

Preoperative haemodynamic measurements compared to haemodynamic response of Tracheal Intubation. Search for the most appropriate baseline

Shazia Nazir, Fauzia Anis Khan
Department of Anaesthesia, Aga Khan University, Karachi.

Abstract

Objective: To measure the variability in blood pressure and heart rate in the pre operative clinic, after admission in the ward, in the holding area of the operating room, and inside the operating room. Our secondary objective was to see which blood pressure and heart rate should be taken as a baseline for clinical monitoring during anaesthesia especially when one is looking at haemodynamic changes associated with tracheal intubation.

Methods: Thirty consecutive patients meeting the study inclusion criteria were enrolled at the preoperative anaesthesia clinic. Non invasive blood pressures and heart rate were measured at the pre operative anaesthesia clinic, in the ward, in the holding area on morning of surgery, and inside the operating room.

Results: The difference between the haemodynamic readings at different locations was not statistically significant for heart rate and diastolic blood pressure however they were statistically significant for systolic and mean arterial pressures with highest pressures recorded in the immediate pre induction period. The change to maximum reading was 17.18% , 11.89% ,7.83% , 3.59% when clinic, ward, holding area or operating room were taken as baseline alternatively .

Conclusion: Variability exists in the measurement of systolic blood pressure taken at different hospital locations in surgical patients. Further work needs to be done to define the appropriate baseline for haemodynamic monitoring and research (JPMA 56:590;2006).

Introduction

Laryngoscopy with or without tracheal intubation provokes a sympathoadrenal response. There is a rise in blood pressure and heart rate of 20 to 30% from baseline and dysrhythmias occur in approximately 15% of the patients.^{1,2} Extensive research has been done to study this haemodynamic response and how it is affected by various anaesthetic interventions. In majority of these studies blood pressure and heart rate with or without a rest interval has been measured in the operating room and taken as a baseline. Evidence is available that if blood pressure and heart rate are recorded in a peaceful environment like watching a relaxing video, it is likely to be lower

than when taken under stressful conditions.³ Several studies have also documented the occurrence of "white coat hypertension" whereby the blood pressure is elevated only in the presence of medical personnel.⁴ Regardless of the nature of surgical procedures, the majority of the patients about to undergo anaesthetic induction, are apprehensive and anxious. This leads to high blood pressure and heart rate due to sympathetic stimulation and catecholamine release.⁵ Although standard anaesthetic practice is to prescribe premedication to relieve anxiety before surgery, patients may still have different levels of anxiety depending upon their personality types, and hence alteration of baseline haemodynamics immediately before surgery, cannot be ruled out.

Our study's objective was to measure the presence of any significant variability in blood pressure and heart rate measurements taken in the pre operative period at different locations that is the anaesthesia clinic, after admission to the surgical ward, in the holding area of the operating room suite and inside the operating room. Our research null hypothesis was that there was no difference between the readings taken in the four areas. Our secondary objective was to see the impact on the percentage change from baseline to maximum change after tracheal intubation if different baseline measurements taken at different locations were substituted for the immediate preinduction measurement (which is the usual baseline for most clinical studies on haemodynamics).

Patients and Methods

This prospective observational study was conducted at the Aga Khan University Hospital, a 500 bedded facility with all surgical specialties. The study population consisted of consecutive surgical patients visiting the preoperative anaesthesia clinic for pre operative anaesthesia assessment except those excluded by the exclusion criteria. Thirty patients were needed to observe a difference of up to 30% in readings taken at thirteen different time intervals with a power of 80 percent and a level of significance of 5 percent.

Approval was obtained from the University Research Ethics Committee and informed written consent was obtained from patients. A strict inclusion criterion was used before being enrolled in the study. All patients between ages of 18 to 65 years, of either gender undergoing an elective surgical procedure requiring tracheal intubation who were admitted a day before surgery were included.

Patients were specifically asked about the presence of the following conditions and a positive response excluded them from the study. Presence of hypertension (systolic blood pressure more than 140mm of Hg and diastolic blood pressure more than 90mm of Hg as defined by WHO criteria), ischaemic heart disease (history of myocardial infarction or angina), history of taking any cardiac or antihypertensive drugs (beta blockers, calcium channel blockers, sodium channel blockers, potassium channel blockers, digoxin, digitalis, beta agonists, phosphodiesterase inhibitors, organic nitrates, ACE inhibitors, diuretics, angiotensin II antagonists etc.). Patients were also excluded if they had any anxiety related disorders (phobic, panic, generalized and obsessive compulsive disorders), history of taking any antianxiety or anti depressant medications (benzodiazepines, tricyclic antidepressants, selective serotonin reuptake inhibitors, monoamine oxidase inhibitors, lithium), emergency cases, day care procedures, terminal diseases e.g. cancer, patients with contraindications to thiopentone sodium i.e. porphyrias, previous hypersensitivity, airway obstruction and patients with renal or liver disease.

All included patients were pre medicated with midazolam 7.5mg per orum one hour before surgery. Dynamap (Omega 1400tm Non-invasive blood pressure monitor. Invivo research laboratories Inc.) was used for all blood pressure measurements, with an appropriate sized cuff selected for each patient and applied to the left upper arm. Stopwatch was used for counting the right radial pulse for sixty seconds in all patients. Readings were recorded by the same investigator in all patients at all locations to reduce the interobserver bias.

The following monitoring and measurements were done at the preoperative anaesthesia clinic, on the inpatients surgical ward, and the preoperative holding area. The first set of readings (R1) was taken after a rest period of five minutes in the preoperative clinic. Three readings of blood pressure and heart rate were taken and a mean value was calculated. Systolic, diastolic and mean arterial pressures were recorded. Surgical ward readings were taken between seven and nine pm on the night before surgery. The same protocol was followed as for anaesthesia clinic and a second set of readings (R2) was obtained.

Patients at our institution are routinely called to the operating room holding area approximately 30 to 60 minutes before the scheduled operating time. A third set of readings (R3) were taken 30 minutes before surgery following the above protocol.

The fourth set of readings (R4) was obtained inside the operating room after application of the routine monitors and again three readings of blood pressure and heart rate were recorded.

All patients were preoxygenated with 100% oxygen for three minutes using the circle system. Time of start of induction was noted. Patients were given pethidine 0.8 mg.kg⁻¹ followed by thiopentone 5 mg kg⁻¹ over 30 seconds and vecuronium 0.1 mg per kg over 10 seconds for induction. Lungs were ventilated with 60% nitrous oxide in oxygen and 0.5% isoflurane via face mask and gentle bagging for three minutes while monitoring and maintaining end tidal CO₂ within a range of 35 -40 mm of Hg. Three readings of blood pressure and heart rate were recorded at one minute interval post induction. A Macintosh laryngoscope blade 3 and polyvinyl chloride tracheal tube size 7.5 for females and 8.5 for males were used. Laryngoscopy and tracheal intubation were done by the primary investigator and duration of laryngoscopy was kept to less than 15 seconds in all patients. Five readings of blood pressure and heart rate were recorded immediately following intubation at one minute interval.

Statistical analysis

The mean difference of age and weight by gender were observed at baseline using independent samples t-test.

Frequency distributions of different variables were also observed. The results of mean blood pressure, heart rate and mean arterial pressure at thirteen different time points in each patient were analyzed using repeated measures analysis of variance (ANOVA). Multiple comparisons using Bonferroni were also made when repeated measures ANOVA was found to be significant. The data was analyzed using SPSS (version 10.0) software.

Results

Twelve patients were male and eighteen were females. No significant differences were observed for gender by age ($p < 0.34$) and weight ($p < 0.19$).

Haemodynamic data is presented in the Table. This relates to heart rate and blood pressure measurements taken at four different time intervals in the preinduction period that is in the preoperative anaesthesia clinic, in the surgical ward, in the holding area of the operating room and in the operating room. Readings were also taken for three minutes postinduction and for five minutes after intubation.

The difference in heart rate between the readings observed at the preoperative anaesthesia clinic, surgical ward, holding area of the operating room and the operating room were not statistically significant ($p < 0.052$).

The readings taken in the clinic, ward, holding area of the operating room and inside the operating room were compared to the maximum reading observed at the time of intubation. There was a 24% ($p < 0.01$) change to the maximum response if the heart rate in the clinic was taken as baseline.

The change was 25% ($p < 0.01$) from the ward, 27% ($p < 0.01$) from the holding area, 22% ($p < 0.01$) from the operating room. The changes to maximum response following intubation were statistically significant ($p < 0.01$) irrespective of whichever baseline reading at any of the four locations was used.

The difference between the readings of the systolic blood pressure observed in the preoperative anaesthesia clinic (R1) compared to readings taken in the holding area the operating room (R4) was statistically significant ($p < 0.001$). The maximum change post-intubation was at one minute following intubation (Figure).

The readings taken in the clinic, ward, holding area of the operating room and inside the operating room were compared to the maximum change observed. There was a 17% (p value < 0.01) positive change to the maximum response if the blood pressure taken at the clinic was taken as baseline. The change was 12% (p value < 0.01) from the ward baseline, 8% (p value 0.03) from the holding area, 4% (p value 0.22) from the operating room. These changes were statistically significant for the readings taken at the preoperative anaesthesia clinic, ward and the holding area, but the change from operating room baseline value to maximum change was not found to be significant.

The changes in diastolic blood pressure mirrored the systolic blood pressure changes but no significant difference was seen between the first four values (p value 0.64). The readings taken in the clinic, ward, holding area of the operating room and inside the operating room were compared to the

Table. Hemodynamic data.

Time	Heart rate mean (SD) beats min ⁻¹	Systolic blood pressure mean (SD) mmHg	Diastolic blood pressure mean (SD) mmHg	Mean arterial pressure mean (SD) mmHg
Preoperative clinic (R1)	83.57 (8.95)	113.76 (11.65)	75.69 (8.20)	88.10 (8.73)
Surgical ward night before Surgery(R2)	82.93 (7.44)	119.14 (12.64)	74.79 (9.66)	89.31 (10.22)
Holding area in OR suite(R3)	81.96 (15.54)	123.62 (22.04)	77.14 (13.90)	92.31 (16.01)
Preinduction in OR(R4)	84.96 (15.71)	128.69 (19.14)	77.86 (12.14)	94.66 (14.08)
Induction 1minute	94.57 (20.13)	122.10 (23.02)	80.17 (17.76)	93.79 (18.46)
2 minute	97.11 (18.32)	121.28 (27.56)	80.48 (20.62)	93.10 (22.45)
3 minUte	94.00 (19.33)	122.86 (23.95)	74.66 (18.88)	90.55 (21.39)
Intubation 1 minute	103.82 (17.43)*†*§	133.31 (26.96)*†	89.34 (17.37) *†*§	104.03 (19.96)*†
2 minute	93.39 (21.90)	127.21 (30.17)	78.03 (17.36)	94.10 (21.32)
3 minute	86.75 (24.19)	123.62 (29.26)	71.07 (17.75)	89.66 (20.73)
4 minute	81.11 (19.52)	111.31 (20.44)	67.90 (14.66)	80.31 (16.84)
5 minute	76.93 (19.16)	109.31 (18.29)	62.24 (12.92)	77.83 (15.02)

OR; operating room

*;significant difference ($p < 0.001$) between maximum reading obtained post intubation and R1

†;significant difference ($p < 0.001$) between maximum reading obtained post intubation and R2

+; significant difference ($p < 0.001$) between maximum reading obtained post intubation and R3

§; significant difference ($p < 0.001$) between maximum reading obtained post intubation and R4

; significant difference ($p < 0.001$) between R1 and R4

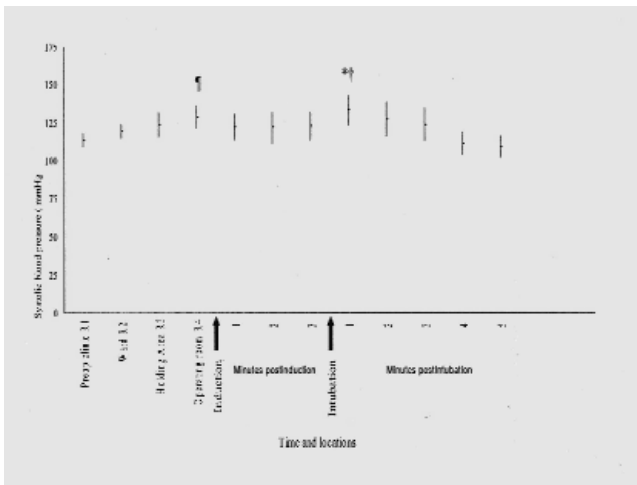


Figure. Mean systolic blood pressure and 95% confidence intervals in the preoperative and postinduction period;
 *: significant difference ($p < 0.001$) between maximum reading obtained post intubation and R1
 ‡: significant difference ($p < 0.001$) between maximum reading obtained post intubation and R2
 ;: significant difference ($p < 0.001$) between R1 and R4

maximum change observed in the readings which was found to be one minute after intubation. There was an 18% (p value < 0.01) change to the maximum response if the blood pressure taken at the clinic was taken as baseline. The change was 19% (p value < 0.01) from the ward, 16% (p value < 0.01) from the holding area, 15% (p value < 0.01) from the operating room. The changes were statistically significant irrespective of whichever baseline reading at any of the four locations was used.

The changes in mean arterial pressure were similar to the diastolic blood pressure changes but statistically significant difference was seen between the readings in the preoperative anaesthesia clinic (R1) and that taken in the holding area (R4) (p value < 0.01). The readings taken in the clinic, ward, holding area of the operating room and inside the operating room were compared to the maximum change observed in the readings which was found to be one minute after intubation. There was an 18% (p value < 0.01) change to the maximum response if the blood pressure taken at the clinic was taken as baseline. The change was 16% (p value < 0.01) from the ward, 13% (p value < 0.01) from the holding area, 10% (p value < 0.01) from the operating room. These changes were statistically significant for the readings taken at the preoperative anaesthesia clinic and the ward. But the change from the holding area (p 0.03) and the operating room baseline value to maximum change (p 0.02) was not found to be significant.

Discussion

Presence of variability in blood pressure during the day and its association with levels of activity, stress and environment are a well known entity.⁶ Many researchers recommend using ambulatory blood pressures as the basis for starting anti hypertensive therapy rather than office blood pres-

ures which may be falsely high.⁷ To date little effort has been made to assess the variability in the blood pressure of patients who are admitted for surgery⁸ and if this variability is real what should be taken as the most appropriate baseline.⁹

White coat hypertension exists as proved by many researchers.¹⁰ The currently accepted criteria define it as an office blood pressure of 140/90 mmHg or greater in the presence of an average day time readings of less than 135/85 mmHg.^{11,12} Although patients are routinely premedicated with benzodiazepines before being moved to the operating room, the effect on the patients is variable and the level of anxiety may vary. In our study we observed the presence of variability in systolic and mean blood pressure at four different places where the anaesthesiologist is most likely to check the blood pressure readings of a surgical patient i.e. at the preoperative anaesthesia clinic, in the surgical ward after admission, in the holding area of the operating room, and inside the operating room just before induction.

Mancia and colleagues¹³ observed variations in blood pressure taken by using a sphygmomanometer at different times by a male doctor and a female nurse. When compared to intra-arterial measurements the arterial pressure returned to near baseline after ten minutes when the reading was taken by a nurse but not when taken by a doctor. In a recent review article by Howell et al, they concluded that in many surgical patients the admission arterial pressure will not equate to the patients usual arterial pressure.¹⁴ They also recommend that if the medical staff finds the blood pressure to be elevated, this should be confirmed by a nurse with appropriate training.

Admission blood pressure has been studied before, but mainly from the point of view of correlating it to perioperative cardiac risk.^{15,16} Although other studies have pointed out the variability in the blood pressure measurements, most of these refer to non surgical patients.^{17,18} In practical anaesthetic practice, decisions about the patients' cardiovascular status have to be based on either the measurement of variables in the physical areas studied by us or the ward blood pressure measurements taken by the nursing staff. We have tried to base our study on the current practice. Our literature search was unable to identify a similar study with which to compare our results. Previously little work has been done to define or establish the most appropriate baseline blood pressures or heart rate but the importance of its absence has been emphasized. Howell et al⁸ correlated the admission blood pressure and perioperative cardiovascular risk. They discussed the probability of the presence of white coat hypertension during hospital admission for surgery and commented that it was unlikely that a limited number of readings taken in the pre-operative period will correlate with perioperative risk. These researchers did a retrospective study and found that in a patient whose admission

blood pressure was within acceptable limits may go to surgery without further blood pressure readings being taken, so it was not possible to examine the significance of subsequent blood pressure readings. They recommended that a prospective study should be designed to study these differences. Thomas¹⁹ who studied baseline arterial pressures before caesarian section has observed that no attempt has been made so far to determine the most appropriate baseline.

Our secondary objective was to see the impact on the percentage change from baseline to maximum change after laryngoscopy and tracheal intubation if different baseline measurements taken at different locations were substituted instead of the immediate preinduction measurements. Significant implications were associated with positive or negative results. If there was no difference between the measurements of heart rate and blood pressure recorded at the pre operative clinic, ward, holding area and operating room then it would mean that any reading of heart rate or blood pressure irrespective of the location can be used as the baseline measurement. A difference would mean that an appropriate baseline needed to be defined, as this would have an impact on the decisions to treat the haemodynamic response.

Our results indicate that only readings for heart rate and diastolic blood pressure taken in the operating room immediately before induction reflected the earlier physiological status of a premedicated patient, as no statistically significant difference was observed compared to previous readings. The measured blood pressures at the clinic and in the ward day before surgery were lower than those found in the holding area and the operating room before induction of anaesthesia. These results show that taking the systolic and mean blood pressure readings in the operating room as a baseline may not be the best estimate of the cardiovascular status of the patient. Also if operating room blood pressures are recorded as the patient's baseline haemodynamics for clinical monitoring and research then it is possible to get false positive or negative end points for treatment. As a result we may not be treating patients who should be treated and the haemodynamic research on stability may also be taking false baselines.

There are certain limitations of our study. We used pethidine 0.8 mg.kg⁻¹ as the analgesic which has cardiovascular effects like tachycardia. Fentanyl which is a more cardio stable drug would be a better choice. However its availability is limited in our part of the world. Also invasive blood pressure monitoring is a more precise method of blood pressure measurement. But considering the risks of arterial cannulation, in ASA I or II non hypertensive patients it was not justified in this observational study. Also it would not reflect true clinical practice. We tried to overcome the variability by tak-

ing multiple readings in each area and reduce the interobserver variability by employing a single investigator taking all the readings. A familiar face taking subsequent readings would also reduce the anxiety element of the patient.

There is a need to agree upon appropriate baselines for haemodynamic monitoring in anaesthetic practice. Diurnal variations and stress responses that prompted scientists to work on variations in blood pressures during the day and in different environments may also stand true for our perioperative management. The traditional practice of recording baseline measurements in the operating room just before start of surgery, a period of high stress in spite of premedication may not be the best estimate of the patients' baseline cardiovascular status.

Conclusion

In conclusion significant variability exists in the systolic and mean blood pressure measurements taken at the pre operative anaesthesia clinic, after admission to the surgical ward, in the holding area of the operating room suite, and inside the operating room. Different conclusions can be drawn if different readings are substituted as baseline in study of haemodynamic response to intubation. A consensus in anaesthetic practice needs to be developed to define an appropriate baseline for clinical monitoring and further research work.

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