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Original Article

EFFECT OF HYDROXYETHYL STARCH FOR PRELOADING IN PRE-ECLAMPTIC PATIENTS UNDERGOING CAESAREAN SECTION UNDER SUB-ARACHNOID BLOCK : A COMPARISON WITH HARTMAN'S SOLUTIONS

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ABSTRACT

When sub-arachnoid block is performed on pre-eclamptic mother, profound hypotension may occur. To maintain haemodynamic stability, patients can be preloaded with crystalloid or colloid solution. 60 pre-eclamptic pregnant mothers with ASA grade I & II were randomly divided into two equal groups by blind envelop method. In Group-A, patients were preloaded with Hartman's solutions @ 15ml/kg and in Group-B, with 6% Hetastarch @ 5ml/kg. The results of the study showed that hypotension was less in group-B (10%) than group-A (56.66%). Total additional volume of fluid required to treat hypotension was less in Group-B, (803.33ml) than Group-A (1526.66ml). Only three (3) cases of Group-B required ephedrine 0.83±2.65 mg) in comparison to 17 cases of Group-A (4.50±4.79 mg). So, it can be concluded that preloading of pre-eclamptic pregnant mothers with 6% Hetastarch is superior to Hartman's solution in caesarean section after sub-arachnoid block to maintain a stable haemodynamic status.

Key words: HES; Pre-eclampsia; Subarachnoid block;

INTRODUCTION

The pre-eclampsia refers to a triad of hypertension, proteinuria and oedema occurring after 20th week of gestation and resolving within 48 hours after delivery[1]. In pre-eclampsia there is generalised vasoconstriction from elevated thromboxine and exaggerated responses to circulating catecholamines increasing both cardiac output and peripheral vascular resistance and ultimately causing profound hypertension. On the other hand, proteinuria results hypoalbuminaemia causing lowering of colloidal osmotic pressure, oedema and ultimately decreasing the blood volume[2].

The most common problems of pre-eclamptic patient after sub-arachnoid block is rapid on set of profound of hypotension[3]. Sub-arachnoid block lowers blood pressure by dilatation of resistance and capacitance vessels causing reduction in venous return. Hypotension can partially be compensated with vasopressors[4]. But preloading either by crystalloid or colloid also plays an important role in prevention of hypotension.

Crystalloids are aqueous solutions of low molecular weight ions (salts) with or without glucose. It expands the plasma volume less but its intravascular half-life is 20-30 minutes and is rapidly excreted. They rarely cause any side effect[5]. So it may be suitable alternative to maintain blood pressure after sub-arachnoid block.

The pre-eclamptic patients may be related with thrombocytopenia, platelet dysfunction, increased circulating concentration of fibrin degradation product and increased bleeding time[2]. Colloid causes volume for volume expansion exerting oncotic pressure near to that of plasma[3]. It causes less tissue and pulmonary oedema. It has minimal coagulation effect, but some time causes anaphylactoid reactions. Coagulation and bleeding time are generally not affected following 0.5 – 1L infusion of 6% Hetastarch[6]. Considering all the above factors, the present study was performed to compare the haemodynamic effects of Hartman's solution with 6% Hetastarch.

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MATERIALS AND METHODS

Sixty (60) pre-eclamptic pregnant mothers with ASA physical status I & II were included in a double-blind, randomized study. The approval of the University Ethical Clearance Committee of BSMMU was duly taken before carrying out the study. The purpose of the study was clearly explained and written informed consent was taken from each patient. The patients with history of allergic reaction to colloid, bleeding diathesis, aspirin ingestion in preceding weeks, twin pregnancies, diabetic mothers, patients receiving MgSO4, cardiovascular diseases, febrile and renal impairment were excluded. The patients were divided into two equal groups by blind envelop method. In Group-A, patients were preloaded with Hartman's solution @ 15 ml/kg and in Group-B, patients were pre loaded with 6% Hetastarch @ 5 ml/kg.

The patients were pre-loaded for half an hour with the above fluids. After pre loading Sub arachnoid block were performed at the L3-4 interspaced with the patient in the sitting position. 10 mg of 0.5% hyperbaric bupivacaine, was delivered through a 25 gauge Quincke needle. Immediately after block, the patient was placed in supine position with wedge under right buttock. Urinary catheterisation was done immediately after sub-arachnoid block. The blood pressure (Systolic, Diastolic & Mean arterial pressure) & SpO_2 were measured with an automated non-invasive device (Datex-ohemeda). Readings were recorded in the data collecting sheet.

Hypotension was defined as the systolic blood pressure drops below 100 mmHg or if pressure falls 20-30 mmHg below the pre anaesthetic level. The hypotensive patients were treated with rapid fluid infusion and incremental dose of intravenous ephedrine. After pre-loading, urine output was measured for 24 hours. After delivery of the baby, the mothers were injected with intravenous Oxytocin 5 IU, which was followed by 10 IU in drip. Total volume of additional IV fluid, required during the procedure were also recorded. Blood loss was estimated by measuring blood in suction container and also by weighing surgical mops before and after surgery. Neonatal outcome was assessed using Apgar scores by neonatologist at one and five minutes. Data was compiled on Sigma Plot and analysed by student's t-test with the help of SPSS version 6.0. All results are expressed as mean ±SD. Values were regarded as significant if $p<0.05$.

RESULTS

The two groups were statistically matched for age ($p=0.837$), weight ($p=0.654$) and height ($p=0.468$) (Table-I). Preoperative heart rate in Group-A, ranged between 76-116/min and in Group-B, ranged between 68-104/min. Systolic blood pressure in Group-A, ranged between 105-165 mm Hg and in Group-B between 120-170 mmHg. Mean heart rate in Group-A was 90.63±8.81 and in Group-B was 86.93±10.27, where $p=0.139$ (Table-II). Mean systolic blood pressure was 137.16±13.81 mmHg in group-A and 141.93±10.27 mmHg in Group-B, where $p=0.230$ (Fig.-1).

Table-I

Patients characteristics

Variables	Group-A n=30	Group-B n=30	t-value	P-value
Age in year	24.70 ±4.95	24.43 ±5.68	0.205	0.837
Weight in kg	62.96±6.08	63.89±9.47	-0.450	0.654
Height in cm	154.43±3.40	155.20±4.69	-0.729	0.468

Values are expressed as mean ± SD; analysis was done by unpaired student's t-test.
Values were significant if $p<0.05$.

Table II

Heart rate recorded before and after sub Arachnoid block in two groups

Groups	Before SAB		After SAB							
	Br-preload	Br-SAB	3-min	5-min	10-min	15-min	20-min	30-min	45-min	60-min
Group-A n=30	90.66 ±8.81	96.66 ±8.76	95.83 ±12.05	94.26 ±12.11	92.73 ±13.04	90.76 ±13.85	90.80 ±14.58	92.46 ±14.38	89.00 ±10.30	86.96 ±8.94
Group-B n=30	86.93 ±10.27	84.33 ±11.31	86.60 ±10.73	85.30 ±10.00	84.46 ±14.43	86.73 ±14.47	86.86 ±14.59	84.26 ±12.88	84.86 ±9.50	84.73 ±9.73
t	1.496	0.891	-0.263	-0.011	-0.978	1.102	2.105	2.610	1.608	0.635
P	0.139	0.376	0.792	0.990	0.331	0.274	0.039	0.011	0.113	0.527

Values are expressed as mean ± SD; analysis was done by unpaired students t-test.
Values were significant if p<0.05.

Heart rate of two studied groups are displayed, where the pre anaesthetic values were not significantly different (p=0.139) in two groups but varied significantly at 20 min (p=0.039) and 30 min (p=0.0 11) after block (Table II). Systolic blood pressure of study groups is displayed in fig-1. Base line systolic blood pressure was not significant (p=o.230) but varied significantly at 5 min (0.000), 10 min (0.003), 15 min (0.000), 20 min (0.000), 45 min (0.000) and 60 min (0.001) after block. Diastolic blood pressure are displayed in table III. Base line diastolic blood pressure was not significant (p=0.209), but varied significantly at 5 min (0.004), 10 min (0.003), 15 min (0.000), 20 min (0.0000), 45 min (0.000) and 60 min (0.000) after block (Table-III). Mean arterial pressure are displayed in Fig-2. Base line mean arterial pressure is not significant (p=0.192), but varied significantly at 5 min (0.002), 10 min (0.000), 20 min (0.000), 30 min (0.000), 45 min (0.000) and 60 min (0.000) after block. After sub-arachnoid block, incidence of hypotension in Group-A was 56.66% and in Group-B was 10%.

The mean additional IV fluid (Ringer's lactate) required to treat hypotension was 1526.66±497.53 ml in Group-A, 803.33±379.00 ml in Group-B. In Group-A, 17 (56.66%) patients developed hypotension. They were treated with additional IV fluid and ephedrine (4.50±4.79 mg). In Group-B, 3 (10%) patients developed hypotension. They were also treated with ephedrine in addition to IV fluid where mean dose of ephedrine was 0.83±2.65 mg. Two patients (6.66%) in Group-A and 4 patients (13.33%) in Group-B were required atropine respectively.

Urine output of the two studied groups was measured for 24 hours after spinal anaesthesia. In Group-A average output was 1273.33±199.45 ml, whereas, in Group-B was 1321.66±150.67 ml. and the different was not significant.

Per-operative blood loss of the two studied groups were measured. In Group-A average loss was 814.66±75.01 ml, whereas, in Group-B was 538.83±103.70 ml (P <0.005).

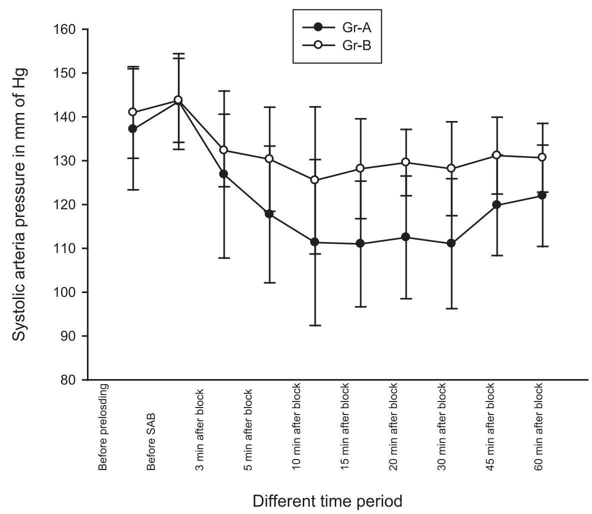

Fig 1: *Changes of Systolic Arterial pressure (mm Hg) at different time in two studied group*

Table III

Changes of diastolic arterial pressure at different time of Sub-arachnoid Block

Groups	Br-preload	Br-SAB	3-min	5-min	10-min	15-min	20-min	30-min	45-min	60-min
Group-A	90.16	90.83	82.76	77.50	74.83	72.66	72.50	78.83	76.83	78.23
n=30	±7.12	±6.30	±12.71	±10.56	±14.82	±11.27	±10.72	±14.50	±8.85	±7.18
Group-B	92.16	92.66	86.83	84.60	83.83	83.56	85.40	84.10	83.83	85.00
n=30	±4.85	±5.20	±5.33	±8.04	±5.97	±9.13	±4.73	±6.39	±6.25	±4.91
t	-1.269	-1.227	-1.615	-2.927	-3.084	-4.115	-6.026	0.555	-3.536	-4.259
P	0.209	0.224	0.111	0.004	0.003	0.000	0.000	0.580	0.000	0.000

Values are expressed as mean ± SD; analysis done by unpaired student's t-test.
Values were significant of $P<0.05$.

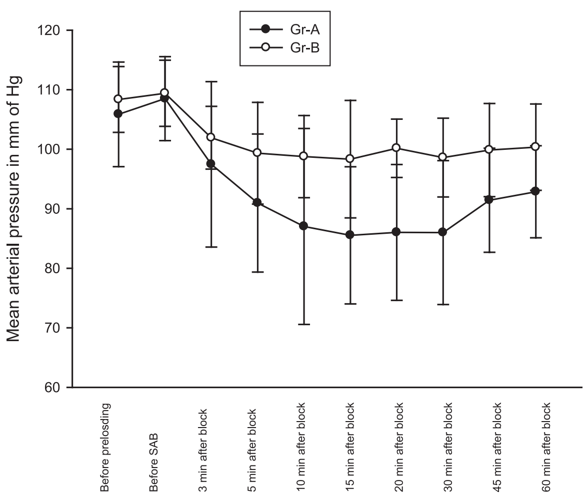

Fig.-2: *Changes of Mean Arterial pressure (mm Hg) at different time in two groups*

DISCUSSION

Pregnancy produces profound physiological changes and affects almost every organ of the body. Many of these physiological changes are adaptive and useful to mother for tolerating stress of pregnancy, labour and delivery. In cardiovascular system, cardiac output and blood volume increase to meet accelerated maternal and foetal metabolic demands[3,7].

In pre-eclampsia as plasma oncotic pressure is lowered and according to Starling's Force, fluids are not reabsorbed from the interstitial space leading to oedema[8]. Spinal anaesthesia causes dilatation of resistance and capacitance vessels, causing venous pooling, which lead to reduce venous return, and marked hypotension. The hypotension can be compensated by preloading either with crystalloid or colloid[3]. In a study, the authors signified the importance of preload where one group receiving no volume load with a group receiving 20 ml/kg over 20 minutes. There was a statistically significant reduction in the incidence of hypotension in the group receiving a volume load (71% vs. 55%)[5].

In our study, 17 cases of Group-A developed hypotension, which is about 56.66% of that study group. On the other hand, only 3 cases of Group-B developed hypotension, which is about 10% of that study population (P=0.001). This is compatible with a study, where 16% hypotension was found in hydroxyethyl starch group and 52% was found in Ringer's lactated group where tubal ligation was done under spinal anaesthesia[9]. In another study a high incidence maternal hypotension was observed during spinal anaesthesia in the crystalloid group (62%) but the incidence was lowered in colloid group (38%)[10].

About 75% of intravenous crystalloid solution diffuses into the interstitial spaces, so that about 3 to 4 times the volume of crystalloid solution is needed to achieve the same degree of blood volume expansion achieved by iso-oncotic solution. Its efficacy in expanding plasma volume is only transient. The dose-response effect of varying amount of crystalloid (10,20 & 30 ml/kg) volume prior to spinal anaesthesia was studied. Maternal colloid osmotic pressure in the 20 and 30 ml/kg groups decreased significantly than the 10-ml/kg groups. They summarised that increasing the amount of intravenous crystalloid volumes to as much as 30 ml/kg in the healthy parturients do not appear to improve maternal haemodynamics after spinal anaesthesia[11]. So, 6% Hetastarch is more logical choice to preload since they remain in the circulation for a longer time. In another study, lactated Ringer's solution 15 ml/kg was compared with 5% albumin during caesarean section under spinal anaesthesia. The albumin group developed no hypotension, where as hypotension developed in approximately 30% of the crystalloid group. The albumin is expansive and not widely used because of its high cost and less availability[12,13]. The 6% Hydroxyethylstarch exert same colloidal osmotic pressure as plasma, has lower incidence of anaphylactic reactions as compared to other colloids like Dextran and has a better efficacy in preventing venous thrombosis. In our study, the administration of 6% Hydroxyethylstarch was found to be superior to Ringer's Lactate solution in preventing spinal anaesthesia induced hypotension in patients undergoing caesarean section.

In Group-A, 17 (56.66%) cases required vasopressor-ephedrine, (4.50±4.79 mg), where as in Group-B, only 3 (10%) cases required ephedrine to control hypotension (0.83±2.65 mg). In Group-A, additional IV fluid (Ringer's lactate) was required to treat hypotension (1526.66±497.53 ml) where as in Group-B additional fluid was only 803.33±369.04 ml ($P<0.05$). In Group-A, average urine output was 1273.33±199.45 ml, whereas, in Group-B, was 1321.66±150.67 ml. Urinary output in Group-B was better as haemodynamic status was well maintained in this group.

After considering all the above factors, it can concluded that preloading of 6% Hetastarch is superior to Hartman's solution in caesarean section after sub arachnoid block in pre-eclamptic mother to maintain a stable haemodynamic status.

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