HES recipients which fell to 70.7, 66.9 and 64.6 after 5, 10 and 20 minutes respectively.

In the present study, hypotension was defined as a 20% drop in the baseline blood pressure. It was measured 25% in control group and 11% in case group. According to the aforementioned results, it can be concluded that in addition to hypotension reduction, homodynamic instability was also lower in HES than NS group.

Mercier et al. (2014) studied 167 pregnant women who had been divided into 2 groups randomly. One group received 500 cc of hydroxyethyl starch as well as 500 cc of Ringer Lactate while the other was given 1000 cc of Ringer lactate to get hydrated (17). It was found that both hypotension and marked hypotension were lower in HES than RL group (36.6 % vs. 55.3%). The results of Mercier's study were consistent with the findings of the present study (17).

Tomoko Yorozu et al. studied 67 healthy pregnant women who were volunteered for elective cesarean. In one group, 35 patients were hydrated with Ringer Lactate while the other group (32 patients) was hydrated with HES. They found that there was not any significant difference in hypotension between both groups, the results of which were not in line with the current study (18).

2. Heart Rate

Most patients have little or no significant change in heart rate. About 10 to 15% pf patients have a significant reduction in heart rate after spinal anesthesia. Like hypotension, bradycardia has a direct relationship with the increase in the level of anesthesia due to the interruption of nerves rattling the heart rate, originating from T1-T4, or reduction in venous blood return.

On the other hand, if blood pressure reduces, heart rate will go up for compensation. In HES group, the mean of baseline heart rate was 96 which fell to 93 after 30minutes while it was 100 in NS group and ascended to 103 after 30 minutes. The results indicated that changes in heart rate did not have any significant difference between both groups.

Riley et al. compared HES and Ringer Lactate. They found that hypotension in both groups of 0 patients underwent such changes i.e. hypotension was observed in 45% of the cases in the recipients of HES and Ringer Lactate compound while it was 85% in the recipients of RL. Furthermore, the highest recorded heart rate was 115 in RL group whereas it was 104 in HES-RL compound group (9). The findings of Riley's study were in line with the results of the present study.

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In a similar study by Ennasr L. Ben Mazrouk et al. (2014), similar results were found consistent with the current study. Amongst 60 pregnant women who were hydrated with NS, about 43 patients underwent severe hypotension while amongst 60 patients who were given HES, about 24 patients endured hypotension (19).

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CONCLUSION

As a final remark, hydroxyethyl starch can be used as an apt serum to hydrate pregnant women. However, further investigation into the complications of drugs on a larger sample size to find a better medication with fewer complications can help prevent many post-operative complications.

CONFLICT OF INTEREST
Authors declare no conflict of interest.

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