Original Article

ISSN (O): 2456-7388; ISSN (P): 2617-5479

Preoperative Hypertension: Incidence, Effect on Perioperative Risks and Outcome

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Abstract

Background: Hypertension (HTN) is the most frequent preoperative abnormality detected in surgical patients. Its high prevalence necessitates an analysis of its severity and the associated perioperative risks. There is always a controversy about whether to postpone elective surgery given poorly controlled HTN or not. The present study aimed to observe the incidence of HTN in pre-surgical patients, associated co-morbidities and end-organ damage, perioperative risks and outcome. **Subjects and Methods:** After approval from ethical committee, in this prospective observational study 1180 adult surgical patients were assessed for HTN. Patients found to be hypertensive were then categorized as known hypertensive, HTN detected at PAC clinic and hypertensive on day of operation. These patients were further investigated for end-organ damage. Hemodynamic changes at the time of intubation, any intraoperative complications and post-operative morbidity and mortality were also observed. **Results:** The incidence of HTN was 9.2%, out of these 47.7% were known hypertensive, 27.5% had raised blood pressure on admission and 24.7% were detected for the first time in the preoperative room. In hypertensive patients, haemodynamic fluctuations were more during the intraoperative period. Eight patients (7.4%) had fresh, transient (lasted<10minutes) ECG changes (five had ischemic changes and three had arrhythmias) that required no treatment. Five (4.6%) patients were postponed due to hypertension. **Conclusion:** HTN is a frequently encountered abnormality seen among presurgical patients and many patients remain undetected till the time of surgery. During surgery, these preoperatively detected hypertensive patients have more swings in BP as compared to known hypertensive patients who are on regular treatment. However, stage 1 & 2 HTN alone is not found to be associated with increased risk and data from the present study indicates that stage 3 HTN without end-organ damage can undergo minor surgeries safely.

Keywords: Hypertension, End organ damage, cardiovascular risk, Anesthesia, Perioperative

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Received: 03 October 2020 **Revised: 25 November 2020** **Accepted: 04 December 2020** **Published: 24 December 2020**

Introduction

HTN is the most frequent preoperative abnormality detected in surgical patients. Long-standing uncontrolled HTN accelerates hypertensive end-organ damage and is one of the main risk factors for cardiovascular mortality accounting for 20-50% of all deaths.[1] HTN is a major risk factor for coronary artery disease, congestive heart failure, dementia, renal and cerebrovascular diseases and is associated with dyslipidemia, diabetes and obesity.[2–4] However, mild to moderate HTN is more common than severe HTN, and much of the population burden of the disease because of it may be attributed to moderate rather than severe HTN.[5] There is still a controversy about whether to postpone or proceed with elective surgery in patients who have poorly controlled or high arterial pressure on admission to hospital. However, an association between preoperative hypertension in well controlled hypertensive patients without significant cardiovascular co-morbidities and major perioperative complications has not been demonstrated.[6] There is a general agreement that patients with mild and moderate HTN and no evidence of coronary artery disease or end-organ damage may undergo surgery safely without delay. In contrast, for patients with severe HTN, the data is insufficient to recommend the optimal approach.

The primary aim of the present study was to observe the incidence of HTN, end-organ damage such as coronary artery disease in surgical patients, and Perioperative risk in such patients. Also we recorded the incidence of HTN in normotensive patients on the day of surgery. The secondary

outcome was to observe in-hospital morbidity and mortality among the study population.

Subjects and Methods

After approval from the institutional ethical committee, this prospective observational study was conducted over a period of one and a half years. Informed written consent was obtained from all adult surgical patients coming to our Preanesthetic checkup (PAC) clinic admitted in various surgical specialties including General Surgery, Orthopaedics, Obstetrics and Gynecology etc. Exclusion criteria were patients below 18 years of age and with pregnancy-induced HTN, emergency surgeries and those done under local anesthesia. ASA grade of patients was decided at PAC clinic based on history and complete physical examination done by a consultant or trainee resident anesthetist with at least two year of experience. Based on blood pressure (BP) recordings done in PAC, wards and preoperative room all the patients were categorized as follows:

- Known Hypertensive (patients with a history of HTN)
- HTN detected at PAC clinic or on day of surgery
- Normotensive patients (BP<140/90mmHg)

For this study the term "Hypertensive Patients" referred to any patient who was either known hypertensive taking antihypertensive medication or who presented with two or more readings of raised arterial pressure [systolic BP (SBP)>140mmHg or diastolic BP (DBP)>90 mm of Hg] at PAC clinic or at any time during preoperative assessment and required some intervention to lower persistently elevated arterial pressure on the day of surgery (they were previously normotensive). Joint National Committee (VII) classification of HTN was used for detection and to classify hypertensive patients in three stages: stage 1(mild HTN SBP 140-159 and DBP 90-99mmHg), stage 2 (moderate HTN SBP160-179 and DBP 100-109mmHg) and stage 3 (severe HTN SBP>180 and DBP>110mmHg).[7] Patients with SBP>140 mmHg and DBP <90mmHg were categorized as isolated systolic hypertension. Recent JNC 8^{th} guidelines on prevention, detection, evaluation and treatment of high BP have reclassified the stages of BP and also changed the target BP according to the age of patients at which treatment should be initiated. However, these changes are not universally adopted by all societies like AHA/ACC etc.[8]

All hypertensive patients were interviewed regarding the duration of HTN, type of medications taken, end-organ damage (coronary artery disease, congestive heart failure, left ventricular hypertrophy, hypertensive nephropathy, retinopathy and cerebrovascular disease), associated diseases (like diabetes), family history of HTN & habits of tobacco chewing, smoking, alcohol consumption. Routine laboratory investigations including complete hemogram, serum creatinine, blood sugar and ECG were done in all patients. Selected patients, with grade 3 HTN and/or ECG changes or with associated diseases were referred to a physician or cardiologist and further investigations like echocardiography and X-Ray chest were done. Retinoscopy was done in randomly selected 56 hypertensives and 98 normotensive patients who consented to this test, to determine the incidence of retinopathy among hypertensive patients and to assess whether hypertensives are more prone for fundal changes or not. Only after adequate control of HTN (BP<140/90mm Hg), patients were posted on the elective surgery list. Surgical procedures were categorized into three types based on invasiveness and potential to disrupt normal physiology as minimally, moderately and highly invasive surgery. All patients received tablet diazepam 5-10mg the night before and tablet alprazolam 0.25-0.5 mg in the morning of surgery which is a routine for almost all presurgical patients (with few exceptions like deranged liver/renal function etc). Antihypertensive medications (except ACE inhibitors) were continued till the morning of surgery. Patients were re-examined in the preoperative room on the day of surgery and if arterial pressure was found raised (>140/90mm Hg), 1-2mg of midazolam was administered intravenously. After anxiolysis, if BP was≤180/110mm Hg, the patient was taken up for the surgery and if BP remained >180/110 mmHg, only minimally invasive surgery was allowed to proceed. Intraoperatively noninvasive BP (NIBP), ECG, heart rate (HR), SpO_2 and urine output were continuously monitored and recorded at regular intervals. Any complication during the intraoperative period like more than 20% swings in BP and HR, ECG changes, falls in urine output etc were recorded. In the postoperative period, ECG, HR and NIBP were monitored for 24 hrs. The patients were observed for any adverse events like myocardial ischemia/infarction, arrhythmia, and decrease in urine output, renal failure etc. and mortality during a hospital stay.

Statistical Analysis

Descriptive statistics included computation of percentages. A Chi-square test was used for intergroup comparison and to test how likely the observed distribution is due to chance. The level of significance was set at $p \leq 0.05$.

Results

A total of 1180 admitted to various surgical specialties [419 (36%) in orthopaedic, 298 (25%) in gynaecology, 317 (27%) in general surgery, 81 (6%) in urology and 65 (5%) in other specialities) were screened and included in the study. 109 (9.2%) patients were found to be hypertensive. Out of which, 52 patients (47.7%) were known hypertensive while 30 patients (27.5%) had raised BP at the time of admission detected in PAC clinic and 27 patients (24.8%) had raised BP for the first time on the day of surgery in

Table 1: Distribution of Hypertensive patients before operation

	Stage1 n (%)	Stage 2 n (%)	Stage 3 n (%)	Total n(%)
Known Hypertensive	24 (46.1%)	24 (46.1%)	4 (7.7%)	52 (47.7%)
Detected in PAC clinic	10 (33.3%)	15 (50%)	5 (16.7%)	30 (27.52%)
Detected on day of Surgery	9 (33.3%)	10 (37.04%)	8 (29.6%)	27 (24.8%)
	43 (39.4%)	49 (44.9%)	17 (15.6%)	109 (100%)

Table 2: Distribution of hypertensive patients according to age and sex

Age (yrs)	Male (n) hyper/normotensive	Female (n) hyper/normotensive	Total(n) hyper/normotensive
18-45	12/578 (2.1%)	13/236 (5.5%)	25/814 (3.1%)
45-60	41/220 (18.6%)	19/75 (25.3%)	60/295 (20.3%)
>60	14/40 (35%)	10/31 (32.2%)	24/71 (33.8%)
Total	67/838 (7.99%)	42/342 (12.3%)	109/1180 (9.2%)

Table 3: Distribution of patients having raised BP on Operation Table

	Stage 1 n (%)	Stage 2 n (%)	Stage 3 n (%)	Total n (%)	>160/100 mmHg
Previous Hypertensive	27 (29.03%)	30 (32.3%)	9 (9.7%)	66 (70.96%)	39 (42%)
Previous Normotensive	9 (9.7%)	10 (10.7%)	8 (8.6%)	27 (29.03%)	18 (19.3%)
	36 (38.7%)	40 (43.01%)	17 (18.3%)	93 (100%)	57 (61.3%)

Table 4: Incidence of Associated diseases and other cardiovascular risk factors

	Hypertensive n (%)	Normotensive n (%)	Intergroup p-value
IHD/CHF	20 (18.3%)	32 (3%)	<0.01*
Obesity	6 (5.5%)	21 (2%)	<0.05*
DM	3 (2.8%)	10 (0.9)%	>0.05#
Fundal Changes	7/56 (12.5%)	1/98 (1%)	<0.01*
Alcohol consumption	15 (13.8%)	93 (8.68%)	>0.05#
Tobacco consumption	55 (50.5%)	316 (29.50%)	<0.01*

* Statistically Significant, # Statistically Insignificant, IHD-ischaemic heart disease/ CHF-congestive heart failure, DM-diabetes.

Table 5: Hemodynamic variations according to type of Anesthesia

	RA n=47 (43%)	GA n=62 (57%)	At L& I n (%)
Within 20% of baseline	19 (40.4%)	14 (22.6%)	37 (59.7%)
Rise >20% of baseline	2 (4.3%)	38 (61.3%)	20 (32.3%)
Fall >20% of baseline	26 (55.3%)	10 (16.1%)	5 (8.01%)
Swings in BP (both rise and fall>20% baseline)	1 (2.1%)	18 (29.03%)	
ECG ischaemic changes	2 (4.3%)	3 (4.8%)	
Postop hemodynamic instability	3 (6.4%)	14 (22.6%)	

RA-Regional Anesthesia, GA- General Anesthesia, L&I- Laryngoscopy and Intubation.

Table 6: Comparison of postoperative morbidity and mortality among two groups

	Hypertensive n=109 (%)	Normotensive n=1071 (%)	p-value
Morbidity	13 (11.9%)	47 (4.4%)	<0.01*
Mortality	1 (0.9%)	3 (0.3%)	>0.05#

* Statistically Significant, # Statistically Insignificant.

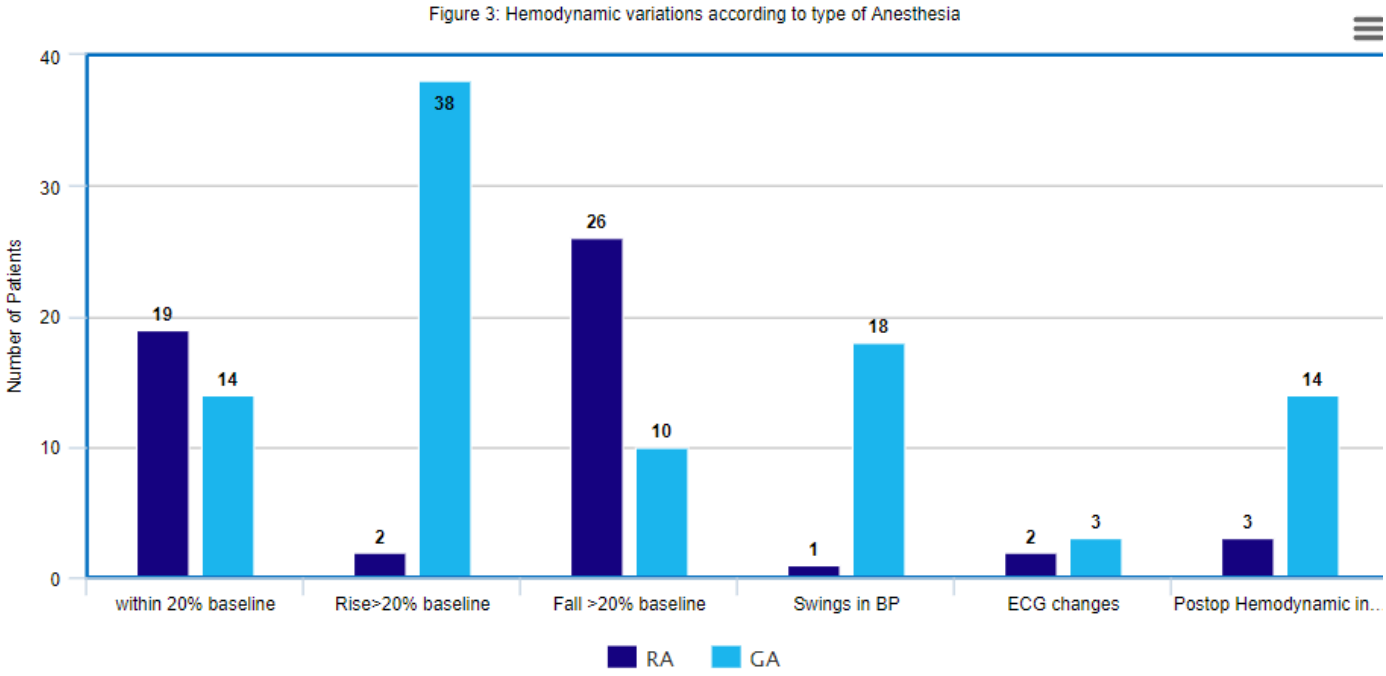

Figure 3: Hemodynamic variations according to type of anesthesia

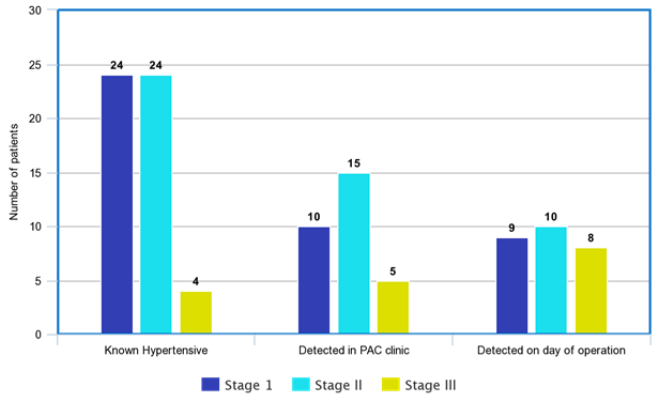

Figure 1: Distribution of hypertensive patients before surgery

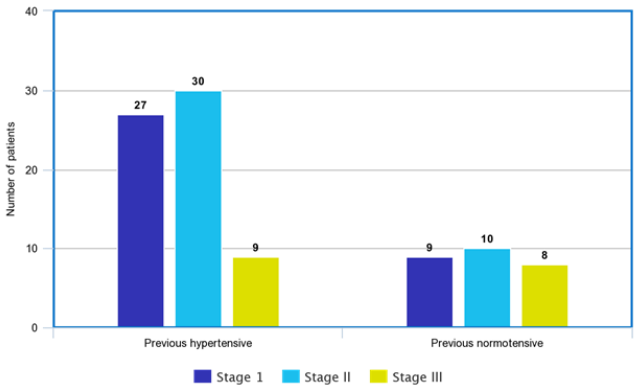

Figure 2: Distribution of patients having raised BP on operation Table

the preoperative room [Table 1, Figure 1]. Out of these 27 patients, 17 remained hypertensive in the post-operative period. [Table 1] also indicates that the maximum number of patients had stage I/II HTN. [Table 2] depicts the distribution of hypertensive surgical patients according to age and sex. This table shows that the maximum incidence of HTN was seen in >60years of age (33.8%) and females were affected more than males (12.3% versus 7.99%). However, in >60years of age group, the incidence of HTN was more frequent in males and isolated systolic HTN was observed in 6 (5.5%) patients, all of them belong to this age group. Maximum hypertensive patients belonged to ASA grade1&2 (75.2%) [as ASA grading was done in PAC clinic, all normotensive patients who were diagnosed to be hypertensive on day of surgery were categorized ASA 1, which was not modified lateron] while only 27 (24.8%) were ASA grade3 patients ($p>0.05$).

93 patients had raised BP on the operation table before surgery; out of these 29.03% of patients were previously normotensive while 70.96% were known well-controlled hypertensive patients [Table3, Figure 2]. Among these, 57 (61.3%) patients were having BP>160/100 (stage II & III).

In 18.3% of hypertensive patients, there was a history of ischemic heart disease (IHD)/ congestive heart failure (CHF), 5.5% were obese. In 2.8% there was a history of diabetes, 50.5% of patients were tobacco users and 13.8% were alcoholics. 12.5% hypertensive patients (7 patients out of 56 fundoscopy done) had fundal changes on ophthalmoscopic examination whereas it was only 1% (1patient had fundus changes out of 98 patients screened) among non-hypertensive [Table 4]. This difference was statistically significant ($p<0.01$). The incidence of coronary artery disease was 18%, renal disease 1%, left ventricular hypertrophy in 47% of patients among the hypertensive subjects. Among hypertensive patients, 43 patients (39%) required minor surgery, 66 patients (61%) moderate surgery and no major surgery was done. General anesthesia was given in 62 hypertensive patients (57%) and 47 patients (43%) received central neural blockade.

In hypertensive patients, BP and pulse rate fluctuations were more during the intraoperative period [Table 5, Figure 3]. 8 patients had fresh ECG changes intraoperatively (transient ischemic changes in 5 patients and 3 had arrhythmia), 2 had excessive bleeding, 1 had fallen in urine output (<0.5ml $Kg^{-1}Hr^{-1}$), 9 had fallen in oxygen saturation (SpO_2<90% and required supplemental oxygen) and 3 had laryngospasm or bronchospasm during the intraoperative period. None of the ECG changes were persistent (lasted>10minutes) and warrant any treatment. 5 (4.6%) patients were postponed due to HTN (BP>180/110) not managed by sedative premedication and rescheduled only after adequate control of BP (<140/90mmHg). It was also noticed that postoperative morbidity was higher among hypertensive patients($p<0.01$) while both groups were comparable with regards to postoperative mortality ($p>0.05$) [Table 6].

Discussion

HTN affects billions of people worldwide and is a causative factor for millions of deaths annually. HTN causes end-organ damage, particularly to the heart, brain and kidney.[5,9] It is undoubtedly one of the most important risk factors for cerebrovascular & coronary artery disease.[10] Although many studies have shown that a history of HTN is a predictor of cardiac death, none has shown a direct correlation between high BP measured at the time of admission in the hospital and perioperative complications.[5,11,12] Nonetheless, proper management with antihypertensive medication considerably decreases cardiovascular morbidity and mortality.[13] The high prevalence of HTN requires the analysis of the severity of the disease and its associated perioperative risks. In the present study, 1180 patients undergoing elective non-cardiac surgeries were screened in the PAC clinic. The drug treatment of known hypertensive (47.7% of total hypertensive patients) was reviewed if required and antihypertensive medications were started in patients with HTN on admission (27.52% of total hypertensive patients) after consulting with the physician [Table 1, Figure 1]. Patients presenting with HTN on day of surgery [93 patients (85.32%)] were further classified into previously hypertensive on treatment and normotensive patients [Table 3, Figure 2]. Similarly, Goldman et al found that 8% of patients who were normotensive before the operation had perioperative hypertensive episodes. In contrast, hypertensive patients who were taking antihypertensive medications, patients who remained hypertensive despite therapy and patients with untreated HTN had an incidence of 2%, 25% and 70% perioperative HTN respectively.[14] In the present study, among the patients who had raised BP on day of surgery,70.96% were known hypertensive on treatment and still exhibited excursions in BP from baseline [Table 3]. Various causes could lead to HTN in the immediate preoperative period such as anxiety, fear, pain etc. Although anxiolytic premedication was given to each patient, patients who were normotensive during PAC also showed increased BP preoperatively. This was contrary to the concept of ”White coat hypertension” and was considered to be due to disturbed night sleep, the anxiety of the operating room and strange atmosphere of operation theater etc. Additional doses of anxiolytics was administered in such patients and only those normotensive patients in whom BP remained persistently high (SBP>140mmHg or DBP>90 mmHg) were labeled as hypertensive [27 patients (24.77%)] and further followed up for persistence of HTN postoperatively.

The association between HTN and end-organ damage is well established.[5,9] HTN is undoubtedly linked to ischemic heart

disease and heart failure, cerebrovascular disease and renal impairment. In the present study, the incidence of ischemic heart disease in hypertensive patients was 18% compared to only 3% in normotensive patients ($p<0.01$) [Table 4].

HTN is a common finding in the middle-aged/elderly population presenting for major non-cardiac surgery and the control rate, particularly of SBP, remains poor despite best available treatment strategies.[15] Anesthetists therefore often face the dilemma that whether or not to postpone the surgery.[6] As the evidence for either course of action is limited, it is not surprising to observe wide variation in practice. Soni et al did a survey on cancellation of surgery due to HTN alone in 2013 and then in 2018 after the publication of the Association of Anaesthetists guidelines in 2016. They observed a raised awareness about 'safe' BP threshold and reduction in practice variations which leads to a significant decrease in cancellations due to HTN from 1.37% to 0.54%.[16] Similarly, 2014 ACC/AHA perioperative guidelines on evaluation and care of non-cardiac surgery did not consider hypertension as an independent risk factor for deferring the surgery to optimize BP control.[17] It is desirable due to high cost involved in delaying of surgeries. However, uncontrolled stage 3 HTN (SBP $\geq$180 mmHg or DBP $\geq$110 mmHg), constitutes a risk factor for perioperative ischemic events.[18] It has been shown that patients with elevated BP in the preoperative period are at higher risk for wide BP fluctuations intraoperatively, thus leading to periods of hypoperfusion and end-organ ischemia.[5] So, appropriate preoperative management of hypertensive patients and individual case to case decision should be taken to minimize cardiovascular morbidity and at the same time curtailing the cost and inconvenience caused by the unnecessary delay of surgery.[18]In the present study, ACC/AHA perioperative guidelines (2014) were followed and all moderate and highly invasive surgery in stage 3 HTN were postponed.17 (15.59%) patients exhibited raised arterial pressure (>180/110 mm Hg) on the day of operation irrespective of their status of arterial pressure on admission. Out of these 17, stage 3 hypertensive patients, 12 patients (11%) who required minimal invasive procedure were allowed to proceed for the surgery after giving sublingual nifedipine. No undue side effect was found intra or postoperatively. This was based on a clinical trial that enrolled and randomized hypertensive patients to a control group that remained in the hospital for BP control and the study group which received intranasal nifedipine immediately before surgery. No difference was recorded in the perioperative complications between the two groups, though hospitalization time was shortened in the study group.[6] Contrary to this, Casadei et al observed that uncontrolled HTN (mostly systolic) was associated with a greater incidence of perioperative myocardial ischemia, supporting the fact that severe HTN may increase the risk in surgical patients.[10] In the present study, transient ischemic changes and dysrhythmias were observed intraoperatively in a very small number of hypertensive patients (5 and 3 patients respectively), similar to that in normotensive patients [Table 5]. None of these ECG changes were serious enough to warrant treatment and were transient. In the postoperative period, transient ECG changes (<10minutes) were seen only in 4 (3.6%) patients who had long standing HTN with a history of angina or LVH.

The other significant finding in hypertensive patients was more swings in BP intraoperatively. A decrease or increase of greater than 20% from baseline BP can precipitate myocardial ischemia by decreasing the blood supply and increasing the cardiac work.[19] Similarly, Sessler et al observed that either absolute fall in mean arterial pressure (MAP) to less than 50mmHg or 40% decrease from baseline value persisting for $\geq$10 minutes and tachycardia >100 beats/minutes were associated with the adverse cardiovascular event.[20] In the present study, 69.7% of hypertensive patients exhibited fluctuations in BP from baseline ($\pm$20% from baseline) [Table 5]. Although these changes were not associated with ECG changes all the time but definitely made the anesthetist worried. These excursions were more frequent in patients who presented with an increase in BP in the immediate preoperative period than those already taking antihypertensive drugs.Although preoperative HTN increases intraoperative hemodynamic instability no known benefit has been observed from the initiation of a new therapy in the perioperative period to achieve normal BP.[19] However, every effort should be taken to maintain intraoperative BP within 20-30% of baseline.[18] In the present study, one patient had myocardial infarction on 3^{rd} post-operative day. He was a controlled hypertensive patient who underwent inguinal hernia repair under spinal anesthesia. He was an obese patient with a history of myocardial ischemia 3 years ago.

Hence, the management of hypertensive patients during the perioperative period is a very challenging situation and final decisions should be based on some strong and compelling evidence that is available in clinical practice. Howell et al in 2018, based on epidemiological data suggested that if the patient is considered fit for surgery in other respects and there is no active co-morbid disease, their surgery should not be deferred if BP<180/100 mmHg. As surgery cancellations have been a major problem in healthcare worldwide, with resulting psychological, social and financial implications for patients and their families, in patients with higher pressures evidence is scanty and decisions should be made on a case-to-case basis.[21] In the preoperative evaluation of HTN, it is important to know whether BP is controlled with medications or not. Delaying surgeries only for BP control might not be necessary unless there is stage 2 HTN and accompanying target-organ damage, or stage 3 HTN that may increase the risk of perioperative arrhythmias, myocardial ischemia and stroke.[22] Invasive arterial pressure monitoring is indicated for major procedures in poorly controlled hypertensive patients,

and the arterial pressure should be actively managed to decrease excursions of the MAP of greater than 20-30% from baseline.[18] Monitoring should continue into the postoperative period until the patient is hemodynamically stable. It may be appropriate to manage these patients in a high dependency area in the immediate postoperative period.

Limitations of our study: In the present study, only admission BP was recorded; it was not possible to examine the significance of subsequent BP readings. However, in the context of elective surgery, management decisions are made frequently based on admission BP alone. A patient whose admission BP falls within acceptable limits may go to surgery without further BP recordings being taken. Ideally the findings of the present study require confirmation in further large sample prospective study. The low overall risks associated with elective surgery will make such a study difficult to design and undertake. The absolute risk of the major cardiovascular event following surgery is low and therefore strategies to reduce the risk further will yield only a small return.

Conclusion

HTN is a frequently encountered abnormality seen among presurgical patients and many times it remains undetected till the time of surgery. During surgery, these preoperatively detected hypertensive patients have more swings in BP as compared to known hypertensive patients who were on regular treatment. However, stage 1 and 2 HTN alone is not found to be associated with increased risk and data from the present study indicates that stage 3 HTN without end-organ damage can undergo minimally invasive surgery safely. The extent of end-organ damage due to HTN particularly cardiovascular and associated co-morbidities like diabetes etc should be evaluated during PAC, so that patients at high risk can be identified and unnecessary delay in surgery can be avoided.

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How to cite this article: Jain M, Singh AK, Arora V, Johar S, Lal J, Bansal T. Preoperative Hypertension: Incidence, Effect on Perioperative Risks and Outcome. Acad. Anesthesiol. Int. 2020; 5(2):117-124.

DOI: dx.doi.org/10.21276/aan.2020.5.2.25

Source of Support: Nil, **Conflict of Interest:** None declared.