INCIDENCE, PREDICTORS AND OUTCOMES OF BLUNT CARDIAC INJURY AMONG TRAUMA PATIENTS PRESENTING TO EMERGENCY DEPARTMENT IN TANZANIA

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By

Janet J. Sugut

A Dissertation Submitted in (Partial) Fulfillment of the Requirements for the Degree of Master of Medicine (Emergency Medicine) of

Muhimbili Univeristy of Health and Allied Sciences
October , 2024

CERTIFICATION

The undersigned certifies that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled: **''Incidence, Predictors and Outcomes of Blunt Cardiac Injury among trauma patients presenting to Emergency Department in Tanzania.**' In partial fulfillment of the requirements for the degree of Master of Medicine (Emergency Medicine) of Muhimbili University of Health and Allied Sciences (MUHAS), Dar es Salaam, Tanzania.



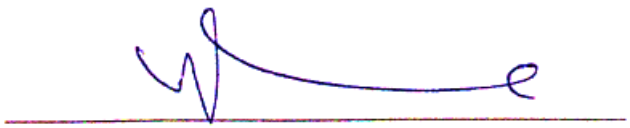
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Date

DECLARATION AND COPYRIGHT

I, **Janet Jebichii Sugut,** declare that this **dissertation** is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.



Signature……. **Date**…….

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ABSTRACT

Background: Blunt cardiac injury (BCI) incidence varies due to non-specific presentation and lack of diagnostic clinical gold standard. Standard of care in BCI screening involves use of electrocardiogram (ECG), troponin and echocardiogram (ECHO) but is often not done in Low and Middle Income Country (LMIC) despite high trauma burden. It is therefore uncertain whether we should use scarce resources to screen for BCI in these entity of patients with BCI among polytrauma or isolated blunt chest trauma. Moreover, it was not known whether patients who have abnormal findings on these tests in Emergency Department (ED) will receive a definitive test like echocardiogram and/or cardiac monitoring once admitted. We therefore aimed to do this sudy with the goal of developing a standard algorithm to guide use of scarce resources in LMIC to target BCI screening.

Objectives: To establish the incidence, predictors and outcomes (48hour and 7-day) of blunt cardiac injury among patients with polytrauma or isolated blunt chest injury who attended the Emergency Department of a Tertiary Hospital in Tanzania.

Methods: Prospective observational cohort study between September 2023-June 2024, with consecutive enrollment of polytrauma or isolated blunt chest trauma patients from September 2023 to February 2024 at the ED of Muhimbili National Hospital and Muhimbili Orthopedic Insititute in Tanzania. BCI was defined as abnormal ECG and elevated troponin. All patients received ECG and if abnormal, troponin was done. Patients meeting BCI criteria were followed up at 48 hours and 7 days after disposition for death and composite adverse events (Intubation for airway protection and/or mechanical ventilation, hypotension, cardiorespiratory arrest resuscitated). Logistic regression analysis was performed to identify independent predictors of BCI.

Results: Seventy three of 315 patients screened had BCI, an incidence of 23.2% [95% CI: 18.6 %- 28.2%]. BCI patients had a median age 31years (IQR: 22.5 – 39.5), and were predominantly male 65(89%). Most were polytrauma 68(93.2%) with 57 (78.1%) involved in motor traffic accidents. Twenty four-hour cardiac monitoring was performed in 30 (41.1%) patients while ECHO was performed in one. Mortality at 48hours was 6.8% and 9.6% at 7 days. Composite adverse events at 48hours and 7 days was 39.7% and 42.5%

respectively. Tachycardia on ED arrival, initial presenting GCS ≤12 and lung contusion were independent predictors of BCI ($p<0.05$).

Conclusion: There is a significant incidence of BCI among polytrauma/isolated blunt chest trauma in our setting, suggesting the need to include BCI screening and cardiac monitoring guidelines in our trauma algorithms. Predictors of tachycardia, initial presenting GCS≤ 12 and lung contusion can be used to target screening to conserve resource use.

TABLE OF CONTENTS

CERTIFICATION i
DECLARATION AND COPYRIGHT i
ACKNOWLEDGEMENT iii
ABSTRACT iv
LIST OF TABLES ix
LIST OF FIGURES x
LIST OF ABBREVIATIONS xi
OPERATIONAL DEFINITIONS xii
CHAPTER ONE 1
1.0 INTRODUCTION 1
1.1 Background 1
1.2 Problem Statement 2
1.3 Conceptual Framework 2
1.4 Rationale 4
1.5 Research Question 4
1.6 Objectives 4
1.6.1 Broad Objective 4
1.6.2 Specific Objective 4
CHAPTER TWO 5
2.0 LITERATURE REVIEW 5
2.1 Trauma burden epidemiology 5
2.2 Polytrauma 5
2.3 Blunt cardiac injury 7
2.4 Predictors of Blunt Cardiac Injury and Mortality 9
2.5 ECG uses in trauma 10
2.6 Use of biomarkers in trauma 10
2.7 Echocardiography (ECHO) in trauma 11
CHAPTER THREE 13
3.0 METHODOLOGY 13
3.1 Study Design 13
3.2 Study duration 13

3.3 Study Setting 13
3.4 Population 14
3.4.1 Target population 14
3.4.2 Accessible Population 14
3.4.3 Study Population 14
3.5 Sampling Strategy 15
3.6 Study Subject 15
3.6.1 Inclusion Criteria 15
3.6.2 Exclusion Criteria 15
3.7 Data collection procedures 15
3.8 Variable of interest 16
3.8.1 Predictor Variables 16
3.8.2 Outcome Variables 16
3.8.3 Confounder Variables 17
3.9 Sample size estimate 17
3.10 Data Management 18
3.10.1 Data collection procedures 18
3.10.2 Data quality assurance 18
3.10.3 Data Analysis 18
3.11 Ethical Consideration 18
3.12 Funding 19
CHAPTER FOUR 20
4.0 RESULTS 20
4.1 Study flow diagram 20
4.2 Clinical characteristics of polytrauma/isolated blunt chest trauma patients. 21
4.3 Clinical findings of polytrauma/isolated blunt chest trauma 22
4.4 Incidence of BCI among polytrauma/isolated blunt chest trauma 24
4.5 Outcomes of patients with BCI 24
4.6 Univariate and multivariate analysis of predictors of BCI 25
CHAPTER FIVE 28
5.0 DISCUSSION 28

CHAPTER SIX 33
6.0 STRENGTHS, LIMITATIONS, CONCLUSION AND RECOMMENDATION 33
6.1 Strengths 33
6.2 Limitations 33
6.3 Conclusion 34
6.4 Recommendations 34
REFERENCES 35
APPENDICES 41
Appendix 1: Data Collection Tool 41
Appendix 2: Consent Form (English) 51
Appendix 3: Consent Form (Kiswahili) 55
Appendix 4: Approval for ethical clearance 59
Appendix 5: Permission to collect data at MNH 61
Appendix 6: MOI Permission Letter 62
Appendix 7: JKCI Permission Letter 63

LIST OF TABLES

Table 1: Clinical charcateristics of polytrauma/isolated blunt chest trauma patients. 21

Table 2: Clinical findings of polytrauma/isolated blunt chest trauma..... 23

Table 3: Incidence of BCI among polytrauma/isolated blunt chest trauma. 24

Table 5: Univariate analysis of predictors of having BCI among Polytrauma/Isolated blunt chest trauma patients 26

LIST OF FIGURES

Figure 1 : Conceptual Framework 3

Figure 2: Study Flow Diagram 20

Figure 3: Outcome trends among BCI positive 25

LIST OF ABBREVIATIONS

AIS	Abbreviated Injury Score
ATLS	Advanced Trauma Life Support
BCI	Blunt Cardiac Injury
CT	Computed Tomography
DALY's	Daily Adjusted Life Years
DAMA	Discharged Against Medical Advice
ECHO	Echocardiogram
ECG	Electrocardiogram
ED	Emergency Department
HDU	High Dependency Unit
ICU	Intensive Care Unit
LMIC	Low- and Middle-Income Country
MNH	Muhimbili National Hospital
MOI	Muhimbili Orthopedic Hospital
MRI	Magnetic Resonance Imaging
Ng/ml	Nanogram per milliliter
Pg/ml	Picograms per milliliter

OPERATIONAL DEFINITIONS

Blunt Cardiac Injury- Injury to the heart caused by blunt force trauma, diagnosed by abnormal ECG and elevated troponin.

Blunt Chest Trauma- Injury to the chest with trauma to organs and structures under the tissue without disruption of tissue integrity. The Injuries result from compression, direct impact, acceleration-deceleration forces and blast injuries through mechanisms as motor vehicle accidents, falls, sports and others.

Bradycardia- Bradycardia is defined as heart rate < 60beats/min. A regular cardiac rhythm is sinus bradycardia while an irregular rhythm is bradyarrhythmia.

Cardiac Monitoring- Is the use of invasive and/or non-invasive methods to monitor hemodynamic status of the patient, including the cardiac rhythm. It involves attaching electrical leads to a patient and the output displayed on a monitor 24-hours per day.

Clinician- A medical practitioner with either degree in medicine and surgery (MBChB) or a resident who is in masters training in emergency medicine.

Emergency Medicine- Is a medical specialty concerned with managing unforeseen and undifferentiated illness and injury. It also involves community emergency response and disaster management. It is not defined by space and can be practiced in any location to save life or limb.

Emergency Physician- Is a specialist who has undergone specialty training in Emergency Medicine. In addition to clinical role, the Emergency Physician also plays a role in leadership and oversight in the Emergency Department.

Electrocardiogram (ECG)- Is a bedside, non-invasive test that uses a machine that has electrodes connected to the chest which gives information on the electrical activity and rhythm of the heart.

Echocardiogram (ECHO)- Is an ultrasound scan of the heart which can be used to visualize the structures of the heart and surrounding vessels and the functioning of the heart.

Emergency Department (ED)- Hospital facility staffed 24-hours a day, 7 days a week that provides unscheduled care to patients in need of immediate care.

Glasgow Coma Scale (GCS)- Is a physical examination tool used to assess the level of consciousness of a patient which guides management and aids in monitoring response to treatment. It involves assessment of verbal, eye and motor responsiveness. Mild GCS has a score of 13-15, Moderate GCS has a score of 9-12 and severe GCS a score of 3-8.

Hypotension- Is blood pressure below unacceptable levels usually defined as blood pressure < 90mmHg systolic and < 60mmHg diastolic in an adult or mean arterial pressures < 65.

Hypertension- Is blood pressure > 140mmHg systolic and > 90mmHg diastolic.

Hypoxia- Is defined as oxygen saturation measured by pulse oximeter < 94%

Low-and-Middle Income country- A country defined by World Bank to have US dollar 1,085 or less, Gross National Income (GNI) per capita.

Lower-and-Middle Income country- A country defined by World bank to have US dollar 1,086 to 4,255 Gross National Income (GNI) per capita.

Polytrauma- Polytrauma is defined as injuries involving two or more body systems.

Tachycardia- Tachycardia is defined as a heart rate > 100 beats/min to 150beats/min.

Tachyarrhythmia- Tachyarrhythmia is defined as a heart rate > 150beatsmin

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Sub-Saharan Africa has a higher burden of injury compared to high income countries with World Health Organization (WHO) ranking road injury at number 7 amongst the top ten leading causes of death in low income countries and number 10 in lower middle-income countries(1). Blunt chest trauma, which can either be penetrating or blunt injury, is the third leading cause of morbidity and mortality from trauma, after head injury and extremity injuries in polytrauma patients(2). Often, penetrating chest trauma patients receive immediate attention as the injuries are apparent. Blunt chest trauma includes injuries like rib fractures, lung contusion, pneumothorax, hemothorax, flail chest, sternal fractures and cardiac injuries amongst others. Blunt cardiac injury (BCI) is difficult to diagnose and it has a high mortality. The various trauma scores that have been formulated rely on physical injuries thus making prediction of solid organ injuries a challenge, where one such solid organ is the heart (3).

The reported incidence of BCI varies from 8% to 76%due to its non-specific presentation and lack of a clinical gold standard for its diagnosis(4). BCI may range from less severe injuries like contusion to more severe forms like myocardial rupture. These injuries may alter electrophysiology of the heart and can be seen as arrhythmias or alter the structure of the heart presenting as rupture of valves or myocardium, amongst others. These injuries are often masked by non-cardiac related injuries where for example, a polytrauma patient with sinus tachycardia will be presumed to have hemorrhage and often BCI will not be a consideration in the immediate setting. This often delays the care of patients who potentially have BCI contributing to morbidity and mortality.

BCI carries a high mortality of 4.3% to 45% and this could be an underestimate as many with severe cardiac injuries die at the scene (3,5,6) Thus, a high index of suspicion and well-defined algorithm that guides identification of these patients is needed. The patients who reach hospital have a chance for healthcare providers to detect and manage blunt cardiac injury even if to prevent one death with early referral to appropriate facility that can manage

the injuries.The Eastern Association for the Surgery of Trauma Practice Management guidelines recommend trauma patients, with suspicion for BCI, be initially screened with an electrocardiogram (ECG) and, if abnormal, a troponin test(7). If these are suggestive of BCI, an echocardiogram (ECHO) should be done to characterize the injuries and patients should have cardiac monitoring for at least 48hours. However, in LMIC, this is not routinely done which could be due to lack of awareness and resources. Thus, in most Low and Middle Income Countries (LMIC) including Africa, the incidence, predictors and outcomes of BCI is not known, despite a high trauma burden. Therefore, this study sought to establish the incidence, the predictors and outcomes of BCI among polytrauma patients and those with isolated blunt chest trauma presenting to Emergency Departments (ED's) of Tanzania. The predictors will give guidance at the ED on who should be screened for BCI in LMIC using the available scarce resources.

1.2 Problem Statement

The burden of injury is high in LMIC, yet the incidence of BCI is unknown. Little research has been done on BCI because of a lack of clinical gold standard for diagnosis and the non-specific nature of the presentation. BCI carries a high mortality rate, and thus, a high index of suspicion is needed to diagnose BCI. Trauma guidelines recommend screening for BCI initially with an ECG and, if abnormal, a troponin, but this is not used in LMIC, which could be due to a lack of awareness and/or resources. It is therefore not clear how frequently BCI occurs or what its outcomes are and, therefore, whether we should use scarce resources to screen for this entity in patients with polytrauma and isolated chest injury. Moreover, it is unknown whether patients who have abnormal findings on these tests in ED receive ECHO and/or cardiac monitoring once admitted.

1.3 Conceptual Framework

Patients with injuries from different mechanisms present with a myriad of possible injuries. The clinicians apply standard trauma care depending on the patient's presentation. Among patients with polytrauma and isolated chest injuries, there will be characteristics that may put them at higher risk of having BCI. These individuals would be screened and considered to have BCI if they have an abnormal ECG and elevated troponin. ECHO is then done

thereafter in patients with positive ECG and troponin to characterize injuries. These patients also need cardiac monitoring after disposition from the ED.

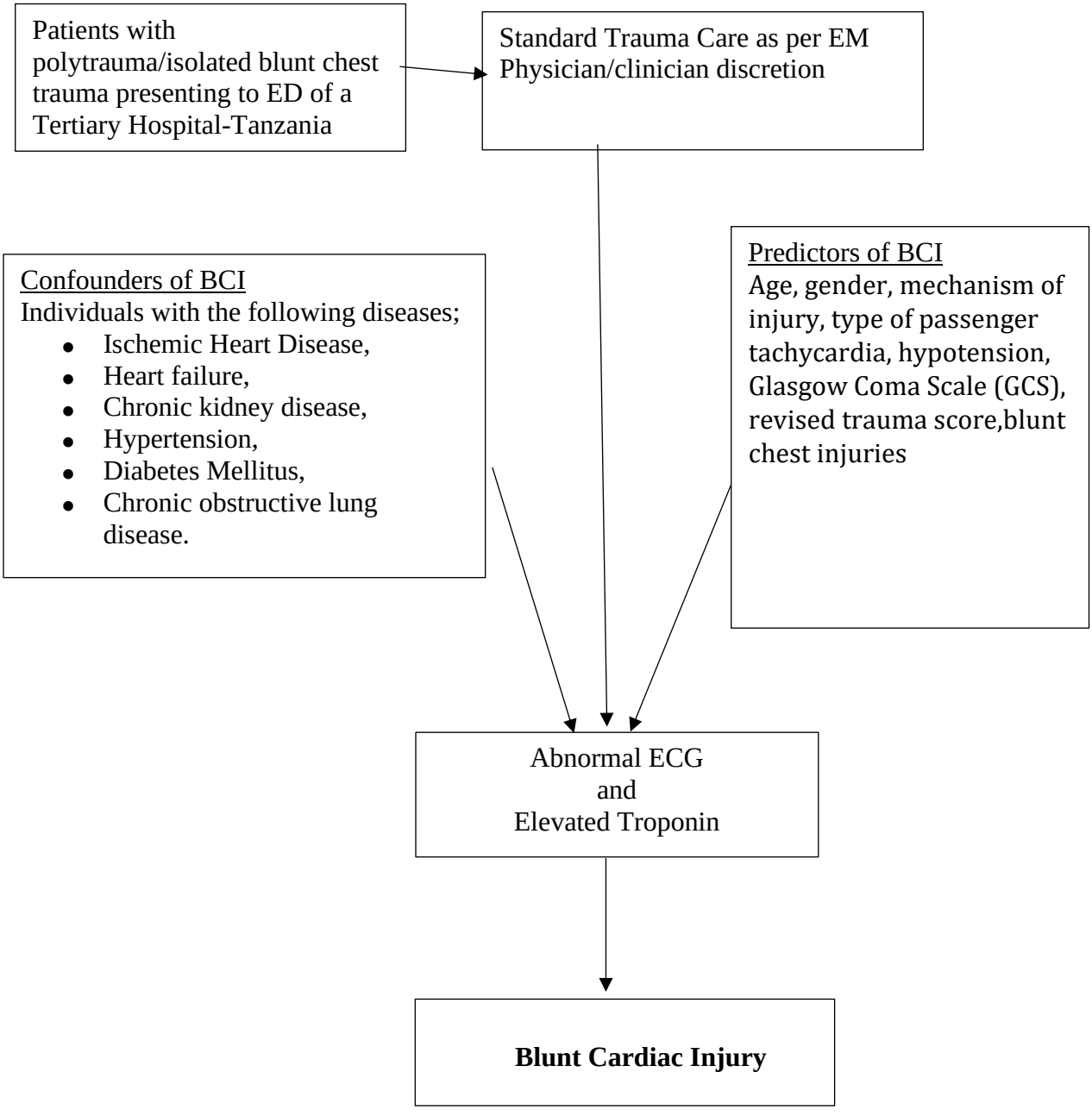


Figure 1 : Conceptual Framework

1.4 Rationale

Screening for BCI requires additional investigations in the ED and in the hospital. Given the limited resources in LMIC, it was important to determine how frequently BCI occurred and what the outcomes were. Additionally, by determining which patients are more likely to have BCI, the findings of this study will be useful in developing a standard algorithm which can guide the use of scarce resources in determining who should be screened for BCI.

1.5 Research Question

In adult patients with polytrauma or isolated blunt chest injury attending the ED of a Tertiary Hospital in Tanzania, what was the clinical profile, incidence, predictors, and outcomes (48 hours and 7 days) of blunt cardiac injury?

1.6 Objectives

1.6.1 Broad Objective

To describe the clinical profile and establish the incidence, predictors and outcomes (48hour and 7-day) of BCI among adult patients with polytrauma or isolated blunt chest trauma who attended the Emergency Department of a Tertiary Hospital in Tanzania.

1.6.2 Specific Objective

1. To describe the clinical profile of polytrauma or isolated blunt chest trauma patients who presented with BCI to ED of a Tertiary Hospital in Tanzania between September 2023 to February 2024.
2. To determine the proportion of patients with polytrauma or isolated blunt chest trauma who had BCI.
3. To determine the proportion of admitted patients with BCI, who received 24-hour cardiac monitoring and/or ECHO.
4. To determine the proportion of patients with adverse events, within 48hours and 7 days, among those with BCI.
5. To establish the predictors of having BCI among patients with polytrauma or isolated blunt chest trauma.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Trauma burden epidemiology

The trauma burden continues to rise with more mechanization and urbanization. According to WHO 2019, road injury ranks number 6 among top 10 causes of disability-adjusted life years (DALY's) (1). The highest burden of injury lies in lower- and middle-income countries with WHO ranking road injury at number 7 amongst the top ten leading causes of death in low income countries and number 10 in lower middle-income countries(1). Tanzania falls in the category of lower middle-income country as per World Bank report in 2023(8).

In Tanzania, 2019 WHO report on road traffic mortality showed an estimate of 31 fatalities per 100,000 population against the world's average of 17 deaths per 100,000 population pointing to a higher trauma burden(9). In Low and lower middle-income countries, emergency systems are still developing and there is a lack of comprehensive pre-hospital and in-hospital emergency response. There is inadequate skilled labor and resources required in emergency situations. Sawe et al found that trauma variables that WHO recommends be documented in acute care facilities were poorly captured(10). This leads to inaccurate, incomplete data and thus overall underestimation of the trauma burden.

2.2 Polytrauma

According to the new Berlin definition, polytrauma is defined as an "Abbreviated Injury Scale (AIS) ≥ 3 for two or more different body regions and one or more additional variables from five physiologic parameters (hypotension [systolic blood pressure ≤ 90 mmHg], unconsciousness [Glasgow Coma Scale score ≤ 8], acidosis [base excess ≤ −6.0], coagulopathy [partial thromboplastin time ≥ 40 s or international normalized ratio ≥ 1.4], and age [≥70 years])"(11). This definition has evolved over time with the terms 'multiple trauma' and 'major trauma' being used interchangeably.

Prior definitions included "at least two injuries of head, chest or abdomen, one of them in association with an extremity injury", "any patient with two or more significant injuries" "a patient with two or more injuries, one of them being potentially life-threatening" (12,13) Prior definitions were vague as they did not clearly define what life-threatening means, and the cut-offs in injury severity scores could variably be contributed by one system or multiple

systems, leading to re-definition. Polytrauma patients have higher likelihood of having sustained injuries to the head, chest, abdomen and extremities and have longer hospital stays, longer ICU stay, more therapeutic requirements and higher mortality rates(11). In low- and middle-income countries, where resources are limited, the care of polytrauma patients leads to financial hardship for patients and their families. A recent study by Gulamhussein et al showed that 85.3% of hospitalized trauma patients had catastrophic out-of-pocket expenditure with a median charge of US$ 342.71, median payment of US$ 168.90 and median outstanding debt of US$ 129.58(14).

Severity of injuries can be assessed using different grading systems based on anatomical classification, physiological parameters or both. These grading systems can be used to estimate prognosis and guide treatment and are also used in trauma research(15). Some are best applied pre-hospital while some are used in-hospital. Anatomical scoring systems include Anatomic profile, Abbreviated Injury Score (AIS), Injury Severity Score (ISS), Modified Injury Severity Score (modified ISS), International Classification of diseases (ICISS) and Penetrating Abdominal Trauma Index (PATI). The physiological scoring systems include APACHE 1, 11, AND 111, Revised Trauma Score, Glasgow Coma Scale, Acute Trauma Index, Trauma Score, Triage Index, Sequential Organ Failure Assessment (SOFA) and Systemic Inflammatory Response Syndrome score (SIRS). Combined systems include Trauma and Injury Severity Score (TRISS), Trauma Index, polytrauma-Schussel and A severity Characterization of Trauma (ASCOT)(16).

Combined systems have been proposed to be better, but there are no ideal acceptable systems, hence each is used with caution(17). The Revised Trauma Score uses parameters that are quickly obtained as the patient enters the emergency department. These parameters are Glasgow Coma Score, systolic blood pressure and respiratory rate; hence these are easy to use without having to order additional tests(16). The Revised Trauma Score is a modification from the prior Trauma Score, which is still in use in some settings. The Trauma score however, has respiratory effort and capillary refill time which are difficult to assess objectively in certain circumstances(18).

2.3 Blunt cardiac injury

BCI is injury to the heart after a blunt impact to the chest. The documented incidence ranges from 8% to 76% among trauma patients(4). Presentation of BCI is non-specific and the symptoms and signs can be masked by or attributed to other injuries the patient is presenting with. For instance, for a patient who is hypotensive and tachycardic, the clinician will think hemorrhage and hypovolemia first before consideration for blunt cardiac injury.

Prior studies in high income countries have established that the age group affected by BCI is between 30 to 70yrs. Victims are mostly male, involved in motor vehicle accident, have associated pulmonary injuries, low mean GCS of 8, high trauma scores and long hospitals stays (19,20) Other causes of cardiac injury are falls, sports injuries and assaults(21). BCI is associated with injuries of the chest, abdomen, head injury, extremity injury and spinal injury(22). The cardiac injuries can range from less severe ectopic beats, transient arrhythmias to persistent arrhythmias, septal and valvular injury, myocardial infarction, myocardial contusion and myocardial rupture, heart failure, and death(23).

Screening for BCI requires use of ECG's and serial troponins for trends. Velhamos et al demonstrated that having an initial normal ECG combined with initial normal troponin has 100% negative predictive value as opposed to using individual tests in isolation(23). Patients with abnormal findings on ECG and troponin should have an ECHO to characterize the injury. A patient with abnormal ECG and troponin requires a minimum 24 hours of cardiac monitoring but ideally 48hours. Serial troponin testing should be done 8hrs after the initial one to observe trends. Computed Tomography (CT) scanning and Magnetic Resonance Imaging (MRI) can be used as complementary(24).

Further management depends on ECHO findings which can be managed surgically requiring advanced cardiothoracic surgeries or medically with interventions such as anti-arrhythmic drugs, pacing for slow heart rates or advanced cardiac support like extracorporeal membrane oxygenation when in the case of severe cardiac dysfunction. These interventions require high level care and cardiac monitoring. Emergency departments can usually provide the initial screening for BCI by obtaining an ECG and then, if positive, ordering a troponin blood test

followed by the correct disposition. Subsequent testing is usually determined by the physicians admitting the patient to the hospital.

Findings of BCI are definitively confirmed only at surgery or autopsy (22,25) Lack of an agreed clinically-based diagnostic gold standard and mixed presentation makes overall diagnosis of BCI challenging yet it carries higher mortality among the injured, with varied reported mortality rates ranging from 4.3% to as high as 45% (3,5,6,26) Even these numbers could be an underestimate, as most patients with BCI die at the scene(25). In LMIC, these numbers could be greater due to an underdeveloped pre-hospital system with the majority of patients having delayed presentations to hospitals, or dying at the scene.

Mortality is influenced by several factors. A study by El-Qawaqzeh et al found that age > 65yrs, hemothorax, diaphragmatic injury, thoracic aortic injury and history of heart failure were independent predictors of mortality among patients with BCI(20). Hanschen et all established that higher injury severity scores among BCI were associated with higher mortality(26). Joseph B et al identified that patients with BCI who were likely to die had hypotension, high lactate and elevated troponin, in their study of BCI patients in Level 1 trauma center(27).

The cost of screening and diagnosing BCI is high, requiring more resources in terms of imaging, blood testing like troponin as well as the need for cardiac expertise. Once screened, extra resources are needed for continuous cardiac monitoring, the first 48hours being critical for detecting and monitoring BCI as arrhythmias are most common within this period(28). In LMIC's, the incidence of BCI has not been well documented for these reasons.

Without a standard practice for screening BCI, these patients may be overlooked as other apparent injuries take precedence. A high index of suspicion, and some guidance on who is likely to have BCI, is thus needed on the part of clinician who encounters these patients. The patients that arrive at a facility have a chance for healthcare provider to screen for BCI and avert the adverse event even if it means that one death is being prevented. As such, predictors of BCI helps to narrow down, who needs to be screened and hence saving on resources as opposed to screening everyone.

2.4 Predictors of Blunt Cardiac Injury and Mortality

Several studies have demonstrated the demographic characteristics, clinical profile and injuries in patients with polytrauma and blunt chest trauma and association with mortality or morbidity from BCI with few studies on predictors of having BCI.

A nationwide analysis of blunt cardiac injury among blunt thoracic trauma in the USA, showed that age ≥ 65years, motor vehicle accident, need for higher transfusion requirement and associated thoracic injuries were independent predictors of BCI while age ≥ 65years, history of heart failure, hemothorax, diaphragmatic injury and thoracic aortic injury was associated with mortality(20). Notably in this study, the study population was older, with mean age of 52years ± 20years.

Abnormal vital signs have been associated with BCI including hypotension, tachycardia and dyspnea(19). Additionally, palpitation, low GCS ≤ 13, abnormal ECG findings were independent predictors of BCI in a study by Emet M et al (29).

Several trauma scores have been used in blunt cardiac injury studies with conclusion that higher injury scores are associated with BCI and mortality. Hanschen et al used Abbreviated Injury Score (AIS) with severe cardiac injury (AIS 4 and AIS 5-6) having higher odds of mortality(26). Injury Severity Scores >15 by Velhamos et al was also found to be an independent predictor of mortality in BCI patients demonstrating that worse trauma scores predicted mortality(23).

Blunt chest injury patterns that include sternal fractures, hemothorax, pneumothorax, hemopneumothorax, rib fractures, lung contusion amongst others have been shown to predict BCI (30,31) In a 9-year retrospective National Trauma Data Bank in the USA by Grigorian et al, hemopneumothorax was a strongest predictor of BCI(30). Regarding sternal fractures, a recent retrospective study of 2020 by Alexander A et al, looking at 380 blunt trauma patients in two level trauma centers in USA, demonstrated that having sternal fracture is not an independent predictor of BCI. However, in the cohort of patients with sternal fractures, pulmonary co-injuries were a statistically significant predictor(31).

2.5 ECG uses in trauma

Electrocardiogram is a device that records electrical activity of heart. The activity is plotted on a grid with X-axis and Y-axis where X-axis denotes time with the standard normal speed as 25mm/sec and Y-axis represents voltage whereby standard 10mm is equal to 1mV. The recorded tracing is presented in form of waves, intervals, complexes and segments. Different patterns of the above waves, segments and intervals can give information on the heart rate, the axis of the heart, the rhythm, signs of myocardial ischemia or abnormal conduction of the heart(32). It is a point of care testing tool in the ED, hence easily accessible by the bedside.

ECG in trauma is often forgotten in the initial work up, but can provide information on myocardial injury. Different patterns have been described in BCI, including tachycardia, bradycardia, left axis deviation, complete and incomplete right bundle branch block, atrial fibrillation, ST segment changes, low voltage ECG, T wave negativity (29). Additionally, non-specific changes like non-specific ST changes like that seen in pericarditis, new Q wave, 1st, 2nd and 3rd degree blocks, atrial and ventricular extra-systoles have been described (33).

ECG used alone is not enough to conclude that myocardial injury has occurred, however, a normal ECG at initial evaluation can nearly rule out myocardial injury with negative predictive value of 98%. When combined with troponin I, the negative predictive value is 100% (23). Velhamos et al also concluded that a normal ECG and troponin at admission and 8 hours later was adequate to rule out blunt cardiac injury (23).

Thus, ECG is a good starting point to screen for myocardial injury in trauma as proposed by Eastern Association for the Surgery of Trauma practice management guidelines (7).

2.6 Use of biomarkers in trauma

Biomarkers are substances released into blood as a measure of normal or pathologic process, or response to therapeutic intervention. They can be enzymes, proteins, peptides and newer molecules like microRNAs. Biomarkers are used for diagnosing, diseases and monitoring treatment. Cardiac biomarkers are detected when there is myocyte injury or ischemia with release of intracellular contents into extracellular space. Several cardiac markers exist and have over time evolved with more research. There are 4 categories of biomarkers: 1)

Biomarkers of myocardial necrosis which include troponin I, troponin II, myoglobin and creatinine kinase isoenzyme (CK-MB); 2)Biomarkers of myocardial ischemia which include heart-type fatty acid binding protein, glycogen phosphorylase BB and ischemic modified albumin;3)Biomarkers of inflammation and prognosis include C-reactive protein, Myeloperoxidase, homocysteine and sCD40L; 4) Biomarkers of heart hemodynamic stress include atrial natriuretic peptide (ANP), B-type natriuretic peptide (BNP) and N-terminal pro BNP(34).

Cardiac troponins I and T are proteins released from the myocardium when there is damage. They have been extensively studied and found to be highly sensitive and specific to myocyte injury compared to the other cardiac biomarkers(35). Troponin I is even more specific than troponin T as troponin T is raised in renal failure and musculoskeletal muscle injury. Troponin levels start to rise at 4 to 6hrs after injury, with high sensitivity troponin I assays starting to rise as early as 3-4hrs. They peak at 12- 24hrs and normalize at 10-14 days (36). Myoglobin, which starts to rise as early as 1 hour, is no longer used as its not specific and can be seen in peripheral muscle injury. Troponins can thus capture patients with myocardial damage in early and late presentations. With more research and advanced technology, there are high sensitivity troponins which can detect injury within 1-2hours, although these are not used in many countries (37). Troponin I and T are usually referred to as conventional assays.

2.7 Echocardiography (ECHO) in trauma

ECHO is a non-invasive imaging modality for evaluating the structural anatomy and physiology of the heart. ECHO in trauma is underutilized yet it has the ability to evaluate pericardial tamponade, aortic rupture, ventricular rupture and dysfunction, and valvular rupture amongst other pathologies leading to timely intervention(38).

The ability of ECHO to detect cardiac injury depends on the modality used. There are two modalities, a Transthoracic ECHO which is non-invasive and Trans-esophageal ECHO which is invasive. Transesophageal ECHO is superior to transthoracic ECHO as it gives more details by making use of high-frequency transducers and is also able to better view the posterior part of the heart. Transthoracic ECHO detected cardiac injury in 3% to 26% of patients as compared to Transesophageal ECHO which detected myocardial injury in 27%

to 56% of patients, according to review by Sybrandy et al (33). Different imaging techniques can be used for ECHO including 2D, 3D views and doppler with 3D images giving more details than 2D images. Addition of tissue doppler imaging to 2D ECHO gave more information on myocardial contusion with difference between the two being statistically significant; p=0.04 (39).

In the ED, transthoracic echo is more applicable as it is non-invasive. In addition to that, ECHO uses sounds waves and hence can be repeated several times without causing harm to the patient, making it more flexible(40). As part of Focused Assessment with Sonography In Trauma (FAST), the Emergency Physician can easily see traumatic pericardial tamponade. Additionally, he can also look at the vena cava for volume status and gross cardiac contractility. ECHO also helps as a guide for treatment in the ED. This was demonstrated by Paul Ferrada et al, where a Limited Transthoracic ECHO in the ED was used to guide management for hypotension in patients with trauma, with ECHO changing therapy in 41% of all cases and 96% of cases of patients older that 65yrs(41).

The disadvantages of ECHO are that it is user dependent and may give inconsistent results depending on expertise. In trauma, a comprehensive ECHO additionally performed by an echocardiographer is usually needed as opposed to point of care ECHO performed by an ED physician alone. Additionally, the transthoracic approach is limited if the patient has painful chest injuries. Standard 2D ECHO has limited ability to detect myocardial edema without regional wall motion abnormalities, hence having a normal ECHO does not rule out cardiac injury, adding to the diagnostic dilemma (42).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Design

This was a prospective cohort study where patients with polytrauma or isolated blunt chest trauma patients were recruited from the ED. An initial ECG was obtained and initial troponin ordered if ECG was abnormal. Incidence of BCI was calculated based on both abnormal initial ECG and elevated troponin. The patients were then followed after disposition from the ED, to determine outcomes at 48hours and 7 days.

3.2 Study duration

The study was done from September 2023 to June 2024 with data collection ending on the 15th February 2024.

3.3 Study Setting

The study was conducted at ED of Muhimbili National Hospital (MNH-Upanga) and ED of Muhimbili Orthopedic Institute (MOI) located in same campus in Dar es Salaam, Tanzania. MNH is the only National Referral Hospital in Tanzania. It is also a Research Centre and a University Teaching Hospital. MNH-Upanga has a bed capacity of 1500 and approximately 2800 staff, with 250 emergency department staff. The ED receives approximately 60,000 patients per year which includes adults and children with medical, surgical and trauma cases. Trauma cases account for 16% (10,000) of all cases seen annually, as per 2022 hospital data. Within MNH, there is the Jakaya Kikwete Cardiac Institute (JKCI) where highly specialized cardiothoracic and cardiology services are offered. The ED of MNH is divided into four adult resuscitation rooms, one wing for patients with triage assignment of “priority” (wing C), a treatment wing (with four rooms) for lowest acuity patients and pediatric wing which includes pediatric cases of all acuities (wing D).

MOI is a trauma center of MNH which also receives trauma patients directly from the scene and as referrals from lower level hospitals for patients needing advanced neurosurgical and orthopedic trauma surgeries. Some patients come through ED of MNH for stabilization before being admitted to MOI. Patients with visceral injury are preferably treated at MNH-

Upanga, as such, these patients are directed to ED of MNH when they make referral call. However, if these patients arrive at MOI from scene or lower levels hospitals, a general surgeon from MNH-Upanga is called in to assess and manage the patient at MOI. MOI has a bed capacity of 363 patients with capacity for inpatient critical care and 9 operating theatres, while the ED attends to approximately 500 trauma patients per month. The ED is staffed with medical officers under orthopedic and neurosurgery services, 22 registered nurses and 2 Emergency Physicians. Patients are admitted under orthopedic or neurosurgery services. Patients requiring advanced cardiothoracic surgeries and cardiac interventions are usually transferred to JKCI.

Both ED's have an ECG and I-stat analyzer for point of care troponin testing. Trauma patients at the Tertiary Hospital in Tanzania, can either be seen at ED of MNH then admitted to MOI while some patients are taken directly to the ED of MOI, by-passing ED MNH. Patients with polytrauma or blunt chest trauma at both sites were eligible for the study.

3.4 Population

3.4.1 Target population

Target population were adult patients with polytrauma or isolated blunt chest trauma patients seen in Emergency Departments in Tanzania.

3.4.2 Accessible Population

The accessible population were polytrauma or isolated blunt chest trauma adult patients who were seen at the Emergency Department of MNH-Upanga and Emergency Department of MOI, during the study period.

3.4.3 Study Population

The study population was patients with polytrauma or isolated blunt chest trauma patients (hereafter written as polytrauma/isolated blunt chest trauma) above 18years of age, presenting to the Emergency Departments of MNH-Upanga or MOI from 1st Sept 2023 to 15th February 2024 who consented and were screened for blunt cardiac injury.

3.5 Sampling Strategy

All trauma patients were consecutively screened, and those who met the inclusion criteria and agreed to a written informed consent were included in the study. For those patients unable to consent due to their critical nature, a waiver of consent was sought from the hospital administrator as per the institution guidelines. Research assistants were available day and night shifts, 7 days a week, to ensure patients were recruited in the day, night and weekends. This was to ensure that no patient was missed irrespective of their time of presentation to the ED.

3.6 Study Subject

3.6.1 Inclusion Criteria

Adult patients ≥18yrs with either Polytrauma (Injuries involving two or more body systems) or Isolated blunt chest trauma

3.6.2 Exclusion Criteria

We excluded patients who had:

- Cardiac surgery in the past 30 days
- Sustained injuries more than 48hours prior to presentation.

3.7 Data collection procedures

Patients who met eligibility criteria and had consented were recruited into the study. The proposal intended that the initial ECG done should be verified by an Emergency Physician on duty, however, this was not logistically possible. Thus, the ECG was read by treating clinician and verified by an Emergency Physician upon availability within 24-hours. If the ECG turned out normal after verification by the Emergency Physician, the patient would still be followed up as non-BCI upto 7 days post disposition.

If the ECG was abnormal based on the initial treating clinician review, a troponin was drawn and analyzed in the ED, using i-stat ® 1 analyzer (by Abbott) which measures conventional troponin, with reference ranges 0.00ng/ml-0.04ng/ml. In the event that point of care test was unavailable due to equipment malfunction, the sample was taken to the main laboratory. The hospital's main lab uses Architect Ci4100 machine (by Abbott) that measures highly

sensitive troponin-I with reference ranges 13.8pg/ml-17.5pg/ml for female and 28.9pg/ml-39.2pg/ml for males. However, only one patient sample was sent to main lab. If both ECG and troponin were abnormal, the patient was considered to have BCI. ECG patterns collected were based on prior blunt cardiac injury studies. Other data that was collected were demographics of the patient, mechanism of injury, vital signs, physical exam findings including initial GCS score and the ED diagnosis based on clinician assessment and diagnostic work up.

The treating clinician was informed of the BCI screening results and the ECG and troponin results were kept in the patients' hospital file. The patients were admitted to the different specialties or discharged at the discretion of treating clinician and followed up to determine results of 24-hour cardiac monitoring, and ECHO (if done) and outcome at 48hours and 7 days after disposition. Patients who were discharged from the ED or before 48 hours and 7 days were called by the research assistantsfor follow-up using the online questionnaire in REDCap.

3.8 Variable of interest

3.8.1 Predictor Variables

The independent variables considered as predictors of a patient having BCI were based on prior literature, it included age, gender, mechanism of injury, type of motor vehicle accident (MVA) patient (driver, front seat passenger, backseat passenger, pedestrian), chest pain (either on palpation or reported), chest bruises, tachycardia, hypotension, tachypnea, Glasgow Coma Scale (GCS), trauma score, hemothorax, pneumothorax, hemopneumothorax, chest contusion, rib fracture, clavicular fracture and flail chest (29, 32,42-44).

3.8.2 Outcome Variables

The primary outcome was the incidence of BCI among polytrauma/isolated blunt chest trauma as defined by initial abnormal ECG and initial elevated troponin. Secondary outcomes were frequency of 24-hour cardiac monitoring and/or ECHO; outcomes at 48hours and 7-days after disposition among patients with BCI. The outcomes were defined as mortality and composite adverse events (which included need for intubation for airway

protection and/or mechanical ventilation, respiratory arrest resuscitated, cardiac arrest resuscitated and hypotension) at 48hours and 7 days after disposition. We also determined predictors of having BCI among polytrauma/isolated blunt chest trauma.

3.8.3 Confounder Variables

Patients with known Ischemic Heart Disease, Heart failure, Chronic kidney disease, hypertension, diabetes, hypercholesterolemia, Chronic obstructive lung disease could affect the diagnosis of BCI as they may have abnormal ECG and/or abnormal troponin hence causing false positive finding (43–45) These variables were checked based on self reporting and previous hospital records. We had very few patients with cormobidities among BCI in this study, 6(8.2%)patients, to have any significant confounding effect. Additionaly, logistic regression did not show presence of cormobidity as being a predictor of BCI.

3.9 Sample size estimate

The sample size calculation for this study was based on the estimated incidence of BCI based on a study by Emet et al(29) Thus, with 95% confidence interval, the minimum sample size was **307** patients.

The formulae used to derive the sample size is as follows:

$$N = 4Z\alpha^2 P\ (1 - P) \div W2$$

where:

N is the sample population

Z_α is the standard normal deviate for a two-sided α

α is equal to 0.05 for a 95% confidence level.

P is the expected proportion

W is the width of confidence interval. (0.1)

A 10% adjustment, to cater to loss to follow up was added, thus the total sample size was **338** patients.

3.10 Data Management

3.10.1 Data collection procedures

Research assistants were taken through training on data collection tools and the consenting process. They were available in the Emergency Department 7 days a week, day and night to collect data. A written informed consent form was read and explained to the patient in the preferred language, either English or Kiswahili. A waiver of consent was used for patients who were too sick to consent or did not have guardian. This was signed by the hospital administrator on their behalf as per hospital guidelines. One copy of the consent was kept in a secure cabinet while a second copy was given to the patient or guardian. An online data capture form, Research and Electronic data capture (REDCap) software, was used. REDCap is password-protected, to ensure the security of the data captured.

3.10.2 Data quality assurance

Testing of data collection instruments was done prior to commencement of data collection and the data collection tool corrected accordingly. The Principal Investigator verified data daily once entered in REDCap and ensured entries were made correctly and were complete. Duplicate entries were also removed as and when they occurred.

3.10.3 Data Analysis

Data collected from REDCap was exported to STATAv17(StataCorp, College Station, TX, USA) statistical software as csv file. Data was verified and records with missing data were excluded. Categorical data were presented as numbers and percentages while continuous variables were analyzed using mean and standard deviation or median and Inter- quartile range. Inferential statistics included binary logistic regression analysis used for predictors of BCI. Predictors with P value <0.05 were then tested on the multivariable analysis to identify independent predictors of blunt cardiac injury. Odds ratios were reported with 95% confidence intervals, with P value <0.05 being statistically significant.

3.11 Ethical Consideration

Study ethical approval was obtained from MUHAS Research and Ethics Committee before commencement of the study. Approvals were also sought from the relevant authorities of MNH and MOI to enable data collection from enrollment to 7 days after disposition. A

written consent was sought from patients before enrollment while a waiver of consent was sought from hospital administration as per hospital guidelines, in the event the patient was critical and could not give consent immediately due to critical nature of the patient. The consent form was administered in either English or Kiswahili, depending on the preference of the patient. One copy of the consent form was given to the patient while another copy was kept within a secured locker within MNH. None of the participants withdrew consent in this study. The data collection form was online, domiciled, within REDCap version, which was password-protected.

3.12 Funding

Although the study was partially funded by the Royal College of Emergency Medicine-United Kingdom, they were not involved in any part of the study. The grant was only for developing research capacity in LMIC. The research grant assited in paying for the ECG's, troponin tests and allowances for the research assistants.

CHAPTER FOUR

4.0 RESULTS

4.1 Study flow diagram

In the study period, 5304 trauma patients visited the ED of MNH-Upanga and MOI where 346 (6.5%) patients who had polytrauma or isolated blunt chest trauma were enrolled in the study. Nine patients had no test data and 22 patients for whom the ECG was read as normal by treating clinician, but later over-read as abnormal by Emergency Physician, were excluded. Therefore 315 (91%) were analyzed for primary outcome out of which 73(23.2%) were BCI positive, and were also analysed for secondary outcomes. The 2(0.6%) patients lost to follow up were BCI negative (Figure 1).

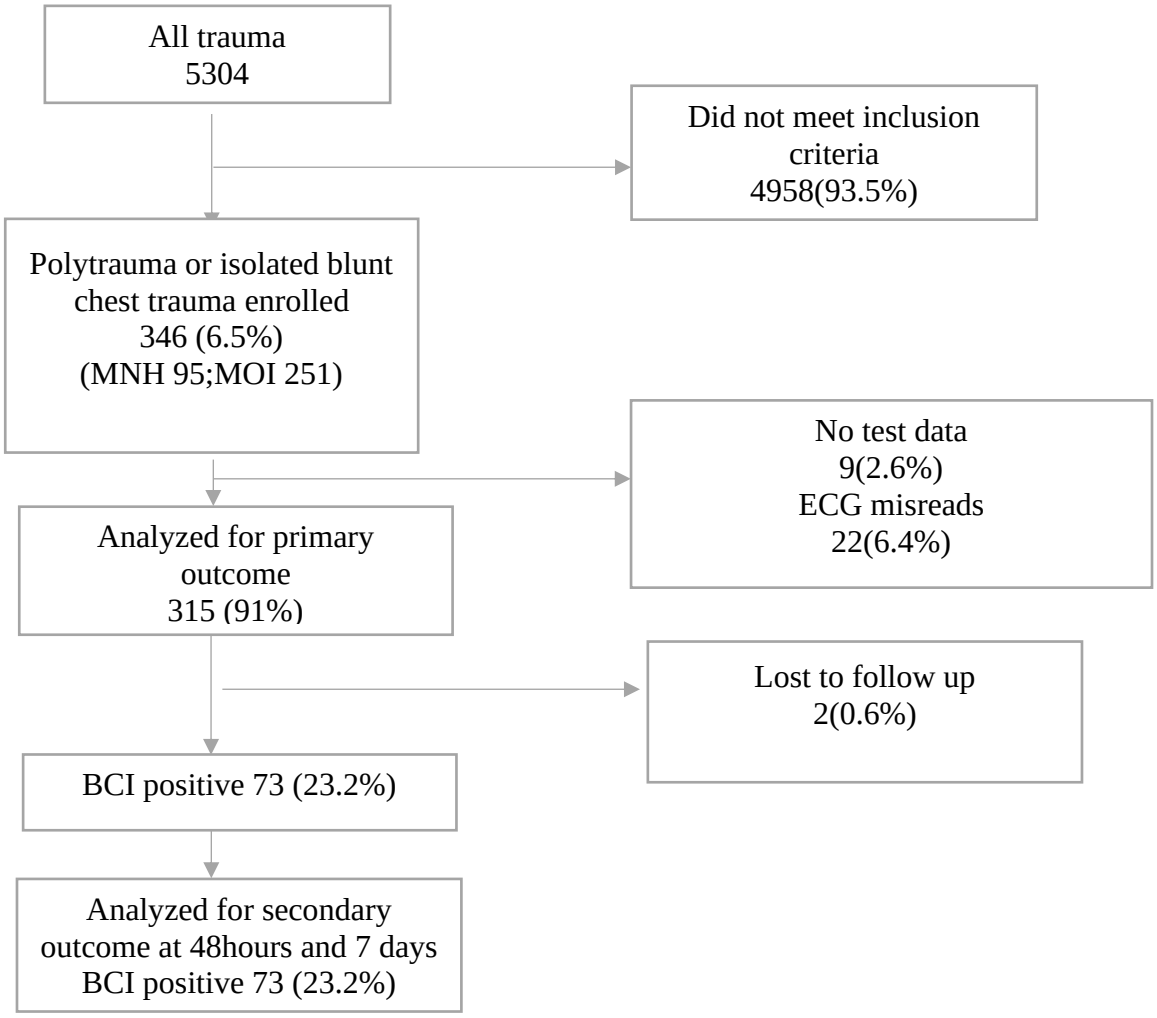


Figure 2: Study Flow Diagram

4.2 Clinical characteristics of polytrauma/isolated blunt chest trauma patients.

The median age of the participants was 32years (IQR 25 – 43). Majority of the patients were male 265 (84%) and the most common mechanism of injury was motor traffic accident 260 (82.5%) with majority of the patients being polytrauma, 297 (94.3%). Among BCI patients, the mean age was 31years (IQR 22.5-39.5) with most being male 65(89%) and majority polytrauma 68(93.2%) and most involved in motor traffic accidents 57(78.1%) as ashown in Table 1.

Table 1: Clinical characteristics of polytrauma/isolated blunt chest trauma patients.

	Total n (% (N =315)	**BC1+ n (%) (N =73)**
Age in years (Median, IQR)	32(25 - 43)	31(22.5 – 39.5)
Gender (n, %)		
Male	265(84.1)	65(89.0)
Female	50(15.9)	8(11.0)
Type of trauma (n, %)		
Polytrauma	297(94.3)	68(93.2)
Isolated chest	18(5.7)	5(6.8)
Presence of underlying comorbidity (n, %)	24(7.6)	6(8.2)
Hypertension	11(3.5)	4(5.5)
Diabetes mellitus	5(1.6)	1(1.4)
Asthma	5(1.6)	1(1.4)
HIV/AIDS	5(1.6)	0
Ischemic heart disease	1(0.3)	0
Peptic ulcer	1(0.3)	0
Tuberculosis	1(0.3)	0
Epilepsy	1(0.3)	1(1.4)
Time of Injury to ED arrival-hours (Median, IQR)	10(5 - 18)	9(5 - 22)
Mechanism of injury (n, %)		
Motor traffic accident	260(82.5)	57(78.1)
Fall	27(8.6)	5(6.8)
Assault	13(4.1)	3(4.1)
Others	10(3.2)	3(4.2)
Unknown	5(1.6)	5(6.8)
Type of MVA (n, %)		
Car	90(28.6)	20(27.4)
Motorcycle	168(53.3)	37(50.7)
Bicycle	1(0.3)	0
Train	1(0.3)	0
Type of MVA patient (n, %)		
Driver	103(32.7)	24(32.9)
Front seat passenger	9(2.9)	4(5.5)
Backseat passenger	70(22.2)	17(23.3)

Pedestrian	76(24.1)	12(16.4)
Unknown	2(0.6)	0
Clinical presentation (n, %)		
Chest pain	107(34)	17(23.3)
Palpitations	19(6)	5(6.8)
Chest bruises	28(8.9)	5(6.8)
Chest tenderness	55(17.5)	11(15.1)
Systolic blood pressure (SBP)*		
Normal	216(68.6)	49(67.1)
Hypotension	17(5.4)	7(9.6)
Hypertension	82(26.0)	17(23.3)
Heart rate**		
Normal	217(68.9)	36(49.3)
Bradycardia	8(2.5)	3(4.1)
Tachycardia	85(27.0)	29(39.7)
Tachy-arrhythmia	5(1.6)	5(6.8)
Respiratory rate***		
Normal	235(74.6)	42(57.5)
Tachypnoea	80(25.4)	31(42.5)
Hypoxia****	32(10.2)	13(17.8)
GCS*****		
13 - 15	265(84.1)	47(64.4)
9 - 12	32(10.2)	14(19.2)
3 - 8	18(5.7)	12(16.4)
Revised trauma score (Mean, SD)	7.8±0.5	7.8±0.7

*Others Mechanisms of injury (Hit by a falling wall (n =3), Hit by a train (n =1), Hit by a falling tree (n =2), Heavy luggage fall (n =1); *SBP <90 (hypotension); 90-140 (normal); >140 (hypertension); ** Heart rate <60 (bradycardia); 60-100 (normal); 101-150 (tachycardia); >150 (tachy-arrhythmia); *** Respiratory rate 12-20(normal); > 20(tachypnea); **** Hypoxia; oxygen saturation <94%; *****GCS : GCS 3-8(severe), GCS 9-12(moderate), GCS 13-15(mild)*

4.3 Clinical findings of polytrauma/isolated blunt chest trauma

The most common injuries among polytrauma/isolated blunt chest trauma were head injury 263(83.5%), long bone fractures 211(67.0), facial injuries 196 (62.2%) and blunt chest injury 138(43.8%). Among those with blunt chest injury, common injuries were clavicular fracture 30(9.5%), lung contusion 26(8.3%) and rib fracture 22(7.0%).

Among patients with BCI, the most common injuries were head injury 64(87.7%), long bone fractures 47 (64.4%) and blunt chest injury 32(43.8%). Among those with blunt chest injury, common injuries were lung contusion 13(17.8%), rib fracture 7(9.6%), and clavicular

fracture 6(8.2%). ECHO was done in one patient and 24-hour cardiac monitoring done in 30(41.1%) patients as shown in Table 2.

Table 2: Clinical findings of polytrauma/isolated blunt chest trauma

	Total n (%) (N =315)	**BCI+ n (%) (N =73)**
ED diagnosis (n, %)		
Head injury	263(83.5)	64(87.7)
Severity of head injury*		
Mild	216(82.1)	39(60.9)
Moderate	29(11.0)	13(20.3)
Severe	18(6.8)	12(18.8)
Long bone fractures	211(67.0)	47(64.4)
Facial injury	196(62.2)	46(63.0)
Blunt chest injury	138(43.8)	32(43.8)
Clavicular fracture	30(9.5)	6(8.2)
Lung contusion	26(8.3)	13(17.8)
Rib fracture	22(7.0)	7(9.6)
Hemo-pneumothorax.	12(3.8)	5(6.8)
Haemothorax	9(2.9)	1(1.4)
Pneumothorax	4(1.3)	3(4.1)
Flail chest	2(0.6)	2(2.7)
Soft tissue injury	65(20.6)	10(13.7)
Pelvic injury	33(10.5)	7(9.6)
Spine injury	32(10.2)	8(11.0)
Blunt abdominal injury	26(8.3)	11(15.1)
Neck injury	20(6.3)	4(5.5)
ECHO done**	3(1.0)	1(1.4)
24-hour cardiac monitoring		
Done	52(16.5)	30(41.1)
Not done	263(83.5)	43(58.9)
Abnormal ECG findings		
Sinus Tachycardia	75(43.3)	41(56.2)
Left axis deviation	37(21.4)	15(20.5)
Prolonged QTC	36(20.8)	17(23.3)
Bradycardia	22(12.7)	7(9.6)
Right bundle	17(9.8)	6(8.2)
Bi phasic T waves	17(9.8)	10(13.7)
Low voltage	10(5.8)	6(8.2)
T wave	10(5.8)	2(2.7)
ST segment	9(5.2)	5(6.8)
Right axis deviation	2(1.2)	1(1.4)
Left bundle	2(1.2)	2(2.7)
First degree	2(1.2)	0
Frequent PVC	2(1.2)	0
Premature atrial	6(3.5)	1(1.4)
Hyperdynamic T waves	5(2.9)	1(0.4)

Note: -Some patients had more than one ECG findings

-2nd and 3rd degree heart block, atrial fibrillation, atrial flutter, supraventricular tachycardia, ventricular tachycardia and ventricular fibrillation had no findings

** Severity of head injury: Mild (GCS 13-15), Moderate (GCS 9-12), Severe (GCS 3-8); **Transthoracic ECHO-normal*

4.4 Incidence of BCI among polytrauma/isolated blunt chest trauma

There were 173 (54.9%) patients among polytrauma/isolated blunt chest trauma patients, who had abnormal ECG findings out of which 73 (42.2%) had elevated troponin levels, making the incidence of BCI 23.2% with a 95%Confidence interval [CI]: 18.6 % to 28.2% as shown in Table 3.

Table 3: Incidence of BCI among polytrauma/isolated blunt chest trauma.

Investigation	Total n(%)
ECG (N =315)	
Normal	142(45.1)
Abnormal	173(54.9)
Troponin level (N =173)	
Normal	100(57.8)
Elevated	73(42.2)

Incidence of BCI: 73 (23.2%) with a 95%Confidence interval [CI]: 18.6 % to 28.2%.

4.5 Outcomes of patients with BCI

The mortality at the ED was 4(1.3%), 13(4.2 %) at 48hours and 20 (6.4%) at 7 days while th composite adverse events were 15(4.8%) at the ED, 47(15.0%) at 48hours and 52 (16.6%) at 7 days. Two patients, who were BCI ngative were lost to follow up at 48hours and 7 days hence a total of 313 patients were used for follow up for adverse events.

Among the BCI positive patients, at 7 days mortality was 7 (9.6%) and the composite adverse events was 31(42.5%) with majority of the adverse events occurring at between ED arrival and 48hours of hospital admission (Figure 3)

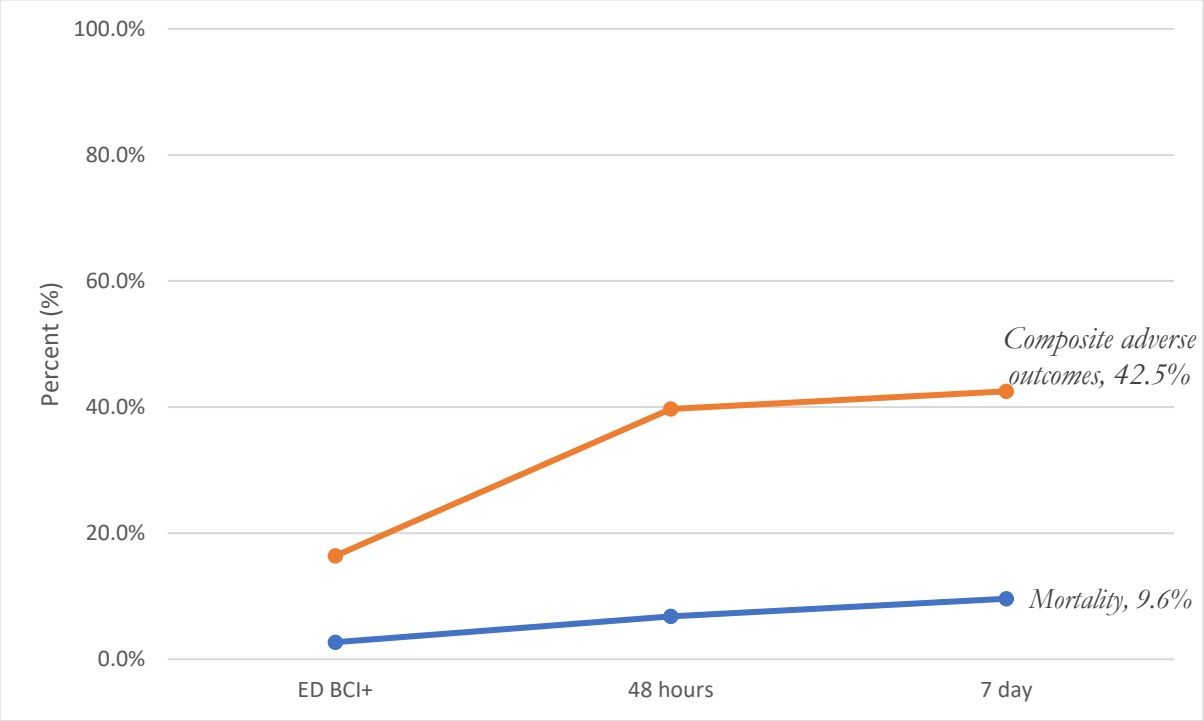


Figure 3: Outcome trends among BCI positive

4.6 Univariate and multivariate analysis of predictors of BCI

The findings from the binary logistic regression analysis revealed that those patients with tachycardia, hypoxia, moderate and severe GCS score, severe head injury, pneumothorax and lung contusion had higher odds of having BCI. However, type of injury (polytrauma versus isolated blunt chest injury) and Revised Trauma Score were not associated with BCI. Tachycardia (aOR) =2.45, 95%CI:1.35 – 4.44, p =0.003; GCS 9-12 (aOR = 2.90, 95%CI:1.27 – 6.61, p =0.011); GCS 3-8 (aOR =9.16, 95%CI:3.01 – 27.88, p<0.001) and lung contusion (aOR =3.39, 95%CI:1.38 – 8.35, p =0.008) were each independent predictors of having BCI as shown in Table 4.

Table 4: Univariate analysis of predictors of having BCI among Polytrauma/Isolated blunt chest trauma patients

	Univariate Analysis		Multivariate Analysis	
	cOR (95%CI)	**P value**	**aOR(95%CI)**	**P value**
Age	1.01(0.99 - 1.04)	0.197		
Gender				
Male	1.71(0.76 - 3.82)	0.207		
Female	Ref			
Type of trauma				
Isolated chest trauma	1.30(0.45 - 3.76)	0.577		
Poly trauma	Ref			
Presence of comorbidity	1.18(0.48 - 2.91)	0.811		
Hypertension	1.13(0.24 - 5.19)	0.596		
Diabetes mellitus	0.84(0.05 - 13.63)	0.706		
Mechanism of injury				
Motor traffic accident	1.42(0.74 - 2.72)	0.298		
Fall	1.36(0.50 - 3.73)	0.641		
Assault	1.01(0.27 - 3.76)	0.646		
Type of patient				
Driver	1.01(0.58 - 1.77)	0.538		
Front seat passenger	2.75(0.72 - 10.51)	0.22		
Backseat passenger	1.08(0.58 - 2.02)	0.873		
Pedestrian	0.55(0.28 - 1.08)	0.087		
Chest bruise	1.43(0.52 – 3.90)	0.64		
Chest tenderness	1.25(0.61 – 2.57)	0.602		
Chest pain	0.91(0.46 – 1.80)	0.804		
Systolic Blood Pressure				
Hypotension	0.89(0.48 - 1.66)	0.717		
Hypertension	0.37(0.12 – 1.13))	0.08		
Normal	Ref			
Heart rate				
Bradycardia	2.03(0.47 - 8.71)	0.393		
Tachycardia	2.90(1.67 - 5.01)	**<0.001**	2.45(1.35 - 4.44)	**0.003**
Tachypnoea	1.17(0.62 - 2.22)	0.635		
Hypoxia	2.54(1.19 - 5.44)	**0.016**	1.01(0.40 - 2.52)	0.985
GCS				
9 - 12	2.95(1.39 - 6.28)	**0.007**	2.90(1.27 - 6.61)	**0.011**
3 - 8	7.74(2.79 - 21.45)	**<0.001**	9.16(3.01 - 27.88)	**<0.001**
13 - 15	Ref		Ref	
Revised trauma score	1.57(0.32 – 3.20)	0.122		
Head injury	0.65(0.30 - 1.41)	0.368		
Severe	6.86(1.83 - 25.70)	**0.004**		

Moderate	0.92(0.16 - 5.49)	0.923		
Mild	Ref			
Blunt chest injury	1.17(0.64 - 2.15)	0.607		
Pneumothorax	10.33(1.06- 34.11)	**0.04**	5.09(0.48 - 54.22)	0.177
Hemo-pneumothorax	2.47(0.76 - 8.03)	0.158		
Hemothorax	0.41(0.05 - 3.30)	0.69		
Rib injury	1.61(0.63 - 4.10)	0.305		
Lung contusion	3.82(1.68 - 8.66)	**0.002**	3.39(1.38 - 8.35)	**0.008**
Clavicular	0.81(0.32 - 2.07)	0.821		

Note: Severity of head injury excluded due to multicollinearity

CHAPTER FIVE

5.0 DISCUSSION

The study sought to find out the incidence of BCI among polytrauma/isolated blunt chest trauma patients as a primary outcome. Additionally, we aimed to describe their the clinical profile, 24-hour cardiac monitoring and ECHO, outcomes at 48hour and 7 days and predictors of BCI. The incidence of BCI in this study was significant with majority being male and with most being involved in motor vehicle accidents.

BCI was defined as an abnormal initial ECG plus elevated initial troponin in which, a normal ECG and normal troponin have a 100% NPP according to Velmahos G. et al (23). The incidence of BCI found in this study is slightly higher than that from recent systematic review and meta-analysis of 2023 where they found an incidence of 18.5% but within the documented variable range of 8% to 76% (4,36). Our findings suggests that trauma patients in our setting should be screened for blunt cardiac injury. ECG and troponin are readily available in the ED and can be used to screened for BCI as ECG and troponin are readily available in most ED's. The availability of Emergency Physicians in these ED's should be able to augment screening of BCI in the ED.

The majority of BCI patients in our study were male with a median young age of 31 years which is consistent with WHO data, who describe the young male population as being more predisposed to injuries (46). This finding is similar to results from road traffic injury studies done in Tanzania by Sawe et al (47,48). Our findings shows majority of the injuries were due to motor traffic injuries out of which, majority were drivers which was consistent with a BCI study done in Japan in 2022(49). In the African setting, males more commonly go out of the home to fend for their families. With urbanization, many are using motorized vehicles, particularly motorcycles which are less expensive than cars, and they have a higher exposure to injuries according to studies in Tanzania(47).

Polytrauma patients usually have more than one injury, commonly, head injury, chest injury and extremity injuries are found(50). Patients with polytrauma could have occult chest injuries that may not be apparent on presentation, as demonstrated by Mahmood et al as these could be missed on initial x-rays as subtle injuries and other injuries may be more

obvious to the patient or the physician (51). For this reason, polytrauma patients was a population of interest in this study. However, in our study, the type of injury i.e having polytrauma or isolated chest injury, was not an independent predictor of BCI. Therefore, both of these populations should be screened for BCI at the ED.

Among BCI patients, the common injuries were head injury, extremity injuries and blunt chest trauma injuries as described by Schultz et al where various injuries have been associated with BCI(22). This demonstrates the need for having a clear guideline for screening BCI as other more obvious, severe injuries can destruct the health care provider from blunt cardiac injury. This has led to missed blunt cardiac injuries and variable incidence seen in the literature. In this study, we found common blunt chest injury patterns as lung contusion, rib fracture, clavicular fracture and hemo-pneumothorax (in descending order) with lung contusion being an independent predictor of BCI in multivariable analysis. This was consistent with a study in Europe where they also found lung contusion to be an independent predictor(20). Despite revised trauma score not being an independent predictor, it demonstrates that these patients are sicker with multiple presenting injuries and hence need for high index of suspicion of BCI amongst other injuries.

Very few patients among BCI had co-morbidities and this is likely a result of this being a younger population. This is important because co-morbidities like hypertension, diabetes, chronic obstructive pulmonary disease (COPD) in elderly patients are associated with ECG changes due to structural remodeling of the heart (43–45) This we think would have confounded, to a greater extent, the ECG findings in this study.

In this study, many of the patients with BCI had fairly normal arrival blood pressure. This result conflicts with the BCI study in Japan where hypotension was a common finding in their population (49). Our study also differed with the study by Joseph et al where they found hypotension as an independent predictor of BCI in addition to lactate(27). The difference in our study could be explained however by the difference in the age groups; in the Japanese study, the median age was 49years (IQR: 27-68) in that study and the mean age in Joseph's study was 51yrs +/- 22years. We had a much younger population with very few co-morbidities which might explain the difference in the finding on hypotension as younger people have greater physiologic reserve. In our setting, this could also be explained by

patients getting resuscitation measures, like intravenous fluids and analgesics, at peripheral hospitals before arrival to the National Referral Hospital while their patients are mostly taken by Emergency Medical Services (EMS) from scene directly to major trauma centers. Despite these interventions however, almost half had tachycardia on arrival. Emet et al found tachycardia as a common presentation of BCI (mean 107 beats/min +/- 24.2) among patients with blunt chest trauma compared with patients who were BCI negative (mean 82.8 beats/min +/- 15.8) (29). Often, tachycardia is the initial sign of shock while blood pressure could still be maintained for some time. In this study, tachycardia was found to be an independent predictor of BCI. Therefore, it is important to ho have initial vital signs upon arrival and think about cardiac injury apart from the obvious hemorrhage and pain as cause of tachycardia.

Despite the evidence about the need for continuous cardiac monitoring, we found less than half of the patients with BCI diagnosed in the ED had a minimum of 24-hour cardiac monitoring. We chose 24-hours as opposed to 48-hours due to high burden of trauma with limited resources and additionally, limited critical care resources in our setting. This gap identified in this study, could be due to lack of awareness of cardiac injuries by the admitting physicians or lack of resources in our hospital such as lack of equipment and lack of specialized personnel or inadequate number of personnel.

Additionally, transthoracic ECHO was done in only one patient with BCI. Lack of awareness of the need to perform an ECHO in potential BCI, lack of expertise in ECHO in trauma and lack of any prior screening algorithm for BCI among trauma patients in our setting, could explain this finding. Additionally, high resolution ECHO is needed, with expertise to screen for minor lung contusion. Studies have shown that trans-esophageal ECHO is more sensitive, yet what is easily available and accessible at Muhimbili National Hospital in Tanzania is transthoracic ECHO(28). The only Trans-esophageal ECHO available is in a separate cardiac specialized unit and requires expertise to use and is mostly available for cardiothoracic surgeries. Addition of tissue doppler imaging in blunt chest trauma as demonstrated by Gautam P et al provides additional reliable information regarding BCI can make trans-thoracic ECHO more reliable (39). This points to a need for specialized training in ECHO in trauma to be able to complete these examinations among patients with the potential diagnosis of BCI to look for subtle structural changes, once admitted to the ward.

However, because definitive diagnosis is either found in surgery or autopsy, patients suspected of BCI still require continuous cardiac monitoring for arrhythmias despite the ECHO results.

BCI has been shown to be associated with numerous adverse events and high mortality rate, with the majority of victims dying on the scene. This was demonstrated by autopsy findings in Los Angeles Forensic Division in the United States where 78% of the study population died on scene, while 22% died en-route to the hospital(25). This could be worse in LMIC where pre-hospital care is still under developed and where there is prolonged time between injury and time of arrival was found in this study to be a median 10-hours after the injury. Those who survive and arrive at the hospital had most of their adverse events in the interval between being seen in the ED and 48-hours after admission, with fewer in the next 5 days. Hence the importance of early diagnosis and need for cardiac monitoring within the first 48-hours of admission if screened positive for BCI. This could pose a challenge in LMIC with limited resources but could be an area of continuous improvement.

The 48-hour mortality among BCI was 6.8% while overall 7-day mortality was 9.6% with majority of deaths occurring within 48hours after arrival. With high injury severity scores as demonstrated in this study, cardiac injury could be a marker of severe injuries or the deaths could have resulted directly from the cardiac injuries, an aspect that can be confirmed by autopsies which was not collected in this study. A study in Germany in 2022 found overall inpatient mortality rate of 45% in BCI versus 12.3% in BCI negative(3). A study in China found a mortality rate of 10.1% among BCI(6). Higher income countries seem to have higher mortality rates of BCI than LMIC, this could be due to early presentation and established pre-hospital systems and ability to diagnose BCI injuries faster and more reliably. In LMIC, many could be dying in the field before arrival to hospital. However, our study findings on mortality were close to the mortality found in the meta-analysis by Kyriazidis et al which determined an overall weighted mean mortality of 7.6% among BCI(36).

Independent predictors of BCI among patients with polytrauma/isolated blunt chest trauma presenting to our ED were tachycardia, lung contusion, moderate and severe GCS. In a nationwide analysis in the United States 2017, lung contusion was similarly found as an

independent predictor of BCI(20). Emet M et al found GCS <13 (moderate and severe GCS) to be associated with BCI as is the case in our study(29). The majority of the patients had head injury as an associated injury, possibly explaining this observation. There is a paucity of data on BCI and most of the studies looked at predictors of mortality among BCI as opposed to predictors of BCI. For the studies mentioned prior, that looked at predictors of BCI, their population group were elderly and tachycardia was not found as independent predictors as is our case.

Our findings on the predictors of BCI in trauma patients in LMIC is important, as limited resources do not allow screening everyone for BCI. With these predictors, it helps to narrow down the kind of patients we shall be screening for BCI and hence better distribute the scarce resources.

CHAPTER SIX

6.0 STRENGTHS, LIMITATIONS, CONCLUSION AND RECOMMENDATION

6.1 Strengths

The strength of this study is the design, where we used prospective cohort methods hence this allowed recruitment of patients as they came into the ED and following them up until end of follow up period. This also enabled us to look at predictors of outcome to come up with independent predictors.

Secondly, the study was conducted in the only National Referral Hospital in the country which is high volume trauma center and only one with specialized cardiac and cardiothoracic surgeries.

To the best of our knowledge, this is the first study looking at blunt cardiac injuries in Tanzania. As such, it will serve as a foundational study for future research on BCI.

6.2 Limitations

The study was limited in being a single center study; however, MNH is the only national referral hospital of Tanzania and with the only cardiothoracic surgery Centre, as such all severe trauma patients (among whom are BCI population) would still end up at MNH for specialized trauma care and cardiac and cardiothoracic surgeries. However, the study should still be done on other trauma centers within the country to compare incidence and outcomes. Additionally, this was observational as such, there could have been a bias of observers on clinicians and their management.

Additionally, there were 22 misreads of ECG due to unavailability of a Specialist at the time of patient enrollment and these individuals did not receive troponins. We had to exclude these patients. These are expected challenges in a growing specialty like EM in LMIC. As such, the continuous quality improvement is needed to mitigate this. Without knowing their troponin values, it is unclear what the impact on the incidence of BCI would have been.

The study did not compare the outcomes of BCI patients against non-BCI patients as this was not the goal of the study. Thus, we cannot be certain that adverse events and mortality

are directly due to cardiac injury. Nevertheless, this group had large number of adverse events and may present high risk group.

6.3 Conclusion

There is a high incidence of BCI among polytrauma/isolated blunt chest trauma presenting to the ED of a Tertiary Hospital in Tanzania with many adverse events occurring within ED and 48hours after disposition. Additionally, 24-hour cardiac monitoring and ECHO were not adequately done among patients with BCI in our setting. As tachycardia, moderate GCS, severe GCS and lung contusion, were identified as independent predictors in this study, patients with these findings should have priority for screening for BCI.

6.4 Recommendations

We recommend the following based on the findings in this study:

1. The screening of BCI should be adopted into the trauma guidelines of EDs in Tanzania given a significant incidence among trauma patients. Patients presenting with polytrauma or isolated blunt chest trauma who have tachycardia, GCS $\leq$12 and lung contusion should undergo priority screening for BCI.
2. If there is a clinical concern for blunt cardiac injury, continuous cardiac monitoring is indicated for at least 24-hours and should be included in the local trauma guidelines as standard of care.
3. National policies on road safety should be strengthened among drivers of motorcycles as they are the group that were largely affected in this study population.
4. Future research should focus on ECHO findings among these patients with BCI and the reasons for inadequate cardiac monitoring in our setting.

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APPENDICES

Appendix 1: Data Collection Tool

Patient Study ID

Inpatient number: …….

Phone number……...

A. Demographics/history/physical exam/ed diagnosis

Age (Years)…..

Gender

- ☐ Male
- ☐ Female

Cor-morbidities

- ☐ Hypertension
- ☐ Diabetes Mellitus
- ☐ Hypercholesterolemia
- ☐ Chronic obstructive lung disease
- ☐ Ischemic heart disease
- ☐ Heart Failure
- ☐ Chronic Kidney Disease
- ☐ Other
- ☐ None
- ☐ Unknown

Date and time of admission

Date of injury? _____

Hours since injury……

Mechanism of injury

- ☐ Motor Vehicle Accident
- ☐ Pedestrian strike by Motor vehicle
- ☐ Fall from height
- ☐ Assault
- ☐ Sport Injury
- ☐ Unknown
- ☐ Other mechanism……

Motor traffic accident (type of motor vehicle)

- ☐ Car
- ☐ Motorcycle
- ☐ Bicycle
- ☐ Other

Type of patient

- ☐ Driver
- ☐ Front seat passenger
- ☐ Backseat passenger
- ☐ Pedestrian
- ☐ Unknown
- ☐ Other

Chest pain

☐ Yes

☐ No

☐ Unknown

Palpitation

☐ Yes

☐ No

☐ Unknown

Vital signs

Blood pressure: SBP ☐ DBP ☐

Heart rate: ☐

Capillary refill: Normal ☐ Delayed ☐ None ☐

Respiratory rate: ☐

Respiratory effort: Normal ☐ Shallow ☐ Increased ☐ None ☐

Oxygen saturation: On room air…. On oxygen…..

GCS: ☐

Trauma score……..

Revised trauma score…….

Physical Exam

Obvious Chest Bruise:

☐ Yes

☐ No

Chest tenderness on palpation:

☐ Yes

☐ No

Injuries

Head injury:

☐ Yes

☐ No

If yes: ☐ Mild

☐ Moderate

☐ Severe

Facial injury:

☐ Yes

☐ No

Neck injury (soft tissue)

☐ Yes

☐ No

Spine injury

☐ Yes

☐ No

Blunt Chest Injury:

☐Yes

☐No

If yes:

Pneumothorax:	☐Yes	☐No
Hemothorax	☐Yes	☐No
Hemo-pneumothorax	☐Yes	☐No
Rib fracture	☐Yes	☐No
Lung contusion	☐Yes.	☐No
Flail chest	☐Yes	☐No
Clavicular fracture	☐Yes	☐ No
Sternal fracture	☐Yes	☐No
Other	…….	

Blunt abdominal Injury:

☐Yes

☐No

Pelvic injury:

☐ Yes

☐No

Extremity injury (femur, tibia, fibula, humerus):

☐ Yes

☐ No

ECG

☐Normal

☐Abnormal

If abnormal Tick all that apply

☐ Sinus Bradycardia

☐Sinus Tachycardia

- ☐ Left axis deviation
- ☐ Right axis deviation
- ☐ Right Bundle Branch Block
- ☐ Left Bundle Branch Block
- ☐ 1st degree AV block
- ☐ 2nd degree AV block type 1
- ☐ 2nd degree AV block type 2
- ☐ 3rd degree heart block
- ☐ Atrial fibrillation
- ☐ Atrial flutter
- ☐ Supraventricular tachycardia
- ☐ Ventricular tachycardia
- ☐ Ventricular fibrillation
- ☐ Low voltage ECG
- ☐ ST segment changes
- ☐ T wave inversions
- ☐ Electrical alternans
- ☐ Frequent PVC's (> X/minute)

Other…….

Troponin

- ☐ Normal
- ☐ Elevated Troponin Value: …….

ED management

- ☐ Oxygen
- ☐ IV fluids
- ☐ Blood transfusion
- ☐ Analgesics
- ☐ Tetanus
- ☐ Anti-arrhythmic

- ☐ Cardioversion
- ☐ Defibrillation
- ☐ Intubation
- ☐ Suturing
- ☐ Chest tube
- ☐ Pericardiocentesis
- ☐ Antibiotics
- ☐ Thrombolytics
- ☐ Primary Percutaneous Intervention
- ☐ Other…

ED Disposition

- ☐ Orthopedic and Trauma Institute
- ☐ Surgical ward
- ☐ HDU
- ☐ Surgical ICU
- ☐ Cardiothoracic ICU
- ☐ Theatre
- ☐ Transfer to Jakaya Kikwete Cardiac Institute (JKCI)
- ☐ Discharged home
- ☐ Mortuary/died in ED
- ☐ DAMA
- ☐ Other….

Date and time of disposition from ED

B. Inpatient medical and surgical management

ECHO

- ☐ Yes
- ☐ No

If done:

Type of echo:

☐ Transthoracic ☐ Transesophageal

☐ Normal

☐ Abnormal

If done: (findings)

☐ Valvular rupture

☐ Aortic aneurysm

☐ Pericardial tamponade

☐ Ventricular rupture

☐ Other findings:

24-hr cardiac monitoring

☐ Done Total Hours in 24hrs post admission: …

☐ Not done

In patient medical management

☐ Oxygen

☐ IV fluids

☐ Blood transfusion

☐ Analgesics

☐ Tetanus

☐ Anti-arrhythmic

☐ Cardioversion

☐ Defibrillation

☐ Intubation after admission

☐ Suturing

☐ Chest tube

☐

Pericardiocentesis

- ☐ Antibiotics
- ☐ Anticoagulants
- ☐ Cardioversion
- ☐ Defibrillation
- ☐ Thrombolytics
- ☐ Primary Percutaneous intervention
- ☐ Other
- ☐ None.

Ward Surgical Management:

- ☐ Pericardiocentesis
- ☐ Aortic repair
- ☐ Pericardial window
- ☐ Valvular repair
- ☐ Open fracture reduction
- ☐ Closed fracture reduction
- ☐ Wound suturing (minor or major)
- ☐ Explorative Laparotomy
- ☐ Evacuation of intra-cranial hematoma
- ☐ Maxillofacial surgery
- ☐ Chest tube
- ☐ Thoracotomy
- ☐ Debridement
- ☐ Coronary Artery By-pass Graft (CBAG)
- ☐ Other……..
- ☐ None

C. **48hour outcome post disposition**

- ☐ Died
- ☐ Alive

If alive;

- ☐ Cardiac arrest
- ☐ Respiratory arrest
- ☐ Surgery
- ☐ Intubated while in the ward
- ☐ Admitted to ICU
- ☐ Discharged home ICU
- ☐ Discharge home
- ☐ No event

D. Outcome at 7 days post disposition

☐ Dead

☐ Alive

- ☐ Cardiac Arrest
- ☐ Respiratory arrest
- ☐ Intubated while in the ward
- ☐ Surgery
- ☐ Intubated while in the ward
- ☐ Admitted to ICU
- ☐ Discharged from ICU
- ☐ Discharged home
- ☐ No event

Appendix 2: Consent Form (English)

INCIDENCE, PREDICTORS AND OUTCOMES OF BLUNT CARDIAC INJURY AMONG TRAUMA PATIENTS PRESENTING TO EMERGENCY DEPARTMENT OF A TERTIARY HOSPITAL IN TANZANANIA.

PRINCIPAL INVESTIGATOR

Dr. Janet Sugut

Mobile no: +255768835683

Email: dr.janetsugut@gmail.com

SUPERVISOR

Dr. Said Kilindimo

Head of Emergency Department

MUHAS

Mobile: +255678944154

Email: skilindimo@yahoo.com

Study introduction

I am carrying out a study to assess Incidence, Predictors and Outcomes of blunt cardiac injury among trauma patients presenting to emergency department of a Tertiary Hospital in Tanzania, using ECG and troponin as initial screening tools. Cardiac injury is a spectrum of injuries that can occur when one is injured. It often requires additional tests to diagnose, that are not usually carried out routinely. The ECG and troponin are such tests that can be done initially in the emergency department. Further tests like ECHO are usually done later to definitely diagnose blunt cardiac injury.

Purpose of the study

The purpose of the study to ascertain the incidence of cardiac injury among trauma patients presenting to the emergency department of MNH. The study shall also look at risk factors of getting blunt cardiac injury as well as outcomes of the same.

Study procedures.

The participant will come into Accident and Emergency department for various injuries and will be triaged by the triage nurse as per triage protocol. The patient shall be admitted to appropriate room in the department according to severity of injury. The research assistant shall then determine whether a patient fits the inclusion criteria. If the patient does, consent shall be sought. If patient is too sick to give consent and has no relative, a waiver of consent shall be sought from hospital adminstrator. The research assistant shall fill a data collection form by asking the patient some questions and most of the form shall be filled from the doctor's electronic medical record. An ECG shall be done and if abnormal, a troponin shall be drawn. If patient is suspected to have cardiac injury from the above tests, the patient shall be followed up to 7 days post admission to determine outcome at 48hours and 7 days. In the ward, additional test like ECHO might be done to further ascertain the extent of injury. Additionally, the patient might be put on a cardiac monitor to continuously monitor the cardiac rhythm.

Role of participant

The role of the participant in this study is to give consent then answer the questions from the research assistant to the best of his/her ability.

Expected time of study

The study period is approximately 3 months and recruitment will occur during the day and night on scheduled days.

Benefits

There will be no monetary compensation for the participant in this study. However, your participation shall help us understand the incidence of cardiac injury in order to put in place systems of screening these patients in order to give onward quality care.

Risks and discomforts

The study has no risk to the participants, as there shall be no risky intervention done on the patient. The research assistant only collects data as per the events that occur during your hospital stay until 7 days post admission. The ECG is an equipment that is placed on your

chest to check the electrical activity of the heart. A gel that is harmless, maybe applied on the chest in order for the equipment to hold well. It is painless and not harmful. A troponin means a small prick shall be made on your vein to draw blood, this shall be done as the doctor or nurse is drawing routine samples for all the other tests usually done for all trauma patients. An ECHO if done, is also harmless as it uses ultrasound which is safe. It helps to create images of your heart which help in knowing the exact injury suffered.

Confidentiality

Utmost confidentiality will be maintained between the participant and the study team. The filled data collection tool is online based and is password protected. The server is domiciled in Redcap which is also password protected. The consent form retained by the research assistant shall be locked in a safe and secure cabinet within the emergency department.

Voluntary participation

The choice to participate in this study is voluntary. The client shall not be forced to participate in any way. The participant has the right to withdraw from the study at any point without penalties.

Contact information of researchers:

Dr. Janet Sugut (Principal Investigator)
Department of Emergency Medicine, MUHAS
Mobile no: +255768835683
Email: dr.janetsugut@gmail.com

Dr. Nahya Salim
Chairman of Research and Publications Committee,
Muhimbili University of Health and Allied Sciences
P.O. Box 65001, Dar Es Salaam
Telephone +255-22-2152489

Participants statement.

I hereby agree to sign this consent having been explained to the purpose of the study, my roles are clear and I have been informed of all risks and benefits of participating in the study.

Signature……

Investigators statement

I hereby under sign this consent form having explained to the participant the purpose of the study, the roles and study procedures have been explained and the risks and benefits have been well elaborated.

Name……... Signature…….

Appendix 3: Consent Form (Kiswahili)

MATUKIO, VITABIRI NA MATOKEO YA JERAHA BUTU LA MISULI YA MOYO MIONGONI MWA WAGONJWA WALO NA JERAHA WANAOWASILISHWA/WANAOFIKA KATIKA IDARA YA MAGONJWA DHARURA NA AJALI YA HOSPITALI YA TAIFA

MTAFITI MKUU

Dkt: Janet Sugut

Namba ya simu: +255768835683

Barua pepe: dr.janetsugut@gmail.com

SUPERVISOR

Dr. Said Kilindimo

Mkuu wa Idara ya Dharura

MUHAS

Namba ya simu: +255678944154

Barua pepe: skilindimo@yahoo.com

Utangulizi wa utafiti

Ninanya utafiti wa kutadhimini matukio, vitabiri na matokeo ya jeraha butu la misuli ya moyo miongoni mwa wagonjwa walo na jeraha wanaowasilishwa katika idara ya dharura ya hospitali ya taifa ya Tanzania, kwa kutumia kipimo cha umeme wa moyo (ECG) na tropinini kama vipimo vya uchuguzi wa awali. Kuumia kwa misuli ya moyo ni wigo mpana wa majeraha ambayo yanaweza kutokea wakati mtu akijeruhiwa na mara nyingi inahitaji vipimo vya ziada ili kutambua ambavo hivifanyiki kwa kawaida.

Kipimo cha umeme wa moyo (ECG) na troponin ni vipimo vile ambavyo vinaweza kufanywa awali katika idara ya dharura, vipimo Zaidi kama ECHO kawaida hufanywa baadaye li kutambua jeraha la misuli ya moyo.

Madhumuni ya utafiti

Madhumuni ya utafiti huu ni kubaini matukio ya jeraha la misuli ya moyo Kati ya wagonjwa wenye jeraha wanaowasilishwa katika idara ya dharura ya MNH. Utafiti huu pia utaangalia sababu za hatari za kupata jeraha butu la misuli ya moyo, pamoja na matokeo yake**.**

Taratibu za utafiti

Mshiriki atakayekuja katika idara ya ajali na dharura kwa majeraha mbalimbali na atachunguzwa na muuguzi wa triage (upangaji wa wagonjwa kadri ya uhitaji wa matibabu). kulingana na muongozo wa triage mgonjwa ataingizwa kwenye chumba kinachofaa katika idara ya dharura kulingana na ukubwa wa jeraha. Msaidizi wa utafiti atamchuguza mgonjwa kama anakidhi vigezo vya utafiti huu. Ikiwa mgonjwa anakidhi vigezo vya utafiti, kibali kitaombwa na ikiwa mgonjwa anaumwa sana na hawezi kutoa ridhaa na hana jamma au ndugu, msamaha wa kibali utaombwa kwa msimamizi was hospitali.

Msaidizi wa utafiti atajaza fomu ya kukusanya taarifa za utafiti kwa kumuuliza mgonjwa baadhi ya maswali na sehemu kubwa ya fomu hiyo itajazwa kutoka kwenye rekodi ya matibabu ya kielectroniki ya daktari. Kipimo cha umeme wa moyo (ECG) itafanywa na ikiwa sio ya kawaida, troponini itachunguzwa. Na ikiwa mgonjwa anahisiwa kuwa na jeraha la misuli ya moyo kutokana na vipimo vilivyo hapo juu, mgonjwa atafuatiliwa wodini baada ya kulazwa kwa muda wa masaa arobaini na nane na siku saba, ili kuamua maamuzi ya matokeo ya jeraha la misuli ya moyo. Akiwa wodini vipimo zaidi kama ECHO vinaweza fanyika ili kubaini zaidi ukubwa wa jeraha, mgonjwa anaweza kuwekwa kwenye mfumo wa ufuatiliaji wa moyo ili kufuatilia mfululizo wa umeme wa moyo.

Wajibu wa mshiriki.

Jukumu la mshiriki katika utafiti huu ni kutoa ridhaa kisha kujibu maswali kutoka kwa mtafiti msaidizi kadri ya uwezo wake.

Muda wa utafiti

Muda wa utafiti unaotarajiwa ni takribani miezi mitatu na ukusanyaji taarifa za utafiti utafanyika mchana na usiku kwa kila siku zilizopangwa.

Faida za utafiti.

Hakutokuwa na faida ya kifedha kwa mshiriki katika utafiti huu, bali ushiriki wako utatusaidia kuelewa matukio ya jeraha la misuli ya moyo ili kuweka mifumo ya uchunguzi wa wagonjwa hawa ili kutoa huduma bora Zaidi.

Hatari na usumbufu wa utafiti.

Utafiti huu hauna hatari kwa mshirika, kwani hakutakuwa na uchunguzi hatarishi utakaofanyika kwa mgonjwa. Msaidizi wa utafiti atakusanya taarifa za utafiti kulingana na matukio yatayotokea wakati mgonjwa amelazwa hospitalini kwa siku saba. Kipimo cha umeme wa moyo (ECG) ni kipimo kinachotumia kifaa ambacho kinawekwa kwenye kifua chako ili kuangalia shughuli za umeme za moyo. Kiminika (geli) ambayo haina madhara inayotumika wakati wa kutumia kifaa hicho ili kifaa kishike vizuri kwenye kifua itatumika. Tropinini itachunguzwa kwenye damu itakayochukuliwa na daktari au muuguzi wakati anachukua damu kwa ajili ya vipimo vingine vya kawada vinavyofanyika kwa wagonjwa wote wenye majeraha. ECHO ikifanyika pia haina madhara kwani inatumia mawimbi ya sauti ambayo ni salama, inasaidia kuunda picha ya moyo wako na itatupa uhalisia wa jeraha ulilolipata.

Usiri wa utafiti

Usiri mkubwa zaidi utadumishwa kati ya mshiriki na timu ya utafiti. Zana iliyojazwa hapo ya kukusanya taarifa inatengemea mtandao na inalindwa na neno siri. Fomu ya idhini iliyohifadhiwa na msimamizi wa utafiti itafungiwa katika baraza la mawaziri salama ndani ya idara ya dharura.

Kushiriki kwa hiari.

Chaguo la kushiriki katika utafiti huu ni hiari. Mteja hatalazimishwa kushiriki kwa njia yoyote ile. Mshiriki ana haki ya kujiondoa kwenye utafiti wakati wowote bila adhabu.

Mawasiliano ya watafiti.

Dkt. Janet Sugut (Mtafiti Mkuu)
Idara ya wagonjwa ya dharura, MUHAS
Namba ya simu: +255768835683

Barua pepe: dr.janetsugut@gmail.com

Dkt. Nahya Salim

Mwenyekiti wa kamati ya utafiti na machapisho, MUHAS

P.O.BOX 65001.Dar es salaam

Namba ya simu: +255-22-2152489

Kauli ya mshiriki

Nakubali kutia sahihi katika fomu hii ya ridha baada ya kuelezwa madhumuni ya utafiti, majukumu yangu yako wazi na nimefahamishwa kuhusu hatari na manufaa yote ya kushiriki katika utafiti huu.

Sahihi……...

Kauli ya mtafiti.

Ninatia Saini katika fomu hii ya idhini baada ya kueleza kwa kinaa madhumuni, majukumu, hatari, manufaa na taratibu za utafiti huu kwa mshirika.

Jina……...

Appendix 4: Approval for ethical clearance

UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

OFFICE OF THE DIRECTOR – RESEARCH, PUBLICATIONS AND INNOVATION

Ref. No.DA.282/298/01.C/1826

Date: 28/07/2023

MUHAS-REC-07-2023-1826
DR. JANET JEBICHII SUGUT
SCHOOL OF MEDICINE
MUHAS

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED: INCIDENCE, PREDICTORS AND OUTCOMES OF BLUNT MYOCARDIAL INJURY AMONGST PATIENTS WITH BLUNT CHEST TRAUMA PRESENTING TO EMERGENCY DEPARTMENT-MUHIMBILI NATIONAL HOSPITAL

Reference is made to the above heading,
I am pleased to inform you that the Chairperson has on behalf of the University Senate, approved ethical clearance of the above-mentioned study, on recommendations of the Senate Research and Publications Committee meeting accordance with MUHAS research policy and Tanzania regulations governing human and animal subjects research.

APPROVAL DATE: 28/07/2023
EXPIRATION DATE OF APPROVAL: 28/07/2024

STUDY DESCRIPTION:
Purpose:
The purpose of this study is to establish the incidence, predictors and 7-day outcomes of blunt myocardial injury among Blunt chest trauma patients attending Emergency Department of Muhimbili National Hospital.

The approved protocol and procedures for this study is attached and stamped with this letter, and can be found in the link provided:
https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%2014844.pdf and in the MUHAS archives.

The PI is required to:

1. Submit bi-annual progress reports and final report upon completion of the study.
2. Report to the IRB any unanticipated problem involving risks to subjects or others including adverse events where applicable.
3. Apply for renewal of approval of ethical clearance one (1) month prior its expiration if the study is not completed at the end of this ethical approval. You may not continue with any research activity beyond the expiration date without the approval of the IRB. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.
4. Obtain IRB amendment (s) approval for any changes to any aspect of this study before they can be implemented.
5. Data security is ultimately the responsibility of the investigator.
6. Apply for and obtain data transfer agreement (DTA) from NIMR if data will be transferred to a foreign country.
7. Apply for and obtain material transfer agreement (MTA) from NIMR, if research materials (samples) will be shipped to a foreign country,
8. Any researcher, who contravenes or fail to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III section 10 (2)
9. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.
10. PI is required to be versed with necessary laws and regulatory policies that govern research in Tanzania. Some guidance is available on our website https://drp.muhas.ac.tz/.

Dr. Nahya Salim Wasoud,

Chairperson, MUHAS Research and Ethics Committee

Muhimbili University of Health and Allied Sciences
DIRECTOR
Research, Publications & Innovations
Box 65001

Appendix 5: Permission to collect data at MNH

THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF HEALTH

MUHIMBILI NATIONAL HOSPITAL

In reply please quote;

Ref. No.: MNH/CRTCU/Perm/2023/474 Date: 21st August, 2023

Head of Department,
Emergency Medicine
Muhimbili National Hospital

RE: PERMISSION TO COLLECT DATA AT MNH.

Name of Student	**Janet Jebichii Sugut**
Title	**"Incidence, Predictors and Outcomes of Blunt Myocardial Injury Amongst Patients with Blunt Chest trauma Presenting to emergency Department- Muhimbili National Hospital".**
Institution	Muhimbili University of Health and Allied Sciences
Supervisors	Dr. Said Kilindimo (MUHAS)
Co - Supervisor	Dr. Juma Mfinanga (MNH)
Period	21st August, 2023 to 30th December, 2023

Approval has been granted to the above mentioned student to collect data at MNH. **A final study report should be lodged with Clinical Research, Training and Consultancy Unit.** Dissemination of study findings to MNH stakeholders shall be overseen by Dr. Juma Mfinanga (MNH) Co – supervisor. Kindly ensure that the student abide to the ethical principles and other conditions of the research approval.

Sincerely,

HEAD: TEACHING, RESEARCH & CONSULTANCY UNIT
P.O. Box 65000
DAR-ES-SALAAM
MUHIMBILI NATIONAL HOSPITAL

Dr. Charles K. Pallangyo
For: Head of Clinical Research, Training and Consultancy Unit

c.c DMS
c.c Dr. Juma Mfinanga
c.c **Janet Jebichii Sugut**

Upanga West, Kalenga Street, Plot No. 10480/3, P.O. BOX 65000, Dar es Salaam, Tanzania.
Telephone: +255-22-2151367-9, Telephone: +255-22-2151351-2
Email: info@mnh.or.tz, Website: www.mnh.or.tz

Appendix 6: MOI Permission Letter

MOI
MUHIMBILI ORTHOPAEDIC INSTITUTE

Ref. PA.382/401/01/71 **26th July, 23**

Muhimbili University of Health and Allied Sciences
P.o.box 65001
Dar es salaam
Tanzania.

RE: APPROVAL FOR STUDY

Reference is made to your letter dated on14th August 2023 for research study with reference no. HD/MUH/K.47/2021

On behalf of the Management I would like to officially inform you that, your permission has been granted for your student **Janet Jebichii Sugut** who is pursuing MMed.Emergency Medicine to conduct study at Muhimbili Orthopaedic Institute (MOI). Her study titled **Incidence, Predictors and Outcomes of Blunt Myocardial injury Amongst Patients Patients with Blunt Chest Trauma Presenting to Emergency Department –Muhimbili National Hospital.**

This letter will introduce you to the Director of clinical support. It's my hope that your stay at MOI will be fruitful. For any clarification contact CRTM +255713764522.

Dr. Joel J Bwemelo, CRTM

For: MOI Executive Director 21/8/2023.

Cc: Manager OT/EMD

Cc: I/C EMD

Muhimbili Orthopaedic Institute (MOI), Upanga West Plot No. 1048/2, Kalenga Street, P. O. Box 65474 - Dar es Salaam; Telephone Number +255 -022-2151298/2152937/2152938 Fax: +255 -022-2151744
Website: www.moi.ac.tz, info@moi.ac.tz,

Appendix 7: JKCI Permission Letter

UNITED REPUBLIC OF TANZANIA

MINISTRY OF HEALTH

JAKAYA KIKWETE CARDIAC INSTITUTE
(JKCI)

JAKAYA KIKWETE CARDIAC INSTITUTE

In reply please quote;
Ref No: AB.123/307/01J/43

29/08/2023

Janet Jebichii Sugut
HD/MUH/K.47/2021
MMed. Emergency Medicine
MUHAS

RE: PERMISSION TO CONDUCT RESEARCH AT JKCI

Reference is made to your letter request to do a research study entitled **"Incidence, predictors and outcomes of blunt myocardial injury amongst patients with blunt chest trauma presenting to emergency department – Muhimbili National Hospital"** here at JKCI.

This letter serves as an official document that permits you to do the above-mentioned task as per your institution's requirement.

Institution also requires you to have JKCI local co-supervisor.

It is our sincere hope that you will abide by the rules and regulations of good clinical practice. We wish you the best and hope your stay at JKCI will be fruitful.

Best Regards,

For: EXECUTIVE DIRECTOR
JAKAYA KIKWETE CARDIAC INSTITUTE
P. O. Box 65141 - DAR ES SALAAM

Dr. Pedro Pallangyo
Head of Research, Training and Consultancy.
CC: ALL DIRECTORATES

Jakaya Kikwete Cardiac Institute (JKCI); Upanga East Plot No. 1048, Kalenga Street, Malik Road, P. O. Box 65141 - Dar es Salaam; Telephone Number + 255 -22- 2152392Email:info@jkci.or.tz, Website: ww.jkci.or.tz.