Section: Anaesthesia

Original Research Article

COMPARISON OF HAEMODYNAMIC RESPONSE FOLLOWING SUBARACHNOID BLOCK BETWEEN CONTROLLED HYPERTENSIVE AND NORMOTENSIVE PATIENTS UNDERGOING BELOW-UMBILICUS SURGERY

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ABSTRACT

Background: Subarachnoid block is commonly used for surgeries below the umbilicus. Hypotension and bradycardia remain important intraoperative concerns, particularly in patients with hypertension or those receiving antihypertensive therapy. The aim is to compare haemodynamic response following subarachnoid block between controlled hypertensive and normotensive patients undergoing below-umbilicus surgery. **Materials and Methods:** This comparative cross-sectional observational study included 160 patients aged 18-65 years undergoing elective lower limb, urological, perineal, or lower abdominal surgery under spinal anaesthesia. Eighty controlled hypertensive patients receiving antihypertensive medication were categorized as Group A and 80 normotensive patients were categorized as Group B. Haemodynamic parameters, incidence of hypotension, rescue intravenous fluid, mephentermine requirement, bradycardia, atropine use, and two spinal segment regression time were recorded. **Result:** Incidence of hypotension was higher in controlled hypertensive patients than in normotensive patients [25/80 (31.25%) vs 19/80 (23.75%)], but the difference was not statistically significant (p=0.288). Controlled hypertensive patients had a significantly greater percentage decrease in systolic blood pressure at 15, 20, and 25 minutes and a greater percentage decrease in diastolic blood pressure at 10 and 15 minutes. Among patients who developed hypotension, mephentermine requirement was numerically higher in controlled hypertensive patients and 6 mg mephentermine requirement was significantly more common in controlled hypertensive patients. **Conclusion:** Controlled hypertensive patients showed greater fall in blood pressure following subarachnoid block, although the overall incidence of hypotension was not statistically different from normotensive patients. Anesthesiologists should anticipate potential haemodynamic changes and tailor interventions accordingly.

INTRODUCTION

Subarachnoid block is a form of neuraxial regional anaesthesia involving the injection of local anaesthetic drug into the subarachnoid space with or without additives. It is used as an alternative to general anaesthesia commonly in surgeries involving the lower limbs, surgeries below umbilicus and urological surgeries. It blocks motor, sensory and autonomic or sympathetic response. This blockage of sympathetic or autonomic responses can lead to intra operative complications like hypotension and bradycardia.

Hypotension is defined as systolic blood pressure (SBP) 20% below the base line or <90 mmHg.[1] This is more likely to happen to those patients who have peak block height of more than T5, female gender, elderly patients, body mass index more than 30kg/m2 and history of hypertension or on antihypertensive therapy, severe anemia or diabetes mellitus.[2,3]High level block > T5 and age >40 years are the two main predictors of haemodynamic instability with an incidence of hypotension after subarachnoid block(SAB) between 15.3 to 33%.[4-7]

Bradycardia occurs due to blockage of sympathetic fibers. These fibers arise from T1-T5 preganglionic

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cardiac accelerator fibers. Bradycardia can also be due to reflexive slowing of heart rate due to vasodilatation which reduces venous return to right atrium where stretch receptors respond by compensatory slowing of heart rate. Factor that may increase the likelihood of exaggerated bradycardia (40-50 beats per min) include baseline heart rate less than 60 beats per minute, age younger than 37 years, male gender, non emergency status, on beta-blockers.[9]

Recent guidelines have emphasized more on avoiding hypotension during neuraxial anaesthesia (defined as 20-30% below base line).[10] Hypotension leads to decreased vital organ perfusion causing increased morbidity and mortality. To reduce the possibility of vital organ ischemia or infarction due to hypotension or bradycardia, various techniques are being used like co-loading IV fluid(15 ml/kg), vasopressors and physical method such as slight trendelenburg position of patient.[11]

Hypertensive patients have increased sympathetic activity, increased nor-epinephrine levels and decreased parasympathetic activity. When these patients receive subarachnoid block, it causes loss of elasticity and structural changes of arterial wall that leads to decreased SBP.[12]

Some studies showed no significant difference in incidence of hypotension between normotensive and controlled hypertensive patients during sub arachnoid blocks.[4,13,14] Other studies showed that incidence of hypotension was approximately two times more in controlled hypertensive patients than normotensive patients and require more intravenous fluids or vasopressors.[15-17]

The present study is aimed to determine the hemodynamic changes and intra operative intravenous fluid or vasopressor requirements in controlled hypertensive and normotensive patients undergoing below umbilicus surgery during spinal anaesthesia so that intraoperative hypotension and ischemia of vital organs can be prevented and predicted in advance.

MATERIALS AND METHODS

Study design, setting and population:

Study Design: Comparative Cross Sectional Observational Study.

Study Duration: 18 months.

Place of Study: The study was conducted in the Department of Anaesthesia & Intensive care, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, after obtaining approval from institutional ethical committee. Written informed consent was taken from all patients participating in the study.

Study Population: Patients aged 18-65 years.

Inclusion criteria

- Patients aged 18 – 65 years.
- Normotensive Patients with BP=<120/6o mmHg,
- Controlled hypertensive Patients with BP<140/90 mmHg on anti-hypertensive medications including taking the medication on the day of the surgery.
- American Society of Anesthesiologists (ASA) physical status I or II.
- Patients scheduled for elective surgeries for lower abdomen, lower limbs, urological and perineum under spinal anesthesia.

Exclusion criteria

- Patients with other coexisting diseases like valvular cardiac diseases, severe hypovolemia, sepsis and coagulopathy.
- Pregnancy.
- Patients with known allergy to local anesthetic
- Contraindications to spinal anaesthesia.

Methodology: PAC was performed for all patients, and preoperative NPO instructions were provided. Patients on antihypertensive medications were instructed to continue their medications until the morning of surgery. After fulfilling all eligibility criteria, the nature of the study was explained in detail to the patients, and written informed consent was obtained from all willing participants. A total of 160 patients, including controlled hypertensive and normotensive individuals, undergoing lower limb, urological, or surgery below the umbilicus, were divided into two groups. Eighty patients receiving antihypertensive medication and well-controlled were assigned to group A, while 80 normotensive patients not receiving antihypertensive medications were assigned to group B.

Upon arrival in the operating room, an 18-G IV cannula was inserted in the non-dominant hand, and all patients were co-loaded with 15ml/kg of crystalloid. Standard monitoring, including continuous ECG, pulse rate, SpO2, and automated noninvasive blood pressure (systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP)) was done. Lumbar puncture was performed in the sitting or lateral position with all aseptic precautions using a 25-G Quincke–Babcock spinal needle in the L3-L4 intervertebral space. Upon establishment of free flow of CSF, 12.5-15mg of 0.5% hyperbaric bupivacaine with 10ug fentanyl was administered over 0.2ml per second.

Motor blockade was assessed using the modified Bromage scale, and sensory blockade level was determined with pinprick at 2 and 5 minutes after the blockade to achieve a sensory level of T6.

Noninvasive blood pressure and heart rate were recorded every 2 minutes for the first 10 minutes and then every 5 minutes until the end of the procedure. Patients were given oxygen at a rate of 4-5L/min through a venturi mask.

Hypotension was defined as a decrease in mean arterial blood pressure of more than 20% or SBP < 90 mmHg. Hypotensive patients were treated with rescue IV boluses of Inj. Mephentermine 3mg IV bolus while receiving IV fluids at 10 ml/kg until both

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SBP increased above the threshold level. The number of times Mephentermine was used was noted.

Bradycardia was defined as a heart rate less than 50 beats per minute. Patients with bradycardia and hypotension were treated with injection Atropine 0.6 mg IV bolus. Maintenance infusion of Ringer lactate was continued throughout the surgery. Side effects like nausea and vomiting were treated accordingly. The total administration of IV fluids, vasopressors, and two spinal segment regressions were noted in both groups.

Sample size and calculation: The study of Gebrargs, et al 16 observed that 23.6% of controlled hypertensive and 7.3% of normotensive patients had hypotension. Taking these values as reference the minimum required sample size with 80% power of study and 5% level of significance is 74 patients in each study group. Taking dropout rate of 5%, total sample size taken is 156 (78 patients per group). To reduce margin of error, total sample size taken is 160 (80 patients per group)

Formula used is:

n>=((pc*(1-pc)+pn*(1-pn))*(Zα + Zβ)2)/(pc-pn)2

with

pc= hypotension in controlled hypertensive

pn= hypotension in normotensive

Where Zα is value of Z at two sided alpha error of 5% and Zβ is value of Z at power of 80% .

Calculations :-

n>= (.236*(1-.236)+.073*(1-.073))* (1.96+.84)2)/ (.236-.073)2

>=73.17=74(approx.)

Taking dropout rate of 5%, n>=74/.95>=77.89=78(approx.)

Statistical analysis: The presentation of the Categorical variables was done in the form of number and percentage (%). On the other hand, the quantitative data were presented as the means ± SD and as median with 25th and 75th percentiles (interquartile range). The data normality was checked by using Shapiro-Wilk test. The cases in which the data was not normal, we used non parametric tests. The following statistical tests were applied for the results:

1. The comparison of the variables which were quantitative and not normally distributed in nature were analysed using Mann-Whitney Test and variables which were quantitative and normally distributed in nature were analysed using Independent t test.
2. The comparison of the variables which were qualitative in nature were analysed using Chi-Square test. If any cell had an expected value of less than 5 then Fisher's exact test was used.

The data entry was done in the Microsoft EXCEL spreadsheet and the final analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, version 25.0.

For statistical significance, p value of less than 0.05 was considered statistically significant.

Ethical issues: This study is being undertaken to comparatively evaluate haemodynamic response and intra operative intravenous fluid (IV Fluid) or vasopressor requirement in controlled hypertensive and normotensive patients undergoing below umbilicus surgery during subarachnoid block. Approval from IEC was obtained before starting the study. Patient meeting the inclusion criterion will be included in the study. A written informed consent was taken from all the enrolled patients in a language well understood by them (ANNEXURE ll).. All the information procedure from the study shall be kept confidential and for academic purposes only.

RESULTS

The study was conducted in the Department of Anaesthesia & Intensive care, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi. 160 patients (controlled hypertensive and normotensive patients) who had undergone any lower limb, urological or surgery below umbilicus were included in the study. 80 patients who received antihypertensive medication and were well controlled were categorized as controlled hypertensive (Group A) and 80 patients who had BP <120/60 and did not receive any antihypertensive medications were categorized as normotensive (group B). Incidence of hypotension was studied and results are as follows.

Out of a total of 160 cases, 80 cases (50.00%) were categorized as controlled hypertensive, and normotensive.

[Table 4] presents the distribution of individuals across different age groups, categorized by their hypertension status (controlled hypertensive or normotensive). The findings reveal significant variations in age distribution between controlled hypertensive and normotensive groups. Specifically, within the 18-20 age bracket, there is a notable difference with 5% of controlled hypertensive individuals compared to 20% of normotensive individuals (p = 0.007). Additionally, in the 41-50 age range, there's a significant difference with 20% of controlled hypertensive individuals compared to 8.75% of normotensive individuals (p = 0.043). Distribution of age group : 21 to 30 years (p=0.137), 31 to 40 years (p=0.339), 51 to 60 years (p=0.101), 61 to 65 years (p=1) between controlled hypertensive and normotensive.

However, across the entire age spectrum, when considering mean age, there is a statistically significant difference between controlled hypertensive and normotensive groups, with controlled hypertensive individuals having a higher mean age (38.35 years ± 12.78) compared to normotensive individuals (31 years ± 12.01), with a p-value of 0.0002.

Overall, these results highlight age-related disparities between controlled hypertensive and normotensive

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groups, suggesting potential age-related factors influencing hypertension status.

The distribution of gender was similar between the controlled hypertensive and normotensive groups. Specifically, in the controlled hypertensive group, 18.75% were female and 81.25% were male, while in the normotensive group, 20% were female and 80% were male. The calculated p-value for this comparison was 0.841, indicating no statistically significant difference in gender distribution between the two groups.

Table 1: Baseline demographic characteristics between controlled hypertensive and normotensive patients.

Variable	Controlled hypertensive (n=80)	Normotensive (n=80)	Total	P value
Age 18-20 years	4 (5%)	16 (20%)	20 (12.50%)	0.007
Age 21-30 years	24 (30%)	33 (41.25%)	57 (35.63%)	0.137
Age 31-40 years	20 (25%)	15 (18.75%)	35 (21.88%)	0.339
Age 41-50 years	16 (20%)	7 (8.75%)	23 (14.38%)	0.043
Age 51-60 years	14 (17.50%)	7 (8.75%)	21 (13.13%)	0.101
Age 61-65 years	2 (2.50%)	2 (2.50%)	4 (2.50%)	1
Age, mean ± SD	38.35 ± 12.78	31 ± 12.01	34.67 ± 12.9	0.0002‡
Age, median (25th-75th percentile)	36.5(28-48.25)	26.5(22-37.25)	31(24-45)	
Female	15 (18.75%)	16 (20%)	31 (19.38%)	0.841†
Male	65 (81.25%)	64 (80%)	129 (80.63%)	

Values are presented as n (%) unless otherwise stated. † Chi-square test; ‡ Independent t-test; * Fisher exact test.

Significant difference was seen in systolic blood pressure(mmHg) pre-operative, at 1 minute, at 3 minutes, at 5 minutes, at 10 minutes, at 40 minutes, at 85 minutes between controlled hypertensive and normotensive (p value <0.05).

No significant difference was seen in systolic blood pressure(mmHg) at 15 minutes (p value=0.115), at 20 minutes(p value=0.935), at 25 minutes(p value=0.825), at 30 minutes(p value=0.647), at 35 minutes(p value=0.268), at 50 minutes(p value=0.754), at 55 minutes(p value=0.984), at 60 minutes(p value=0.35), at 65 minutes(p value=0.543), at 70 minutes(p value=0.454), at 75 minutes(p value=0.217), at 80 minutes(p value=0.181), at 90 minutes(p value=0.199), at 95 minutes(p value=0.838), at 100 minutes(p value=0.671), at 105 minutes, at 110 minutes between controlled hypertensive and normotensive.

A significant difference was observed in the percentage change in systolic blood pressure (mmHg) at 15 minutes, 20 minutes, and 25 minutes between the controlled hypertensive and normotensive groups (p value < .05). In the normotensive group, the median (25th-75th percentile) of the percentage decrease in systolic blood pressure (mmHg) at 15 minutes, 20 minutes, and 25 minutes was -8.93 (-13.472 to -1.932), -7.97 (-12.654 to -1.261), and -7.53 (-14.583 to 0.208), respectively. These values were significantly lower in magnitude compared to the controlled hypertensive group, which had a median of -12.54 (-21.921 to -7.024) at 15 minutes (p value = 0.0004), -13.82 (-20.962 to -9.263) at 20 minutes (p value < .0001), and -13.82 (-20.583 to -8.645) at 25 minutes (p value < .0001), respectively. . Which means controlled hypertensive group experience more decrease in percentage of change in SBP then normotensive groups.

Significant difference was seen in diastolic blood pressure(mmHg) pre-operative, at 1 minute, at 85 minutes between controlled hypertensive and normotensive(p value <.05).

No significant difference was seen in diastolic blood pressure(mmHg) at 3 minutes (p value=0.435), at 5 minutes(p value=0.133), at 10 minutes(p value=0.202), at 15 minutes(p value=0.767), at 20 minutes(p value=0.735), at 25 minutes(p value=0.339), at 30 minutes(p value=0.521), at 35 minutes(p value=0.734), at 40 minutes(p value=0.951), at 50 minutes(p value=0.494), at 55 minutes(p value=0.803), at 60 minutes(p value=0.831), at 65 minutes(p value=0.737), at 70 minutes(p value=0.98), at 75 minutes(p value=0.821), at 80 minutes(p value=0.503), at 90 minutes(p value=0.819), at 95 minutes(p value=0.401), at 100 minutes(p value=0.143) between controlled hypertensive and normotensive.

A significant difference was observed in the percentage change in diastolic blood pressure (mmHg) at 10 minutes and at 15 minutes between the controlled hypertensive and normotensive groups (p value < .05). The median (25th-75th percentile) of the percentage decrease in diastolic blood pressure (mmHg) at 10 minutes was -3.08 (-7.833 to 6.839) and at 15 minutes was -1.52 (-10.239 to 5.287) in the normotensive group. These values were significantly decreasing in magnitude compared to the controlled hypertensive group, which had a median of -8.13 (-16.061 to 3.077) at 10 minutes (p value = 0.003) and -7.84 (-17.27 to 1.956) at 15 minutes (p value = 0.002), respectively.

A Significant difference was seen in mean arterial pressure(mmHg) at 1 minute, at 3 minutes, at 5 minutes, at 85 minutes between controlled hypertensive and normotensive.(p value <.05)

Mean ± SD of mean arterial pressure(mmHg) at 1 minute, at 3 minutes, at 5 minutes, at 85 minutes in controlled hypertensive was 88.51 ± 8.29, 85.2 ± 8.13, 82.73 ± 9.15, 84.53 ± 5.92 respectively which was significantly higher as compared to normotensive (83.67 ± 5.95(p value<.0001), 82.01 ± 7.47(p value=0.011), 79.05 ± 7.52(p value=0.006), 79.4 ± 6.11(p value=0.004)) respectively.

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No significant difference was seen in mean arterial pressure(mmHg) at 10 minutes (p value=0.191), at 15 minutes(p value=0.769), at 20 minutes(p value=0.84), at 25 minutes(p value=0.452), at 30 minutes(p value=0.547), at 35 minutes(p value=0.447), at 40 minutes(p value=0.264), at 50 minutes(p value=0.71), at 55 minutes(p value=0.464), at 60 minutes(p value=0.527), at 65 minutes(p value=0.95), at 70 minutes(p value=0.711), at 75 minutes(p value=0.62), at 80 minutes(p value=0.833), at 90 minutes(p value=0.909), at 95 minutes(p value=0.572), at 100 minutes(p value=0.242) between controlled hypertensive and normotensive.

A significant difference was observed in the percentage change in mean arterial pressure (mmHg) at 20 minutes and at 25 minutes between the controlled hypertensive and normotensive groups (p value < .05). The median (25th-75th percentile) of the percentage decrease in mean arterial pressure (mmHg) at 20 minutes was -6.83 (-12.369 to -0.425) and at 25 minutes was -7.44 (-13.621 to 0.403) in the normotensive group . These values were significantly lower in magnitude as compared to the controlled hypertensive group, which had a median of -12.11 (-18.027 to -5.516) at 20 minutes (p value = 0.002) and -12.01 (-18.773 to -4.408) at 25 minutes (p value = 0.002), respectively.

Table 2: Significant percentage changes in blood pressure parameters after subarachnoid block.

Parameter and time point	Controlled hypertensive (n=80)	Normotensive (n=80)	Total	P value
Systolic blood pressure: At 15 minutes	Mean -12.92 ± 9.52; Median -12.54(-21.921--7.024)	Mean -7.27 ± 8.42; Median -8.93(-13.472--1.932)	Mean -10.1 ± 9.4; Median -10.57(-16.397--3.427)	0.0004§
Systolic blood pressure: At 20 minutes	Mean -14.54 ± 10.09; Median -13.82(-20.962--9.263)	Mean -6.97 ± 8.41; Median -7.97(-12.654--1.261)	Mean -10.75 ± 10.01; Median -10.92(-17.742--4.338)	<.0001§
Systolic blood pressure: At 25 minutes	Mean -14.8 ± 9.44; Median -13.82(-20.583--8.645)	Mean -7.05 ± 9.27; Median -7.53(-14.583-0.208)	Mean -10.92 ± 10.1; Median -11.76(-17.771--3.564)	<.0001§
Diastolic blood pressure: At 10 minutes	Mean -6.22 ± 14.08; Median -8.13(-16.061-3.077)	Mean -0.42 ± 12.52; Median -3.08(-7.833-6.839)	Mean -3.32 ± 13.6; Median -5.11(-13.433-4.977)	0.003§
Diastolic blood pressure: At 15 minutes	Mean -7.47 ± 14.65; Median -7.84(-17.27-1.956)	Mean -0.35 ± 12.86; Median -1.52(-10.239-5.287)	Mean -3.91 ± 14.2; Median -5.14(-11.986-3.226)	0.002§
Mean arterial pressure: At 20 minutes	Mean -12.02 ± 11.52; Median -12.11(-18.027--5.516)	Mean -7 ± 10.93; Median -6.83(-12.369--0.425)	Mean -9.51 ± 11.47; Median -9.78(-15.942--2.006)	0.002§
Mean arterial pressure: At 25 minutes	Mean -11.88 ± 10.74; Median -12.01(-18.773--4.408)	Mean -6.16 ± 10.85; Median -7.44(-13.621-0.403)	Mean -9.02 ± 11.14; Median -9.36(-16.091--2.33)	0.002§

Values are percentage change from baseline. § Mann-Whitney test.

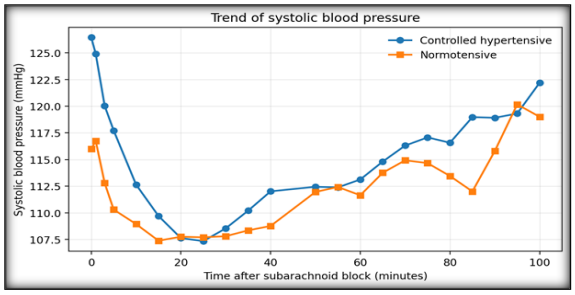

Figure 1: Comparison of trend of systolic blood pressure (mmHg) at different time intervals between controlled hypertensive and normotensive patients.

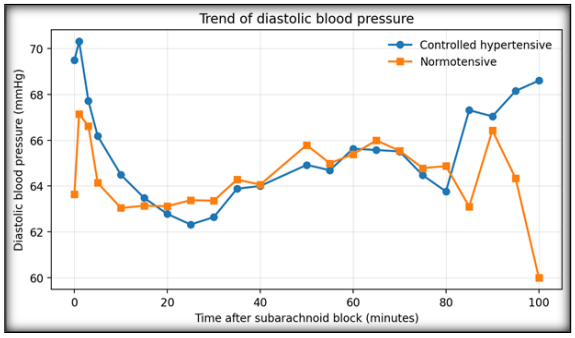

Figure 2: Comparison of trend of diastolic blood pressure (mmHg) at different time intervals between controlled hypertensive and normotensive patients.

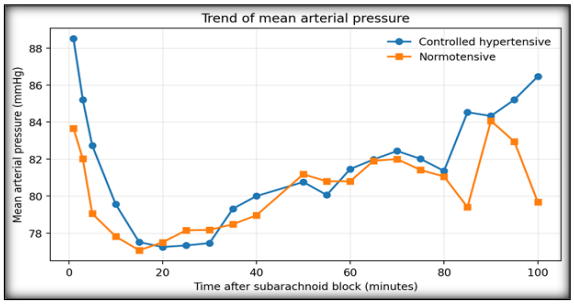

Figure 3: Comparison of trend of mean arterial pressure (mmHg) at different time intervals between controlled hypertensive and normotensive patients.

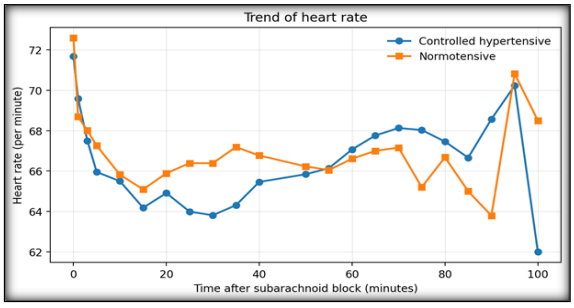

Figure 4: Comparison of trend of heart rate (per minute) at different time intervals between controlled hypertensive and normotensive patients.

* Fisher's exact test, † Chi square test

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The distribution of the requirement for rescue IV fluid was similar between the controlled hypertensive and normotensive groups. Specifically, in the controlled hypertensive group, 31.25% did required rescue IV fluid, while 68.75% did not required. In the normotensive group, the corresponding percentages were 23.75% for requiring rescue IV fluid and 76.25% for not requiring it. The calculated p-value for this comparison was 0.288, indicating no statistically significant difference in the distribution of the need for rescue IV fluid between the two groups.

* Fisher's exact test, † Chi square test

The Comparison of injection Mephentermine who experience hypotension between controlled hypertensive(n=25) and normotensive (n=19)were also calculated Showed in table 13. Specifically, in the controlled hypertensive group who experience hypotension, 56% did require injection Mephentermine, while 44% did not. In the normotensive group patients who underwent hypotension ware, the corresponding percentages were for 42.11% requiring injection Mephentermine and 57.89% for not requiring it. The calculated p-value for this comparison was 0.361, indicating no statistically significant difference in the distribution of the need for injection Mephentermine between the two groups (table 14).

However, the proportion of patients receiving injection Mephentermine at a dose of 6mg was significantly higher in the controlled hypertensive group compared to the normotensive group (92.86% vs 25%). Conversely, the proportion of patients receiving injection Mephentermine at a dose of 3mg was significantly lower in the controlled hypertensive group compared to the normotensive group (7.14% vs 75%). The p-value for these dose-specific comparisons was 0.002, indicating statistical significance.

Significant difference was seen in heart rate(per minute) at 25 minutes, at 30 minutes, at 35 minutes, at 75 minutes between controlled hypertensive and normotensive (p value <0.05).

Mean ± SD of heart rate(per minute) at 75 minutes in controlled hypertensive was 68.03 ± 6.98 which was significantly higher as compared to normotensive (65.2 ± 6.57(p value=0.032)).

Mean ± SD of heart rate(per minute) at 25 minutes, at 30 minutes, at 35 minutes in normotensive was 66.39 ± 7.76, 66.39 ± 7.77, 67.19 ± 7.83 respectively which was significantly higher as compared to controlled hypertensive (63.99 ± 7.43(p value=0.047), 63.81 ± 6.21(p value=0.022), 64.31 ± 5.23(p value=0.007)) respectively.

In both the controlled hypertensive group (comprising 80 individuals) and the normotensive group (also consisting of 80 individuals), all participants, accounting for 100% in each group, did not experience bradycardia. The total number of participants across both groups was 160, and none of them had occurrences of bradycardia. No p-value is provided for this comparison since there is no variability in the occurrence of bradycardia; it is uniformly "No" for both groups.

In both the controlled hypertensive group (comprising 80 individuals) and the normotensive group (also consisting of 80 individuals), all participants, accounting for 100% in each group, did not require injection Atropine. The total number of participants across both groups was 160, and none of them needed injection Atropine. No p-value is provided for this comparison since there is no variability in the need for injection Atropine; it is uniformly "Not required" for both groups.

No significant difference was seen in SpO_2(%) pre-operative (p value=1) and thorough out intra operative period (p value=1) between controlled hypertensive and normotensive.

In both the controlled hypertensive group (comprising 80 individuals) and the normotensive group (also consisting of 80 individuals), all participants, accounting for 100% in each group, exhibited the T10 level of block. The total number of participants across both groups was 160, and none of them had a block level other than T10. No p-value is provided for this comparison since there is no variability in the level of block; it is uniformly "T10" for both groups.

The mean ± standard deviation (SD) of the time for two spinal segments regression (in minutes) in the controlled hypertensive group was 67.38 ± 6.21, while in the normotensive group, it was 66.38 ± 7.07. There was no statistically significant difference observed between the two groups, as indicated by a p-value of 0.343.

The mean ± standard deviation (SD) of total IV fluid volume (in mL) in the controlled hypertensive group was 1707.5 ± 239.61, while in the normotensive group, it was 1733.75 ± 298.5. There was no statistically significant difference observed between the two groups, as indicated by a p-value of 0.54.

The median (25th-75th percentile) of blood loss (in mL) in the controlled hypertensive group was 50 (50-150), while in the normotensive group, it was 100 (50-150). No statistically significant difference was observed between the two groups, as indicated by a p-value of 0.411.

The median (25th-75th percentile) of blood loss in patients with hypotension was 100 mL (with a range of 50-162.5), significantly higher than those without hypotension, where the median was 50 mL (with a range of 50-100). The statistical analysis yielded a p-value of 0.013, indicating a significant difference between the two groups.

The median blood loss (25th-75th percentile) in individuals with controlled hypertension was 50 mL (50-150), while in normotensive individuals, it was 100 mL (100-200). There was no statistically significant difference between the two groups, as indicated by a p-value of 0.137.

The median blood loss (25th-75th percentile) in individuals with controlled hypertension was 50 mL (50-50), while in normotensive individuals, it was 100 mL (50-125). Notably, there was no observed

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statistically significant difference between the two groups, as evidenced by a p-value of 0.132.

The median blood loss (25th-75th percentile) among individuals with controlled hypertension was 150 mL (100-175), while in normotensive individuals, it was also 150 mL (100-225). Importantly, there was no statistically significant difference observed between the two groups, as indicated by a p-value of 0.637.

Table 3: Hypotension, rescue intervention, bradycardia, atropine and level of block.

Outcome	Controlled hypertensive	Normotensive	Total	P value
Hypotension - No	55 (68.75%)	61 (76.25%)	116 (72.50%)	0.288†
Hypotension - Yes	25 (31.25%)	19 (23.75%)	44 (27.50%)	0.288†
Rescue IV fluid not required	55 (68.75%)	61 (76.25%)	116 (72.50%)	0.288†
Rescue IV fluid required	25 (31.25%)	19 (23.75%)	44 (27.50%)	0.288†
Mephentermine not required	66 (82.50%)	72 (90%)	138 (86.25%)	0.168†
Mephentermine required	14 (17.50%)	8 (10%)	22 (13.75%)	0.168†
Mephentermine 3 mg among hypotensive patients	1 (7.14%)	6 (75%)	7 (31.82%)	0.002*
Mephentermine 6 mg among hypotensive patients	13 (92.86%)	2 (25%)	15 (68.18%)	0.002*
Bradycardia	0 (0%)	0 (0%)	0 (0%)	NA
Injection atropine required	0 (0%)	0 (0%)	0 (0%)	NA
Level of block T10	80 (100%)	80 (100%)	160 (100%)	NA

† Chi-square test; * Fisher exact test. Mephentermine dose distribution is among patients who developed hypotension and required mephentermine.

Table 4: Percentage of hypotension in different class of antihypertensive medications.

Types of antihypertensive therapy	Total no. Of patients	% of patients who had hypotension
CCB	9	44%
Beta-blockers (BB)	7	85%
ARBs	23	5%
CCB+BB	9	44%
CCB+ARB	32	18%

Table 5: Two spinal segment regression, total intravenous fluid and blood loss between groups.

Variable	Controlled hypertensive	Normotensive	Total	P value
Two spinal segment regression, mean ± SD (min)	67.38 ± 6.21	66.38 ± 7.07	66.88 ± 6.65	0.343‡
Two spinal segment regression, median (25th-75th percentile)	70(60-70)	65(60-70)	70(60-70)	0.343‡
Total IV fluid, mean ± SD (mL)	1707.5 ± 239.61	1733.75 ± 298.5	1720.62 ± 270.13	0.54‡
Total IV fluid, median (25th-75th percentile)	1800(1800-1800)	1800(1500-1800)	1800(1500-1800)	0.54‡
Blood loss, mean ± SD (mL)	98.12 ± 69.1	107.5 ± 75.52	102.81 ± 72.3	0.411§
Blood loss, median (25th-75th percentile)	50(50-150)	100(50-150)	50(50-150)	0.411§

Table 6: Association of blood loss with hypotension.

Blood loss (mL)	With hypotension(n=44)	Without hypotension(n=116)	Total	P value
Mean ± SD	125 ± 78.87	94.4 ± 68.13	102.81 ± 72.3	0.013§
Median(25th-75th percentile)	100 (50-162.5)	50 (50-100)	50 (50-150)	0.013§
Range	50-300	50-300	50-300	0.013§

§ Mann-Whitney test.

DISCUSSION

In our study, we identified patients on antihypertensive medications, without any coexisting illnesses. 80 patients who received antihypertensive medication and were well controlled were categorized as controlled hypertensive (Group A) and 80 patients who had BP <120/60 and did not receive any antihypertensive medications were categorized as normotensive (group B).

Hypertension is defined as a sustained systolic blood pressure above 140 mm Hg or a diastolic pressure above 90 mm Hg, hypertension affects about one-quarter of the global population. In adult surgical patients, nearly one-third presenting for noncardiac surgery and two-thirds presenting for coronary bypass have a preexisting history of hypertension. The incidence of hypertension increases with age. It is more prevalent in men until age 45, the gender disparity dissipates at age 64.[24] In our study similar findings were revealed. Significant variations in age distribution between controlled hypertensive and normotensive groups were seen in age bracket of 41-50 year where the maximum significant difference was seen between controlled hypertensive and normotensive (20% and 8.75% respectively) with p value of 0.043. However significant difference was seen in the age bracket of 18- 20 year where 5% patients were hypertensive as compared to 20% normotensive patients with p value of 0.007 showing that hypertension can strike even at younger age group in small percentage of people. Also the mean age of controlled hypertensive calculated was 38.35 yr +12.58 as compared to 31.04 yr +12.01 in normotensive group (p value =0.0002) suggesting age related factors influence hypertension. This aligns well with the existing knowledge that the incidence of hypertension increases with age.[24,25]

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In present study we didn't find any gender related comparative significance within two age group which aligns well with findings from previous study.[13,24]

In the present study, significant difference in SBP and change(drop) in the interquatile range (25th-75th percentile) of controlled hypertensive was observed at various time intervals as compared to the normotensive group. This is shown in figure, table. Similar findings were reported by Gebrargs at al in his study where the maximal drop of mean SBP was seen at 25 min and 30 min in the controlled hypertensive (CH) group than normotensive group where the drop of mean SBP in the CH group was higher than the normotensive group,[11]

A possible reason for non significant value after 30 min may be that the episode of hypotension had been effectively managed without serious hazard to the patient.[11]

Similarly, the comparison of diastolic BP and the change(drop) in the median of interquatile range (25th-75th percentile) was significant at 10min. and 15min. in controlled hypertensive as compared to normotensive patients (p value =<0.05) as shown in figure, table,9 respectively. While in contrast to our study Gebrargs et al found that the maximal fall of mean DBP was seen 25 min in the CH group and in the N group at 25 min,30 min, and 35 min., but was not statistically significant. Possible explanation was diastolic blood pressure should remain unchanged or rise slightly. The exact DBP threshold has been widely debated or unclear. Furthermore, whether this threshold differs in patients with obstructive coronary disease who may be vulnerable to reduced coronary perfusion during diastole is a point of debate.[20]

The mean arterial pressure was significantly higher in controlled hypertensive group as compared to normotensive at various time intervals as showed in table.

This is because of higher basal blood pressure values in hypertensive group as compared to normotensive group.

Hypotension is defined as systolic blood pressure (SBP) 20% below base line or <90 mmHg.[1] Multiple studies done by Whiteside at al, Critchley at al, Fukuda at al, Sigdel et al, Park et al at different centers concluded that hypotension is more likely to happen to those patients who have peak block height of more than T5, female gender, elderly patients, body mass index more than 30kg/m3 and history of hypertension or on antihypertensive therapy, severe anemia or diabetes mellitus.[2,3] Monotherapy with CCB was effective in 50% of hypertensive patients and combination therapy with beta-blockers effective in 30-40% of hypertensive patients.[22] Block > T5 and age >40 years are the two main predictors of haemodynamic instability with an incidence of hypotension after subarachnoid block(SAB) between 15.3 to 33%.[4-7] SBP, DBP, MAP and HR are most significant predictors of morbidity and patients cardiac events.

Our study showed that incidence of hypotension was more in controlled hypertensive patients 25 (31.25%) than in normotensive 19 (23.75%), but was not statistically (p value =0.288) indicating that as expected hypotension occurs more in controlled hypertensive but it is not significant. The result of present study is concurrent with the research by Fukuda et al and Nishikawa et al that demonstrated that normalizing preoperative blood pressure with antihypertensive therapy eliminated differences in hypotension incidence between hypertensive and normotensive patients, suggesting that effective antihypertensive treatment improves vascular structure and reduces basal sympathetic activity.[4,26]

Amongst the patient who did develop hypotension, the distribution of rescue IV fluids was similar in both groups. In controlled hypertensive 25 (31.25%) and in normotensive group (23.75%) of patients needed rescue IV fluid. A maximum of 21 patients that was 84%of controlled hypertensive needed 400ml of rescue IV fluid (i.e. 200ml bolus twice) as compared to 14 patients i.e. 73% of normotensive group. 4 patients(16%) in controlled hypertensive group and 3 patients (15.79%) in normotensive needed 600ml (i.e. 200ml bolus thrice) as showed in table, figure. This finding of rescue IV fluids indicated that hypotension, when occurred in both groups was managed effectively with rescue iv fluids and with similar amount needed in either groups.

Ceruti at al in his study concluded that the use of ultrasound-guided measurement of the inferior vena cava before spinal anesthesia proved effective in mitigating hypotension risks and optimizing fluid management strategies.[23]

Apart from rescue IV fluid 14 patients (56%) of controlled hypertensive patients needed injection Mephentermine as compared to 8 patients (42.11%) in normotensive patients this however was not statistically significant (p=0.361). However proportion of patients receiving injection Mephentermine at a dose of 6mg (rescue Mephentermine twice) was 92.85% which is significantly higher than 25% (2 patients), the proportion of patients receiving injection Mephentermine 6mg in normotensive patients. The lower dose of 3mg injection Mephentermine needed to control hypotension in controlled hypertensive was statistically significant (p=0.002) but much lower 7%(1 patient) as compared to 25%(2 patients) in normotensive group. This means that when hypotension occurred in controlled hypertensive it needed statistically more amount of injection mephentermine in the present study as compared to normotensive individuals, which aligns well with results from previous studies.[13-17]

An intra group comparison was made in controlled hypertensive patients to observe if any type of antihypertensive medication usage cause more hypotension as compared to another group of antihypertensive. Patients on beta blocker (atenolol) had maximum 85% incidence of hypotension. Patients on calcium channel blockers (amlodipine) whether given alone (44%) or in combination with beta-blockers (45%) had similar incidence of

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hypotension. Patients on angiotensin II receptor blockers (telmesartan) had lowest incidence of hypotension when given alone 21% and when given in combination with calcium channel blocker (18%). In contrast to our study Kaimar at al found that the number of times mephentermine was used to treat hypotension was significant in the patients receiving calcium channel blockers while incidence of bradycardia in patients treated with β-blockers being significant (P<0.001).[13]

Kavyashree et al also reported hypotension was more prevalent in patients on CCB and require more rescue vasopressors and fluids, while bradycardia (heart rate <60) was more frequent in patients on beta blocker and often requiring atropine, both statistically significant (P < 0.001).[22] .

Dinakar at al in his study concluded that there is an increased chance of intraoperative hypotension in hypertensive patients receiving ARBs on the day of surgery, but the hypotension can be managed effectively with vasopressor agents. There was no significant change in the heart rate and DBP.[15]

Here the disparity in results may be due to the fact that in theses studies, they had taken equal number of patients in each antihypertensive group while in our study we selected controlled hypertensive patients irrespective of antihypertensive medications Anesthesiologists should anticipate and prepare for potential complications accordingly.

The study by Acar et al., showed the results which were similar to our study where the incidence of hypotension between controlled hypertension and normotensive patients was not statistically significant (p > 0.05).[14] The incidence of hypotension was 20% (6 out of 30) in controlled hypertension and 3.3% (1 out of 30) in the normotensive group. In contrast to our study, Gebrargs et al discussed that SBP had a drop of 25% more than the baseline which was seen in 13 (23.6%) in controlled hypertension and 4 (7.3%) in the normotensive group. There was a statistically significant difference between the two groups (p 0.018).[16] Overall, the findings from our study did not match with findings from Gebrargs et al study. The inconsistent result may be due to the different management protocols, techniques of patient monitoring, and antihypertensive medications used.

Hypertensive individuals exhibit heightened sympathetic activity and elevated levels of norepinephrine, coupled with reduced parasympathetic activity. This persistent sympathetic stimulation, independent of hypertension per se, contributes to arterial wall rigidity and structural alterations, leading to increased peripheral vascular resistance. Studies indicate a direct correlation between basal sympathetic activity and post-sympathetic block blood pressure reductions. Furthermore, the magnitude of blood pressure decline post-spinal anesthesia correlates with preoperative blood pressure levels.

The sympathetic nervous system regulates intravascular fluid volume, and dehydration due to insufficient fluid intake amplifies sympathetic activity. Prehydration, guided by heart rate variability as an indicator of sympathovagal balance, has been shown to mitigate hypotension risk post-spinal anesthesia. Hypertensive individuals typically exhibit reduced venous capacitance, implying that sympathetic blockade following spinal anesthesia may further diminish central volume and venous return to the heart. However, antihypertensive therapy's ability to enhance venous capacitance alongside peripheral vascular resistance elucidates the lack of significant difference in hypotension incidence between normotensive from controlled hypertensive patients.[10,11,18,24]

With regard to the change in heart rate in our study, no patients developed bradycardia with bradycardia being defined as HR less than 50bpm. Significant difference was seen in heart rate(per minute) at 25 minutes, at 30 minutes, at 35 minutes, at 75 minutes between controlled hypertensive and normotensive.(p value <.05) Mean ± SD of heart rate(per minute) at 75 minutes in controlled hypertensive was 68.03 ± 6.98 which was significantly higher as compared to normotensive (65.2 ± 6.57(p value=0.032) . While in study by Gebrargs et al 7 patients in each group developed bradycardia and required rescue medication injection Atropine which is 12.7%, and there was no statistically significant difference between the two groups (p > 0.05).[16] In another similar study (Dinakar et al.) It was shown that the occurrence of bradycardia was 4 (13.3%) patients in each group, which was not different.[15] Another study which was done by Acar et al. showed the occurrence of bradycardia to be 6 (20%) in controlled hypertension and 7 (23.3%) in normotensive patients which was consistent with our findings (p value >0.05).[14] Variation in percentage between the current study and the other studies may be due to the difference in sample size used in those studies .

Heart rate may decrease during a high neuraxial block as a result of blockade of the cardioaccelerator fibers arising from T1 to T4 Heart rate may also decrease in the presence of extensive peripheral sympathectomy (T5-L2), with venous pooling in the lower extremity and the abdominal and pelvic viscera. Although hypotension will trigger a compensatory baroreceptor sympathetic response (vasoconstriction and increased heart rate) above the level of blockade, the reduction in venous return and right atrial filling causes a decrease in signal output from intrinsic chronotropic stretch receptors located in the right atrium and great veins, leading to a marked increase in parasympathetic activity (vagal tone).[28] The two opposing responses are usually in check with a minimal change in heart rate (or a slight reduction). However, when neuraxial anesthesia is extended to the T1 level, blockade of the cardioaccelerator fibers in addition to a marked reduction in venous return may result in severe bradycardia and even asystole because of unopposed parasympathetic activity. However rare, the

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likelihood of cardiac arrest appears to be more likely in young, healthy, and conscious patients. The Bezold-Jarisch reflex may be a possible cause of profound bradycardia and circulatory collapse after spinal anesthesia, especially in the presence of hypovolemia, when a small end-systolic left ventricular volume may trigger a mechanoreceptor-mediated bradycardia.[8]

In the present study the level of block didn't reach T4-T5 as the nature of surgery was below umbilicus. In our study there is no statistical significant difference in intraoperative blood loss with hypotension as showed in table,23,26.

Limitations of the Study

Our study had several key limitations. We could not evaluate the effect of antihypertensive medication in SAB based on the duration of treatment. However, we could evaluate the difference in hemodynamic parameters between monotherapy and combination therapy antihypertensive treatments. We could not corroborate body mass index with hypertension as we did not record patient height. We also did not use invasive arterial blood pressure monitoring or inferior vena cava ultrasonography to assess fluid responsiveness.

CONCLUSION

In this study, we investigated the incidence of hypotension among surgical patients on antihypertensive medications, comparing controlled hypertensive individuals with normotensive counterparts. Despite a higher occurrence of hypotension in the controlled hypertensive group, statistical significance was not reached, indicating effective management strategies. Significant age variations between the groups highlighted the impact of age-related factors on hypertension. Notably, hypertension was observed even in younger age groups, underscoring the importance of early detection and intervention. Analysis of blood pressure parameters revealed substantial differences, with controlled hypertensive patients experiencing more significant drops. However, both groups demonstrated similar responses to hypotensive episodes, suggesting effective management protocols. The study also examined the influence of antihypertensive medications on hypotension incidence, revealing varying responses among different medication groups. While further research is warranted to refine management strategies, our findings contribute valuable insights into perioperative blood pressure management for hypertensive patients. Anesthesiologists should anticipate potential complications and tailor interventions accordingly. Despite discrepancies with previous studies, likely due to differences in protocols and patient populations, our results emphasize the need for individualized approaches to hypertension management in the perioperative setting.

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