COLLEGE OF MEDICINE AND HEALTH SCIENCES

SCHOOL OF MEDICINE AND PHARMACY

DEPARTMENT OF ANESTHESIA, CRITICAL CARE AND EMERGENCY MEDICINE

Association of Intraoperative Hypotension and Hypertension on Hospital Stay, and in-Hospital Mortality after Major Elective and Emergency Surgery in the University Teaching Hospital of Kigali (CHUK)

Dissertation submitted in partial fulfillment of the requirements of the award of Master of Medicine degree in Anesthesia, School of Medicine and Pharmacy, College of medicine and health Sciences, University of Rwanda

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Kigali, November 2021

DECLARATION

DECLARATION AND AUTHORITY TO SUBMIT THE DISSERTATION

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Title of the project:

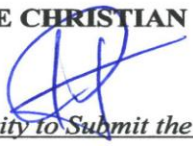
Association of Intraoperative Hypotension and Hypertension on Hospital Stay, and in-Hospital Mortality after Major Elective and Emergency Surgery in the University Teaching Hospital of Kigali (CHUK).

a. *Declaration by the Student*

I do hereby declare that this ***dissertation*** submitted in partial fulfillment of the requirements for the degree of **MASTERS OF SCIENCE** in **Anesthesiology, Critical Care and Emergency**, at the University of Rwanda/College of Medicine and Health Sciences, is my original work and has not previously been submitted elsewhere. Also, I do declare that a complete list of references is provided indicating all the sources of information quoted or cited.

Date and Signature of the Student

NDARIBITSE CHRISTIAN August 28, 2021



b. *Authority to Submit the dissertation*

In my capacity as a Supervisor, I do hereby authorize the student to submit his dissertation.

Prof. Paulin RUHATO BANGUTI

Signature:  ... Date: August 29, 2021

ABSTRACT

Background: Intraoperative blood pressure fluctuation is associated with poor outcomes in a recent study done in high-income countries; although exact values to cause harm are still not well identified. There is limited information in lower-income countries.

Aims: To evaluate the association of intraoperative hypotension, and hypertension with prolonged hospital length of stay and in-hospital mortality after major elective and emergency surgery in the University Teaching hospital of Kigali (CHUK).

Methods: This is a prospective observational study linking intraoperative hypotension and hypertension with postoperative in-hospital outcomes. I collected data from 350 patients that underwent elective and emergency major surgeries from 1st June to 31st August 2020; demographic, pre- and post-operative information were collected manually using a questionnaire, whereas intraoperative information was electronically extracted from photographed intraoperative anesthesia charts using optical recognition software. I linked intraoperative hypotension and hypertension with hospital length of stay and postoperative in-hospital mortality by the univariate analysis, negative binomial regression model, and a logistic regression model, using R software (version 4.0.3).

Results: Three hundred and fifty patients (350) were included in the analysis. In the univariate analysis, older age, female gender, and more time spent below a diastolic blood pressure of 50 mmHg was found to be frequent inthe group of patients that died. In the logistic regression model, mortality had an association with an increased age (OR: 1.04, CI: 1.00, 1.09, p= 0.037) and more time spent below a diastolic blood pressure less than 50 mmHg (OR: 1.02, CI: 1.01, 1.04, p=0.004). I found no association with mortality for hypertension, gender, presence or absence of comorbidity, and emergency vs. elective surgery. Male gender, emergency surgery, orthopedic and plastic surgery had an association with increased hospital length of stay. ENT surgery had an association with a shorter length of stay.

Conclusions: I found an association between intraoperative hypotension and post-operative in-hospital mortality, and there was no association with intraoperative hypertension. The study indicates no association between hospital length of stay and intraoperative hypotension or hypertension, however, the hospital length of stay was increased in the male gender, emergency surgery, and orthopedic surgery. Further larger studies are needed in lower-income countries to evaluate their association for improving intraoperative blood pressure monitoring and management.

Keywords: Blood pressure, length of hospital stay, in-hospital mortality

Table of Contents `

ABBREVIATIONS

CHUK: University Teaching hospital of Kigali

MAP: Mean arterial pressure

SBP: Systolic blood pressure

DBP: Diastolic blood pressure

ICU: Intensive care unit

ENT: Ear, nose, and throat

LOS: Length of stay

MAC: Minimum alveolar concentration

ROC:Receiver operator characteristic

GOF: Goodness of fit

IRB: Institutional Review Board

WHO-WFSA: World Health Organization with World Federations of Societies of Anesthesiologists

LISTS OF TABLES

ACKNOWLEDGMENTS

This dissertation would have never been accomplished without the tireless guidance and mentorship of my supervisor PROFPaulin RUHATO BANGUTI.

I would like to appreciate PROFMarcel DURIEUX, DR BHIKEN NAIK, DR Josue NZARORA and DR Jean Paul MVUKIYEHE for their great inspiration.

I am thankful for the unmeasurable support from non-physician anesthetists, nurses and doctors of the ICU and Anesthesia Department at the University Teaching Hospital of both Kigali and Butare, Rwanda military Hospital and King Faisal Hospital. I am also thankful to my fellow anesthesia residents in University of Rwanda, College of Medicine and Health Sciences.

DEDICATION

I dedicate this work to the Almighty God, whose love for mankind is everlasting and his many blessing,

To my beloved wife **MUKANZABARUSHIMANA Gloriose**, our two sons **SUGIRA N. James Brian,** and **SANGWA N. Jayce Baldwin**for their perseverance,

To my parents, my brothers and sisters and to all close to me for the encouragement and support which I have benefited during my studies.

I. CHAPTER I: INTRODUCTION

I.1. Background

Intraoperative monitoring is essential in every surgical procedure, and physiologic monitors for oxygenation, ventilation, circulation, and temperaturesduring anesthesia are recommended.(1) Non-invasive blood pressure measurement is one of the highly recommended vitalsigns to measure during surgery for patients under anesthesia. Exposure to low blood pressure values during surgery is associated with high mortality(2), although exact numbers to cause harm is still debatable.

Definition of intraoperative hypotension and hypertension are not well defined and are still with no consensus(3), althoughhypotension was considered when the mean arterial pressure (MAP) went less than 70mmHg with a 30% decrease from the baseline or a MAP of less than 60mmHg alone.(4) Intraoperative hypertension is when SBP> 160mmHg(5), and considered an emergency when the systolic blood pressure (SBP) or diastolic blood pressure are above 180 mmHg and above 120 mmHgrespectively (6). Intraoperative blood pressure monitoring targets those mentioned values to maintain the MAP above 65 mmHg for non-cardiac patients. Blood pressure during the intraoperative period should be measured at least every 5minutes for early identification of abnormality and management.(1)

It is well known from studies in affluent countries that the time spent at low blood pressure during a surgical procedure predicts postoperative mortality. The impact of even short periods of modest hypotension is remarkable: 30-day mortality is increased (odds ratio 2.9) if there is a decrease ofsystolic blood pressure to less than 70 mmHg for a period above five minutes(2). Although this does not imply causality, it means that patients who are hypotensive during surgical procedures need extra close monitoring afterward (e.g. by being admitted to the ICU).(1) In another study done, patients who have been exposed to hypotension for more than 10 minutes have 4.5 times the risks of developing postoperative major organ complications.(4)

I can, however, not assume that this same relationship holds in Rwanda, for a variety of reasons: patients are operated on for different diseases, their degree of illness when coming to surgery is different, they have different comorbidities, nutritional status, age, and genetic makeup, anesthetic and surgical management is different, etc. To assure that limited ICU beds are allocated to patients who will benefit from the heightened observation and care, it is necessary to confirm that intraoperative hypotension predicts mortality in the Rwanda setting.

Clinical documentation in Rwanda and most low and middle-income countries is largely on paper, and this is a major barrier to performing quality control and retrospective research projects.(7) To provide insight into clinical practice, handwritten charts have to be manually reviewed and extracted. This is very time-consuming and prone to error.(8)

Electronic medical records are slowly being implemented but are far from common: the main hospitals in Rwanda have implemented the Open Clinic software system, but mainly in their outpatient facilities and finance service delivery only. The high acuity settings such as the operating room and intensive care unit particularly suffer from this issue, as data, there are collected so frequently (often every few minutes) that even if an electronic medical record system was in place, data entry would not be practical.

Only true electronic data capture (directly from monitors and other devices) would solve this problem, but the cost and complexity of acquisition and maintenance of those systems make them unfeasible in Rwanda setting at this time. Currently, key data such as blood pressure and heart rates are graphically entered into flowcharts by hand, making it very difficult to access data for research and quality improvement. [**Annexes**]

To overcome this problem, a collaboration between the Department of Anesthesia, Emergency Medicine and Critical Care at the University of Rwanda and the Schools of medicine, Data Science and Engineering at the University of Virginia has worked on a highly innovative solution: flow charts have been photographed using a mobile

phone, and the data were electronically extracted using optical recognition software that has been written by a team of Systems Engineering students as their capstone project (under the guidance of Prof. Don Brown, founding Director of the School of Data Science). This model may well revolutionize how clinical data are captured in low/middle-income countries.

Perioperative mortality in Rwanda teaching hospitals was approximately 6%.(9)Major elective and emergency surgeries are commonly performed in the University Teaching Hospital of Kigali, commonly known as CHUK.

It istherefore hypothesized that this index study will show an association between intraoperative blood pressure variations (hypotension and hypertension) with in-hospital postoperative mortality, and prolonged hospital stay in University Teaching Hospital of Kigali (CHUK) for patients who underwent major elective and emergency surgeries. This would be almost impossible to do with a manual chart review, but we did it with the optical data extraction system described above.

I.2. Rationale

A. Intraoperative blood pressure monitoring is crucial during all major surgeries, as blood pressure lability is associated with major organs affection. Intraoperative hypotension and hypertension are not uncommon but the exact range to react in management for preventing postoperative poor outcomes is not known nor documented in operating rooms of CHUK, and anesthesia charts.

B. There is no data available on the bad effects of intraoperative hypotension or hypertension on postoperative outcomes for patients who underwent major surgeries in CHUK/Rwanda.

I.3. Research questions and hypothesis

Question: Does intraoperative hypotension or hypertension increase in-hospital mortality and hospital length of stay after elective and Emergency major surgeries at CHUK?

Hypothesis: Intraoperative hypotension and hypertension has a measurable association with in-hospital postoperative mortality andincreased hospital length of stay in patients who underwent major elective and emergency surgeries at CHUK.

I.4. Study objectives:

I.4.1. General objective

To evaluate the association of intraoperative blood variations to postoperative outcome

I.4.2. Specific objectives

- To determine the relationship between intraoperative hypotension and hypertension with in-hospital mortality in the University Teaching Hospital of Kigali (CHUK) after elective and emergency major surgeries.
- To determine the relationship between intraoperative hypotension and hypertension with hospital length of stay in the University Teaching Hospital of Kigali (CHUK) after elective and emergency major surgeries.

II. CHAPTER II. LITERATURE REVIEW

II.1. Definition

Definition of intraoperative hypotension and hypertension are not well defined and are still with no consensus(3), although this study consider a mean arterial pressure (MAP) below 70 mmHg with a decrease of more than 30%from baseline, or a MAP below 60 mmHg alone as hypotension.(4)Intraoperative hypertension is considered an emergency when the systolic blood pressure (SBP) and or diastolic blood pressure are above 180 mmHg and 120 mmHg respectively.(5)
Intraoperative hypotension is also defined as systolic blood pressure below 80mmHg and intraoperative hypertension a systolic blood pressure above 160mmHg.(5)

In general, systemic hypertension is defined when the systolic blood pressure or diastolic blood pressureare above 140mmHg and above 90mmHg respectively.(10)

II.2. Incidence

The incidence of intraoperative hypotension was found to be 41% and 93% based on SBP below 80mmHg and a decrease of 20% of SBP to baseline respectively(11); although, the incidence may vary based on the definition used to define intraoperative hypotension. Lonjaret et al found the incidence to be 5-99%.(12)

Perioperative hypertension was found to be around 25% and is associated with adverse outcomes(12), and is age-dependent.

II.3. Risk factors

Intraoperative hypotension

The intraoperative risks of hypotension include massive blood loss, use of high MAC inhalational anesthetic gases, intravenous hypotensive anesthetic drugs, insufficient fluid administration, positive pressure ventilation, sensory block, a medical condition like sepsis, and anaphylaxis.(13) It may also be induced by intraoperative positioning and compression impairing venous return.(12)

Intraoperative hypertension

In general, systolic hypertension is increased with advanced age groups.

During surgery, intraoperative hypertension mainly occurs due to light anesthesia during induction, anxiety, and stress for a patient under regional anesthesia, surgical stimulation, and technique like the use of a tourniquet and aortic clamping(12), sympathetic stimulation, and preexisting hypertension.(14)

II.4. Complications

Intraoperative hypotension

It may potentially lead to a decrease of perfusion of major organs; postoperative myocardial infarction (MI)(5), impair kidney function, increase perioperative mortality and delay discharge from hospital.(4)

Intraoperative hypertension

Systolic hypertension also increases the risk of poor perioperative outcomes.(10) It make worse intraoperative blood loss, perioperative myocardial ischemia and stroke, acute heart failure, and acute aortic dissection.(12,15)

III. CHAPTER III: METHODS

III.1. Study description

III.1.1. Study design

It is a prospective observational study for the period of 3months, from June to August 2020.

III.1.2. Study site

I conducted the study in the University Teaching Hospital of Kigali (CHUK).

III.1.3. Study population

The study population included all adult patients that underwent elective and emergency major surgeries at the University Teaching Hospital of Kigali (CHUK) during the period from June to August 2020.

III.1.4. Exposures

Intraoperative blood pressure variations

III.1.5. Outcomes

- The length of hospital stay after surgery
- Deaths within hospital stay post-surgery

III.2. Selection of the Study Population

III.2.1. Inclusion criteria

- All adult patients, who underwent elective and emergency major surgery.

III.2.2. Exclusion criteria

- Pediatrics patients (<15yrs)
- Patients with known cardiac diseases except for controlled hypertension
- The second or more operation for one patient
- Loss of postoperative information

- Patients to whom their anesthesia charts failed to be extracted by the software.

III.3. Sample size

The study was time limited.We anticipated being able to assess at least 10 patients per day, for a total of 300 patients during the 6weeks, though we extended the duration to 3 months because they were a decrease of patients due to the coronavirus pandemic. We, therefore, anticipated approximately 20 deaths over the study period, which will allow calculating the correlation between intraoperative hypotensionor hypertension with mortality.

III.4. Data collection

Data were collected by the primary investigator and assigned and trained research assistants with the following variables: Age,sex, date of admission, date of surgery, type of procedure(elective, emergency), specialty, comorbidity (Sepsis/septic shock, renal failure, electrolytes imbalances, diabetes mellitus, hypertension, cancer). Intraoperative anesthesia record flow charts were photographed within 24hrs post-surgery and data were electronically extracted from the scan using optical recognition software (Convolutional Neural Network). The postoperative outcomes were collected after two monthsfrom the OpenClinicsoftware system of the University teaching hospital of Kigali (CHUK).

III.5. Data entry and statistical analysis

Data entry was done in excel format.Summary statistics, boxplots, and histograms were created to initially explore the data. Length of stay variables coded as negative was recorded as missing. Comorbidities were collapsed into a two-factor categorical variable (Yes vs. No) based on the presence or absence of any coexisting disease. Univariate analysis of predictors dichotomized by mortality was performed. All continuous data that were normally distributed are reported as means and standard deviation and analyzed using a two-tailed independent samples t-test; all non-normally distributed data were reported as medians and interquartile ranges and analyzed using a Wilcoxon Rank Sum test. Categorical data were analyzed using a chi-square or Fisher's exact test. The significance level was $p < 0.05$. The primary outcome for this analysis was mortality. Independent predictors that had a $p < 0.05$ from the univariate analysis were included in the model with mortality as the response variable. To assess the

goodness of fit for our model, we calculated the Hosmer and Lemeshow goodness of fit (GOF) test. If the model fit was deemed inadequate (as defined by $p < 0.05$), the predictors were re-examined and transformed as appropriate. The final model with appropriate good of fit was then evaluated to assess the prediction characteristics. C statistic was computed and a receiver operator characteristic (ROC) curve was computed. The secondary outcome analyzed was the hospital length of stay (LOS).LOS had a right-skewed distribution. Multiple transformations of the response variable were performed including (box cox) and log transformation with offset without significant improvement in model fit characteristics. Due to the right-skewed data characteristics, LOS was modeled initially as a Poisson regression. However, due to over-dispersion of the residual deviance, a negative binomial regression model was explored. Estimates are reported as Incidence Rate Ratios with 95% CI. All statistical analyses were performed in R (version 4.0.3; R Foundation for Statistical Computing, Austria. Available at: (https://www.r-project.org/)

III.6. Ethical considerations

III.6.1. Ethical issues:

I obtained ethical approval: **No 029/CMHS IRB/2020**and**EC/CHUK/049/2020**from the University of Rwanda and the hospital respectively.

III.6.2. Data confidentiality

I obeyed the confidentiality of patients, no names were collected. The scanning software system randomly generated a number and this number was the identifier of the patient in this study.

Refusal to participate in this study had no impact on patient care delivery.

Hard copies were kept in a locked cupboard in the department office and electronic data are being kept by the primary investigator. Data will be kept for a period of 10 years.

IV. CHAPTER IV: RESULTS

IV.1. Demographic trend

I included three hundred and fifty (350) patientsin the analysis.The median age was 35years in general and 55years in the mortality group; there was 125(35.7%) and 225(64.3%) female and male patients respectively in general, 7(70%) and 3(30%) in mortality group. Elective and emergency procedures were 284(81.1%) and 66(18.9%) respectively in general, 8(80%) and 2(20%) in the mortality group.Patients for general surgery was 85(24.3%) with 4(40%) in-hospital deaths; 168(48%) and 4(40%) in-hospital deaths in orthopedics; 18(5.1%) with 0 in-hospital death for plastic surgery; 27(7.7%) with 0 in-hospital death for urology; 20(5.7%) with 1(10%) in-hospital death for neurosurgery; 25(7.1%) with 0 in-hospital death in ENT surgery; 7(2.0%) with 1(10%) in-hospital death in maxillo-facial surgeries.Patients with comorbidities was 64(18.3%) from the entire patients.(Table 1)

Table 1.The univariate analysis for mortality

	0 (N=340)	**1 (N=10)**	**Total (N=350)**	**p value**
Age				**0.02**
Medium	35	55	35	
Q1, Q3	27.0, 50.0	36.0, 69.2	28.0, 51.8	
Gender				**0.02**
Female	118.0 (34.7%)	7.0 (70.0%)	125.0 (35.7%)	
Male	222.0 (65.3%)	3.0 (30.0%)	225.0 (64.3%)	
Types of procedure				0.93
Elective	276.0 (81.2%)	8.0 (80.0%)	284.0 (81.1%)	
Emergency	64.0 (18.8%)	2.0 (20.0%)	66.0 (18.9%)	
Specialty				0.33
General surgery	81.0 (23.8%)	4.0 (40.0%)	85.0 (24.3%)	
Orthopedic	164.0 (48.2%)	4.0 (40.0%)	168.0 (48.0%)	
Plastic surgery	18.0 (5.3%)	0.0 (0.0%)	18.0 (5.1%)	
Urology	27.0 (7.9%)	0.0 (0.0%)	27.0 (7.7%)	
Neurosurgery	19.0 (5.6%)	1.0 (10.0%)	20.0 (5.7%)	
ENT	25.0 (7.4%)	0.0 (0.0%)	25.0 (7.1%)	
Maxillo-facial surgery	6.0 (1.8%)	1.0 (10.0%)	7.0 (2.0%)	
Comorbidities				0.07
No	280.0 (82.4%)	6.0 (60.0%)	286.0 (81.7%)	
Yes	60.0 (17.6%)	4.0 (40.0%)	64.0 (18.3%)	

LOS				0.34
Median	5.0	6.5	5.0	
Q1, Q3	2.0, 10.0	3.2, 12.5	2.0, 10.0	
SBP80_90mmHg				0.05
Median	0.0	0.0	0.0	
Q1, Q3	0.0, 0.0	0.0, 0.1	0.0, 0.0	
DBPbelow_50mmHg				**<0.01**
Median	0.0	0.3	0.0	
Q1, Q3	0.0, 0.1	0.1, 0.4	0.0, 0.1	
MinsSBP80_90mmHg				**0.04**
Median	0.0	2.5	0.0	
Q1, Q3	0.0, 0.0	0.0, 8.8	0.0, 0.0	
MinsDBPbelow_50mmHg				**0.01**
Median	0.0	27.5	0.0	
Q1, Q3	0.0, 12.5	7.5, 62.5	0.0, 15.0	

IV.2. Outcomes:

Association of intraoperative hypotension and hypertension with in-hospital mortality

In-hospital mortality was 2.9%(10) in general; and was 4.7%(4) in general surgery, 2.9%(4) in orthopedics, 5%(1) in neurosurgery, and 14%(1) in maxillofacial surgery in the univariate analysis (Table 1); older age, female gender and more time spent below DBP_50 mmHg were more frequent in the mortality group. In the logistic regression model, mortality was associated with elderly (OR: 1.04, CI: 1.00, 1.09, p= 0.037) and more time spent below a diastolic blood pressure less than 50 mmHg (OR: 1.02, CI: 1.01, 1.04, p=0.004) (Table 2). There was no association with mortality on intraoperative hypertension, gender, presence or absence of comorbidity, and emergency vs. elective surgery.

Table 2.Logistic regression model for mortality

	I(In-hospital death ="1")		
Predictors	*Odds Ratios*	*CI*	*p*
(Intercept)	0.00	0.00 – 0.03	**<0.001**
Age	1.04	1.00 – 1.09	**0.037**
Gender [Male]	0.38	0.07 – 1.59	0.202
Types of procedure [Emergency]	1.94	0.27 – 9.52	0.442
Comorbidities [Yes]	2.13	0.48 – 8.66	0.293
MinsDBPbelow_50 mmHg	1.02	1.01 – 1.04	**0.004**
Observations	309		

Association of intraoperative hypotension and hypertension with hospital length of stay

The medium length of stay was 5 and 6.5 days in general and in the mortality group respectively. Estimates, confidence intervals, and p values for the length of stay are reported in Table3. There was no association with intraoperative hypotension (IR1.0, CI 1.00-1.01, P 0.104) or hypertension. Although male gender, emergency surgery, orthopedic and plastic surgery were associated with a longer hospital stay. ENT surgery was associated with a shorter hospital stay.

Table 3.Negative binomial regression model for LOS

Predictors	*Incidence Rate Ratios*	*CI*	*p*
(Intercept)	3.56	2.30 – 5.58	**<0.001**
Age	1.01	1.00 – 1.01	0.061
Gender [Male]	1.44	1.12 – 1.85	**0.005**
Types of procedure [Emergency]	1.43	1.07 – 1.95	**0.021**
Orthopedic	1.43	1.06 – 1.92	**0.016**
Plastic surgery	1.89	1.13 – 3.28	**0.020**
Urology	0.78	0.47 – 1.35	0.360
Neurosurgery	1.01	0.60 – 1.77	0.972
ENT	0.58	0.34 – 1.00	**0.043**
Maxillo-facial	1.04	0.49 – 2.52	0.923
Comorbidities [Yes]	1.04	0.76 – 1.42	0.829
In-hospital death [1]	1.23	0.65 – 2.54	0.544
MinsDBPbelow_50mmHg	1.00	1.00 – 1.01	0.104
MinsSBPbelow_80mmHg	1.00	0.96 – 1.04	0.877
Observations	308		
R^2 Nagelkerke	0.191		

V. CHAPTER V: DISCUSSION

In 2018, the WHO-WFSA elaborate internationals standards to deliver safe anesthesia which include highly recommended intraoperative vital signs monitoring, and including blood pressure.(1)The estimation of surgical procedures annually is 321.5 million globally with more than 21 million in Eastern sub-Saharan Africa.(16)

The surgical capacity in Rwanda was found to be over 80.000 procedures in 2009 and 2010.(17)Another study conducted in CHUK/Rwanda in 2015 found the perioperative mortality to be 6.5%(9), this show that a lot have to be done to identify associated factors to improve postoperative outcomes. Studies done in developed countries showed that blood pressure fluctuation with intraoperative hypotension was linked with poor postoperative outcomes.(2,4)

In line with my hypothesis, the results indicate an association of intraoperative hypotension with postoperative in-hospital mortality mainly when the DBP fluctuates for a long time below 50mmHg, and there was no association with intraoperative hypertension. There is a similarity with the study done by Terri G et al(2),and Wijnberge M et al.(18).There was also an association with age. I didn't find any correlation withcomorbidity that the patient has), gender, or types of surgery, although the risks factors may not differ from the ones known like the type of anesthesia given and its depth, the anesthetics drugs used, massive intraoperative blood loss, inadequate fluid deficit replacement and poor monitoring.(19)

The results of my study found no association of intraoperative hypotension or hypertension with the hospital length of stay contrary to the hypothesis. The hospital length of stay was found to be longer in male gender, emergency surgery, orthopedic, and plastic surgery, and to be shorter in ENT surgery. However, based on the findings of a similar study done in a high-income country there was an association of intraoperative hypotension with increased hospital length of stay.(4)I cannot exclude the association of intraoperative blood pressure variations with hospital length of stay on our single studyhowever future studies on big population data in lower-income countries will be a good additive.

Limitations

My limitations mainly were that intraoperative anesthesia follow-up sheets are manually filled and contain errors, poor handwriting, poor graphic use, and incomplete documentation. My study didn't demonstrate also the risk factors associated with intraoperative hypotension or hypertension.

VI. CHAPTER VI: CONCLUSION

In the population of 350 patients who underwent elective and emergency surgeries and met inclusion criteria during my study period, I found that intraoperative hypotension was associated with postoperative in-hospital mortality, and there was no association with intraoperative hypertension. There was no association of length of hospital stay on intraoperative hypotension or hypertension but the hospital length of stay was increased in the male gender, emergency surgery, and orthopedic surgery. Further larger studies are needed in lower-income countries to evaluate their association for improving intraoperative blood pressure monitoring and management.

Recommendations

I recommend the use of recommended symbols and mark them carefully and correctly. I recommend also consistent intraoperative blood pressure monitoring for every patient that underwent elective or emergency surgery, for at least every 5 minutes and quick action to be made on diastolic blood pressure (DBP) below 50 mmHg as it lead to poor postoperative mortality and morbidity.

I recommend the implementation of the electronic medical record for intraoperative blood pressure monitoring and recording.

I recommend future studies to use big data and also emphasize on the risk factors that are associated with intraoperative blood pressure fluctuation in lower-income countries to direct the goal of prevention, and management.

ACKNOWLEDGEMENTS

I am thankful for the unmeasurable support of non-physician anesthetists and anesthesiologists of the University Teaching Hospital of Kigali, and the College of Medicine and Health Sciences at University of Rwanda.

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ANNEXES

DATA COLLECTION QUESTIONNAIRE

Demographic information

1. **Patient ID…….**

2. **Date of birth**……. 3. **Age…..**

4. **Gender …..**

Preoperative patient information

1. Date of admission
2. Date of enrolment
3. Date of surgery: …..
4. Type of procedure: Elective …….. Emergency……
5. Types of surgery…….
6. Comorbidities:

- Sepsis ……
- Septic shock ……
- Renal failure…..
- Electrolyte imbalance……..
- Chronic hypertension ….
- Diabetes mellitus …..
- Confirmed cancer …….

- Others …….

Intraoperative data information

Minutes of occurrence & Percentage of occurrence:

Intraoperative hypertension

SBP> 160mmHg:

SBP 140-160mmHg:

Intraoperative hypotension

SBP 90-80 mmHg**:**

SBP < 80mmHg:

DBP 60-50mmHg:

DBP <50mmHg:

Intraoperative vitals: BP at 5 minutes interval (Will be extracted from intraoperative anesthesia flow chart, see appendix XI.2)

Postoperative data information

1. Hospital stay:

- Date of hospital discharge
- The number of days in hospital stays: ……..

2. In-hospital mortality: Yes……, No…….

CONSENT FORM AND **INFORMATION SHEET**

For the study entitled "**Association of intraoperative hypotension and hypertension on hospital stay, and in-hospital mortality after major elective and emergency surgery in the University Teaching Hospital of Kigali (CHUK)**".

I. Researcher identification:

NDARIBITSE CHRISTIAN, MD, Postgraduate Resident in Anesthesia at the University of Rwanda.

II. Purpose of the Research project

This study will aim to define the association of intraoperative hypotension and hypertension with prolonged hospital stay and postoperative in-hospital mortality. The results of this study will be used by policymakers at CHUK and countrywide to come up with strategies to decrease hospital length of stay and decrease the risk of postoperative in-hospital mortality after major and elective surgery.

III. How long will take this part of this research?

The study will take 3 months, from June to August 2020

IV. Benefits, Risk, or Discomfort

There will be no direct benefit from this study to the participants. But the result of this The study will be used for further improvement of the intraoperative care given to patients. There will be no risk of participating in this study.

V. Participation is voluntary

VI. Confidentiality:

The information collected from the study subjects will be kept confidential and by assigning a code number to each patient, the name of the patient will not be recorded or used in any report.

VII. Right to refuse or withdraw

Study subjects will have the full right to refuse from participating in this research without penalty.

VIII. Persons to contact

For any question or concern you can contact the principal investigator or co-investigator using the following addresses:

Dr. NDARIBITSE Christian, +250783687815, chrisnno77@gmail.com
Dr MVUKIYEHE Jean Paul, +250783088895, mvukipaul@gmail.com
Dr. RUSINGIZA KAMANZI EMMANUEL, +250785466254, erkamanzi@gmail.com, Chairperson of IRB/CHUK

IX. Study subjects consent

As a patient or caregiver, I agree to participate in this study described above.

Patient signature

_____ Date____/_____/____

Next of kin signature: _____ Date___/_____/____

Intraoperative anesthesia record flow chart