ORIGINAL ARTICLE

Comparative Efficacy of Crystalloid Preloading and Co-Loading to Prevent Spinal Anesthesia Induced Hypotension In Elective Caesarean Section

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ABSTRACT

Aim: To compare the efficacy of crystalloid preloading and co-loading for prevention of hypotension during spinal anesthesia for elective caesarean section.

Methods: This Randomized clinical trial was conducted in Department of Anesthesiology, Combined Military Hospital, Quetta. Study was carried out over a period of six months from july to December 2013. A total of 74 patients (37 in each group) were included in this study. Patients with ASA classification 1 & 2, aged 18-40 years were included. Patients with complicated pregnancy or failed spinal were excluded. Group-P received crystalloid preload and group-C was given crystalloid co-load. Blood pressure was recorded at 1,2,3,5,10 minutes. Patients received vasopressors when systolic blood pressure dropped below 90 mmHg.

Results: Total study population was 74 pregnant women underwent elective caesarean section. Mean age of the patients was 28.38±5.07 years and 28.27±5.07 years in group-P and C, respectively. Overall hypotension was noted in 23 patients (62.2%) of group-P and 18 patients (48.6%) of group-C. The difference between two groups was statistically insignificant (p=0.242). After induction of spinal anesthesia at 1 minute hypotension was noted in 6 patients (16.2%) of group-P and in 11 patients (29.7%) of group-B, at 2 minutes in 19 patients (51.4%) of group-A and in 20 patients (54.1%) of group-C, at 3 minutes in 21 patients (56.8%) of group-P and in 22 patients (59.5%) of group-C, at 5 minutes in 15 patients (40.5%) of group-P and in 16 patients (43.2%) of group-C, at 10 minutes in 11 patients (29.7%) of group-P and in 5 patients (13.5%) of group-C hypotension was developed.

Conclusion: Both preloading and co-loading with 15 ml/kg of Hartmann's solution (lactated Ringer's solution), when used alone, are ineffective for the prevention of hypotension in the obstetric population receiving spinal anesthesia.

Keywords: Elective Caesarean section, Spinal anesthesia, Crystalloid preload, Crystalloid co-load.

INTRODUCTION

Maternal hypotension is the most common cardiovascular response to spinal anesthesia [1,2] that results in decrease in cardiac output and blood flow to the placenta[3] which occurred due to decrease in venous capacitance and reduction in systemic vascular resistance as a result of sympathetic blockade caused by neuraxial anesthesia[4]. Spinal anesthesia is commonly used for elective caesarean section delivery[5], because of decreased risk of aspiration, failed intubation and maternal mortality when compared with general anesthesia[6,7]. These effects are more marked in pregnant women having aortocaval compression and decreased in peripheral vascular resistance[8].

Many techniques are used to prevent or treat spinal anesthesia induced hypotension including preloading with fluids (colloid or crystalloid), avoidance of aortocaval compression (left uterine displacement) and administration of vasopressor drugs[9]. Rapid administration of crystalloid fluid bolus over 20 minutes before spinal anaesthesia is called preload the goal is to increase venous return to preserve central blood volume and cardiac output but crystalloids are having the risk of development of pulmonary edema and also lead to postoperative urinary retention. However, fluid bolus given at the time of intrathecal injection is called co-loading. Crystalloids have a short intravascular half life of 15-20 minutes because of their rapid redistribution into the interstitial space. This is the reason that crystalloid co-load is considered to be better than crystalloid preload, as co-load expands intravascular compartment only at the time of maximum vasodilatation. It also prevents unnecessary delay in surgery in order to deliver a preload[10].

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Earlier studies showed that hypotension occurred in 85% of cases with crystalloid preload[11,12] and 59.3% of cases with co-load [13]. Another study reported 60% hypotension in crystalloid preload group and 46% in co-load group, which is not significant statistically[14]. The result of a study conducted locally was 60% hypotension occurred in crystalloid preload group and 36% in colloid preload group[15].

The objective of this study was to evaluate the efficacy of crystalloid preloading and co-loading to prevent hypotension associated with spinal anesthesia during elective caesarean section. The hypothesis was efficacy of crystalloid co-loading is better than the preloading to prevent spinal anesthesia induced maternal hypotension.

MATERIALS AND METHODS

This randomized control trial was conducted at Department of Anesthesiology, Combined Military Hospital, Quetta, Pakistan from July to December 2013

After approval from hospital ethical committee and taking written consent all healthy patients brought for elective list were included in the study. Source of patients was ones admitted through outdoors in obstetrical ward for elective caesarean section and kept on operation list. Patients were assigned randomly into two groups, group-P (Preload) and group-C (Co-load), by trainee anesthesia or anesthetist incharge of the case. Two large bore I/V cannulas were passed. Standard monitors pulse oximetery and electrocardiogram were attached. Measured baseline mean arterial pressure (MAP) by non invasive blood pressure (NIBP) technique before given preload or co-load to a patient by trainee anesthesia or anesthetist. Preload group-P received 15ml/kg Hartmann's solution (lactated Ringer's solution), 20 min before administration of spinal anesthesia. Co-load group-C received bolus of 15 ml/kg Hartmann's solution at time of administration of spinal anesthesia. Spinal anesthesia was given by consultant anesthesiologist in sitting position at L3/L4,L4/L5 space after aseptic measures with 0.75% hyperbaric 1.6ml bupivicaine with 25 guage quinckie spinal needle, who were responsible for recording hemodynamic variables for hypotension before and during spinal anesthesia. Mean Arterial Pressure (MAP) was measured after spinal anesthesia at 1 minute interval till 3 minutes, then at 5 minutes and again at 10 minutes by NIBP. All these readings were entered in a proforma. Reduction of mean arterial pressure at least 20% from baseline after spinal anesthesia was treated by injection of vasopressor (ephedrine or phenylephrine) intravenous stat; nausea and vomiting if occur, were observed and treated accordingly. Patients was handed over for procedure after 10 minutes of spinal anesthesia.. Patients going into complications during surgery were excluded. All the information was documented and collected through a proforma. All the data were entered in SPSS version 17 and analyzed using its statistical package. Mean±standard deviation was calculated for quantitative variables like age, systolic blood pressure, diastolic blood pressure, and MAP at baseline then follow up at 1 minute till 3 minutes, then at 5 minutes and 10 minutes following spinal anesthesia.

Frequency and percentage of persons developing hypotension at 1-3 minutes, 5 minutes and 10 minutes were calculated in both the groups and was compared by applying Chi-square test. p-value of <0.05 was considered significant.

RESULTS

In this study, total of 74 patients (37 in each group) were included during the study period of six months from July to December 2013. Patients were assigned into two groups. Group-P received crystalloid preload and group-C was given crystalloid co-load. Regarding age distribution, in group-P 23 patients (62.2%) and in group-C 25 patients (67.6%) were < 30 years of age while 14 patients (37.8%) in group-P and 12 patients (32.4%) in group-C were > 30 years old. Mean age of the patients was 28.38±5.07 years and 28.27±5.07 years in group-P and C, respectively (Table-1). Overall hypotension was noted in 23 patients (62.2%) of group-P and 18 patients (48.6%) of group-C. The difference between two groups was statistically insignificant (p=0.242) (Table-2).

Table 1: Distribution of cases by age (n=74)

Age (Year)	Group P	Group C
≤ 30	23(62.2%)	25(67.6%)
> 30	14(37.8%)	12(32.4%)
Total	37(100%)	37(100%)
Mean±SD	28.38±5.07	28.27±5.07

Table 2: Distribution of cases by overall hypotension(n=74)

Hypotension	Group-P (Preload)	Group-C (Co-load)
Yes	23(62.2%)	18(48.6%)
No	14(37.8%)	19(51.4%)
Total	37(100%)	37(100%)

Chi square=1.37 P value=0.242

After induction of spinal anesthesia at 1 minute hypotension was noted in 6 patients (16.2%) of group-P and in 11 patients (29.7%) of group-C (Table-3), at 2 minutes in 19 patients (51.4%) of

group-P and in 20 patients (54.1%) of group-C, at 3 minutes in 21 patients (56.8%) of group-P and in 22 patients (59.5%) of group-C, at 5 minutes in 15 patients (40.5%) of group-P and in 16 patients (43.2%) of group-C, at 10 minutes in 11 patients (29.7%) of group-P and in 5 patients (13.5%) of group-C hypotension was developed (Table 3).

Table-3: Distribution of patients developing hypotension (n=74)

Hypotension	Time	Group-P (Preload)	Group-C (Co-load)	p-value	Chi-square
Yes	1	06(16.2)	11(29.7)		
No	Min	*31(83.8)*	26(70.3)	0.167	1.907
Yes	2	19(51.4)	20(54.1)		
No	Mins	18(48.6)	17(45.9)	0.816	0.054
Yes	3	21(56.8)	22(59.5)		
No	Mins	16(43.2)	15(40.5)	0.184	0.056
Yes	5	15(40.5)	16(43.2)		
No	Mins	22(59.5)	21(56.8)	0.184	0.056
Yes	10	11(29.7)	05(13.5)		
No	Mins	26(70.3)	32(86.5)	0.090	2.871

DISCUSSION

This study was carried out to test the hypothesis that crystalloid co-load is a better option than crystalloid preload to prevent maternal hypotension during spinal anesthesia in elective caesarean section. The most common side effect associated with spinal anesthesia is hypotension. In present study, hypotension developed in 62.2% and 48.6% of the patients in preload group and co-load group, respectively (p=0.242). The value of previous preloading techniques for treatment of hypotension associated with spinal anesthesia for caesarean section has now been questioned by many studies. The importance of crystalloid preload was challenged first by Clark et al[16], he studied the use of preload, both with and without uterine displacement and compare them with control without any prophylactic measure. Crystalloid solutions have shorter half life of 15-20 minutes and rapidly diffuse into interstitial space, decreased its efficacy for prevention of postspinal hypotension.

Park et al[18], who compare different volumes of crystalloid preload 10, 20 and 30ml/kg, suggested that the incidence of hypotension was not reduced with either techniques. Tercanli et al[19] also reported the ineffectiveness of high dose crystalloid preload (15ml/kg) versus low volume(150ml) to decrease the incidence of spinal induced hypotension (45.5% in both groups)[19]. Administration of large volumes of preloaded fluid may result in hemodilution[20] and having the risk of development of pulmonary edema in susceptible patients[21].

Volume kinetic studies of Ringer Lactate solution during general and spinal anesthesia by Ewaldsson et al[22],suggested that fluid administration at time of induction of anesthesia better maintained the arterial pressure than by preloading[22]. Dyer et al. postulated that coloading limit fluid redistribution and excretion as it contribute to intravascular volume at the time of maximal vasodilatation as a result of spinal anesthesia induced sympathetic blockade.

The results of this study showed that the incidence of spinal induced hypotension in the coload group was less as compared to the preload group (48.6% vs 62.2%), however this difference was statistically insignificant. Previous studies have showed variable incidence of hypotension in the preload and coload groups in obstetrical patients. Mercier et al[23.] had noticed the incidence of hypotension as 62.5% and 50% in the crystalloid coload and preload groups respectively[23], when compare one liter crystalloid as preload versus coload. Dyer et al[17] who compared 20ml/kg crystalloid solution in parturients, reported that 84% hypotension developed in the preload group and 60% in the coload group[17]. Cardoso et al[24] observed the incidence of hypotension as 22.5% and 25% in the coload and preload groups respectively[24].In contrast to above findings, Bouchnak et al[25] who compare 20 ml/kg of crystalloid as coload or preload in the partrients[25] noticed a higher incidence of hypotension in the coload group (96.6%) versus preload group (86.6%). The differences in these studies may be due to the different amount of crystalloids used, definitions of hypotension used in the studies vary, height of block, drugs effect and the difference in the rates of administration of the crystalloids.

The results of this study is close to the study of Bannerjee et al, a meta analysis, who noticed the incidence of hypotension 59.3% in the coload group as compared with 62.4% in the preload group during spinal anesthesia in elective caesarean section. The difference between the two groups was statistically not significant[13].

This study had certain limitations. This study had

smaller sample size, of shorter duration and single centre. More studies are suggested to accept or reject the hypothesis.

CONCLUSION

It is concluded that both crystalloid preloading and co-loading, when used alone, are not effective to prevent the spinal anesthesia induced hypotension in the obstetrical patients.

RECOMMENDATION

Although both crystalloid preloading and coloading alone are ineffective for prevention of spinal induced hypotension, however, a crystalloid coload can replace a preload to save valuable time and avoid any delay in surgery.

Acknowledgement: We acknowledge the contribution of the patients who voluntarily participated in the study

Conflict of interest: Authors declare no conflict of interest

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