

Management of Hypertension Before, During and After General and Orthopedic Surgeries- A Pragmatic Approach of Anaesthetists

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Received: 15-09-2022 / Revised: 20-10-2022 / Accepted: 30-11-2022

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Conflict of interest: Nil

Abstract

Background: Among all the risk factors encountered before, during and after General and Orthopedic surgeries, Hypertension was considered as the foremost in the minds of all the Anesthetists. However, there is no definite and uniform protocol of using antihypertensive drugs in its management in the Indian literature. The situation such as this initiated the idea of conducting the present clinical trial.

Aim of the Study: To study the peri-operative evaluation, care and management of the patient with hypertension undergoing general & orthopaedic surgeries. The objectives were to study the antihypertensive drug usage, types of anesthesia and their effects and side effects on hemodynamics during the surgery and their management strategies in peri-operative period.

Methods: A tertiary care center where this cross-sectional, observational study was conducted included patients from General Surgery and Orthopaedics Departments. Patients were examined by the Anesthetists before, during and after the surgeries up to 48 hours postoperative period. The variables included Initial blood pressure, Antihypertensive drugs used, Anaesthesia drugs used, Blood loss during surgery, Blood and Intravenous fluids used during the surgery. Statistical analysis done by using descriptive measures, mean, standard deviation and nonparametric tests and $P < 0.05$ was taken as significant in the study.

Results: 93 Hypertensive patients undergoing General surgery and Orthopedics surgeries were included in this study. A Shpauro Wilk test was applied to test the normality of the subjects. There were 51/93 (54.83%) General surgery patients and 42/93 (45.16%) Orthopedic patients. There were 58 (54.83%) males (General Surgery- 38 (40.86%) and Orthopedic surgery- 20 (21.50%) and 35 (37.63%) female patients (General Surgery- 13 (13.97%) and Orthopedic surgery- 22 (23.65%) in the study. The male to female ratio was 1.28:1. The mean age was 34.85 ± 6.15 years in General Surgery patients and 37.25 ± 4.60 years in Orthopedic patients. Among The General Surgery patients the mean duration of history of Hypertension was 54.86 ± 7.50 months. Among The Orthopedics patients the mean duration of history of Hypertension was 52.31 ± 2.75 months.

Conclusion: Intraoperative hemodynamic changes were less in patients who used regularly Beta blockers than other antihypertensive drugs. They had lower heart rate also. Patients on diuretics on the morning of the surgery showed gross hemodynamic changes such as raised

Systolic Blood Pressure and Diastolic Blood Pressure. Other antihypertensive drugs did not show significant hemodynamic changes intra-operatively.

Keywords: Haemodynamic, Orthopedics, Shpairo Wilk, Intra- Operatively

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Introduction

In the primary health care system diagnosis and management of Hypertension remains the crucial duty of all the anaesthetists while conducting pre-anaesthetic check-up of surgical patients [1]. Hypertension is one of the preventable risk factors playing as a contributor to disease and complications [2]. Irregular use of antihypertensive medications is a common clinical history elicited in Indian Scenario [3]. It causes rebound hypertension, anxiety, tachycardia, angina, myocardial infarction and edema feet and lungs; sometimes death [4]. Hypertension is exaggerated by conditions like infection, abdominal distension, acute trauma, renal infections and the surgeries itself [5]. General and Orthopaedic surgeries demand manipulation of blood pressures to minimize the blood loss and to provide a blood less surgical field to the surgeon [6]. It is also needed to prevent complications that may arise due to sudden rise in systolic blood pressure resulting in complications like, cerebral hemorrhage, renal failure and pulmonary edema [7]. Among the therapeutic protocols available based on pharmacological principles of antihypertensive drugs, either the same antihypertensive drug could be continued or a newer agent could be used [8]. One such protocol is to undertake surgeries if the diastolic blood pressure (DBP) is less than 110 mmHg and there is no other cause to delay the surgery provided the blood pressure is closely monitored by the anesthetist to correct either rise or fall of SBP or DBP [9]. Another protocol is when the DBP is above 110 mm Hg and there is no emergency surgical situation, the surgery itself could be deferred until the DP and SBP are normalized

[10]. Review of literature showed no studies on methods of manipulation of antihypertensive drugs before, during and after major surgeries [11]. There were no critical comparisons between the various classes of anti-hypertensive drugs, their usage during the pre, intra and post-operative periods [12]. Joint National Committee 8 guidelines do not recommend beta blockers in the management of Hypertension but they are used vastly by all physicians in India [13]. The actions of beta blockers in patients undergoing stressful surgeries wherein they are positioned in different positions for variable periods of time are not taken into consideration by any of the studies available. The present study was conducted in such situations, to understand and formulate a definite protocol useful in the tertiary care Hospital. The aim of the study was to evaluate how a hypertensive patient would be managed in terms of the antihypertensive drug usage, complications and adverse events handled appropriately.

Materials

93 patients were included in this study that was posted for major surgeries in General surgery and Orthopaedics departments of Princess Esra Hospital of Hyderabad and Aarupadai Veedu Medical College Hospital. It was an observational study and cross sectional one. The study period was for 18 months. An institutional ethics committee clearance was obtained before commencing the study. An ethics committee approved consent letter was used for the study. The study was conducted between Jan 2021 to July 2022.

Inclusion Criteria: Patients aged between 20 and 70 years were included. Patients of both the genders were included. Patients admitted to General surgery and Orthopaedics departments were included. Patients who were known hypertensive and irrespective of taking medicines or not were included. Patients admitted for elective surgeries were included.

Exclusion criteria: Patients aged below 20 years and above 70 years were not included. Patients not admitted in the wards were not included. Patients with risk factors, such as pheochromocytoma, Myocardial infarction, pregnant women, history of previous complications during surgery and emergency procedures were not included. All the patients were subjected to thorough clinical examination, vital signs recording and surgical profile investigations. Clinical history of hypertension, Diabetes Mellitus, Renal insufficiency and allergic symptoms were elicited. BP was recorded on the first visit to the anesthetist, time lapse for correction of higher BP, date of Anaesthetic fitness granted time and time to control high BP, changes in the antihypertensive drugs prescribed by the anesthetist, time rescheduled for surgery were noted and recorded. Vital signs on the day of surgeries were recorded. All the surgeries were done by the author conducted the study. The risk of anaesthesia by the anesthetist was discussed with the patient and his attendants and wherever necessary risk consent was taken. The American Society of Anesthesiologists (ASA) grades, type of surgery, If antihypertensive drugs were stopped before surgery or continued was noted, pre-anesthetic medications used was recorded. Type of anesthesia, used, intra-operative hemodynamic drugs used, blood loss, time taken for surgeries. Adverse events, complications during an immediate post operative period were noted. The nature of antihypertensive drugs used in the post-operative period and its duration were noted.

Re-starting of antihypertensive drugs after surgery was noted. Data was collected up to 48 hours after the surgeries. Intra-operative hemodynamic recordings were SBP, DBP & HR (Heart Rate). The number of times the SBP, DBP and HR had fallen or shot up was recorded. Fall of BP was considered when there was a drop of 30% of the baseline (BP at the time of starting of the surgery) BP. Shooting up of the BP was considered when the BP rose by 10% of the baseline BP. ECG (electrocardiogram) changes were monitored with the help of a 5 channel continuous monitor and non-invasive BP cuff. The intra-operative ECG changes were recorded and any positive change was noted and immediately intervened. A proforma was used to note all these findings from the time of visit of the patient to the anesthetist till 48 hours after surgeries by the author.

The sample size was calculated by the prevalence of major surgeries done earlier in the same hospital calculated over the total surgical patients admitted with a margin of error of 08% and confidence interval of 95%. The data was analysed using standard Statistical methods, like percentage, mean standard deviation, using IBM SPSS statistics software version 23 and $P < 0.05$ was considered as significant.

Result

93 patients admitted in the General surgery and Orthopaedics departments of Princess Esra Hospital of Hyderabad, Telangana and Aarupadai Veedu Medical College Hospital were included in this study. A Shpauro Wilk test was applied to test the normality of the subjects. There were 51/93 (54.83%) General surgery patients and 42/93 (45.16%) Orthopaedics patients. There were 58 (54.83%) males (General Surgery- 38 (40.86%) and Orthopaedic surgery- 20 (21.50%) and 35 (37.63%) female patients (General Surgery- 13 (13.97%) and Orthopaedic surgery- 22 (23.65%) in the study. The male to female ratio was 1.28:1.

The mean age was 34.85 ± 6.15 years in General Surgery patients and 37.25 ± 4.60 years in Orthopaedic patients. The youngest patient was aged 21 years and the eldest one was aged 70 years. Among The General Surgery patients the mean duration of history of Hypertension was 54.86 ± 7.50 months. Among The Orthopaedics patients the mean duration of history of Hypertension was 52.31 ± 2.75 months. The longest duration was 73 months and the shortest duration was 11.4 months. Among the 51/93 General Surgery patients 04 (07.84%) were not taking any antihypertensive treatment, Amlodipine 5 mg was used by 06 (11.76%) patients, Telmisartan 40 mg was used in 08/51 (15.68%) patients, Atenelol was used in 07/51 (13.72%) patients, Losartan was used in 06/51 (11.76%) patients and metaprolol

was used by 05 (09.80%) patients, Diuretics was used in 05/51 (09.80%) patients, alpha blockers in 03 (05.88%), Angiotensin receptor blocker (ARB) in 06/51 (11.76%) and vasodilators in 01/51 (01.96%) patients. Among the 42/93 Orthopaedics patients 03 (07.14%) were not taking any antihypertensive treatment, Amlodipine 5 mg was used by 06/42 (14.28%) patients, Telmisartan 40 mg was used in 06/42 (14.28%) patients, Atenelol was used in 05/42 (11.90%) patients, Losartan was used in 05/42 (11.90%) patients and metaprolol was used by 05 (11.90%) patients, Diuretics was used in 05/51 (11.90%) patients, alpha blockers in 04 (09.52), Angiotensin receptor blocker (ARB) in 03/42 (07.14%) and vasodilators in 01/51 (02.38%), (Table 1).

Table 1: Showing the demographic data and incidence of antihypertensive drugs used (n-93)

Observation	General Surgery 51-(54.83%)	%	Orthopedic surgery 42-(45.16%)	%
Male	38	40.861	20	21.50
Female	13	13.97	22	23.65
Mean Age	34.85 ± 6.15	---	37.25 ± 4.60	---
Duration of Hypertension	12 to 72 months	---	12 to 61 months	---
Mean duration of Hypertension	54.56 ± 7.50		52.31 ± 2.75	
Antihypertensive drugs				
No treatment	04	07.84	03	07.14
Amlodipine 5mg	06	11.76	06	14.28
Telmisartan 40 mg	08	15.68	06	14.28
Atenelol	07	13.72	05	11.90
Metaprolol	05	09.80	05	11.90
Losartan	06	11.76	04	09.52
Diuretic	05	09.80	04	09.52
Angiotensin inhibitors (ARB)	06	11.76	04	09.52
Alpha blockers	03	05.88	03	07.14
Vasodilators	01	01.96	02	02.38

Based on the classification of the antihypertensive drugs among the 51/93 General Surgery patients, Calcium Channel Blocker (CCB) was used in 10/51 (19.60%), Angiotensin Receptor Blocker (ARB) in 16/51 (31.37%) patients, Beta Blockers (BB) in 17/51 (33.33%) patients, Diuretics in 04/51 (%) alpha blocker was used in 03/51 (05.88%) and vasodilators in 01/51 (01.96%) patients (Table 2). Based on the classification of the antihypertensive drugs among the 42 Orthopaedic Surgery patients, Calcium Channel Blocker (CCB) was used in 09/42 (21.42%), Angiotensin Receptor Blocker (ARB) in 15/42 (35.71%) patients, Beta Blockers (BB) in 10/42

(23.80%) patients, Diuretics in 04/51 (09.52%) alpha blocker was used in 03/51 (07.14%) and vasodilators in 01/51 (02.38%) patients (Table 2).

Table 2: Showing the incidence of antihypertensive drugs used according to Classification (n-93)

Classification of Antihypertensive drugs	G. Surgery		Orthopaedics	
	Number	%	Number	%
Calcium Channel Blocker (CCB)	10	19.60	09	21.42
Angiotensin Receptor Blocker (ARB)	16	31.37	15	35.71
Beta Blockers	17	33.33	10	23.80
Diuretics	04	07.84	04	09.52
Alpha Blockers	03	05.88	03	07.14
Vasodilators	01	01.96	01	02.38

In this study the commonly found prescriptions of antihypertensive drug combinations were CCB with BB was observed in 24/51 (47.05%) patients of General surgery, CCB with ARB was seen in 16/51 (31.37%) patients, ARB with diuretics in 06/51 (11.76%) patients and CCB with ACE was used in 05/51 (09.80%) patients. (Table 3) Among the Orthopaedics patients prescriptions of antihypertensive drug combinations were CCB with BB was observed in 14/42 (33.33%) patients of General surgery, CCB with ARB was seen in 13/42 (30.95%) patients, A RB with diuretics in 11/42 (26.19%) patients and CCB with ACE was used in 04/42 (09.52%) patients (Table 3).

Table 3: Showing the combination of Antihypertensive drugs used in the study (n-93)

Combination of Antihypertensive drugs used	G. Surgery		Orthopaedics	
	Number	%	Number	%
CCB+BB	24	47.05	14	33.33
CCB+ARB	16	31.37	13	30.95
ARB+DIURETIC	06	11.76	11	26.19
CCB+ACE	05	09.80	04	09.52

Among the General Surgery patients the co-morbidities observed were Diabetes Mellitus in 11/51 (21.56%) patients, COPD in 06/51 (11.76%) patients and Renal insufficiency in 03/51 (05.88%) patients, (Table 5). Among the Orthopaedics patients the co-morbidities observed were Diabetes Mellitus in 06/51 (11.76%) patients, COPD in 05/51 (09.80%) patients and Renal insufficiency in 03/51 (05.88%) patients (Table 4).

Table 4: Showing the co-morbidities in the study (n-93)

Co-morbidities	G. Surgery		Orthopedics	
	Number	Percentage	Number	Percentage
Diabetes Mellitus	11	21.56	06	14.28
Renal Insufficiency	06	11.76	05	11.90
COPD	03	05.88	03	07.14

In General surgery patients a combination of Spinal and Epidural was used in 14/51 (27.45%) of the General surgery patients, Spinal anaesthesia alone was used in 12/51 (23.52%) of the General surgery patients. General Anaesthesia was used in 06/51 (11.76%) patients, General and epidural anaesthesia was used in 05/51 (09.80%) patients, spinal and regional anaesthesia was used in 03/51 (05.88%) patients and spinal + local anaesthesia was used in 03/51 (05.88%) patients (Table 5). In Orthopaedics surgery patients a combination of Spinal and Epidural was used in 09/51 (17.64%) of the General surgery patients, Spinal anaesthesia alone was used in 07/51 (13.72%) of the General surgery patients and 08/42 of the Orthopedics patients. General

Anesthesia was used in 07/51 (13.72%) patients, General and epidural anesthesia was used in 05/51 (9.80%) patients, spinal and regional anesthesia was used in 04/51 (7.84%) patients and spinal + local anaesthesia was used in 02/51 (3.92%) patients (Table 5).

Table 5: Showing the types of Anaesthesia used in the study (n-93)

Types of Anaesthesia used	General Surgery		Orthopedics	
	Number	%	Number	%
Spinal and Epidural	14	27.54	09	17.64
Spinal anesthesia	12	23.52	08	19.04
General Anesthesia	06	11.76	07	13.72
General and epidural anesthesia	05	09.80	05	07.84
spinal and regional anesthesia	03	05.88	04	07.84
spinal + local anaesthesia	03	05.88	02	03.92

In 11 patients, new antihypertensive medications were started. In 8 cases Amlodipine 5 mg OD (once daily), in 1 patient Amlodipine 10 mg BD (twice daily), in 1 patient Amlodipine 5 mg OD & Losartan 25 mg OD and in 1 patient Losartan 50 mg SOS was started. The mean SBP in General surgery patients at their first visit was 135.84 ± 5.25 mmHg and DBP was 84.26 ± 7.15 mmHg. The mean SBP in Orthopedics patients at their first visit was 132.25 ± 4.50 and DBP was 86.05 ± 3.50 mmHg. Out of 51 General surgery patients 21 (41.17%) got approval for their surgeries at their first visit. Out of 30 remaining patients for, 24 (47.05%) patients the mean time taken to get fitness for anaesthesia was 3.60 ± 2.14 days. The mean time taken to control the Hypertension before giving fitness for surgery was 2.5 ± 1.15 days. In these patients antihypertensive medications were changed by the Anesthetist. In 13/30 (43.33%) patients Ramipril was stopped before surgeries and in another 12/30 (40%) patients Atenelol was stopped. In the remaining 06/30 (20%) patients a delay of more than 14 days was observed due to uncontrolled Hypertension and ECG changes showing left ventricular failure in 02/51 (3.92%), Left axis deviation in 04/51 (7.84%) patients (Table 6). Out of 42 Orthopedic patients 16/42 (38.09%) got approval for their surgeries at their first visit. Out of 26

remaining patients, for 12 (28.57%) patients the mean time taken to get fitness for anaesthesia was 4.12 ± 1.85 days. The mean time taken to control the Hypertension before giving fitness for surgery was 3.05 ± 2.10 days. In these patients antihypertensive medications were changed by the Anaesthetist. In 08/42 (19.05%) patients Ramipril was stopped before surgeries and in another 06/42 (14.29%) patients Atenelol was stopped.

Thus the total number of patients in whom antihypertensive drugs were stopped was 14 (33.33%) and continued were 28 (66.66%). In the remaining 07/51 (13.72%) patients a delay of more than 14 days was observed due to uncontrolled Hypertension and ECG changes showing left ventricular failure in 04/51 (7.84%), Left axis deviation in 03/51 (5.88%) patients. Among the 93 patients in 39 (41.93%) patients (General surgery 24 and 15 Orthopaedic surgery) the morning dose of antihypertensive dose was stopped and in the remaining 54 (58.06%) patients (General surgery 39 and 15 Orthopaedic surgery) the morning dose was administered. The Most common antihypertensive drugs continued till morning of surgery were CCB in 14/39 (35.89%) patients, ARB in 08/30 (26.66%) patients, BB in 06 patients, Diuretics in 06 patients, ACE inhibitors in 04 patients, AB in 01 and Vasodilators in none. According to ASA classification all the patients belonged

to ASA class II status in the study. The types of General surgeries performed in this study were, Herniorrhaphy, Laparotomy for GIT emergencies, Thyroid surgeries, retroperitoneal tumour excision, Renal calculus and Appendicectomies. Most common type of Orthopaedic surgeries were

fracture reduction (n = 14), hemiarthroplasty (n = 10), TKR – Total Knee Replacement (n = 06), THR – Total Hip Replacement (n = 05), Spacer (n = 3), decompression Fixation (n = 2) and closed Reduction (n = 2), (Table 6).

Table 6: Showing the incidence drug stoppage and mean times taken for fitness for surgeries in the study groups (n-93)

Observation	General Surgery 51	%	Orthopaedics 42	%
Mean SBP	135.84±5.25	--	132.25±4.05	----
Mean DBP	84.26±7.15	--	86.05±3.50	---
First time approval	21	41.17	16	38.09
Mean time for second approval	3.60±2.14	--	4.12±1.85	---
Mean time to control Hypertension	2.5±1.15	--	3.05±2.10	---
Change of Medication				
Stopping Ramipril	13	43.33	08	09.52
Stopping Atenelol	12	40.00	06	07.14
Morning dose				
Stopped-39 (41.93%)	25	49.01	14	33.33
Not stopped-54 (58.06%)	26	50.98	28	66.66
Antihypertensives continued				
CCB	07	13.72	08	19.04
ARB	06	11.76	06	14.28
BB	07	13.72	05	11.90
AB	04	07.84	05	11.90
Vasodilators	01	01.96	04	09.52
Types of surgeries	Appendicectomy Laparotomy for GIT diseases Thyroid surgeries Renal calculus Retroperitoneal tumour excision	---	Fracture reduction Hemi arthroplasty Total Knee replacement Decompression fixation Hip replacement Spacer	---

A combination of Spinal and Epidural (neuraxial anaesthesia) was the most common method of anaesthesia used in the is study with n- 23 (24.73%). The correlation between SBP, DBP and Heart rate were measured at the beginning of anesthesia, end of anesthesia and intra-operatively in all patients in the study and it was observed that the values were correlating well with each other irrespective of the antihypertensive drugs used on the day of surgery and in those stopped prior to surgery (p value significant at <0.05), (Table 7).

Table 7: Showing the HR, SBP and DBP intra-operatively (n-93)

Observation	Mean	Minimum	Maximum	P value
Heart Rate	91	58	124	
Start of the Anesthesia	78	56	126	
End of the Anesthesia Maximum value	95	62	132	0.001
Intra-operatively	77	55	122	
Systolic Blood Pressure	136	88	184	
Start of the Anesthesia	122	92	158	
End of the Anesthesia Maximum value	144	114	188	0.001
Intra-operatively	114	84	156	
At maximum DBP	138	80	174	
At minimum DBP	116	62	88	
DBP	90	70	86	
Start of the Anesthesia	80	68	84	
End of the Anesthesia Maximum value	88	66	82	0.001
Intra-operatively	74	62	88	
At maximum DBP	92	60	84	
At minimum DBP	68	56	66	

The commonly used anesthetic agent in the study was bupivacaine in 71/93 (76.34%) of patients. Midazolam was used in 61/93 (65.59%) patients, Fentanyl in 55/93 (59.13%) patients, lidocaine in 22/93 (23.65%) patients, buprenorphine in 09/93 (09.67%) patients. Other anaesthesia drugs used were N₂O, clonidine, ketamine, deflurane, Pentathol, pentazocine, dexmedetomidine, etomidate and tramadol. Intraoperative ECG changes was observed in 03/93 (03.22%) patients. The mean blood loss in the General surgery patients was 356.25±23.20 ml and in Orthopedics patients it was 428.30±6.50 ml. Maximum blood loss observed was in Orthopaedics patients; 2100 ml. Total blood loss (in ml) in General Surgery patients was 342.35±5.14. Maximum blood loss in a patient was 1200 ml, and the minimum was 24 ml. Allergic reactions were noted in 07/93 (07.52%) patients. They were managed by inj Adrenaline, Inj Avil and Hydrocortisone injections during the surgeries. Out of 07 allergic reactions 05/93 (05.37%) were due to antibiotic injections during the surgeries. Whenever there was fall in SBP during

surgeries or immediate post operative period, the patients were managed by IV fluid replacements, vasoconstrictors and colloid fluid replacements. Mean time of restarting antihypertensive drugs in those patients in whom they were stopped was 14.85±4.16 hours post-surgery periods. Minimum duration was 4.20±1.70 hours and the maximum time lapse was 21.5±4.20 hours. In 39/93 patients antihypertensive drugs were restarted within 48 hours.

The most common class of anti-hypertensive drug used was CCB in 08/39 (20.51%) patients, ARB in 09/39 (23.07%) patients, BB in 08/39 (20.51%) patients, diuretics in 02/39 (05.12%), ACE inhibitors in 09/39 (23.07%) and alpha blockers (AB) in 3/54 (7.69%) patients. In patients who were on BB drugs regularly showed a lower heart rate at the end of the surgery which significant in this study with p value less than 0.05. (Mann-Whitney U Test, P < 0.05).

Patients using Beta blockers on the morning of the surgery showed a significant lower heart rate at the end of surgery. In patients who were on diuretics on the morning of surgery showed a significant association with

higher heart rate and DBP (higher) at the end of surgery ($P < 0.05$). The DBP values were found to be lower in patients who were administered Fentanyl when compared with those who did not receive it (Chi-square test, $P < 0.05$). Patients receiving Desflurane showed a significant higher SBP and DBP (Chi-square test, $P < 0.05$). There was no significant differences in ECG changes when compared to any of the variables ($P > 0.05$).

Discussion

The present study was conducted with an aim to study the peri-operative evaluation, care and management of the patient with hypertension undergoing general & orthopaedic surgery which included the antihypertensive drug use, anaesthesia and their actions and side effects on hemodynamics with their management strategies in peri-operative period. There was no variability in the outcomes during the peri-operative period according to age or gender. Similar findings were reported by Jarari N, Rao N, Peela JR *et al* [6] who studied geriatric patients who were using CCB drugs for Hypertension.

The present observations go hand in hand with the pharmacological recommendations of CCBS in Hypertension as the first choice drug in patients with Hypertension and Diabetes Mellitus [1]. There were 56 patients whose surgery was postponed due to Hypertension in this study, they were with associated co-morbidities such as Diabetes Mellitus, COPD and Renal insufficiency. Studies by Varon J, Marik PE and Skarvavn K [7,8] suggested that preoperative Hypertension predisposes the patients to the risk of hemodynamic instability, myocardial infarction and chances of hypotension during the surgeries.

Few other complications such as intracerebral bleeding, hypertensive encephalopathy, aortic dissection, disruption of the aortic or arterial suture, and left ventricular failure were reported by [9]. But

the level of evidence for postponing a surgery in view of complications was less when the SBP was less than 180/110 mmHg. In the present study the patients who were on BB drugs regularly and also on the morning of surgery showed a lower heart rate at the end of surgery compared to patients not on beta blockers. But those who were on diuretics showed higher heart rate and DBP at the end of anaesthesia. Such hemodynamic changes were not associated with other classes of antihypertensive drugs [9]. Similar reports were recorded from the studies by Fleisher LA, Fleischmann KE and Dai *et al* [10-12] who showed peri-operative beta blockers were cardio-protective and patients chronically treated with beta-blockers should continue to take them throughout the peri-operative period. A study by Lindenauer PK, Pekow P, Wang K *et al* demonstrated a rise in incidences of Myocardial infarction and death on Withdrawal of beta-blockers during the 1st week after surgery [13]. BBs were the most common antihypertensive drugs taken in this study by the patients. In our study, CCBs were the most common antihypertensive drug taken in this study on the morning and 48 hours after the surgery. But CCBs were not proved to be protective in preventing myocardial infarction and death like BBS when continued during the 48 hours after surgery [14].

A Meta Analysis showed that at the same time CCBs do not have any side effects when continued after surgery and known to be cardio-protective and prevent death and hence should be continued [15]. Review of literature has shown that ACE inhibitors and ARBs are known to produce intra-operative hypotension [16,17]. There was also no benefit of continuing ACE inhibitors in the post-operative period to prevent mortality, morbidity and hemodynamic complications [18]. Studies by Comfere T, Sprung J, Kumar MM *et al* have recommended discontinuing ACE inhibitors on the morning of surgery [19,20]. Kheterpal S, Khodaparast O, Shanks

A *et al* showed that patients who were using regularly ACE inhibitors and omitted the dose on the morning of the surgery experienced more episodes of hypotension and need for vasopressor drugs intra-operatively [21]. But there were also contradicting reports in the literature which showed no increase in the incidence of hypotension in patients who took ACE inhibitors [22]. In view of such contradicting reports in the literature one of the authors of a study recommended to re-inspect the usage of ACE inhibitors in Hypertension and its effects during surgeries [23]. Randomized studies on the usage of furosemide in hypertensive patients undergoing surgeries found that avoiding morning dose was not associated with intra-operative hypotension, intra-operative administration of vasopressors and fluids when compared to placebo [24]. A study by Modig J. showed that epidural anesthesia was associated with significant blood loss when compared to inhalational anesthetic [25]. The type of anesthesia and baseline SBP and DBP were definitely had a role in the fluctuation of BP in the intra and post operative periods although for a lesser degree. This may be due to the fact patients undergoing surgeries on spinal anesthesia had some degree of pain which was the stimulus for the fluctuating BP. Poh KS, Lim TA, Airini IN from their study concluded that spinal anesthetic might give a better pain relief during the early postoperative period in patients, leading to a less change in BP [26]. Also these patients with hypertension were found to have a lower heart rate [26].

Benson M, Junger A, Fuchs C, Quinzio L, Böttger S, Hempelmann G *et al* from their study revealed that Propofol caused the greatest drop in blood pressure whereas etomidate caused the least [27]. It was reported that usage of Fentanyl was associated with higher rises in DBP, and hypotension intra-operatively. It was concluded that inadequate analgesia by

Fentanyl lead to increase in intra-operative BP. Similarly Buprenorphine was associated large levels of fall in the SBP intra-operatively. In this study Desflurane was found to be associated with higher incidence of rise of SBP. but in geriatric patients it was known to produce hypotension [28]. Propofol induce General anesthesia was known to produce Hypotension by Propofol-mediated decrease in sympathetic activity which causes decrease in systemic vascular resistance and decrease in cardiac output by a combination of venous and arterial vasodilatation, impaired baroreflex mechanism and depression of myocardial contractility [29]. It was a common experience of all anesthetists that patients being operated under GA experience a initial drop in BP at the induction of anesthesia. This was followed by an increase after tracheal intubation. But that was not the situation in patients undergoing surgeries on spinal anesthesia where the BP profile was different in patients who were given spinal anesthesia. The fluctuations of SBP and DBO are less profound unlike GA.

This was consistent with similar previous studies that hypertensive patients are more vulnerable to blood pressure fluctuations in response to anaesthetic agents and vasodilators [26]. IV fluids are required in patients undergoing surgeries irrespective of their controlled or uncontrolled SBP and DBP especially during the post-operative period. They can be given preoperatively as preloading method or to prevent hemodynamic disturbances intra-operatively especially during neuroaxial blockades of spinal anaesthesia. Bajwa SJS, Kulshrestha A, Jindal R *et al* showed that none of the methods used to infuse IV fluids were efficient in preventing the hypotension alone and has to be coupled with judicious use of vasopressors [30].

Limitations of this Study: Intra-operative haemodynamic like heart rate and blood

pressure might not be as accurate as electronic recordings of such variables.

Conclusion

Intraoperative hemodynamic changes were less in patients who used regularly Beta blockers than other antihypertensive drugs. They had lower heart rate also. Patients on diuretics on the morning of the surgery showed gross hemodynamic changes such as raised SBP and DBP. Other antihypertensive drugs did not show significant hemodynamic changes intra-operatively.

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