Research Article

To Compare the Haemodynamic Parameters in Patients on Calcium Channel Blockers and Beta Blockers Undergoing Subarachnoid Block

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ABSTRACT

In lower extremity surgery, a subarachnoid block (SAB) is a regularly used anaesthetic method. SAB is most commonly related with hypotension, with hypertensive patients having a higher frequency. There is insufficient evidence on the effects of antihypertensive drugs such as calcium channel blockers and beta blockers on hemodynamic measures following subarachnoid block. The question of which antihypertensive drug should be stopped prior to surgery and which can be continued post-operatively is always a conundrum. The aim of the study is to profile Pulse rate, Systolic Blood Pressure, Diastolic Blood Pressure, and Mean Arterial Pressure in Patients on Calcium channel blockers and Beta blockers and to compare the haemodynamic parameters between both the groups. Heart rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP) was measured at baseline before the anaesthetic procedure and 3, 6, 9, 15, 30, 45, 60, 75, 90, 105 and 120 minutes after the procedure. Episodes of hypotension during surgery was also recorded. Chi-square test and ANOVA was used in checking significance of difference between outcome parameters of both groups. There was more reduction in heart rate of hypertensive patients on beta blocker therapy as compared to patients on calcium channel blockers and normotensive patients. There was more reduction of systolic, diastolic and mean arterial blood pressure in hypertensive patients as compared to normotensive patients. Hypotension was more frequently observed in patients on Calcium Channel Blocker therapy as compared to patients on beta blocker therapy and normotensive patients. After corelating findings of our study with earlier research, it can be concluded that chances of bradycardia after subarachnoid block is greater in hypertensive patients and patients on beta blocker therapy are at greater risk. From our study, it was found that hypertensive patients on calcium channel blockers were at higher risk of hypotensive episodes. Anaesthetist should be cautious and ready with rescue measures after subarachnoid block on these patients.

Keywords: Subarachnoid Block, Calcium Channel Blocker, Beta Blocker, Heart rate, Blood Pressure.

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INTRODUCTION

In lower extremity surgery, a subarachnoid block is a regularly used anaesthetic method. It's a safe and effective substitute for general anaesthesia. SAB is most commonly related with hypotension, with hypertensive patients having a higher frequency. This effect can be mitigated by using antihypertensive drugs on a regular basis. Reduced perfusion to important organs has been associated with intraoperative arterial hypotension, leading to a rise in patient's morbidity and mortality. After a subarachnoid block, it has been reported that about 16-33 percent of patients have hypotension. It rises with age, from about 36% in younger age group to 75% in patients over 50 years. In subjects with impaired neuro-humoral regulation of heart function, this effect can be amplified due to homeostasis impairment. Another factor is the quick extension of block height or the simultaneous administration of medications.[1]

A sympathetic blockade of the venous reservoir[2] occurs as a result of the subarachnoid block, resulting in blood pooling in the lower capacitance veins.[3] Pooling in the hepato-splanchnic area can affect up to 20% of the circulating blood volume when the sensory block is higher than or up to T6 level. As a result, vasopressors are required to offset the hypotensive effect of subarachnoid block (SAB). Hypertensive individuals have higher susceptibility to vasoconstrictor drugs, needing less vasopressor.

Most patients have bouts of hemodynamic instability when under Spinal anaesthesia. It is tolerable in healthy people, but it can be fatal in hypertensive patients. The large pressure changes and sympathetic hyperactivity cause this. Anaesthetists face a tremendous challenge in maintaining the hemodynamic stability during spinal anaesthesia, especially in hypertensive patients. Due to the danger of severe hypotension and the associated

management difficulties, anaesthesiologists hesitate to perform subarachnoid block in hypertensive patients. They have an excessive response to vasopressors and pulmonary oedema as a result of fluid challenges.[4]Endothelial damage and vascular remodelling caused by poorly or untreated hypertension over a long period of time can promote both arteriosclerosis and atherosclerosis. Hemodynamic response to anaesthesia is primarily influenced by structural changes in arteriolar walls. This explains why hypertensive individuals with similar degrees of sympathetic inhibition have higher alterations in systemic vascular resistance and arterial pressure than normotensive patients.[5]

There is insufficient evidence on the effects of antihypertensive drugs such as calcium channel blockers and beta blockers on hemodynamic measures following subarachnoid block. The question of which antihypertensive drug should be stopped prior to surgery and which can be continued post-operatively is always a conundrum.[6]

As a result, this study was planned to compare the hemodynamic parameters between patients on calcium channel blocker and beta blocker therapy and to assess the requirement for intravenous fluids and vasopressors after subarachnoid block in hypertensive participants using these drugs. There is no shortage of literature on the subject, however there are very few comparative studies in our area to analyse the hemodynamic changes after subarachnoid block in hypertensive patients.

MATERIALS AND METHODS

This was prospective study carried out in the Department of Anaesthesiology in tertiary care hospital of northern India. Universal sampling method was used before recruitment of study participants. The duration of study was 6 months. The study was started after getting approval from institutional ethics committee and taking informed consent from study participants.

Inclusion criteria:

- Patients posted for elective surgeries under subarachnoid block.
- Are above 20 years and below 60 years belonging to American society of Anaesthesiologist physical status I and II.
- Are diagnosed cases of essential hypertension and are on calcium channel blockers or beta blockers

Exclusion criteria:

- Patients on antihypertensive drugs other than calcium channel blockers and beta blockers.
- Patients with other co-morbid conditions like diabetes, coronary artery disease or other cardiac diseases, severe hypovolemia, sepsis.
- Pregnant women.
- Patients having contraindications for subarachnoid block.

At the preanesthetic visit, patients were assessed, explained about the anaesthetic procedure and consent was obtained. Detailed history regarding the antihypertensive medications, duration of treatment and other coexisting diseases, and other medications, if any, was obtained. On arrival in the operating room, IV cannula was inserted in the non-dominant hand. All patients were preloaded with 10ml/kg of Ringer Lactate solution. Standard monitoring including continuous ECG, pulse rate, SPO_2 and automated non-invasive blood pressure (systolic, diastolic and mean arterial blood pressure) was carried out. Baseline values were taken as the reading after infusion of fluids. The patients were allotted into two groups as per their antihypertensive treatment. The patients receiving calcium channel blockers was group I, beta-blockers were group II and the normotensive patients as the control group was group III. Lumbar puncture was performed in the sitting position with all aseptic precautions using 25-G spinal needle in the L3-L4 space. When free flow of CSF had been established, 3 ml of hyperbaric bupivacaine (0.5%) was administered over 10seconds.

Heart rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP) was measured at 3, 6, 9, 15, 30, 45, 60, 75, 90, 105 and 120 minutes after the procedure. Episodes of hypotension during surgery was also recorded.

Statistical Analysis

Data was recorded using Microsoft Excel 365 software. Data was found to be normally distributed as per Q-Q plot and Saphiro-wilk test. Chi-square test was used in checking significance of differences between categorical data such as sex distribution and episodes of hypotension while ANOVA was used in checking significance between continuous data expressed as mean $\pm$ standard deviation (SD), such as heart rate, blood pressure, mean age and body weight.

RESULTS

25 patients receiving calcium channel blocker, 24 patients receiving beta blocker and 29 patients receiving placebo were analysed and compared. Comparison of baseline demographics is given in table 1.

Table 1: Baseline demographics in different groups

	CCB (Group-I) N = 25	Beta blocker (Group-II) N=24	Normal (Group-III) N=29	P Value
Age (Mean ± SD)	51.40±12.33	48.54±10.04	44.03±7.80	**0.03 – S** (ANOVA)
Sex				
Male	10	12	15	0.66 - NS
Female	15	12	14	(Chi-Square)
Body Weight	63.12±10.78	56.58±6.15	58.66±8.79	**0.03 – S** (ANOVA)

S = Statistically Significant NS = Statistically Non-Significant

Overall, hypertensive patients were of higher age group and have higher body weight than normotensive patients. There was no significant difference between groups in sex distribution.

Table 2: Comparison of Heart rate in all the three groups

Heart rate	CCB GRP	Beta blocker	Normal	ANOVA TEST
Base line HR	79.40±11.27	80.29±8.49	77.66±10.24	F Value--3.13, **p value-0.048 – S**
HR 3 min	86.28±11.58	89.25±13.49	78.66±12.45	F Value—2.89, **p value-0.06 – S**
HR 6 min	87.08±15.28	89.88±17.86	80.76±14.49	F Value- 2.79, p value-0.067 – NS
HR 9 min	81.56±14.75	87.83±19.23	85.03±14.85	F Value—7.75, **p value<0.01 – S**
HR 15 min	74.44±13.46	78.58±14.04	82.41±14.78	F Value- 10.51, **p value-<0.01 – S**
HR 30 min	74.44±13.46	78.58±14.05	74.21±18.35	F Value- 1.79, p value-0.17- NS
HR 45 min	75.04±12.21	75.83±14.14	70.17±16.11	F Value- 0.45, p value-0.63 NS
HR 60 min	72.64±11.85	72.50±13.58	68.86±14.11	F Value- 0.21, p value-0.81 NS
HR 75 min	71.80±10.93	72.38±11.24	67.10±12.19	F Value-0.52, p value-0.59 NS
HR 90 min	72.44±10.98	71.54±6.59	66.28±13.27	F Value- 1.31, p value-0.27 NS
HR 105 min	71.24±10.46	69.54±5.50	63.62±8.47	F Value-3.26, **p value-0.04 S**
HR 120 min	70.12±10.07	67.13±5.83	65.45±9.07	F Value- 0.35, p value-0.69

S = Statistically Significant NS = Statistically Non-Significant

Table 2 shows comparison of heart rate among 3 groups. At baseline there is no significant difference between the groups but it shows significant results at 9, 15 and 105 mins. Overall, reduction of heart rate and risk of bradycardia was found more in patients on beta blocker.

Table 3: Comparison of SBP in all the three groups

SBP	CCB GRP	Beta blocker	Normal	ANOVA test P value
Base line SBP	130.72±9.32	136.46±9.63	127.59±12.99	**0.025 S**
SBP 3 min	137.32±13.59	133.17±12.38	128.10±13.06	**<0.001 S**
SBP 6 min	134.56±16.15	125.96±14.25	129.52±28.39	0.051 NS
SBP 9 min	124.76±12.09	117.75±11.03	129.93±18.46	0.16 NS
SBP 15 min	117.76±10.23	113.13±11.15	124.45±18.18	**<0.01 S**
SBP 30 min	119.12±15.51	113.88±15.03	119.45±16.62	0.21 NS
SBP 45 min	113.56±10.54	112.67±13.91	120.62±14.14	**0.07 S**
SBP 60 min	114.76±12.03	115.21±10.76	117.69±18.34	0.66 NS
SBP 75 min	115.64±13.00	114.21±11.65	114.17±23.28	0.48 NS
SBP 90 min	113.20±10.26	119.33±10.20	113.38±15.84	**<0.01 S**
SBP 105 min	114.12±11.14	118.46±10.48	115.79±12.73	**0.013 S**
SBP 120 min	115.76±10.41	118.83±9.96	115.90±11.08	**<0.01 S**

S = Statistically Significant NS = Statistically Non-Significant

Table 3 shows systolic blood pressure changes in all 3 groups. The baseline values are comparable in all 3 groups. There is significant difference between groups at 3,15,90 and 120 mins. Overall, there was more lowering of systolic blood pressure in hypertensive patients.

Table 4: Comparison of DBP in all the three groups

DBP	CCB GRP	Beta blocker	Normal	ANOVA TEST p value
Base line DBP	83.20±6.09	86.50±6.05	81.72±7.11	**0.019 S**
DBP 3 min	83.24±10.53	84.75±9.119	82.76±8.34	0.12 NS
DBP 6 min	76.44±9.439	79.50±9.217	85.86±10.78	**<0.01 S**
DBP 9 min	73.12±10.23	75.08±8.49	81.45±14.01	**<0.01 S**
DBP 15 min	74.24±12.42	73.79±10.32	78.00±12.57	0.051 NS
DBP 30 min	71.92±11.13	70.17±10.98	75.41±14.33	**0.033 S**
DBP 45 min	72.20±9.98	72.63±7.64	76.55±11.64	0.24 NS
DBP 60 min	72.68±11.08	72.46±7.56	76.66±14.93	0.55 NS
DBP 75 min	71.76±8.64	75.00±6.62	76.21±11.98	0.24 NS
DBP 90 min	72.48±9.26	74.29±8.12	73.17±12.25	0.53 NS
DBP 105 min	72.72±8.38	73.00±7.11	76.17±11.62	0.79 NS
DBP 120 min	73.00±7.04	71.75±7.23	74.90±10.95	0.94 NS

S = Statistically Significant NS = Statistically Non-Significant

Table 4 shows Comparison of diastolic BP in all the three groups at baseline and up to 120 mins. At baseline there is difference in mean DBP in all the 3 groups which is significant on applying ANOVA(P-0.019). There is no significant difference in DBP among these three group except at 6 min, and 9 min post spinal. Overall, Overall, there was more lowering of diastolic blood pressure in hypertensive patients.

Table 5: Comparison of MAP in all the three groups

MAP	CCB	Beta blocker	Normal	ANOVA Test P Value
Base line MAP	83.64±7.45	82.42±6.17	74.03±5.97	**<0.001 S**
MAP 3 min	83.12±7.38	83.33±7.46	74.03±5.98	**<0.001 S**
MAP 6 min	82.48±7.42	82.92±7.25	73.28±5.70	**<0.01 S**
MAP 9 min	80.80±7.57	81.25±7.38	72.93±5.67	**<0.01 S**
MAP 15 min	79.48±7.22	79.96±6.96	73.28±5.70	**<0.01 S**
MAP 30 min	78.72±5.99	78.75±6.11	73.21±5.63	**<0.01 S**
MAP 45 min	77.40±5.98	77.63±5.99	73.28±5.70	**0.039 S**
MAP 60 min	76.64±5.87	76.92±5.82	72.93±5.67	**0.046 S**
MAP 75 min	76.64±5.27	76.75±5.36	73.21±5.63	**0.01 S**
MAP 90 min	75.92±4.89	75.29±4.90	73.28±5.70	**0.026 S**
MAP 105 min	76.12±5.15	76.08±4.92	72.93±5.67	**0.013 S**
MAP 120 min	76.12±5.15	76.29±5.19	73.00±5.03	0.066 NS

S = Statistically Significant NS = Statistically Non-Significant

Table 5 shows Comparison of MAP in all the three groups at baseline and up to 120 min post SAB. At baseline there is difference in MAP in all the 3 groups which is significant on applying ANOVA (P-0.01). There is also significant difference in MAP among these three groups post SAB. Overall, there was more significant reduction in MAP in hypertensive patients as compared to SBP and DBP.

Table 6: Comparison of incidence of hypotension in all the three groups

Hypotension	CCB	Beta blocker	Normal
Absent	15	22	26
Present	10	2	3
Total	25	24	29

S = Statistically Significant NS = Statistically Non-Significant

Table 6 shows Comparison of incidence of hypotension in all the three groups. In normotensive group 3 study subjects had hypotension whereas 10 subjects had hypotension in CCB group and 2 subjects in beta blocker group. On applying chi-square test we found Chi square value- 10.02, p value- 0.02 which is significant.

DISCUSSION

In our study, it was found that hypertensive patients were generally older than normotensive patients. There was significant difference in age group distribution. Our result was in agreement with study by Handschin et al[7]. Our result was not in line with study of Kaimar et al[8] who concluded that demographic parameters were comparable with no significance among age group. The mean distribution of study subjects with respect to gender was not significant in our study. This was similar to the study conducted by Kaimar et al[8] which showed no significance.

Mean body weight of hypertensive patients was also higher in hypertensive patients and it was significantly higher than normotensive patients. This result was in line with study of Gelbar et al[9] which concluded that there was strong association between higher BMI and incidence of hypertension. In a study conducted by Kaimar et al[8], there was no significant difference with body weight and incidence of hypertension.

The prevalence of central obesity, metabolic syndrome and other risk factors for hypertension are generally higher in older age group as compared to young population. Similarly, it is found in study groups of our study.

The primary objective of our study was to compare the intraoperative haemodynamic parameters among 3 groups. As there was no difference in preoperative heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure, the three groups were comparable and no statistical significance was noted.

Also in our study, there was no significant difference in heart rate at different time intervals amongst the 3 groups, but there was significant difference observed at 9 mins,15 mins and 105 mins. This decrease in heart rate could be due to subarachnoid block effect reaching >=T4 level and the effect of beta blockers requiring atropine. Our results were in concordance with Kyokong et al[10] who found out that incidence of bradycardia may increase with increasing age and level >=T4 dermatomes. Also, there was greater risk of bradycardia in patients on beta blockers.

In our study, the systolic blood pressure among the 3 groups was comparable and non-significant. However, there was fall in systolic blood pressure at 15 mins, 90mins and 120 mins post subarachnoid block. This could be explained due to inadequate preloading with fluids prior to sub arachnoid block. This could also be due to use of inadequate maintenance fluid or intraoperative loss. In a study conducted by Ceruti et al[11], they concluded that significant hypotension is frequent after spinal anaesthesia and fluid administration is an empirical therapy in its management. They used ultrasound guided measurement of Inferior vena cava in 160 patients as an effective way to prevent post spinal anaesthesia hypotension.

In our study, the diastolic blood pressure showed no significant difference among the 3 groups at different time intervals. However, there was significant difference at 6 mins and 9 mins post spinal owing to sympathectomy caused by spinal anaesthesia.

At all the different time intervals the MAP in our study showed significant difference with p value of <0.01.MAP which did not vary much between calcium channel blockers and beta blockers group. However, there was significant difference when compared to normotensive group. MAP is directly related to organ perfusion. In hypertensive patient, the MAP is affected or decreased as compared to normotensive group. In our study, the comparison of I/V fluids in all 3 groups was comparable and was non-significant.

The atropine required in 3 groups showed significant result. In the subjects taking calcium channel blockers 8 out of 16 subjects required atropine. This result could be due to the block height reaching >=T4.

In our study, bradycardia was significant in beta blockers group. This was in line with Pollard et al[12] who demonstrated that bradycardia and cardiac arrest was common with beta blockers.

In our study there was significant difference in incidence of hypotension in hypertensive patients on calcium channel blockers as compared to normotensives. On comparing the use of ephedrine in all 3 groups we found no significance. Thus, we conclude that the incidence of hypotension did not require use of ephedrine.

In a study by Gebrags et al,[13] they showed that there was significant difference in MAP, Systolic blood pressure between controlled hypertensive and normotensive group following subarachnoid block. Under subarachnoid block, the patients with controlled hypertension are more likely to develop hypotension than normotensive patients.

There were certain limitations in our study. Sample size of study was smally as it was confined to single centre. Impact of concomitant medication and co-morbidities was not assessed and sub-group analysis was not done.

CONCLUSION

After corelating findings of our study with earlier research, it can be concluded that chances of bradycardia after subarachnoid block is greater in hypertensive patients and patients on beta blocker therapy are at greater risk. From our study, it was found that hypertensive patients on calcium channel blockers were at higher risk of hypotensive episodes. Otherwise, both drugs had almost similar effect on hemodynamic parameter. Either of the two antihypertensive drugs being equally effective in controlling blood pressure prior to surgery. We should be cautious in patients taking beta blockers as they are more prone to bradycardia post subarachnoid block.

The result of our study and earlier research highlights that anaesthetist should be aware of possible risks and outcomes on selective population and should keep themselves updated in this era of changing evidences.

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