

Comparative Evaluation of Hemodynamic Changes in Different Positions in Normotensive Versus Hypertensive Patients Undergoing Percutaneous Nephrolithotomy (PCNL) Under Regional Anaesthesia

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Abstract

Background: Hemodynamic changes occur with position change, are exaggerated under anesthesia and differ in magnitude between normotensive and hypertensive patients.

Aim: To evaluate hemodynamic changes in different positions in 2 groups of patients: Normotensive versus Hypertensive undergoing PCNL under regional anaesthesia (RA).

Methods: After ethical committee's approval, a comparative study was conducted at a tertiary healthcare center, included 50 consenting patients >25 years age of ASA Class 1 and 2 undergoing PCNL under RA and divided into two groups of 25 patients each, Group 1-Normotensive patients and Group 2- Hypertensive patients. Hemodynamic variables (heart rate, Systolic, Diastolic and Mean arterial pressures, Electrocardiogram) were monitored throughout surgery and were recorded at Baseline (before instituting RA), Supine to Lithotomy, Lithotomy to Supine, Supine to Prone and Prone to Supine. Hypotensive episodes (Fall in systolic blood pressure (SBP) >20% from baseline) and vasopressor requirement (If SBP <80mm Hg then Inj. Ephedrine IV 5 mg given) were recorded in both the groups.

Results: Statistical analysis was done using Chi-Square test and independent sample t test. Inter group comparison of hemodynamic parameters were comparable and statistically insignificant for all positions. Intra-group comparison of hemodynamic parameters showed lower readings as compared to baseline in all with respect to position change. Number of hypotensive episodes and vasopressor used did not differ significantly between two study groups.

Conclusion: A well-controlled hypertensive patient behaves like a normotensive patient hemodynamically with respect to position change under anesthesia. Therefore, preoperative control of hypertension is essential.

Keywords: PCNL; Regional anesthesia; Position change; Hypertension.

Key Message: Control of hypertension enables a hypertensive patient to behave like a normotensive patient hemodynamically with respect to position change under anesthesia.

Introduction

Percutaneous Nephrolithotomy is the treatment of choice for large renal calculi and involves multiple positions, i.e. Supine to Lithotomy, Lithotomy to Supine, Supine to Prone and Prone to Supine which result in complex hemodynamic changes which are further exaggerated under anesthesia.¹

These changes and responses may differ in magnitude between Normotensive and Hypertensive patients.

Hypertension is a progressive disease with multisystem involvement and perioperatively has its own challenges. Long standing hypertension and its manifestations have a direct effect on

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perioperative morbidity and mortality. Thorough preoperative assessment and optimization of blood pressure is important to reduce risk of intraoperative adverse events.

Aims and Objectives

Aim

To evaluate hemodynamic changes in different positions in 2 groups of patients: Normotensive (Group 1) versus Hypertensive (Group 2) undergoing PCNL under Regional Anaesthesia (RA).

Objectives

- To monitor intra-operative hemodynamic changes (Heart rate, Systolic blood pressure, Diastolic blood pressure, Mean Arterial Pressure, ECG) in both groups with respect to change in position that is Supine to Lithotomy, Lithotomy to Supine, Supine to Prone and Prone to Supine.
- To observe and record number of hypotensive episodes, vasopressors requirement in the two groups and document any adverse intra operative event.

Materials and Methods

After approval from institutional ethical committee a comparative study was conducted on 50 patients undergoing PCNL surgery under Regional anesthesia in Department of Anesthesiology at a tertiary care hospital. The study was conducted between years 2018 to 2020.

50 patients belonging to ASA 1 and 2 were divided into 2 Groups of 25 patients each:

- Group 1- Normotensive patients operated for PCNL.
- Group 2- Hypertensive patients operated for PCNL.

Inclusion criteria

Patients Age greater than 25 years, of both genders belonging to ASA 1 and 2 patients were included. According to ACC/AHA 2017 HYPERTENSION GUIDELINES (13th Nov 2017) 2 normal category patients were included in Group 1 and in Hypertensive patients- elevated BP, Stage 1 and 2 patients were included in Group 2.

Exclusion criteria

Patients with h/o Coronary Artery Disease,

Diabetes Mellitus, any other known cause of orthostatic hypotension and contraindications to Spinal Anaesthesia such as deformities of spine, coagulopathies, raised intracranial pressure, etc were excluded.

Methodology of Study

Pre anaesthetic check-up of all the patients posted for surgery was done before the day of surgery. Appropriate pre-operative instructions were given.

On day of surgery, it was ensured that patient has taken appropriate prescribed dose of anti-hypertensive agent in the morning in Group 2 patients (standard instruction 7 am with sip of water) and patient received 500ml of Ringer's Lactate during preoperative nil per oral status.

Spinal Anaesthesia was carried out with all aseptic precautions. Bupivacaine (heavy) 0.5% with adjuvant Fentanyl doses adjusted to target sensory level of T5-T6.

During the study, Heart Rate, Blood Pressure (Systolic Blood Pressure, Diastolic Blood Pressure), Mean Arterial Pressure, ECG and Pulse oximetry were continuously monitored. These parameters were recorded in the following time intervals:

- Before instituting regional anesthesia- Baseline.
- Supine to Lithotomy- Immediate, 5 min, 10 min and 15 min intervals.
- Lithotomy to Supine- Immediate (In our study, during change in position from Lithotomy to Supine, only single reading of parameters was recorded because of immediate institution of Prone position).
- Supine to Prone- Immediate, 5 min, 10 min and 15 min intervals.
- Prone to Supine- Immediate, 5 min, 10min and 15 min intervals.

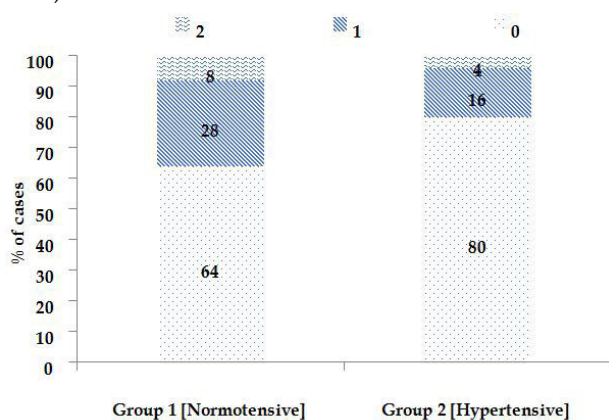
Hypotensive episodes during the procedure (defined as 20% fall in Systolic Blood Pressure from baseline) and Vasopressor requirement (when Systolic Blood Pressure <80 mmHg Inj. Ephedrine 5mg iv was given) were recorded.

Statistical Analysis

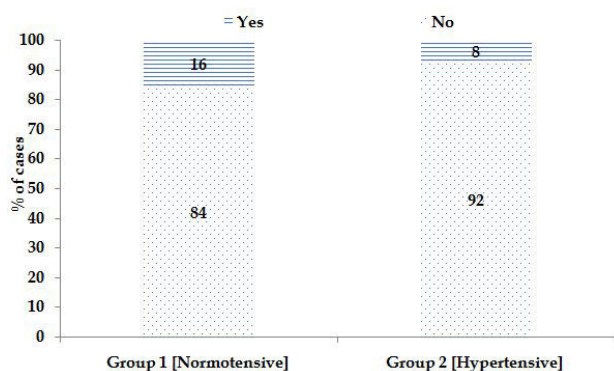
The inter-group statistical comparison of distribution of categorical variables is tested using Chi-Square test or Fisher's exact probability test if more than 20% cells have expected frequency less than 5. The inter-group statistical comparison is done using independent sample t test.

The intra- group statistical comparison of means of continuous variables is done using repeated measures analysis of variance (RMANOVA). The underlying normality assumption was tested before subjecting the study variables to t test and RMANOVA.

In the study, the p-values less than 0.05 are considered to be statistically significant. All the hypotheses were formulated using two tailed alternatives against each null hypothesis (hypothesis of no difference). The entire data is statistically analyzed using Statistical Package for Social Sciences (SPSS ver 21.0, IBM Corporation, USA) for MS Windows.



Graph 1: Hypotensive episodes in both the groups.



Graph 2: Incidence of vasopressor use in two groups.

Results

The mean age of cases studied was higher in Group 2 patients. This may be correlated to hypertension as a co-morbidity in Group 2 patients. The sex distribution did not differ significantly between two study groups. Inter group comparison of mean heart rate, SBP, DBP and MAP between the two groups were comparable and statistically insignificant for all the position changes. Intra-group comparison of Mean heart rate, systolic

BP, diastolic BP and MAP showed lower readings as compared to baseline in all with respect to position change. Out of 25 cases studied in Group 1, 9 patients had hypotensive episodes (fall in SBP >20% from baseline), of which 7 had one and 2 had two episodes. Out of 25 cases studied in Group 2, 5 patients had hypotensive episodes, of which 4 had one episode and 1 had two episodes. The number of hypotensive episodes among the cases studied did not differ significantly between two study groups. Vasopressor (5 milligrams of Inj Ephedrine intravenous) was given when SBP fell below <80mmHg. Out of 25 cases studied in Group 1 patients 4 required vasopressor use. Out of 25 cases studied in Group 2 patients, 2 required vasopressor use. The incidence of use of vasopressor did not differ significantly between two study groups.

No patients in our study had any hypertension related or surgery related adverse events.

Discussion

Our study involves patients undergoing Percutaneous Nephrolithotomy (PCNL) surgery under regional anesthesia. This involves lot of position changes and we have intended to study hemodynamics during these various position changes in these patients. We made two groups, that is Normotensive (Group 1) and Hypertensive (Group 2). PCNL surgery requires multiple position changes namely, Supine to Lithotomy, Lithotomy to Supine, Supine to Prone and Prone to Supine which in our study was under spinal anesthesia. Position changes in anesthetized patients are accompanied by hemodynamic changes.

Hypertension is a leading cause of global disease burden, affecting 26.4% or 1 billion of the adult population according to a study in 2000 and is responsible for 9.4 million deaths per year.³

Our study included 50 patients belonging to ASA 1 and 2, divided in two groups, Group 1 and 2 consisting of 25 normotensive and 25 hypertensive patients respectively. Both sets of patients received preloading of 500 ml of Ringers' Lactate preoperatively. PCNL involves change in position namely, Supine to Lithotomy, Lithotomy to Supine, Supine to Prone and Prone to Supine and in our study was done under regional anesthesia. We have studied hemodynamic changes following these positions which included Heart rate (HR), Systolic blood pressure (SBP), Diastolic blood pressure (DBP) and Mean arterial pressure (MAP). We have also noted hypotensive episodes (drop in SBP by 20% of baseline SBP) and vasopressor requirement (fall in SBP to less than 80 mmHg).



Table 1: Comparison of hemodynamic parameters in both the groups- inter group.

INTER GROUP	Group 1 [Normotensive] (n=25)										Group 2 [Hypertensive] (n=25)										P value	
	Heart rate		SBP		DBP		MAP		Heart rate		SBP		DBP		MAP		Heart rate	SBP	DBP	MAP		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD						
Baseline	84.96	12.76	133.28	15.15	81.24	9.18	97.56	10.54	90.68	14.87	147.08	14.87	89.96	11.49	108.72	12.20	0.225 ^{NS}	0.002 [*]	0.005 ^{**}	0.001 ^{***}		
Supine to Lithotomy																						
Immediate	83.88	14.44	125.96	14.99	75.92	9.11	92.08	10.78	91.32	15.52	134.76	15.52	80.64	12.49	98.52	13.61	0.133 ^{NS}	0.047 [*]	0.133 ^{NS}	0.070 ^{NS}		
5 min	80.36	16.25	122.68	14.80	72.76	11.32	87.44	12.60	87.96	17.54	131.08	17.54	81.64	12.01	95.88	14.13	0.119 ^{NS}	0.073 ^{NS}	0.010 ^{**}	0.031 [*]		
10 min	79.12	14.30	122.72	15.69	74.00	10.02	88.64	9.91	87.64	15.85	131.36	15.85	80.56	11.81	96.04	12.41	0.064 ^{NS}	0.059 ^{NS}	0.039 [*]	0.024 [*]		
15 min	80.59	14.15	120.09	14.43	72.23	12.57	86.50	12.23	87.04	13.97	128.00	13.97	79.75	12.19	95.75	11.82	0.165 ^{NS}	0.066 ^{NS}	0.045 [*]	0.012 [*]		
Lithotomy to Supine																						
immediate	80.91	14.08	117.43	12.30	73.52	13.66	87.00	11.36	86.44	18.70	119.48	19.04	76.12	13.26	89.16	15.68	0.257 ^{NS}	0.664 ^{NS}	0.507 ^{NS}	0.590 ^{NS}		
Immediate	79.16	14.82	112.48	17.23	68.60	13.05	81.16	14.66	84.12	17.32	117.32	24.59	73.32	16.82	87.64	18.89	0.282 ^{NS}	0.424 ^{NS}	0.273 ^{NS}	0.182 ^{NS}		
5 min	78.68	15.44	117.43	15.58	71.64	10.72	86.08	13.30	83.92	16.15	118.20	20.68	72.84	16.03	86.76	17.82	0.247 ^{NS}	0.854 ^{NS}	0.757 ^{NS}	0.879 ^{NS}		
10 min	77.56	14.64	114.76	13.20	70.16	11.71	85.40	12.77	84.16	17.87	123.84	20.75	74.52	17.15	90.48	17.23	0.160 ^{NS}	0.071 ^{NS}	0.299 ^{NS}	0.242 ^{NS}		
15 min	77.60	14.06	115.56	11.98	70.68	11.20	85.52	11.11	82.96	15.62	122.60	20.95	76.64	17.70	89.60	17.60	0.208 ^{NS}	0.151 ^{NS}	0.161 ^{NS}	0.332 ^{NS}		
Supine to Prone																						
Immediate	80.32	16.78	119.68	13.88	72.04	10.73	87.00	10.84	82.32	13.04	119.68	19.87	78.16	14.72	88.04	17.00	0.640 ^{NS}	0.999 ^{NS}	0.099 ^{NS}	0.798 ^{NS}		
5 min	80.00	15.12	122.56	13.91	74.84	15.76	88.56	13.70	81.72	15.53	117.00	19.35	73.04	13.09	85.56	15.91	0.693 ^{NS}	0.249 ^{NS}	0.662 ^{NS}	0.478 ^{NS}		
10 min	80.00	16.48	119.08	14.92	74.00	13.49	89.25	13.98	79.83	16.41	119.00	20.68	75.08	16.35	87.79	16.82	0.972 ^{NS}	0.987 ^{NS}	0.803 ^{NS}	0.745 ^{NS}		
15 min	75.10	14.09	118.65	13.31	77.60	11.61	90.25	12.14	78.26	17.96	116.84	18.29	75.47	13.74	87.63	15.19	0.543 ^{NS}	0.725 ^{NS}	0.604 ^{NS}	0.555 ^{NS}		

Table 2: Comparison of hemodynamic parameters in both groups- intra group.

P-value (Intra-group)	Group C							
	Heart rate	SBP	DBP	MAP	Heart rate	SBP	DBP	MAP
Baseline vs Supine to Lithotomy	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}
Baseline vs Lithotomy to Supine	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}
Baseline vs Supine to Prone	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}
Baseline vs Prone to Supine	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}	0.001 ^{***}

Values are mean and SD, P-value (Inter-Group) by independent sample t test. P-value<0.05 is considered to be statistically significant. *P-value<0.05, **P-value<0.01, ***P-value<0.001, NS-Statistically Non-significant.

The mean of age of cases studied in Group 1 was 42.20 ± 12.53 years and in Group 2 was 53.92 ± 11.47 years and was significant higher in Group 2 (P -value <0.05). This may be correlated to hypertension as a co-morbidity in Group 2 patients. The sex distribution of cases was comparable and statistically insignificant.

The hemodynamic parameters (Mean heart rate, systolic BP, diastolic BP and MAP) between the two groups (Table 1) were comparable and statistically insignificant for all the position changes between the groups (inter-group). The hemodynamic parameters (Mean heart rate, systolic BP, diastolic BP and MAP) within the two groups (intra-group-Table 2) showed lower readings as compared to baseline in all with respect to position change. Khoshrang H, et al⁴ found a greater degree of hemodynamic variation and lower mean blood pressure readings in prone position PCNL than in supine PCNL.

A hypotensive episode was defined as decrease in the systolic BP by more than 20% of baseline systolic BP. Though lesser number of hypotensive episodes were seen in Group 2 patients than in Group 1, The results were not statistically significant. Vasopressor (5 milligrams of Inj Ephedrine intravenous) was given when there was a fall in systolic BP to less than 80 mmHg. Though lesser vasopressor requirement was seen in Group 2 patients than in Group 1, the incidence of use of vasopressor did not differ significantly between two study groups. A similar study by Terrence L. Trentman, et al⁵ showed an increased incidence of intraoperative hypotension and vasopressor use in hypertensive patients on treatment versus normotensive patients posted for shoulder surgery under GA.

The strength of this study was comparing the hemodynamic parameters with each change in position of PCNL surgery and comparing the magnitude of their differences in a normotensive and a controlled hypertensive patient. We also studied hypotensive episodes and vasopressor use in these two groups. There is paucity of

literature about studies involving position related hemodynamics in PCNL surgery. The limitations of this study are the small sample size and exclusion of high-risk ASA 3 and above patients.

Conclusion

Our study concludes that controlled hypertensives behave like a normotensive patient with respect to hemodynamic parameters during various positioning changes in PCNL surgery carried out under RA and this possibly applies to all surgical patients. Therefore, control of hypertension is essential for elective procedures to maintain hemodynamic stability intraoperatively and for preventing hypertension associated complications.

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