

Original Research Article

A COMPARISON OF HEMODYNAMIC CHANGES FOLLOWING SUBARACHNOID BLOCK BETWEEN CONTROLLED HYPERTENSIVE AND NORMOTENSIVE PATIENTS UNDERGOING LOWER LIMB SURGERIES

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ABSTRACT

Background: Hypotension is the most common complication post subarachnoid block. Hypertensive patients can develop wide fluctuations in blood pressure following subarachnoid block intraoperatively due to sympathetic blockade with increased risk of postoperative cardiac and renal complications such as myocardial ischemia, cardiovascular accident, acute renal failure which increase morbidity and mortality. We conducted study to find out whether the hypotension is significant in controlled hypertensive or normotensive patients.

Materials and Methods: The comparative prospective observational study included 84 patients posted for elective lower limb surgeries under subarachnoid block. Patients were allocated in two groups. one group is 42 Normotensives (GROUP N) and other group is 42 Controlled Hypertensives (GROUP H, who were on regular Angiotensin receptor blockers, Tablet. TELMISARTAN 40 milligrams once daily, monotherapy). The baseline Systolic blood pressure, Diastolic Blood pressure, Mean Arterial Pressure and Heart Rate were recorded and compared after subarachnoid block at predetermined fixed intervals.

Results: Haemodynamic changes were recorded at various time interval. Significant differences in mean Heart Rate were observed between two groups from 25 minutes to 75 minutes. More fall in systolic pressure was found from 5 to 30 minutes in controlled hypertensive groups compared to normotensive group which was statistically significant. Requirement of mephentermine was more in hypertensive group. No incidence of bradycardia in both the groups. Nausea, vomiting, shivering is higher in hypertensive group than normotensive group which was insignificant.

Conclusion: There was more incidence of hypotension in controlled hypertensive group compared with normotensive group after subarachnoid block with 0.5% hyperbaric bupivacaine.

Keywords: Hypertension, Angiotensin receptor blocker, Subarachnoid block, Hypotension.

INTRODUCTION

Subarachnoid block is an anaesthetic technique which is frequently, widely and popularly used which provides excellent anaesthesia and postoperative analgesia for lower abdominal, pelvic and lower limb surgeries¹. The main concern with subarachnoid

block is hypotension which is due to sympathetic blockade with cardiovascular alternations like decrease in Cardiac Output, Stroke Volume, Heart rate, Central Venous Pressure².

The counteractive physiological mechanism to prevent these alternations of cardiovascular system are vasoconstriction of unblocked upper part of body

and application of Mary's law by which heart rate is increased to maintain the cardiac output³.

In patients with controlled hypertension on various class of drugs may compromise defence mechanism and may lead to exaggerated hypotension⁴.

Hypertension is a major cause of premature death worldwide which is one of the most common noncommunicable diseases in general population. Hypertensive patients can develop wide fluctuations in blood pressure following subarachnoid block intraoperatively with increased risk of postoperative cardiac and renal complications such as myocardial ischemia, cardiovascular accident, acute renal failure which increase morbidity and mortality⁵. This study aims to observe the hemodynamic changes following subarachnoid block between controlled hypertensive patients (on Tablet TELMISARTAN 40 milligrams once daily) and normotensive patients.

MATERIALS AND METHODS

Total 84 patients were included in the study after obtaining institutional ethical committee approval and written informed consent of patients. Patients undergoing elective lower limb procedures, ASA GRADE 1 or 2, Patients with age 18 to 60 years, Patients diagnosed to have essential hypertension receiving antihypertensive medications (on Tablet Telmisartan 40 milligrams once daily) at least for 2 months, were allocated to one of the two study groups (n= 42).

Group N: Normotensive group (n=42)

Group H: Controlled Hypertensive group on Angiotensin Receptor Blockers (Tablet TELMISARTAN 40 milligram once daily), (n=42). Patients who do not give consent for regional anaesthesia, ASA GRADE 3 or 4, Pregnant women, Patients with other coexisting disease like cardiac disease (coronary artery disease, MI, valvular heart disease) diabetes mellitus, severe hypovolemia, sepsis, renal disease, liver disease, coagulopathies etc., Patients having contraindications to subarachnoid block were excluded from study.

All pre-anaesthetic evaluation of the patients was performed by an anaesthesiologist a day before the surgery. Basic investigations including complete blood count, blood grouping, blood sugar levels fasting and postprandial, Kidney function tests, serum electrolytes, Liver function tests, ECG, Chest Xray were done. All patients were kept nil by mouth for 8 hours prior to surgery. A written informed valid consent was obtained from the patients who satisfy the inclusion criteria, after explaining about the procedure and technique of subarachnoid block. In the pre operative room, a peripheral intravenous access will be secured using 18 Gauge cannula and all patients will be pre-loaded with 10ml/kg of Ringer's lactate solution.

Baseline pulse rate, non-invasive blood pressure, electrocardiograph, pulse oximetry will be recorded

after attaching multipara monitor. Spinal anaesthesia was performed at the L4-5 intervertebral space in the sitting position with a 25 G Quincke spinal needle using the midline approach. After confirming free flow of clear cerebrospinal fluid, a total of 3 ml bupivacaine 0.5% heavy given over approximately 10–15 seconds with cephalad orientation of the spinal needle. Then the spinal needle was removed and the patient was placed in the supine position.

The end of the injection was defined as time 'zero'. The sensory block was evaluated by pinprick method using a 22-G hypodermic needle.

Time to achieve sensory T 10 level was noted. Sensory level achieved after 30 minutes of subarachnoid block was recorded. Patients unable to reach a sensory block level of T10 were excluded from the study and given general anaesthesia.

Maintenance infusion of Ringer's lactate (RL) was continued throughout the surgery at 5ml/kg/hr.

Hypotension was defined as a decrease in mean arterial pressure (MAP) of more than 20% from baseline and it was treated with 6 mg of mephentermine.

Bradycardia, defined as a heart rate of less than 60 beats per minute. It was treated with 0.6 mg of atropine intravenously (IV) as a stat dose, if Heart Rate less than 50 beats per minute or less than 60 beats per minute if patient is symptomatic.

Heart rate, Systolic blood pressure, Diastolic blood pressure, mean arterial blood pressure and spo2 was noted in patients in both the groups before the administration of the block considered as baseline. Heart rate, Systolic blood pressure, Diastolic blood pressure, mean arterial blood pressure, incidence of hypotension, Number of times mephentermine used, requirement of 2nd dose of mephentermine, episode of bradycardia and atropine requirement and other complications like Nausea, vomiting and shivering was noted in both the groups at 5-minute intervals for first 30 minutes and then every 15 minutes till end of surgery.

Statistical analysis: The data was collected and entered in Microsoft excel and analysed using IBM SPSS Statistics 20.0 The quantitative data was expressed in terms of mean and standard deviation. The qualitative data was expressed in terms of numbers and percentages. Independent t test was used to compare mean between two independent group. Fisher exact test was applied to determine the association between the two categorical variables. p value < 0.05 was considered significant.

RESULTS

The demographic characteristics age, sex, height, weight, body mass index, time to achieve T10 level, duration of surgery of our study is comparable between the two groups and not significant statistically as depicted in following table.

Table 1: Comparison of demographic variables between two groups

Variable	Group N		Group H		Mean difference	P value
	Mean	SD	Mean	SD		
Age	50.57	7.171	51.43	6.612	0.85	0.571
Male	29	69%	32	76.2%	0.539	0.463
Female	13	31%	10	23.8%		
Weight(kg)	64.43	5.75	65.29	5.55	-0.86	0.489
Height(cm)	164.24	2.84	163.69	2.50	0.548	0.351
BMI(Kg/m2)	23.9	2.18	24.37	2.13	-0.48	0.313
Duration of surgery(minutes)	110.29	20.91	116.24	12.06	-5.95	0.114
T10 achieved at	6.14	1.507	6.36	1.495	-0.214	0.515
Level after 30 minutes	T10	T8	T10	T8	0.534	0.434
	33	8	36	6		

Table 2: Comparison of mean heart rate between normotensive and hypertensive groups at different time intervals:

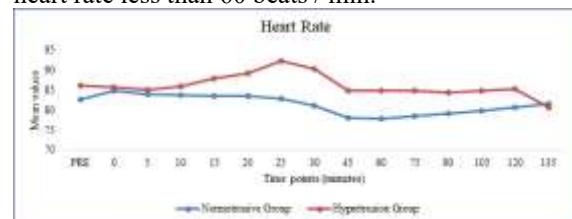
TIME	Group N		Group H		Mean Difference	p-value
	Mean	Std. Deviation	Mean	Std. Deviation		
Pulse Rate(min)						
PRE	82.57	10.73	86.1	10.46	-3.52	0.131
0	84.83	14.24	85.71	11.69	-0.88	0.757
5	84	12.48	85.12	12.22	-1.12	0.679
10	83.79	12.39	85.88	13.75	-2.1	0.465
15	83.64	12.79	87.88	13.91	-4.24	0.15
20	83.55	14.83	89.19	15.94	-5.64	0.097
25	82.9	14.85	92.38	17.62	-9.48	0.009
30	81.1	15.69	90.31	15.94	-9.21	0.009
45	78.12	11.97	84.76	12.59	-6.64	0.016
60	77.76	12.29	84.88	13.71	-7.13	0.015
75	78.55	10.96	84.81	11.56	-6.26	0.015
90	79.19	12.11	84.44	11.81	-5.25	0.056
105	79.84	10.85	84.92	12.18	-5.08	0.073
120	80.63	11.97	85.39	12.75	-4.76	0.204
135	81.67	13.5	80.75	8.85	0.92	0.917

Base line heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure was comparable between the two groups and statistically not significant

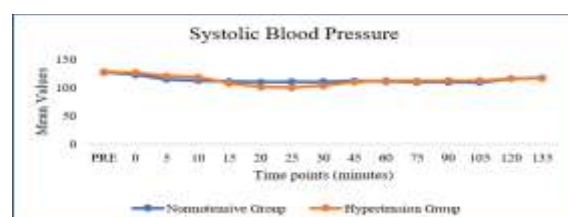
Significant differences in mean Heart Rate was observed from 25 minutes to 75 minutes.

Throughout observation period, the hypertensive group showed consistently higher mean heart rates compared to the normotensive group.

In both groups, none of patients had bradycardia, heart rate less than 60 beats / min.

**Table 3: comparison of systolic blood pressure (SBP) between normotensive and hypertensive groups at different time intervals**

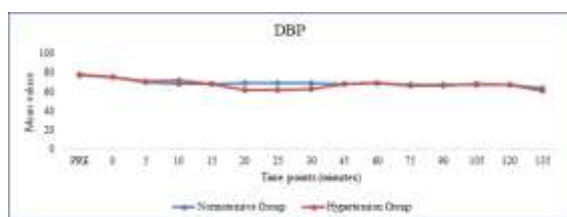
TIME	Group N		Group H		Mean Difference	p-value
	Mean	Std. Deviation	Mean	Std. Deviation		
SBP (minutes)						
PRE	127.405	8.206	131.881	6.060	-4.476	0.084
0	123.214	12.942	126.690	9.161	-3.476	0.165
5	115.143	11.292	120.833	9.039	-5.690	0.014
10	112.690	13.970	118.548	12.097	-5.857	0.046
15	111.286	11.897	107.857	9.206	3.429	0.008
20	110.357	14.351	101.214	15.116	9.143	0.006
25	110.667	11.051	100.524	14.818	10.143	0.001
30	110.762	10.228	103.405	11.972	7.357	0.004
45	112.195	10.367	110.000	9.217	2.195	0.317
60	111.317	8.959	112.976	7.645	-1.659	0.373
75	109.947	8.275	112.381	8.767	-2.434	0.211
90	109.892	9.667	112.659	7.080	-2.767	0.163
105	109.548	8.639	112.923	4.571	-3.375	0.059
120	115.947	9.886	116.143	7.675	-0.195	0.944
135	117.667	10.209	116.500	5.545	1.167	0.893



Significant difference between two groups in mean systolic blood pressure from 5 minutes to 30 minutes was observed. At 15, 20, 25 and 30 minutes, the mean systolic blood pressure in group H becomes lower than that in group N. These results suggested that hypertensive group has greater fall in mean systolic blood pressure more than Normotensive group.

Table 4: comparison of diastolic blood pressure between normotensive and hypertensive groups at various time intervals

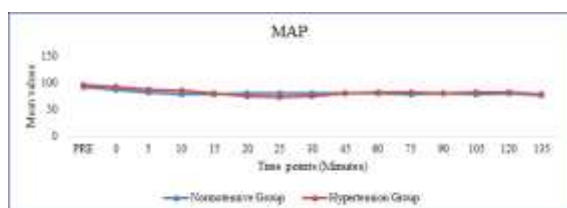
TIME DBP (minutes)	Group N		Group H		Mean Difference	p-value
	Mean	Std. Deviation	Mean	Std. Deviation		
PRE	76.86	6.7	77.81	6.41	-0.95	0.508
0	75.07	9.73	75.55	7.78	-0.48	0.805
5	70.38	8.28	70.9	6.67	-0.52	0.75
10	68.45	10.21	71.36	8.91	-2.91	0.168
15	68.38	7.47	68.05	7.81	0.33	0.842
20	68.76	10.85	61.93	12.01	6.83	0.008
25	68.88	8.61	61.9	11.44	6.98	0.002
30	69.29	8.82	62.93	10.49	6.36	0.004
45	68.1	8.31	68.36	7.99	-0.26	0.885
60	68.68	7.88	68.67	6.66	0.02	0.992
75	66.29	6.24	67.71	5.96	-1.43	0.299
90	66.78	7.99	67.17	5.16	-0.39	0.798
105	68.45	7.18	66.82	5.48	1.63	0.285
120	66.89	6.79	67	5.92	-0.11	0.955
135	64	3.46	61.25	0.96	2.75	0.18



There was statistically significant difference in mean Diastolic Blood Pressure between two groups at 20, 25 and 30 minutes. After 30 minutes values remained relatively stable suggesting a return to hemodynamic equilibrium.

Table 5: comparison of mean arterial pressure (map) between normotensive and hypertensive groups at various time intervals

TIME MAP	Group N		Group H		Mean Difference	p-value
	Mean	Std. Deviation	Mean	Std. Deviation		
PRE	93.19	6.33	95.55	5.31	-2.36	0.068
0	87.64	11.61	91.71	7.98	-4.07	0.065
5	82.76	7.94	86.67	6.76	-3.91	0.017
10	79.5	11.86	86.07	9.09	-6.57	0.006
15	79.5	11.86	86.07	9.09	-6.57	0.006
20	80.24	11.48	74.48	12.86	5.76	0.033
25	80.83	8.86	73.52	11.62	7.31	0.002
30	80.24	8.38	75.38	10.33	4.86	0.02
45	80.32	7.69	80.62	7.51	-0.3	0.857
60	80.68	6.92	82.33	6.25	-1.65	0.257
75	79.45	5.97	81.93	5.91	-2.48	0.066
90	80.05	8.32	80.61	5.51	-0.56	0.727
105	79.45	7.03	81.54	4.4	-2.09	0.134
120	79.74	7.38	82.79	5.58	-3.05	0.114
135	76.67	7.57	79.25	2.5	-2.58	0.542



Statistically significant differences in mean arterial pressure were observed between 5 minutes and 30 minutes after the sub arachnoid block.

At 5, 10 and 15 minutes, Group H maintained a significantly higher mean arterial pressure than Group N, which was statistically significant. Interestingly, at 20, 25, and 30 minutes, the trend reversed, as Group N had higher mean arterial pressure than Group H. These differences were also statistically significant at 20 minutes ($p = 0.033$), 25 minutes ($p = 0.002$), and 30 minutes ($p = 0.020$), indicating a notable decline in mean arterial pressure among hypertensive patients during this period.

Table 6: comparison of number of times mephentermine required in normotensive and hypertensive patients

Number of times	GROUP N	GROUP H	P value
Mephentermine requirement	7(16.6%)	20(47.61%)	0.0051

Requirement of mephenteramine to treat hypotension was more in hypertensive group

Table 7: showing distribution of study population according to variation in complications between two groups

Complications	GROUP N	GROUP H	P values
HYPOTENSION	6(14.28%)	17(40.47%)	0.013
BRADYCARDIA	-	-	1.00

NAUSEA	3(7.14%)	6(14.28%)	0.48
VOMITING	1(2.3%)	1(2.3%)	1.00
SHIVERING	0(0%)	1(2.3%)	1.00

DISCUSSION

Variation in haemodynamic parameters are very common after sub arachnoid block. In hypertensive patients altered sympathetic function is observed compared to normotensive patients. Some antihypertensive pharmacotherapies lower blood pressure by targeting the sympathetic nervous system. Spinal anaesthesia cause hypotension due to sympathetic blockade. So, this study was conducted to compare haemodynamic effects after subarachnoid block in normotensive and controlled hypertensive in lower limb surgeries

Demographic parameters of patients like age, gender, weight, height were comparable. Sensory level at T10 and duration of surgery were also comparable in two groups.

The baseline mean heart rate was higher in hypertensive group (86.1 ± 10.46) compared with normotensive group (82.57 ± 10.73) but statistically not significant ($p=0.062$) correlated with study done by Ashish Prakash prasad et al² (2022), Bisma Shafi et al⁹ (2023). In hypertensive group, from 15 minutes to 30 minutes mean heart rate was higher compared to baseline mean heart rate which correlates with fall in mean arterial pressure from 15 to 30 minutes in hypertensive group which might be due to reflex tachycardia. Similar findings were observed in the study done by Ajeesh Kumar et al⁷ (2024). Throughout observation period, the Hypertensive group showing consistently higher mean heart rates compared to the Normotensive group correlates with study done by Ajeesh Kumar et al⁷ (2024).

There is statistically significant difference in mean systolic blood pressure at 5, 10, 15, 20, 25 and 30 minutes (p value < 0.05) correlates with study done by Leake Gebrargs et al⁶ (2020). At 15, 20, 25 and 30 minutes, the systolic blood pressure in group H becomes lower than that in group N with statistically significant difference. This might be due to delayed vasodilatory response and due to preexisting higher baseline vascular tone as increased vascular tone is observed in hypertensive patients. This was comparable with study done by Ashish Prakash et al² (2022).

After an initial fall in SBP until 30 minutes, many patients begin to compensate by redistribution of intravascular volume that occurs in normotensives more effectively compared with hypertensives.

From 45 minutes no statistical difference was observed between the two groups. The increase in SBP following maximal drop was seen to greater degree in group H than group N.

These results suggested that hypertensive group has greater fall in mean systolic blood pressure more than Normotensive group. Our study findings are correlating with studies done by Ashish Prakash prasad et al² (2022), Soniya Dohare et al⁵ (2024),

Ajeesh Kumar et al⁷ (2024), Mahila Mani et al⁸ (2025).

There was a statistically significant difference in Diastolic Blood Pressure at 20, 25 and 30 minutes. There was a greater fall in Diastolic Blood Pressure at these time intervals 20, 25 and 30 minutes in hypertensive group when compared with normotensive group, which might be due to impaired autonomic compensation in hypertensive group.

From 45 minutes to 135 minutes, the mean difference in Diastolic Blood Pressure between the two groups was not statistically significant. The values remained relatively stable and similar in both groups, suggesting a return to hemodynamic equilibrium.

In hypertensive group, there was greater and prolonged fall in Diastolic Blood Pressure which might be due to long standing vascular stiffness, impaired autonomic compensation, blunted baroreceptor mechanisms. These findings of Diastolic blood pressure correlate with the studies done by Ashish Prakash prasad et al² (2022), Bisma Shafi et al⁹ (2023), Soniya Dohare et al⁵ (2024), Ajeesh Kumar et al⁷ (2024).

At baseline, hypertensive group had a higher Mean Arterial Pressure 95.55 ± 5.31 mmHg compared to normotensive group 93.19 ± 6.33 mmHg, but the mean difference was not statistically significant ($p=0.068$). There was no statistically significant difference was observed at "0" minute ($p=0.065$). These findings were similar with studies done by Padmanabha Kaimar et al¹² (2011), Ashish Prakash prasad et al² (2022), Bisma Shafi et al⁹ (2023).

There was fall in the mean arterial pressure in both the groups after subarachnoid block due to sympathetic blockade. Statistically significant differences in Mean Arterial Pressure were observed between 5 minutes and 30 minutes after the sub arachnoid block. These findings were similar to studies done by Padmanabha Kaimar et al¹² (2011), Ashish Prakash prasad et al² (2022), Bisma Shafi et al⁹ (2023), Mahila Mani et al⁸ (2025).

Interestingly, at 20, 25, and 30 minutes, the trend reversed, as Group N had higher mean arterial pressure values than Group H. These differences were also statistically significant at 20 minutes ($p=0.033$), 25 minutes ($p=0.002$), and 30 minutes ($p=0.020$), indicating a notable decline in mean arterial pressure among hypertensive patients during this period, which might be due to altered baroreceptor reflexes, impaired autoregulation in hypertensive patients.

From 45 minutes onwards, mean arterial pressure differences between the two groups was not statistically significant. The values remained relatively stable which might be due to redistribution of intravascular volume and compensatory mechanisms take effects Soniya Dohare et al⁵ (2024).

In the present study, Requirement of mephentermine in Group H was 20 times and in Group N was 7 times, with statistically significant difference ($p=0.0051$). This suggests, incidence of hypotension is more in hypertensive group compared with normotensive group. These findings correlate with the studies done by Sunita Meena et al³ (2016), Bisma Shafi et al⁹ (2023), Tati Parasuram et al¹⁰ (2021), Dinakar et al¹¹ (2018).

In the present study, hypotension was seen in 6 patients (14.28%) in normotensive group and in 17 patients (40.47%) in hypertensive group, which was statistically significant ($p=0.013$).

This finding was similar with the studies done by Dinakar et al¹¹ (2018), Amrita Panda et al¹³ (2021), Ashish Prasad et al² (2022), Bisma Shafi et al⁹ (2023), Ajeesh Kumar et al⁷ (2024).

In the present study, no bradycardia was noted in both the groups correlates with study done by Soniya Dohare et al⁵ (2024). Nausea was more common in the Hypertensive group compared to Normotensive group with $p=0.48$ which was not significant. One patient in each group had an episode of vomiting, which was not statistically significant. In Normotensive group shivering was absent and was observed in 1 patient (2.3%) in hypertensive group, which was not statistically significant, these findings correlate with the studies done by Sunita Meena et al³ (2016).

The limitations of our study were that we included only lower limb surgeries, patients on only one antihypertensive. More studies are required including different type of surgeries and antihypertensive to find out substantial results.

CONCLUSION

From our study we conclude that hypotension is significant in controlled hypertensive group on monotherapy with angiotensin receptor blockers (Tablet TELMISARTAN 40 milligrams once daily) compared with Normotensive group after subarachnoid block with 0.5% hyperbaric bupivacaine. Therefore, we recommend vigilant monitoring and timely detection and treatment of hypotension after subarachnoid block in controlled hypertensive patients.

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