



PERIOPERATIVE HEMODYNAMIC PARAMETERS IN OPTIMIZED HYPERTENSIVE PATIENTS POSTED FOR ELECTIVE SURGICAL PROCEDURES UNDER GENERAL ANAESTHESIA

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Abstract

Background: Arterial hypertension is one of the most common co-morbid conditions affecting general population, which contributes to pathogenesis of various diseases, worsening the treatment outcome.

Aim: To observe perioperative hemodynamic parameters in optimized hypertensive patients posted for elective surgical procedures under general anaesthesia.

Methods: The present prospective observational study conducted in the Postgraduate Department of Anaesthesiology and Critical Care, Government Medical College, Srinagar and Associated Hospitals, over a period of 18 months on patients with optimized hypertension posted for elective surgical procedures under general anaesthesia. A total of 136 patients with controlled hypertension were observed and were classified according to duration of surgery. During the study period patients were observed for perioperative hemodynamic parameters in optimized hypertensive patients posted for elective surgical procedures under general anaesthesia, to observe the incidence of perioperative complications and any prolongation of hospital stay thereafter and to compare incidence of perioperative complications in surgeries of different durations.

Results: Among 136 patients, 19.85% patients belonged to surgeries upto one hour of duration, 28.65% patients belonged to surgeries upto two hours of duration, 24.26% patients belonged to surgeries upto three hours of duration and 27.29% patients belonged to surgeries upto four hours of duration. All the patients demonstrated hemodynamic stability during anesthesia and showed no statistically significant deviation of hemodynamic parameters from pre-induction hemodynamic parameters during intraoperative and postoperative periods. Incidence of perioperative complications was 0% in surgeries of one hour duration, 2.5% in surgeries of 2 hours duration, 3.0% in surgeries of 3 hours duration and 5.4% in surgeries of 4 hours of duration.

Conclusion: Controlled hypertension decreases the incidence of major perioperative complications such as arrhythmias, myocardial ischemia, and stroke.

Keywords: Controlled hypertension, Elective surgical procedures, arrhythmias, myocardial ischemia, General anesthesia.

Introduction:

Arterial hypertension is one of the most common co-morbid conditions affecting general population, which contributes to pathogenesis of various diseases, worsening the treatment outcome and is an independent risk factor for cardiovascular complications after anesthesia and surgery. [1] It has been shown to increase the perioperative morbidity and mortality, frequently resulting in cancellation of surgical procedures and increased cost of treatment. [2]

During anesthesia, most patients experience periods of hemodynamic instability, which healthy individuals can tolerate, but are usually catastrophic in hypertensive patients due to the wide pressure fluctuations and sympathetic hyperactivity. [3] Hypertension, especially when not treated, increases the risk of cardiovascular changes during the anesthetic-surgical procedure. On the other hand, pharmacological treatment of this condition is associated with possible interactions with anesthetic and adjuvant drugs. [4] Besides, hypertensive individuals represent a challenge to the professionals involved with perioperative medicine because target-organ compromise (heart, brain, and kidneys), associated with variable functional changes, contribute to the increase in cardiac risk. [5]

Hypertension is defined as, a systolic blood pressure of 140 mmHg or more, or diastolic blood pressure of 90 mmHg or more, or taking antihypertensive medications. [6]

Controlled / optimized hypertension is defined as a systolic blood pressure of less than 140 mmHg and a diastolic blood pressure of less than 90 mmHg among hypertensive patients on antihypertensive medications.[7,8]

Peri-operative hypertension may occur in patients with pre-existing arterial hypertension or manifest as a de novo phenomenon. [9,10] Perioperative hypertension occurs in 25% of hypertensive patients that undergo surgery. [11-13] In the perioperative period, patients with and without pre-existing hypertension are likely to develop blood pressure elevations and tachycardia on induction of anaesthesia. [14]

Various factors may be responsible for hypertension during the peri-operative period, which include preoperative anxiety, pain and sympathetic responses during surgical stimulation. Hypertensive spikes may occur during direct laryngoscopy for endotracheal intubation and reversal from anesthesia with added stimulation from the presence of an endotracheal tube. In addition to blood pressure changes related to perioperative issues, patients with previously unrecognized hypertension or those who are non-compliant with their current medication regimen may present for operative procedures. These issues are further confounded by the current recommendations to withhold certain antihypertensive medications (Angiotensin converting enzyme inhibitors or Angiotensin receptor blockers) for 12-24 hours prior to surgery, given their association with profound and refractory hypotension during anesthesia care. [15,16]

Methods:

The present study was a prospective observational study conducted in the Department of Anaesthesiology and Critical Care, Government Medical College, Srinagar and Associated Hospitals, over a period of 18 months on patients with optimized hypertension posted for elective surgical procedures under general anaesthesia. The study was conducted after obtaining approval from Institutional Ethical Committee.

Patients above 40 years of age of either sex, with ASA status of II, scheduled for elective surgeries under general anesthesia were selected for this study. Patients with diabetes mellitus, chronic obstructive pulmonary diseases, bronchial asthma, hypothyroidism/hyperthyroidism, pregnant females, valvular heart diseases, heart blocks, dysrhythmias, cerebrovascular event, non-elective surgical procedures, cardiac and neurological surgical procedures were excluded from the study.

Written informed consent was taken from the patients for participation in the study. Age, gender, weight, type of surgery, anesthesia time and surgery time was noted down in all patients.

Patients selected for study were admitted 24 hours prior to surgery. The pre-operative assessment of patients including thorough history, particularly regarding duration of hypertension and use of Anti-hypertensive medications and history of other co-morbid disease, previous anaesthetic exposure, medications, allergy to any drugs and personal habits was elicited.

General physical examination as well as systemic examination of Cardiovascular system, Respiratory system and Central nervous system was performed. All baseline investigations like CBC, BT/CT, KFT, LFT, Serum Electrolytes (Sodium and Potassium), blood glucose, chest X-ray (P/A view), ECG were checked. The patients were advised to remain fasting for minimum of 8 hours and advised to take tablet Alprazolam 0.25 mg at night before the day of surgery.

Patients were connected to multichannel monitor and hemodynamic parameters (heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, oxygen saturation) was recorded preoperatively before induction, after induction, after intubation, during maintenance of anesthesia at 24 min interval, after extubation, at 10 min, at 20 min and postoperatively for 24 hours, as per the proforma devised. Anaesthetic procedure was standardized for all the patients. Patients were preoxygenated with 100% oxygen for 3 minutes with face mask. Injection Fentanyl 2mcg/kg IV was given before induction. Subsequent induction was done with injection Propofol 2mg/kg IV, muscle relaxation was accomplished with injection Rocuronium 0.6mg/kg IV for tracheal intubation; and anaesthesia was maintained with Oxygen, Nitrous oxide and Isoflurane. For maintenance of intraoperative muscle relaxation injection Rocuronium 0.15mg/kg IV was used. For analgesia, intraoperatively patients were given injection Paracetamol 1gm IV infusion, and local infiltration with Ropivacaine 0.2% at the incision site. At the end of surgical procedure, residual neuromuscular blockade was antagonized with injection Neostigmine 50µg/kg IV and injection Glycopyrrolate 10µg/kg IV. All the patients were shifted to Post Anaesthesia Care Unit for first 24hrs monitoring. Any perioperative complications (bradycardia, tachycardia, hypertension, hypotension, arrhythmias, myocardial ischemia, cerebrovascular accidents, heart failure etc.) were noted in all the patients. Hypertension was defined when systolic blood pressure was >20% from baseline/preoperative value, hypotension was defined when systolic blood pressure was <20% of baseline/preoperative value or MAP <20% of baseline or preoperative value. Bradycardia was defined when heart rate was <60bpm and tachycardia when was heart rate was >100bpm.

Postoperatively, analgesia was provided with injection Paracetamol 1gm IV infusion and injection Ketorolac 30mg IM whenever needed. Patients were further assessed for postoperative complications and length of hospital stay.

STATISTICAL ANALYSIS

Statistical software SPSS (version 20.2) and Microsoft Excel were used to carry out the statistical analysis of data. Data was analysed by means of descriptive statistics viz, means, standard deviations and percentages presented by Bar diagrams.

Results:

Demographic profile with respect age, sex and weight is depicted in table 1.

Variables	Mean ±SD
Age	48.3±7.63
Sex M/F	49.26/50.74
Weight	58.4±8.37

A total of 136 patients with controlled hypertension were observed and were classified according to duration of surgery. Among 136 patients, 19.85% patients belonged to surgeries upto one hour of duration, 28.65% patients belonged to surgeries upto two hours of duration, 24.26% patients belonged to surgeries upto three hours of duration and 27.29% patients belonged to surgeries upto four hours of duration [Table 2].

Table 2: Distribution of Study Patients as per Duration of Surgery

Duration of Surgery	Type of Surgery	No. of Patients	Total	%age
Upto 1 hour	Laparoscopic Cholecystectomy	22	27	19.85
	Open Nephrolithotomy	4		
	Excision of Lipoma Upper Limb	1		
Upto 2 hours	Open Cholecystectomy	8	39	28.67
	Total Abdominal Hysterectomy	7		
	PCNL	7		
	Laprosopic IPOM for Incisional Hernia	5		
	Thyroid Lobectomy	4		
	Myomectomy	4		
	Ovarian Cyst Removal	2		
	ORIF of # BB Forearm	2		
Upto 3 hours	Hemithyroidectomy	9	33	24.26
	Mastoidectomy	8		
	Superficial Parotidectomy	8		
	Nephrectomy	8		
Upto 4 hours	Partial Nephrectomy	14	37	27.29
	Total Thyroidectomy with Neck Dissection	12		
	Gastrectomy	11		
Total		136		100

Mean arterial pressure showed no statistically significant deviation during pre-induction, intraoperative and postoperative periods [table 3].

Table 3: Intraoperative Mean MAP (mmHg) of study patients as per duration of surgery at different time intervals

Time Interval	Upto 1 hour surgeries	Upto 2 hour surgeries	Upto 3 hours surgeries	Upto 4 hours surgeries
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Before Induction	95.34±4.83	94.00±5.73	96.56±4.60	95.59±4.63
After Induction	80.85±3.71	80.66±3.51	81.22±3.88	79.67±4.42
After Intubation	104.23±4.89	104.66±4.80	102.88±4.12	104.78±2.44
20 Min	93.99±4.86	90.45±4.56	90.78±3.80	91.23±2.16
40 Min	92.20±4.18	91.56±3.18	89.45±4.51	93.45±6.45
60 Min	93.49±4.08	93.78±5.08	88.23±6.70	94.67±2.66
80 Min		89.66±7.33	91.22±4.15	86.56±6.41
100 Min		89.00±5.66	87.56±5.44	90.34±3.48
120 Min		95.00±4.56	88.67±6.46	91.45±3.12
140 Min			91.88±6.23	88.67±5.56
160 Min			96.55±3.08	90.44±6.44
180 Min			96.67±4.88	85.67±6.12
200 Min				90.67±5.18
220 Min				95.22±3.12
240 Min				97.57±3.20

Mean oxygen saturation showed no statistically significant differences during pre-induction, intraoperative and postoperative periods [table 4].

Mean heart rate showed no statistically significant differences during pre-induction, intraoperative and postoperative periods [Fig 1].

Incidence of perioperative complications was 0% in surgeries of one hour duration, 2.5% in surgeries of 2 hours duration, 3.0% in surgeries of 3 hours duration and 5.4% in surgeries of 4 hours of duration. No major complications like arrhythmias, myocardial infarction, stroke was seen in any of the patients and there was no prolongation of length of hospital stay thereafter [Fig 2].

Table 4: Intraoperative mean oxygen saturation (SpO₂) of study patients as per duration of surgery at various time intervals

Time Interval	Upto 1 hour surgeries	Upto 2 hour surgeries	Upto 3 hour surgeries	Upto 4 hour surgeries
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Before Induction	96.99±1.60	97.77±1.40	97.56±1.60	97.88±1.06
After Induction	98.06±0.94	98.06±0.94	97.67±0.93	98.55±0.94
After Intubation	97.10±1.03	97.55±1.02	98.66±0.97	98.45±0.97
20 Min	98.04±1.06	98.66±1.06	97.88±1.03	98.05±1.04
40 Min	98.90±1.08	98.56±1.06	98.15±0.93	98.03±0.94
60 Min	98.05±1.04	98.56±1.04	97.67±0.90	97.67±1.60
80 Min		98.33±0.93	97.88±1.04	96.78±1.90
100 Min		97.67±1.09	98.15±0.60	97.56±1.06
120 Min		98.67±0.93	99.01±0.60	97.67±1.60
140 Min			97.88±1.04	98.77±1.04
160 Min			97.07±1.03	97.65±0.96
180 Min			98.67±0.60	98.45±1.09
200 Min				98.45±0.60
220 Min				98.77±0.63
240 Min				96.14±0.63

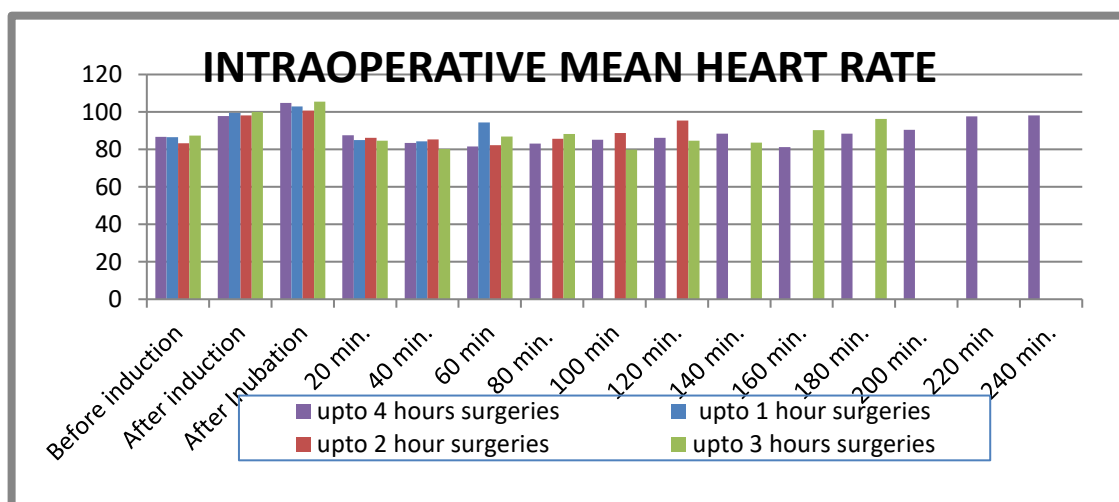


Fig 1

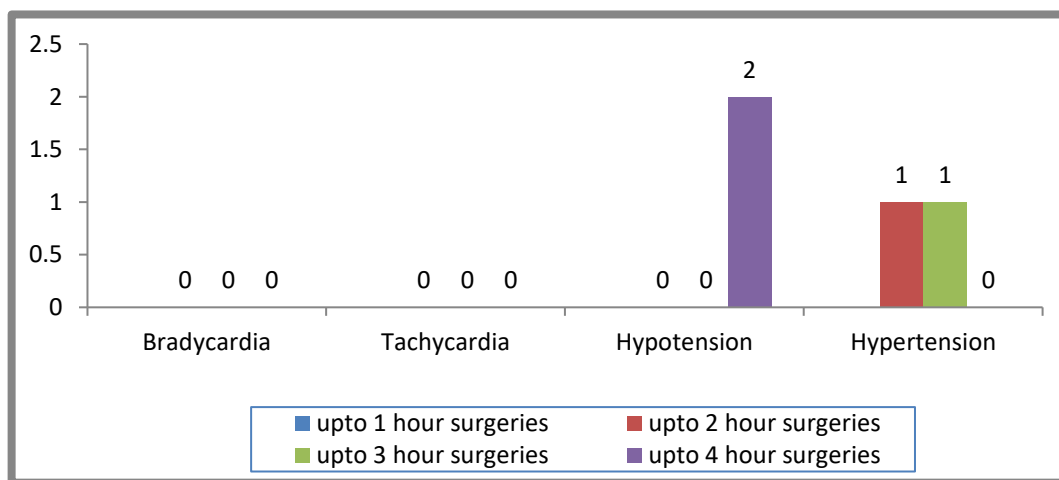


Fig 2.

Discussion:

Optimized hypertension is defined as systolic blood pressure of less than 140 mmHg and a diastolic blood pressure of less than 90 mmHg among hypertensive patients on antihypertensive medications. [7,8] During anesthesia, most patients experience periods of hemodynamic instability, which healthy individuals can tolerate, but are usually catastrophic in hypertensive patients due to the wide pressure fluctuations and sympathetic hyperactivity.[3] Hypertension, especially when not treated, increases the risk of cardiovascular changes during the anesthetic-surgical procedure. Overall, the incidence of substantial intraoperative blood pressure elevations (i.e. Systolic blood pressure >160mmHg) in hypertensive patients undergoing non-cardiac elective surgery appears to be <10% with appropriate patient selection (i.e. controlled hypertension). [17] Patients with higher preoperative BP undergoing elective surgery are at risk of increased perioperative hypertensive episodes, though the relationship of these episodes to clinically important complications has not been demonstrated.

In our study, one patient developed hypertension with a incidence of 2.5% in surgeries of 2 hours of duration and one patient developed hypertension with a incidence of 3.0 % in surgeries of 3 hours of duration and two patients developed hypotension in surgeries of 4 hours of duration which was statistically insignificant and no complication was seen in patients with surgeries of one hour duration. None of the patients developed major complications like arrhythmias, myocardial ischemia, stroke and there was no prolongation of length of hospital stay seen among all patients thereafter.

Howell SJ, et al. (2004) performed a meta-analysis to evaluate the effect of hypertension on composite 30 day perioperative adverse cardiovascular events following surgery. The authors concluded that there is very little evidence of admission blood pressure <180/110 mmHg causing any adverse perioperative complications. In other words there is very little benefit to be obtained to deferring or cancelling elective surgeries if the blood pressure is less than 180/110 mmHg. [18]

Walter viterbo da Silva Neto et al (2008) conducted an observational study to evaluate hemodynamic variations (systolic blood pressure, diastolic blood pressure, and heart rate) during the anesthetic induction of hypertensive and normotensive patients scheduled for elective surgeries under general anesthesia, at four moments: preparation (MP), drug (MD), laryngoscopy/intubation (ML), and 5 minutes after laryngoscopy/intubation (ML5)The sample was composed of 128 patients divided into two groups: hypertensive (GH) and normotensive (GN). [19] Diastolic blood pressure was reduced at MD in both groups, with a smaller percentage reduction in GH (18.3 +/- 14.0% versus 23.0 +/- 11.4%, p = 0.04). There was an increase in SBP and DBP at ML in both groups, with smaller percentage reductions in GH (8.2 +/- 16.3% versus 18.2 +/- 21.2%, p < 0.01; 8.6 +/- 20.2% versus 25.0 +/- 27.9%, p < 0.01, respectively for DBP and SBP). As for ML5, HR, SBP and DBP did not show significant differences between both groups. Their study concluded that hypertensive patients under treatment and with controlled blood pressure levels demonstrated greater hemodynamic stability during anesthetic induction.

Weksler N, et al. (2003) studied 989 treated chronic hypertensive patients scheduled for elective non-cardiac surgery, with DBP of 110–130 mmHg on day of surgery, but without any evidence of target organ damage or disease such as previous myocardial infarction or history of coronary revascularisation, unstable or severe angina pectoris, left ventricular hypertrophy, renal failure, aortic stenosis, pregnancy-induced hypertension, any active cardiac conditions or stroke. Patients were randomised into control and treatment arms; the control group had their surgery postponed and remained in hospital to optimise blood pressures before surgery whereas the treatment group received 10 mg of intranasal nifedipine and proceeded to surgery. The frequency of perioperative hypotension, hypertension, brady- and tachy-arrhythmias was similar between the two groups, and there was no cardiovascular or neurological complication in either group. [20] The American College of Cardiology and the American Heart Association (2007) lists uncontrolled systemic hypertension' as

a minor predictor that has not been shown to independently increase perioperative risk. [21] Similarly, recent guidelines from the

Association of Anaesthetists of Great Britain and Ireland and the British Hypertension Society(2016)

states that in the absence of organ damage, blood pressure <180/110 mmHg does not warrant cancellation or deferment of elective cases in an attempt to optimize the blood pressure.[22]

Prys-Roberts et al. (1971) demonstrated increased cardiovascular lability and greater risk of perioperative myocardial ischaemia in patients with poorly controlled hypertension. Studies in Stage 1 and 2 hypertensive patients showed that there is no association between admission blood pressure and perioperative cardiac risk. [11]

Charlson et al. (1990) have shown that hypertensive patients and diabetic patients who had a cumulative 1 hour decrease in mean arterial pressure >20 mmHg or <1 hour decrease of >20 mmHg and >15 minutes increase of >20 mmHg were at greatest risk for post-operative adverse events. [23]

Prys-Roberts et al (1980) demonstrated increase in heart rate by 15-20 beats per minute after induction of anesthesia and reduction in blood pressure by 20-30 mmHg after induction followed by increase in blood pressure after laryngoscopy and endotracheal intubation secondary to sympathetic stimulation, [24] similar hemodynamic changes were observed in our study.

Mangano DT, et al.(1990) studied association of perioperative myocardial ischemia with cardiac morbidity and mortality in men undergoing non-cardiac surgery and observed that overall, the incidence of substantial intraoperative elevations i.e. systolic blood pressure > 160 mmHg in hypertensive patients undergoing non-cardiac surgery appears to be < 10% in controlled hypertensive patients.[17]

Hsieh JK, et al. (2016) conducted a study entitled “The Association Between Mild Intraoperative Hypotension and Stroke in General Surgery Patients” and the authors did not find an association between intraoperative hypotension, defined as MAP < 70 mm Hg, and postoperative stroke. [25]

Conclusion:

Hypertensive patients on antihypertensive medications with controlled blood pressure levels undergoing elective surgical procedures remain haemodynamically stable under general anesthesia. Patients with Controlled hypertension modulate their hemodynamic responses within normal limits under general anaesthesia.

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