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"BLOOD PRESSURE AND HEART RATE DYNAMICS IN NORMOTENSIVE AND HYPERTENSIVE PATIENTS ADMINISTERED ANGIOTENSIN RECEPTOR BLOCKERS DURING SPINAL ANESTHESIA"

Dr.Mahilamani P P 1, Dr.Sneha Susan Koshy2

1-*Professor, Department of Anesthesiology, Sree Mookambika Institute Of Medical Sciences, Kanyakumari, Tamil Nadu*

*2-Junior Resident, Department of Anes*thesiology, Sree Mookambika Institute Of Medical Sciences, Kanyakumari, Tamil Nadu

Corresponding Author- Dr.Sneha Susan Koshy, Junior Resident, Department of Anesthesiology, Sree Mookambika Institute Of Medical Sciences, Kanyakumari, Tamil Nadu

ABSTRACT

Background: Hypotension is the most common complication associated with spinal anesthesia, particularly prevalent in patients with a history of hypertension. Regular use of antihypertensive medications can help mitigate this effect. However, the continuation of drugs that inhibit the renin-angiotensin-aldosterone system on the day of surgery remains a subject of debate.

Aims and Objectives: This study aims to examine the intraoperative changes in blood pressure (BP) and heart rate in patients on angiotensin receptor blockers (ARBs) undergoing surgery under spinal anesthesia, comparing the results with those of normotensive patients.

Materials and Methods: We compared 30 normotensive patients (Group A) with 30 hypertensive patients who regularly took ARBs and continued their medication on the day of surgery (Group B). Baseline BP and heart rate were recorded for all participants. After spinal anesthesia, BP and heart rate were monitored at predetermined intervals. The primary parameters evaluated included changes in mean arterial pressure and heart rate.

Results: In both the cases and controls, the fall was maximally seen at 10 min post-spinal anesthesia. The fall of SBP in the controls or cases was statistically significant from 10 min post-spinal anesthesia when compared with baseline of the same group as analyzed by one-way ANOVA followed by a post hoc analysis. The DBP dropped after spinal anesthesia in both cases and controls and the fall was maximally seen at 10 min post-spinal anesthesia. The fall of DBP in the controls or cases was statistically significant over the time periods starting at 8 minutes when compared with baseline of the same group. There was a fall in the MAP following spinal anesthesia , but the fall was statistically significant within the group from 6 minutes post-spinal

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anesthesia. The heart rate also reduced after spinal anesthesia with a maximum fall at 10 min in Group A and 6 min in Group B

Conclusion: Hypertensive patients who continue ARBs on the day of surgery have an increased risk of intraoperative hypotension. Nonetheless, this hypotension can be effectively managed with vasopressor agents.

INTRODUCTION

Hypotension is the most common complication associated with spinal anesthesia, particularly in patients with a history of hypertension[1]. While antihypertensive medications can help control blood pressure (BP) and mitigate this effect, their varying impacts on the cardiovascular system may lead to significant hemodynamic changes during the initial phase of spinal anesthesia. A thorough understanding of these agents will enable anesthesiologists to anticipate potential hemodynamic alterations.

Most anesthetic agents, both general and spinal, reduce the influence of sympathetic tone on the cardiovascular system. Consequently, there is increased reliance on the renin-angiotensin system (RAS) to maintain BP during anesthesia. Drugs that antagonize the RAS—such as angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs)—can impair the RAS response to hypotension, thereby increasing the intraoperative risk of hypotension[2]. This often necessitates inotropic support to restore BP to normal levels.

Research has examined the effects of antihypertensive medications on both general[3,4] and spinal anesthesia[5]. Studies have also explored the benefits of continuing calcium channel blockers and beta-blockers on the day of surgery in both types of anesthesia. However, findings regarding the continuation of ACE inhibitors on the day of surgery for patients undergoing spinal anesthesia have been inconsistent. The debate over the continuation of drugs that inhibit the renin-angiotensin-aldosterone system remains ongoing[6,7].

This study aims to observe and analyze the effects of ARBs on BP and heart rate in patients undergoing surgery under spinal anesthesia, particularly when these medications are continued on the day of surgery.

MATERIALS AND METHODS

The present randomized controlled study was conducted at Sree Mookambika Institute of Medical Sciences, Kulasekharam from January 2024 to December 2024. A total of 60 patients

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undergoing surgery under spinal anesthesia were included in the study. Group A, the control group, comprised 30 normotensive patients, while Group B, the test group, consisted of 30 hypertensive patients who were on monotherapy with angiotensin receptor blockers (ARBs).

Inclusion Criteria

Patients with essential hypertension who have been on angiotensin receptor blockers (ARBs) for at least 1 month.

Patients scheduled for elective surgeries under spinal anesthesia.

Exclusion Criteria

Patients with coexisting conditions such as diabetes, coronary artery disease, cardiac diseases, severe hypovolemia, pregnancy, and sepsis were excluded from the study.

At the preanesthetic clinic, after obtaining written informed consent, a detailed history was collected from each patient regarding their antihypertensive medications, duration of treatment, coexisting diseases, and concomitant medications.

Upon arrival in the operating room, all patients were preloaded with 10 mL/kg of Ringer's lactate (RL) solution. Standard monitoring included continuous electrocardiography, pulse rate, oxygen saturation via pulse oximetry, and automated non-invasive blood pressure (NIBP) measurements. Baseline values were recorded during the rest period following fluid infusion.

Lumbar puncture was performed with all aseptic precautions in the L3–L4 space. Once free flow of cerebrospinal fluid was established, 3 mL of 0.5% hyperbaric bupivacaine was administered over a 10-second period. The patient was then positioned supine.

Non-invasive blood pressure (NIBP) and pulse rate were recorded every 2 minutes for the first 10 minutes, followed by recordings every 5 minutes until the end of the surgical procedure, specifically at 2, 4, 6, 8, 10, 15, and 20 minutes.

Hypotension was defined as a decrease in mean arterial pressure (MAP) of more than 30% from baseline within a 20-minute interval, with relevance defined as the need for therapeutic intervention using fluids or pressors within the same timeframe. If hypotension occurred, it was treated with 6 mg of mephentermine and intravenous fluids at a rate of 5 mL/kg until both systolic blood pressure (SBP) and MAP increased above the threshold level. The time to the rescue dose and the total dose of rescue medication were recorded.

Bradycardia, defined as a heart rate of less than 50 beats per minute that did not respond to intravenous fluids, was treated with 0.6 mg of atropine administered intravenously (IV) as a stat

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dose. Maintenance infusion of Ringer's lactate (RL) was continued throughout the surgery, and the total volume of IV fluid administered was recorded. The administration of all rescue medications was at the discretion of the anesthetist.

OBSERVATION AND RESULTS

Baseline data were analyzed using descriptive statistics. The changes in systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate were analyzed as follows:

Changes in each parameter within the groups were first assessed using one-way ANOVA. Post hoc tests were then conducted to determine which group exhibited the maximum variability compared to baseline.

Intergroup comparisons at 2, 4, 6, 8, 10, 15, and 20 minutes were performed using an unpaired t-test, comparing the data from the control and test groups.

Statistical significance was defined as follows: $P \leq 0.001$ was considered very highly statistically significant; $P \leq 0.01$ was highly statistically significant; $P \leq 0.05$ was statistically significant; and $P > 0.05$ was considered statistically insignificant.

A total of 60 patients undergoing surgery under spinal anesthesia were included in the study. Group A, the control group, consisted of 30 normotensive patients, while Group B, the test group, included 30 hypertensive patients on monotherapy with angiotensin receptor blockers (ARBs). All patients were deemed fit for surgery by both the physician and the anesthetist prior to the procedure.

SBP

The mean SBP was 124.7 mm of Hg and 130.2 mm of Hg in the Group A and Group B, respectively, at the baseline before the patient was administered spinal anesthesia. The SBP dropped after spinal anesthesia. In both the cases and controls, the fall was maximally seen at 10 min post-spinal anesthesia. The fall of SBP in the controls or cases was statistically significant from 10 min post-spinal anesthesia when compared with baseline of the same group as analyzed by one-way ANOVA followed by a post hoc analysis. The unpaired t-test did not show any difference statistically when the changes in the SBP were compared between Group A and Group B at the respective time intervals

DBP

The mean DBP was 77.06 mm of Hg and 84.4 mm of Hg in the Group A and Group B, respectively, at the baseline [Figure 2]. The DBP dropped after spinal anesthesia in both cases

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and controls and the fall was maximally seen at 10 min post-spinal anesthesia. The fall of DBP in the controls or cases was statistically significant over the time periods starting at 8 minutes when compared with baseline of the same group. The unpaired t-test showed that the fall was greater in the control group than the cases at 2 min, 6 min, 8 min, and 10 min (P = 0.02, 0.05, 0.01, and 0.01, respectively)

MAP

The change seen in MAP was similar to the SBP and DBP. The baseline mean of MAP was 92.7 mm of Hg and 102.6 mm of Hg in the control and case group, respectively. There was a fall in the MAP following spinal anesthesia , but the fall was statistically significant within the group from 6 minutes post-spinal anesthesia. When the MAP of Group A was analyzed against the data obtained from Group B, there was a significant drop of more than 30% in patients of Group B (P = 0.04)

Heart Rate

The mean heart rate at the baseline was 80.8 bpm in controls and 79.6 bpm in cases. The heart rate also reduced after spinal anesthesia with a maximum fall at 10 min in Group A and 6 min in Group B. In both the groups, there was an increase in heart rate after the maximal drop, but the increase in Group B was greater than the increase in Group A. There was statistical significance in the heart rate changes within the groups

	GROUP A(Age)	GROUP B(Age)	GROUP A	GROUP B	GROUP A(Weight)	GROUP B(Weight)
N	30	30	30	30	30	30
Missing	1	1	1	1	1	1
Mean	51.0	55.5			60.3	61.7
Median	51.0	56.5			62.5	61.0
Standard deviation	7.73	9.54			7.39	6.39
Minimum	37	40			45	46
Maximum	67	69			72	76

DISCUSSION

In our study, we identified patients on antihypertensive

medications, without any coexisting illnesses. We enrolled

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30 patients in each group. Group A or the control group

consisted of 30 normotensive patients and Group B or the test

group consisted of 30 hypertensive patients on monotherapy

with ARBs. The SBP dropped after spinal anesthesia. In both the cases and controls, the fall was maximally seen at 10 min post-spinal anesthesia. The fall of SBP in the controls or cases was statistically significant from 10 min post-spinal anesthesia when compared with baseline of the same group as analyzed by one-way ANOVA followed by a post hoc analysis. The unpaired t-test did not show any difference statistically when the changes in the SBP were compared between Group A and Group B at the respective time intervals

The DBP dropped after spinal anesthesia in both cases and controls and the fall was maximally seen at 10 min post-spinal anesthesia. The fall of DBP in the controls or cases was statistically significant over the time periods starting at 8 minutes when compared with baseline of the same group

There was a fall in the MAP following spinal anesthesia , but the fall was statistically significant within the group from 6 minutes post-spinal anesthesia. When the MAP of Group A was analyzed against the data obtained from Group B, there was a significant drop of more than 30% in patients of Group B ($P = 0.04$)

The heart rate also reduced after spinal anesthesia with a maximum fall at 10 min in Group A and 6 min in Group B. In both the groups, there was an increase in heart rate after the maximal drop, but the increase in Group B was greater than the increase in Group A. There was statistical significance in the heart rate changes within the groups

Hypotension is the most common physiological effect of spinal anesthesia, yet it is frequently misinterpreted as a complication. It is crucial to differentiate between the physiological effects of anesthetic techniques and actual complications that could harm patients.

Rooke et al. found that elderly patients experience an exaggerated decrease in blood pressure (BP) following spinal anesthesia. They noted that individuals with cardiovascular disease also exhibit significant decreases, with systemic vascular resistance dropping by approximately 25% and cardiac output decreasing by about 10%.

Additionally, Singla et al. identified several variables that are independently associated with an early fall in BP after anesthesia. These include age, female sex, body mass index (BMI) of 30 kg/m^2 or higher, history of hypertension, diabetes, anemia, baseline heart rate, and baseline systolic and diastolic BP. Furthermore, a pulse pressure and vascular overload index, along with a sensory level of blockade at or above T6, are also linked to this early hypotensive response.

Our study allowed us to observe the natural course post-anesthesia based on the anesthetist's judgment. The parameters for evaluation were defined according to previous studies, ensuring

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that patient well-being was not compromised. However, the limitations of this study include a small sample size of 30 and the potential presence of undiagnosed cardiovascular and concomitant conditions in the participants.

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