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Effect of Hyperbaric Bupivacaine Injection Speed of 20 vs 40 Seconds Along with Preload Colloid on Hemodynamics in Caesarean Women

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Author`s Contribution

[1,2]Substantial contributions to the conception or design of the work; or the acquisition, [3,5]Active participation in active methodology, [6,8]analysis, or interpretation of data for the work, [7,5]Drafting the work or revising it critically for important intellectual content, [4]Final approval of the study to be published

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ABSTRACT

Objective: To compare 20 seconds vs 40 seconds hyperbaric bupivacaine speed along with preload colloid in the prevention of hemodynamics like hypotension in caesarean women.

Methodology: This randomized controlled trial study was conducted in Anesthesia Department, Federal General Hospital, Islamabad from November to May 2023. Total 100 women undergoing cesarean section were systematically randomly equally allocated to hyperbaric bupivacaine injection in 20 seconds speed (n=50) or 40 seconds speed (n=50) along with preload colloid. Study outcome was hemodynamics (hypotension, heart rate and side effects) between two groups. The study outcome was measured in terms of patient hemodynamics considered as incidence of hypotension. The incidence of hypotension and nausea were compared using chi-square test. A probability level of 0.05 was considered statistically significant. . Data was analyzed in SPSS version 25.0.

Results: Patients demographics and gestational history was found comparable in the two groups. The average systolic and diastolic BP varied from 4 to 15 minutes after anesthesia induction. The incidence of hypotension was significantly high in the 40 seconds preload colloid group 27 (54.0%) compared to 12 (24.0%) in the 20 seconds group (p-value, <0.001). Rate of nausea was found similar in two study groups.

Conclusion: Incidence of hypotension was significantly high in 40 seconds group compared to 20 seconds injection speed of bupivacaine in this study.

Keywords: Hyperbaric bupivacaine, preload colloid, injection speed, 20 seconds, 40 seconds, hemodynamic control.

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Introduction

Hemodynamic derangements after spinal anaesthesia are expected in routine. Anaesthetist and intensivists look for ways to tackle these complications during and after induction of anesthesia.[1] Caesarean section is a frequent procedure and anaesthesia induction is pivotal for it. Hypotension is commonly experienced by caesarean women. If the hemodynamic derangement is not prevented it may lead to severe side effects for both mother and the child.[2] There are numerous preload and coload infusions which can prevent hypotension after spinal anaesthesia (SA).

There are other techniques for the prevention of hypotension too, these include; leg wrapping, anti-thromboembolic stockings, patient positioning, and fluid and vasopressor administration.[3] The aim of fluid

infusion prior to anaesthesia is to neutralize the hypovolemia induced by SA. The use of preload and coload colloid infusion have been in practice before spinal anaesthesia with variable effects.[4]

Scientific evidence has proven that the administration of colloid or crystalloid fluids approximately 20 min before injecting anaesthetic drug may control hemodynamics after SA.[5] Several other trials have demonstrated that colloid solutions as preloading infusion are effective in the prevention of the hypotension after SA.[6]

Despite all these measures, there are still complications related to anaesthesia in women undergoing caesarean section. Around 80.0% women have the incidence of hypotension during spinal anaesthesia for C-section.[7] This can instigate nausea and vomiting in the women which can result in a still birth or serious birth injury for the foetus. The maintenance of hemodynamics is a significant intervention towards preventing maternal and neonatal poor outcomes.[8]

Considering the significance of hemodynamic stability in SA, especially in pregnant women. Moreover, the presence of the contradictory results from earlier studies for various interventions, demands further exploration of the ideal and cost effective option. These options may include various doses of anaesthesia, frequency and speed of injection. In the local context where now most deliveries are facility based, prevention of hypotension can reduce maternal and child side effects thus, reduce burden on healthcare settings and workers. The current study was conducted with the aim to assess the effects of preload colloids and speed of hyperbaric bupivacaine on the hemodynamics after spinal anaesthesia in women undergoing c-section. Specifically, the objective was to compare 20 seconds vs 40 seconds hyperbaric bupivacaine speed along with preload colloid for preventing hemodynamic derangement in terms of hypotension in caesarean women.

Methodology

This randomized controlled trial was conducted in the department of Anesthesia and Critical Care, Federal General Hospital, Islamabad. The study was approved by hospital ethics committee, no F.3-144/Admin EC FGH and a written informed consent was taken from all study patients/guardians. A total of 50 women each undergoing c-section were randomly systematically assigned to receive hyperbaric bupivacaine in either 20 seconds or 40 seconds speed of injection. The patients were given preload colloid before induction of anesthesia.

This RCT was conducted on term Singleton Pregnancy aged 15-49 years. ASA (American Society of Anesthesiologist) I-II were selected. The patients were randomized using systematic method where every odd case was enrolled in the 20 seconds speed while every even case was assigned to 40 seconds of hyperbaric bupivacaine injection.

The patients received the preload infusion in 15 mL/kg of HES 130/0.4. As soon as the preload was completed, spinal anesthesia was initiated. Spinal anesthesia was given in 25-G Quincke needle in the sitting position at the L4-5 intervertebral spaces after preparation of anesthetic area. After observing a free cerebrospinal fluid (CSF), 2.5 ml of 0.5% hyperbaric bupivacaine was injected by the anesthesiologist.

The study outcome was measured in terms of patient hemodynamics considered as incidence of hypotension. Hypotension was considered if there was a 20% decrease in the baseline systolic BP measurement at different occasions after SA. Hypotension was assessed after 6 minutes of induction of anesthesia in this study.

Data was entered and analyzed in SPSS version 25.0. The continuous numerical variables like age, systolic and diastolic BP, MAP and heart rate were measured as mean and standard deviation. The categorical variables like nausea and hypotension were measured as frequency and percentages. As per study objective the average BP, MAP, and HR were compared using student's t-test between the two study groups i.e. 20 seconds vs 40 seconds of bupivacaine injection. The incidence of hypotension and nausea were compared using chi-square test. A probability level of 0.05 was considered statistically significant.

Results

The mean age of patients in Group A (40 seconds) was 28.0 ± 5.3 years while in group B (20 seconds), it was 30.4 ± 5.8 years, the difference was close to significant, however, not proven (p-value, 0.06). The mean gravidity was 2.7 ± 0.9 in 40 seconds group and 3.1 ± 1.2 in 20 seconds group, this difference was also statistically not significant (p-value, 0.11). The mean parity was 1.4 ± 0.7 in 40 seconds group compared to 1.6 ± 0.8 in 20 seconds group. (Table I)

At baseline the mean systolic blood pressure was 138.6 ± 12.2 mmHg in 40 seconds group while it was 139.1 ± 18.1 mmHg in 20 seconds and there was no difference in the two means. At baseline the mean diastolic BP was

Table I: Baseline and reproductive details in the two study groups. N (100)

	Group A (40 seconds) n=50	Group B (20 seconds) n=50	p-value
Age (years)			
Mean ± SD	28.0 ± 5.3	30.4 ± 5.8	0.064
Gravidity			
Mean ± SD	2.7 ± 0.9	3.1 ± 1.2	0.110
Parity			
Mean ± SD	1.4 ± 0.7	1.6 ± 0.8	0.220
Hemoglobin (mg/dl)			
Mean ± SD	11.0 ± 0.9	10.5 ± 1.3	0.130

79.1 ± 8.4 mmHg in 40 seconds group and 89.1 ± 15.1 mmHg in 20 seconds. Similarly, the baseline MAP was 98.9 ± 9.6 in 40 seconds group and 105.7 ± 16.2 mmHg and was found high in the latter group (p-value, <0.001). At 4 minutes, the mean MAP level was slightly low in 20 seconds group than the 40 seconds group. However, after 6 minutes, at 10 minutes and 15 minutes the diastolic BP (59.6 vs 76.4) dropped significantly in the 40 seconds compared to 20 seconds group. And similarly, the mean arterial pressure was also found significantly low in 40 seconds group than the 20 seconds group (p-value, <0.001). Thus, there has been a variation between the two injection speeds after the initial similar response. Further details can be found in table II.

When the average heart rate was compared among the two groups, a significant variation was noted amongst the two study groups. At 4 minutes the heart rate was almost similar in both groups (p-value, 0.06). However, at 6 minutes the heart rate jumped in the 40 seconds group to 98.6 compared to 88.6 in the 20 seconds group. At 10 minutes and 15 minutes the heart rate remained significantly low in the 40 seconds group compared to the 20 seconds group (p-value, 0.01). (Table III)

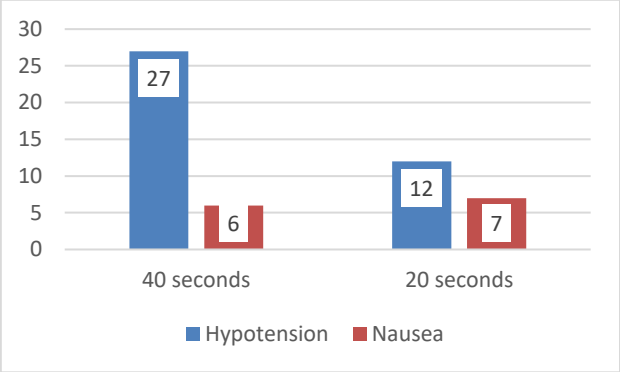
The incidence of hypotension was significantly high in the 40 seconds preload colloid group 27 (54.0%) compared to 12 (24.0%) in the 20 seconds group (p-value, <0.001). However, the rate of nausea was found comparable between the two study groups i.e. 6 (12.0%) in 40 second group and 7 (14.0%) in the 20 seconds group. (Figure I)

Table II: Comparison of baseline and post induction blood pressure and MAP between the two groups. N (100)

	Group A (40 seconds) n=50	Group B (20 seconds) n=50	p-value
Baseline Systolic BP (mmHg)			
Mean ± SD	138.6 ± 12.2	139.1 ± 18.1	0.064
Baseline diastolic BP (mmHg)			
Mean ± SD	79.1 ± 8.4	89.1 ± 15.1	0.110
Baseline MAP			
Mean ± SD	98.9 ± 9.6	105.7 ± 16.2	0.034
4 minute systolic BP (mmHg)			
Mean ± SD	135.7 ± 12.6	127.0 ± 29.9	0.010
4 minute diastolic BP (mmHg)			
Mean ± SD	78.2 ± 6.7	75.6 ± 17.0	<0.001
4 minute MAP			
Mean ± SD	97.9 ± 10.9	88.9 ± 20.0	0.110
6 minute systolic BP (mmHg)			
Mean ± SD	101.0 ± 19.5	130.1 ± 30.6	0.010
6 minute diastolic BP (mmHg)			
Mean ± SD	59.6 ± 15.7	76.4 ± 18.0	<0.001
6 minute MAP			
Mean ± SD	69.8 ± 18.4	91.6 ± 22.0	<0.001
10 minute systolic BP (mmHg)			
Mean ± SD	123.0 ± 10.6	133.0 ± 20.7	0.010
10 minute diastolic BP (mmHg)			
Mean ± SD	69.4 ± 6.0	75.5 ± 12.2	<0.001
10 minute MAP			
Mean ± SD	85.6 ± 6.9	92.6 ± 13.3	0.021
15 minute systolic BP (mmHg)			
Mean ± SD	120.4 ± 10.4	131.2 ± 23.8	0.010
15 minute diastolic BP (mmHg)			
Mean ± SD	68.1 ± 6.1	74.1 ± 15.6	<0.001
15 minute MAP			
Mean ± SD	84.2 ± 6.2	91.0 ± 16.7	0.034

Table III: Comparison of mean baseline and post induction heart rate between the two groups. N (100)

	Group A (40 seconds) n=50	Group B (20 seconds) n=50	p-value
Baseline Heart rate (min)			
Mean ± SD	84.4 ± 12.5	89.5 ± 11.8	0.06
4 minute Heart rate (min)			
Mean ± SD	80.3 ± 10.7	84.7 ± 11.2	0.01
6 minute Heart rate (min)			
Mean ± SD	98.6 ± 16.1	88.6 ± 14.6	<0.001
10 minute Heart rate (min)			
Mean ± SD	81.4 ± 12.3	88.2 ± 13.3	0.01
15 minute Heart rate (min)			
Mean ± SD	80.0 ± 13.1	88.5 ± 18.5	<0.001



Difference in hypotension rate: p-value, <0.001

Figure I: Rate of hypotension and nausea between two groups.

Discussion

This study reveals that the average blood pressure levels were significantly low in the 40 seconds hyperbaric bupivacaine group compared to 20 seconds hyperbaric bupivacaine group. Similarly, the incidence of hypotension was also found significantly high in the 40 seconds group when compared with the 20 seconds injection speed. To our knowledge this is the first attempt on comparing two injection speeds of preload colloid during spinal anesthesia in women undergoing cesarean section. Thus, this study brings new knowledge in this context as a basic evidence. The effect of preload colloid injection has been proven before, however, its speed to injecting is assessed for the first time. Previous studies by Chekol WB et al compared the speed of bupivacaine injection as up to 20s and up to 60s and witnessed that hypotension was more prevalent in fast speed.[9] In the current study in contrast findings have been witnessed where slow speed of injection of 40 seconds of preload colloid has been found associated with high rate of hypotension than the 20 seconds speed. Another study by Chiang and colleagues described that there was no differences in the incidence of spinal induced hypotension beyond 15–60 s of speed of injection.[10] One previous trial by also witnessed an in contrast finding of higher incidence of hypotension in speed of injection within 20s when compared with 60s.[11]

Ogata et al concluded that colloid preloading with moderate volume might prevent the decrease in cardiac preload with increasing ANP, however, it might not prevent spinal-induced hypotension significantly.[12] Some investigators have found that colloid preload is better than crystalloid preload resulting in increased CO and less hypotension.[13]

A systematic review regarding effect of preload colloid reported variable effects on control of hypotension in spinal anesthesia in women undergoing cesarean section.[14]

The overall incidence of hypotension after preload colloid in spinal anesthesia was noted to be 39.0% in the current study of total 100 patients. Similarly, the rate of complications like nausea and vomiting were also lesser in this trial. Many investigators have reported similar findings, a study by Chekol WB witnessed 56.8% hypotension after preload colloid.[9] A study by Shitamaw and colleagues witnessed a very high incidence of hypotension among cesarean mothers after spinal anesthesia which was 64%.[15] Others have also witnessed very high rate of hypotension during anesthesia induction in cesarean cases. Overall, the current study has comparatively low magnitude of hypotension than some of these previous studies.[16]

We noticed a variation in the heart rate as well, in the 20 seconds group it was well maintained after 6 months of induction of anesthesia compared to significant variation in the 40 seconds speed of injection. In this way it was proven that preload colloid and hyperbaric bupivacaine given in 20 seconds speed are better than 40 seconds speed in controlling hemodynamics like heart rate. Previous reports also witnessed that preload colloid has a role in controlling heart rate and overall hemodynamics.[17,18]

In brief it can be stated that this study highlights that fast speed of preload colloid (20s) in spinal anesthesia might decrease the incidence of hypotension compared to slow speed (40s). There were very few complications like nausea. As in this study few patients had prior high BP, if the true effect of speed of injection to control hypotension and other side effects in spinal anesthesia has to be evaluated then proper matching of cases with controlled BP before intervention is necessary.

Hemodynamic control during anesthesia is the hallmark of anesthetic practices. This is one of the few studies to identify the incidence of hypotension in emergency cesarean section. This finding will help primarily to reassure the magnitude of the problem to the anesthetists and to overcome the problems. There are some limitations of this study as well, we didn't include elective procedures and it was single centered study.

Conclusion

It is concluded that incidence of hypotension was significantly high in the 40 seconds group compared to the 20 seconds injection speed in this study. There were few side effects like nausea which were found equal in both groups.

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