CHARACTERISTICS, MANAGEMENT AND OUTCOME OF PATIENTS WITH BLUNT ABDOMINAL INJURY AT MOI TEACHING AND REFERRAL HOSPITAL, ELDORET KENYA.

TANUI SHADRACK KIRWA

A research thesis submitted to the school of medicine, department of surgery and anesthesiology in partial fulfillment of the requirements for the award of the degree of master of medicine (General surgery)

DECLARATION

This research thesis is my original work and to the best of my knowledge, has not been submitted for an award of academic credit in any other university or research institution.

SIGNATURE:_____ DATE:_____

TANUI SHADRACK KIRWA, SM/PGGS/05/12

Declaration by supervisors:

This thesis has been submitted with our approval as university supervisors

Dr. David Lugaria Lumarai

MBChB, MMed Surgery, University of Nairobi

Consultant Surgeon

Moi Teaching and Referral Hospital, Eldoret, Kenya

SIGNATURE:_____ DATE:_____

Dr. Kennedy Khasakhala Imbaya

MD, MMed Anesthesiology, University of Nairobi

Lecturer, Moi University, school of medicine, department of surgery and anesthesiology and consultant Anesthesiologist,

Moi Teaching and Referral Hospital, Eldoret, Kenya.

SIGNATURE:_____ DATE:_____

DEDICATION

I dedicate this work to all the surgeons, anesthesiologists, anesthetists, nurses and all those involved in the care of patients with blunt abdominal injury. I would also like to dedicate it to all those who have put a lot of effort in the search for the best ways of management of patients with blunt abdominal injury and all that have got a scar or lost an organ due to blunt trauma to the torso.

DISCLOSURE

The investigator did not receive any outside funding or grants in support of this study. Neither he nor a member of his immediate family received payments or other benefits or commitment or agreement to provide such benefits from a commercial entity.

SIGN…… **DATE …….**

Tanui Shadrack Kirwa,

SM/PGGS/05/12

ABSTRACT

Background: Blunt abdominal trauma (BAT) is physical injury caused by transfer of energy to and within the person involved by non-penetrative mechanism to the abdomen. BAT remains one of the commonest causes of morbidity and mortality in patients with multiple injuries. Three mechanisms are involved, deceleration, crushing and compression. MTRH handles a significant proportion of these patients and local data is not available on their characteristics, management and outcome. This study was therefore necessary to generate MTRH data which will form the baseline in management of patients with BAT.

Objective: To determine the characteristics, management and outcome of patients with blunt abdominal trauma at the MTRH.

Methods: The study was carried out at the emergency department and surgical wards at MTRH. The study included Patients who presented with blunt abdominal trauma and met the inclusion criteria at the MTRH between October 2013 and September 2014.This was an observational cross sectional study that used the consecutive sampling technique. A total of 34 patients met the inclusion criteria and were all included. Data was collected using a standardized questionnaire, clinical examinations and review of medical records. The data was analyzed and presented in form of percentages and ratios.

Results: A total of 34 patients, (29 males, 5 females) were studied, with a male to female ratio of 6:1.A median age of 29yrs (IQR 13, 36) with a range of 3yrs to 65yrs. Majority of patients 19 (55.9%) presented to the hospital more than 12hrs after injury. The commonest mechanism of injury was Road traffic accident 16 (46.1%) and they comprised of 8 (23.5%) motor bike accidents 6 (17.6 %) public service vehicles and 2 (5.9 %) personal vehicles while the spleen and mesentery were the commonest location of injury 13 (38.3%). Majority of patients 19(55.9%) presented to hospital more than 12 hours after injury. During presentation 30 (88.2%) patients were hemodynamically stable. The main presentation was abdominal pain 34 (100%) and vomiting 11(32.4%). Nausea was the least presentation 3 (8.9%).Tenderness and guarding were the main signs at 31(91.8%) and 12 (35.3%) of patients respectively. A total of 16 patients underwent laparotomy giving an operative management rate of 47.1%. Non operative management rate of 53%with a non-operative management failure rate of 11.1%. Complications occurred in 4 patients giving a complication rate of 11.8%. An overall mortality of 2.9% was observed in this study and this was attributed to multiple injuries, delayed presentation and a low Glasgow coma scale.

Conclusion: Road traffic accident is the leading cause of blunt abdominal trauma at MTRH with the spleen and mesentery as the commonest injured intra-abdominal organs. Late presentation and multiple injuries were associated with poor outcome in patients with blunt abdominal trauma.

Recommendation: Creation of public awareness on the importance of early presentation to hospital after BAT. Timely diagnosis and management of blunt abdominal trauma should be encouraged to reduce on morbidity and mortality. Non-operative mode of management to be encouraged

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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LIST OF ABBREVIATIONS

BAT	Blunt Abdominal Trauma
CEUS	Contrast Enhanced Ultrasound
CT	Computed Tomography
DL	Diagnostic Laparatomy
DPL	Diagnostic Peritoneal Lavage
ED	Emergency Department
FAST	Focused Abdominal Sonography for Trauma
HVI	Hollow Viscus Injury
ICU	Intensive Care Unit
IREC	Institutional Research Ethics Committee
KNH	Kenyatta National Hospital
LOS	Length of hospital stay
MTRH	Moi Teaching and Referral Hospital
MVA	Motor Vehicle Accident
NGT	Nasogastric tube
NOM	Non Operative Management
RTA	Road Traffic Accident
SPSS	Statistical Package for Social Sciences
SSI	Surgical Site Infection
US	Ultrasound
WBC	White Blood Cell count

OPERATIONAL DEFINATION OF TERMS

Blunt abdominal trauma: Is physical injury caused by transfer of energy to and within the person involved by non-penetrative mechanism to the abdomen.

Characteristics: The demographics, etiology and time taken between diagnosis and appropriate intervention of patients with blunt abdominal trauma.

Length of stay: Duration of time taken from admission to discharge or the occurrence of eventual outcome.

Management: Clinical evaluation, investigation and treatment given to patients.

Morbidity: The rate of appearance of complications following a surgical procedure or other treatment.

Mortality: Death attributable to the pathophysiological changes following blunt abdominal injury.

Outcome: The eventual result: morbidity (complications, length of hospital stay) and mortality at time of discharge or death.

Surgical site infection: Infection within 30days after the operation characterized by purulent drainage, organism isolation, signs and symptom of redness, localized swelling or heat.

CHAPTER ONE: INTRODUCTION

1.1 Background Information

Blunt abdominal trauma results from injury to the torso either in isolation or as one of the component of multiple trauma during major trauma (Aziz, Bota, & Ahmed, 2014). Three mechanisms have been identified in blunt abdominal trauma and they can occur in isolation or in combination(Siddique, Rahman, & Hannan, 2004). These are acceleration deceleration forces, compression forces and crushing forces. Road traffic accidents, fall from a height, assault and violence are responsible for majority of blunt abdominal trauma cases(Musau, Jani, & Owillah, 2006).

Patients usually present with abdominal pain, nausea, vomiting(Gupta et al., 1996) as the main symptoms and the severity is proportional to the degree of injury (Nishijima, Simel, Wisner, & Holmes, 2012). Tenderness, guarding, hematuria, hematemesis are the main signs of abdominal trauma. Seat belt sign is usually a sign of major intraabdominal injury and identification of one should prompt the clinician to consider operative management in this group of patients(Borgialli et al., 2014). BAT patients can be classified as either hemodynamically stable or hemodynamically unstable based on their hemodynamic status at presentation. Patients with systolic blood pressure above 90mmhg and a pulse rate below 110beats per minute are considered to be stable whereas patients with deranged hemodynamic status are said to be hemodynamically unstable(Weil, 2005b).

Diagnosis of blunt abdominal trauma is mainly clinical, through history taking and physical examination .The use of erect abdominal x-ray in diagnosis of blunt abdominal trauma is based on evidence of free air under the diaphragm as a sign of hollow viscous injury(Remedios & McCoubrie, 2007). The choice of diagnostic

modality is dependent on the hemodynamic stability of the patient and the availability of the modality.

Computed Tomography scanning is mainly reserved for patients who are hemodynamically stable and there is need to rule out intra-abdominal injury(Radwan & Abu-Zidan, 2006). Laboratory investigations are used as adjuncts to the diagnosis of blunt abdominal trauma especially when surgery is being considered as an option(Raza et al., 2013).

BAT can either be managed conservatively or definitively through surgery and the decision as to whether to manage conservatively or surgically depends on several factors but the main is usually the hemodynamic stability of the patient. Aggressive resuscitation and restoration of circulating volume is crucial in the management of patients with blunt abdominal trauma(Carmont, 2005b). Hemodynamically unstable patients are best managed surgically in order to control the source of hemorrhage and restore stability. Conservative management is reserved for patients who are hemodynamically stable and have no signs of infection. This group of patients receives intravenous fluids and antibiotics as well as decompression of gut via Nasogastric tube. Conservative management is deemed to have failed if the patient's hemodynamic stability deteriorates or the patient doesn't show signs of improvement after 72hours(A. Ziya Anadol, Topgül, Güngör, Bilgin, & Kesim, 2007).

The outcome of management of blunt abdominal trauma is dependent on a number of factors. These factors are duration between injury and presentation to the hospital, multiple injuries, admission to ICU, and gastric rupture among others(Álvarez et al., 2004).

Mortality from BAT varies from region to region depending on their socioeconomic level of development and availability of technical personnel and equipment to deal with blunt abdominal trauma. Regionally the mortality ranges from 5-15% (P. L. Chalya & Mabula, 2013; Edino, 2003a; Musau et al., 2006; OV Nyongole, 2013). Blunt abdominal injury remains one of the commonest causes of mortality and morbidity in patients with multiple injuries. Blunt abdominal trauma (BAT) makes up 65.3% of all blunt trauma and is the most common example of this injury(OV Nyongole, 2013). Management of blunt abdominal injury still poses a great challenge in developing countries due to limited diagnostic modalities and resource constraints. In developed countries, the availability of advanced imaging modalities has now reduced the necessity for laparatomy to less than 10% following blunt abdominal trauma (BAT) in children(Ameh, Chirdan, & Nmadu, 2000).

The aim of this study was to determine the characteristics, management and eventual outcome of patients with blunt abdominal trauma. The outcome was determined through hospital morbidity and mortality as well as hospital length of stay.

1.2 Problem Statement

Blunt abdominal trauma (BAT) is a frequent emergency and is associated with significant morbidity and mortality in spite of improved recognition, diagnosis and management(Mehta, Babu, & Venugopal, 2014). BAT constitutes 30% of all trauma cases, with surgery being required in 25% of these cases (Karamercan, Yilmaz, Karamercan, & Aytaç, 2008).MTRH handles a significant proportion of these cases.

Management of BAT remains challenging even to the most experienced of surgeons (Stawicki, 2017). Over the years there has been a lot of changes and improvement in the management of BAT patients due to the availability of advanced diagnostic

modalities. The outcome of management of BAT varies from region to region and is dependent on institutional and individual factors.

With the advent of industrialization/urbanization and the introduction of motor cycles locally known as “Boda boda” there has been a steady rise in the cases of BAT as a result of RTA. According to WHO report of 2010 the number of registered motor cycle in 2005 in Kenya was < 20,000, as at 2011 the number had increased to 140,000. This translates to a proportional increase in the number of RTA which is the major cause of BAT.

There is very limited data as to the major causes; evidence based best practice and diagnostic modalities for blunt abdominal injury in MTRH. Such information is critical for the optimum management of patients and also for purposes of health planning and disaster preparedness. This forms the baseline during evaluation, management and monitoring of patients with BAT.

1.2.2 Scope of this study

The study aimed at determining the characteristics, management and outcomes of patients with BAT managed at MTRH. The patients were followed from the time of admission until a decision to discharge them was made or until their death.

1.2.3 Expected impact

There is need to develop an institutional guideline on the management of patients with blunt abdominal trauma. Such a guideline can only be developed if there is available data on the characteristics, management and outcome of such patients. This study aims at filling in the informational gap that exists currently on the characteristics, management and outcome of patients with blunt abdominal trauma at MTRH.

1.3 Justification for the Study

Road traffic accidents are a major cause of BAT and is associated with high morbidity and mortality in Kenya. This therefore means that there will be resultant negative impact on socio-economic status of the population if proper management of resultant BAT is not given priority. Most deaths resulting from BAT are preventable if the current diagnostic and treatment modalities are followed. Patients who survive end up incurring huge bills due to unnecessary laparotomies and out dated diagnostic modalities and thus the need for this study. This information is important to the surgeons, patients, policy makers and the general public. Furthermore, the patterns of blunt abdominal injury keep changing over time and this necessitates periodical studies to monitor the current impact of the available diagnostic and treatment modalities. This study aims at determining the current characteristics, management and related outcomes of blunt abdominal trauma patients. The information derived from this study will be of great value to not only MTRH but also the public in general.

1.4 Research Questions

1. What are the demographic characteristics of patients presenting with BAT in MTRH?
2. What are the associated injuries in patients with BAT presenting in MTRH?
3. What are the determinants of the outcome of management of blunt abdominal trauma?
4. What is the common location of injury in BAT patients at MTRH?
5. What are the diagnostic and treatment modalities given to patients at MTRH?
6. What are the outcomes of management of patients with BAT in MTRH?

1.5 Objectives

1.5.1 Broad Objective

To determine the characteristics, management and outcome of patients with blunt

1.5.2 Specific Objective

1. To determine the characteristics of patients with BAT in MTRH
2. To determine the diagnostic and treatment modalities given to patients with BAT at MTRH
3. To determine the outcome of management of patients with BAT in MTRH

CHAPTER TWO: LITERATURE REVIEW

Blunt abdominal trauma (BAT) is any injury to the abdomen that results from blunt force by deceleration, compression or crushing force. BAT is regularly encountered in the emergency department (ED). The lack of historical data and the presence of associated injuries or altered mental status, from head injury or intoxication, can make these injuries difficult to diagnose and manage(Musau et al., 2006). Victims of blunt trauma often have both abdominal and extra-abdominal injuries, further complicating care(Mohammad A Gad, Aly Saber, Shereif Farrag, Mohamed E Shams, & Goda M Ellabban, 2012). BAT accounts for majority of abdominal injuries seen at the emergency department and is responsible for substantial morbidity and mortality(Abbas & Upadhyay, 2007). Blunt injury usually results from road traffic accident, fall from a height and direct blow(Memon, Sanghi, Abbasi, & Memon, 2013). Trauma is still the most frequent cause of death in the first four decades of life, and it remains a major public health problem in every country, regardless of the level of socioeconomic development(Mock, Jurkovich, Arreola-Risa, & Maier, 1998). The abdomen is the third most common injured region, with surgery required in about 25% of civilian cases(M. A. Gad, A. Saber, S. Farrag, M. E. Shams, & G. M. Ellabban, 2012). Occult BAT may also occur with child abuse and domestic violence. The morbidity and mortality rate is related to the number of associated injuries, delays in diagnosis, and development of diagnosis(Khan, Iqbal, & Gardezi, 2006). BAT is the main cause of death in individuals under 45 years (Costa et al., 2010). The liver and the spleen are the commonest injured organs in high speed motor vehicle crashes (Edino, 2003b; G Ruhinda, 2008; OV Nyongole, 2013). The liver at 35%, spleen 32%, and small gut 30%(Khan et al., 2006).

Gastric rupture is very rare and accounts for 0.02-1.7% and the commonest cause is road traffic accident. Gastric rupture is an indicator of worse prognosis in BAT(Tejerina Álvarez et al., 2004).

2.1 Presentation

Patients usually present with various signs and symptoms that include: Pain, tenderness, gastrointestinal hemorrhage, hypovolemia and evidence of peritoneal irritation. However, large amounts of blood can accumulate in the peritoneal and pelvic cavities without any significant or early changes in the physical examination findings(Mohammadi, Daghighi, POURISA, Afrasiabi, & Pedram, 2008). The presentation may also depend on the specific organ that is injured and the associated co-morbidities. The presence of head injury may influence the clinical presentation of a patient with blunt abdominal injury(Abbas & Upadhyay, 2007). A high index of suspicion and an adequate observation period therefore are mandatory for proper care of patients subjected to blunt trauma(Davis, Cohn, & Nance, 1976). Patients can also be classified into two groups: hemodynamically stable and hemodynamically unstable. One indirect sign, which seems to be associated with hollow viscus injury are seat belt signs, which increase the likelihood of significant abdominal injury(Biswas, Adileh, Almogy, & Bala, 2014; Vailas, Moris, Orfanos, Vergadis, & Papalampros, 2015).

2.2 Hemodynamically stable

A patient is considered hemodynamically stable if after up to two liters of crystalloid infusion the patient is maintaining a systolic blood pressure >90mmHg (>100mmHg for patients > 60 yrs),does not have a base deficit, (or is normalizing the base deficit),and is making >50ml of urine every hour. The evaluation of such patients has two aims. First is to rapidly identify patients who will need operative therapy, and

second is to triage patients to optimum level of care observation in the ICU, observation in a regular hospital bed, and discharge without admission. Physical examination is the simplest form of evaluation.

2.3 Hemodynamically unstable

Hemodynamic instability on the other hand as a clinical state, is a perfusion failure represented by clinical features of circulatory shock(Weil, 2005a). Hemodynamic instability can be caused by hypovolemic shock due to blood or fluid losses .Distributive shock can also result from loss of automatic controls which usually occurs in cord transection following road traffic accidents and other causes of trauma. Features of hemodynamic instability include; Hypotension – systolic blood pressure <90mmhg.Pulse rate >100bpm, Altered level of consciousness, Cold extremities and Peripheral cyanosis.

The diagnostic priority in the unstable blunt trauma patient is to rapidly determine the source of hemorrhage while resuscitative measures are being carried out.

Resuscitation is performed concomitantly and continues as the physical examination is completed. Priorities in resuscitation and diagnosis are established on the basis of hemodynamic stability and the degree of injury. The goal of the primary survey according to Advanced Trauma Life Support (ATLS) protocol, is to identify and expediently treat life-threatening injuries(Carmont, 2005a). The protocol includes the following: Airway and cervical spine, Breathing, Circulation, Disability and Exposure.

After an appropriate primary survey and initiation of resuscitation, attention should be focused on the secondary survey of the abdomen. The secondary survey is the identification of all injuries via a head-to-toe examination. For life-threatening

injuries that necessitate emergency surgery, a comprehensive secondary survey should be delayed until the patient has been stabilized. Many injuries initially are occult and manifest over time. Frequent serial examinations, in conjunction with the appropriate diagnostic studies, such as abdominal computed tomography (CT) and bedside ultrasonography, are essential in any patient with a significant mechanism of injury(A. Mohammadi & M. Ghasemi-Rad, 2012). The evaluation of a patient with blunt abdominal trauma must be accomplished with the entire patient in mind, with all injuries prioritized accordingly. The objective is rapid identification of those patients who need a laparatomy (Erfantalab-Avini, Hafezi-Nejad, Chardoli, & Rahimi-Movaghar, 2011). Clinical evaluation alone has an accuracy rate of only 65% for detecting the presence or absence of intraperitoneal blood(Powell, Bivins, & Bell, 1982). The most reliable signs and symptoms in alert patients are pain, tenderness, gastrointestinal hemorrhage, hypovolemia, and evidence of peritoneal irritation. Bradycardia may indicate the presence of free intraperitoneal blood in a patient with blunt abdominal injuries(Davis et al., 1976).Rectal and bimanual vaginal pelvic examinations should be performed(AD & JM, 2009).

There are obvious anatomic and clinical differences between children and adults that must be kept in mind, including the following; a pediatric patient’s physiologic response to injury is different. Effective communication with a child is not always possible. Physical examination findings become more important in children.

Tertiary survey is usually done after completing primary and secondary survey to ensure that there are no missed injuries. It involves repeating primary and secondary surveys, reviewing the laboratory and radiological findings.

2.4 Diagnosis

2.4.1 Laboratory investigations

2.4.1.1 Full hemogram

Complete blood count is important in all patients of BAT. The presence of massive hemorrhage may be obvious from hemodynamic parameters, and an abnormal hematocrit value merely confirms the diagnosis. Normal hemoglobin and hematocrit results do not rule out significant hemorrhage. Transfusion is usually recommended for patients who have relatively normal hematocrit results (i.e., >30%) but have evidence of clinical shock, serious injuries (e.g., open-book pelvic fracture), or significant ongoing blood loss(Ruf, Manner, Friedl, & Meybier, 1988). Hemodynamic instability in an adult despite the administration of 2 L of fluid over a period of 30 minutes indicates ongoing blood loss and is an indication for immediate blood transfusion. Platelet transfusions is used to treat patients with thrombocytopenia (i.e., platelet count < 50,000/μL) and ongoing hemorrhage(Gansslen, Hildebrand, & Pohlemann, 2012). An elevated white blood cell (WBC) count on admission is nonspecific and does not predict the presence of a hollow viscus injury (HVI). The diagnostic value of serial WBC counts for predicting HVI within the first 24 hours after trauma is very limited(Schnuriger et al., 2010).

2.4.1.2 Serum chemistries

Serum chemistries are not commonly used for patients who are less than 40 years of age. Selection should be based on the patient's medications, the presence of concurrent nausea or vomiting, the presence of dysrhythmias, or a history of renal failure or other chronic medical problems associated with electrolyte imbalance(Hall, 2010). Serum chemistries that measure serum glucose and carbon dioxide levels are

indicated. Rapid bedside blood-glucose determination, obtained with a finger-stick measuring device, is important for patients with altered mental status.

Liver function tests (LFTs) may be useful in the patient with blunt abdominal trauma; however, test findings may be elevated for several reasons (e.g., alcohol abuse).One study has shown that an aspartate aminotransferase (AST) or alanine aminotransferase (ALT) level more than 130 U corresponds with significant hepatic injury(Sahdev, Garramone, Schwartz, Steelman, & Jacobs, 1991; Tian et al., 2012).Lactate dehydrogenase (LDH) and bilirubin levels are not specific indicators of hepatic trauma.

The serum lipase or amylase level is neither sensitive nor specific as a marker for major pancreatic or enteric injury. Normal levels do not exclude a major pancreatic injury. Elevated levels may be caused by injuries to the head and face or by an assortment of nontraumatic causes (e.g., alcohol and narcotics)(Kumar et al., 2012). Amylase or lipase levels may be elevated because of pancreatic ischemia caused by the systemic hypotension that accompanies trauma. However, persistent hyperamylasemia or hyperlipasemia (e.g., abnormal elevation 3-6 hours after trauma) should raise the suggestion of significant intra-abdominal injury and is an indication for aggressive radiographic and surgical investigation (Mahajan et al., 2014).

2.4.1.3 Grouping and cross matching

Blood from all trauma patients with suspected blunt abdominal injury should be grouped and cross matched. This practice greatly reduces the time required for cross-matching. An initial cross-match should be performed on a minimum of 4-6 units for those patients with clear evidence of abdominal injury and hemodynamic instability. Until cross-matched blood is available, O-negative or type-specific blood should be

used("Guidelines for compatibility testing in hospital blood banks. A joint publication of the British Society for Haematology and the British Blood Transfusion Society," 1987).

2.4.1.4 Blood gas analysis

Arterial Blood Gas (ABG) values may provide important information in major trauma victims. In addition to information about oxygenation, this test provides valuable information regarding oxygen delivery through calculation of the alveolar-arterial. ABG determinations also report total hemoglobin more rapidly than CBCs. Attempt to improve systemic oxygen delivery by ensuring an adequate SaO_2 and by acquiring volume resuscitation with crystalloid solutions and, if indicated, blood(McNamara & Worthley, 2001).

2.4.1.5 Toxicology

Drug and alcohol screening should be performed on all trauma patients with altered level of consciousness .Breath or blood testing may quantify alcohol level. Urine studies; Blood in urine is an indicator of trauma to the urogenital structure and is usually associated with severe intra-abdominal injuries. Occult blood in urine could be from the kidneys or the urinary bladder (van der Vlies et al., 2012). Urine should also be taken for pregnancy test in female patients of child bearing age.

2.4.1.6 Thromboelastography

Thromboelastography is a method of testing the efficiency of coagulation in the blood. It is used to evaluate platelet function. This includes: Speed of clot formation, potential for hypercoagulable states, accelerated clot breakdown, clot strength and Partial assessment of components of clotting process. Transfusion of allogenic blood products is associated with increased morbidity and mortality. Most patients with

blunt abdominal injury who present with hemodynamic instability will likely require blood transfusion and thus the need for Thromboelastography guided treatment of traumatic hemorrhage(Brenni, Worn, Bruesch, Spahn, & Ganter, 2010; Grassetto et al., 2012) .

2.4.1.7 Gastric intramucosal PH

Blunt abdominal trauma is usually associated with increased intraabdominal pressure with resultant abdominal compartment syndrome(Nicolau, 2011).

This is accompanied by a decrease in gastric mucosal PH and lactic acidosis due to impaired mucosal perfusion. Measurement of gastric intramucosal PH therefore can be used as a predictor of severity of abdominal trauma(Herbert, Holzer, & Roewer, 2012).

2.4.2 Radiological investigations

2.4.2.1 X rays

Plain radiograph is used to detect pelvic fractures, pneumothorax, ruptured hemi diaphragm, rib fractures. Plain radiography is important since several systems are usually involved in blunt abdominal injury (Fu et al., 2009; Matsevych, 2008).

2.4.2.2 Ultrasound

Bedside ultrasonography is a rapid, portable, noninvasive, and accurate examination that can be performed by emergency clinicians and trauma surgeons to detect hemoperitoneum. The FAST examination is based on the assumption that all clinically significant abdominal injuries are associated with hemoperitoneum (Brasel, Olson, Stafford, & Johnson, 1998). The detection of free intraperitoneal fluid is based on factors such as the body habitus, injury location, presence of clotted blood, position of the patient, and amount of free fluid present. Hollow viscous injury (HVI)

rarely is identified; however, free fluid may be visualized. The basic four-view examination (**perihepatic, perisplenic, pelvic, and pericardial views**) has become the foundation of the FAST examination. In the supine patient, the hepatorenal space is the most dependent area and the least obstructed for fluid flow. Fluid in the abdomen can move freely up the right pericolic gutter into this space.

The left pericolic gutter is higher and the phrenicocolic ligament blocks the flow; consequently, fluid tends to flow to the right pericolic area. On the right, fluid flows into Morison's pouch, the potential space in the hepatorenal recess. On the left, fluid flows preferentially into the subphrenic area and not into the splenorenal area, this is important because the subphrenic area may be difficult to visualize due to bowel gas and splenic flexure gas. Fluid in the pelvic region flows to the retro vesicular area in the male patient and to the pouch of Douglas in the female patient because these areas are the most dependent areas of the pelvis(Standring, 2008). Given these anatomic relationships, the FAST examination has evolved into three to five intraperitoneal views and one cardiac view. Ultrasonography has proved to be a thoroughly reliable, cost efficient, and noninvasive modality in primary evaluation and follow-up of blunt abdominal trauma(Afshin Mohammadi & Mohammad Ghasemi-rad, 2012).

2.4.2.3 CT Scanning

CT scanning often provides the most detailed images of traumatic pathology and may assist in determination of operative intervention. In hemodynamically stable patients, CT accurately predicts whether invasive therapy is urgently needed by identifying active hemorrhage of hepatobiliary, splenic, pancreatic, genitourinary, intestinal or diaphragmatic injury(Radwan & Abu-Zidan, 2006). CT scanning, unlike DPL or FAST, has the capability to determine the source of hemorrhage. In addition, many retroperitoneal injuries go unnoticed with DPL and FAST examinations.

Predictive factors of intraabdominal injury that may require CT evaluation include; abnormal chest, abdominal, pelvis X ray .Abnormal abdominal, pelvic examination. Abnormal FAST. Intubation and/or GCS<14.Multiple injuries .Long bone fractures. Costal margin tenderness. Seat belt sign. Hematuria. Hematocrit<30%.AST>110 iu/l and ALT>63 iu/l. For selected patients, endoscopic retrograde cholangiopancreatography (ERCP) may complement CT scanning to rule out a ductal injury(Anand, Ferrada, Darwin, Bochicchio, & Scalea, 2011).

2.4.2.4 Laparoscopy

Diagnostic laparoscopy involves placing a sub umbilical or subcostal trocar for the introduction of the laparoscope and creating other ports for retractors, clamps, and other tools necessary for visualization of the repair. Laparoscopy has gained widespread acceptance as a useful tool in the diagnosis and management of patients with blunt abdominal injuries. It was first used for a trauma patient in 1956 by Lamy, who observed two cases of splenic injury and later, it was noted that laparoscopy is useful for determining the need for laparotomy (Memon et al., 2013).

2.4.3 Diagnostic peritoneal lavage

Diagnostic peritoneal lavage is used as a method of rapidly determining the presence of intraperitoneal blood (Githaiga & Adwok, 2002). It is particularly useful if the history and abdominal examination of an unstable patient with multisystem injuries are either unreliable (e.g., because of head injury, alcohol, or drug intoxication) or equivocal (e.g., because of lower rib fractures, pelvic fractures, or confounding clinical examination)(Bamvita, Bergeron, Lavoie, Ratte, & Clas, 2007). DPL is also useful for patients in whom serial abdominal examinations cannot be performed (e.g., those in an angiographic suite or operating room during emergency orthopedic or neurosurgical procedures).DPL is indicated for the following patients in the setting of

blunt trauma: Patients with a spinal cord injury, those with multiple injuries and unexplained shock, obtunded patients with a possible abdominal injury, intoxicated patients in whom abdominal injury is suggested.

The only absolute contraindication to DPL is the obvious need for laparatomy. Relative contraindications include morbid obesity, a history of multiple abdominal surgeries, and pregnancy(Rosen, Legome, & Wolfe).

2.5 Management of specific organ injuries

2.5.1 Splenic injury

Splenic injury is the most common indication for laparatomy following BAT. Blunt splenic injuries result from compression or deceleration due to a variety of mechanisms, from falls to motor vehicular accidents. The spleen receives approximately 5% of cardiac output, primarily through the splenic artery, making any splenic bleeding potentially life threatening. The splenic artery usually bifurcates into superior and inferior polar arteries, and the spleen has an open microcirculation without endothelium. Clinical presentation of splenic injury may vary widely. Of importance is the presence of referred left shoulder pain (Kehr's sign) as well as the association of splenic injury with left lower rib fractures (ribs 9 through 12)(Klimpel, 2004). In fact, up to 25% of patients with left lower rib fractures can have some degree of splenic injury. In modern trauma practice, more and more splenic injuries are treated nonoperatively. If hemodynamically stable, adult patients with lower grade splenic injuries (grades I and II) can most often be treated nonoperatively. Grade III splenic injuries can be treated nonoperatively, based on patient stability and reliability of the physical examination. Even very severe splenic injuries, associated with significant hemoperitoneum, have been successfully managed nonoperatively .There is evidence that nonoperative management of splenic injury that rapidly stabilizes

with little fluid or blood replacement is successful in 80% to 90% of cases(Stassen et al., 2012).

Computed tomographic findings that may predict failure of non-operative therapy include the presence of large hemoperitoneum, as well as the presence of radiographic 'blush'. Nonoperative treatment of splenic injuries fails in approximately 15-20% of adults. Because of that, patients with significant splenic injuries treated nonoperatively should be observed in the intensive care unit for 48 hours and have immediate access to CT imaging, angiography, and/or the operating room.

2.5.2 Hepatic injuries

Though hepatic and splenic injuries still represent the most common injuries in BAT, the liberal use of high resolution CT scanning has showed that the liver and not the spleen is the commonest solid organ injured in blunt abdominal trauma(Soto & Anderson, 2012).Modern imaging techniques, more than ever, are able to demonstrate small, otherwise undetectable hepatic injuries. Because physical examination is often unreliable in the blunt trauma patient, up to 40% of liver injuries may be missed on physical examination. Therefore, in hemodynamically stable blunt trauma patients, computed tomography is preferred. Most hemodynamically stable patients with hepatic trauma can be treated nonoperatively, provided that no other injuries that require laparatomy are present. Predictors of decreased success of non-operative management include large hemoperitoneum, arterial 'blush' or pooling of contrast, as well as high grade (IV and V) injuries. The criteria of non-operative treatment of blunt hepatic trauma include hemodynamic stability, absence of peritonitis, reliable examination neurologically intact patient, delineation of the injury by CT and radiological absence of other operative injuries, less than two units of packed red blood cells transfused for the injury, as well as CT documentation of resolution of the

injury. In addition, posterior right hepatic lobe and ‘split liver’ injuries (where seemingly extensive injury occurs along a relatively a vascular plane) can usually be managed nonoperatively(Swift & Garner, 2012).

Observation of patients with blunt hepatic injury depends mainly on injury grade. Grade I and II injuries can generally be observed on the ward. Injuries of grades III and above should be observed in the intensive care unit for the first 48 hours. Observation includes serial hematocrit determinations, 3 to 5 days of bed rest, and a follow-up CT scan at approximately 48 hours post-injury for injury grades III or higher. Most liver injuries treated nonoperatively heal by 8 to 12 weeks.

2.5.4 Duodenal injuries

Nonoperative management of duodenal injuries is largely limited to isolated contusions due to blunt trauma. Intramural duodenal hematomas, which are more common in children than in adults, can be managed nonoperatively. In these patients, a follow-up upper gastrointestinal series with gastrografin should be performed every 7 days if the obstruction persists clinically (Ben Hassine et al., 2010). Other components of therapy in nonoperatively treated duodenal injuries include nasogastric suction and intravenous alimentation. The usually accepted time limit to nonoperative management is 2 to 3 weeks. In one study, 57% of duodenal injuries were managed nonoperatively(Huerta, Bui, Porral, Lush, & Cinat, 2005).

2.5.5 Bladder injuries

Bladder injuries following blunt trauma are rare, constituting less than 2% of surgical abdominal injuries.

The relative rarity of these injuries has been attributed to the protected position of the bladder deep in the bony pelvis, which also makes bladder injury a marker for other severe injuries, and significant associated mortality(Guttmann & Kerr, 2013). Bladder

injuries following blunt trauma are significantly associated with pelvic fractures, with over 80% of patients with bladder injuries having a pelvic fracture, and approximately 10% of patients with pelvic fractures having a bladder injury. Majority of patients with bladder injury present with gross hematuria, although a small minority will only have microscopic hematuria. Gross hematuria is felt to be associated with more significant injury (i.e., bladder rupture) while microhematuria has been seen commonly with bladder contusions or hematomas. The algorithm for management of suspected urinary tract injury starts with proper history and physical examination. Lower abdominal pain, tenderness, and bruising over the lower abdomen and perineum may be present. However, these signs and symptoms may be difficult to discern from the findings associated with pelvic fractures. Some intraperitoneal bladder injuries are discovered when a urethral catheter fails to return urine. In patients with a delayed diagnosis of bladder injury, fever, absence of voiding, peritoneal irritation, and elevated blood urea nitrogen may be observed. Any patient with these signs and symptoms should have formal cystography to rule out bladder injury. Inspection for blood at the urethral meatus should be performed during routine trauma evaluation, and this sign is present is approximately half of significant urethral injuries. Passage of a urinary catheter should not be attempted in these patients, and an immediate retrograde urethrogram should be obtained to rule out urethral injury.

2.5.6 Renal injuries

Approximately 80% of renal injuries are due to blunt mechanism, and are associated with a 5% incidence of renal loss(Bent et al., 2008). Blunt renal injury is suggested by the mechanism of injury, the presence of hematuria, as well as physical findings and radiography. Computed tomography of renal injuries has evolved to a point where renal injury staging can be done almost exclusively by CT criteria. In the setting of

blunt renal trauma and selected instances of penetrating renal trauma, nonoperative approach may be chosen, starting with careful patient selection as the preliminary step. Exclusion of concurrent injuries is key in choosing nonoperative treatment(Broghammer, Fisher, & Santucci, 2007). The anatomic structure of the kidney lends itself well to nonoperative management in the setting of blunt trauma. The kidney has an end arterial blood supply with a segmental pattern of division that supplies the renal parenchyma(Gray, Standring, Ellis, & Berkovitz, 2005). When subjected to blunt force, renal lacerations tend to occur through the parenchyma. The resulting hematoma may displace renal tissue, but the segmental vessels themselves often are not lacerated. The closed retroperitoneal space around the kidney also promotes tamponade of bleeding renal injuries. Finally, the kidney is rich in tissue factor, further promoting hemostasis after injury via activation of the extrinsic coagulation pathway(Agarwal et al., 2013).

2.6 General principles of management

Management of abdominal trauma can either be operative or non-operative depending on the physical examinations, laboratory findings, radiological findings or the hemodynamic stability of the patient(A. Z. Anadol, Topgul, Gungor, Bilgin, & Kesim, 2007; Phillipo L. Chalya et al., 2012; Musau et al., 2006). The nonoperative care of intraabdominal trauma in the polytraumatised patient greatly depends on imaging techniques.

The hemodynamically unstable patient should undergo expedient sonography to rule out abdominal hemorrhage. In the hemodynamically stable patient however, computer tomography is the modality of choice to evaluate the injured abdomen. Nonoperative treatment can be successful in up to 80% of selected cases(Musau et al., 2006). Adjuncts to nonoperative care include embolisation of the spleen and liver in cases of

arterial bleeding, and endoscopic retrograde cholangio pancreaticography (ERCP) and stenting for injuries to the biliary tree(Leenen, 2009).

The decision on whether to operate or not to operate depends on mainly the hemodynamic stability of the patient and the physiological status of the patient. A FAST scan in hemodynamically unstable patients should determine the need for laparatomy. The sensitivity and specificity of FAST in the detection of hemoperitoneum in hemodynamically unstable patients has been reported as high as 89% with the presence of intraperitoneal fluid outside the pelvic cavity strongly associated with intraabdominal injury. The exceptions to this are in patients with isolated pelvic fluid in women of reproductive age and children. A negative FAST in a hemodynamically unstable patient reliably excludes the abdomen as the source of hemodynamic instability. If FAST results are negative, other causes of hemodynamic instability must be searched during the secondary survey.

2.6.1 Operative management

Therapeutic laparatomy/management is indicated for the critically injured patients who require emergent intervention. This includes patients with liver laceration that require packing or hemostasis , splenic laceration, bleeding renal laceration requiring neprhectomy or embolisation, bleeding mesentery requiring repair and expanding retroperitoneal hematoma .When laparatomy is indicated, broad-spectrum antibiotics are given. A midline incision is usually preferred.

When the abdomen is opened, hemorrhage control is accomplished by removing blood and clots, packing all 4 quadrants, and clamping vascular structures. Obvious hollow viscus injuries (HVIs) are sutured. After intra-abdominal injuries have been repaired and hemorrhage has been controlled by packing, a thorough exploration of the abdomen is then performed to evaluate the entire contents of the abdomen. After

intraperitoneal injuries are controlled, the retroperitoneum and pelvis must be inspected. External fixation of pelvic fractures is used to reduce or stop blood loss. Large or expanding midline retroperitoneal hematomas should be explored, with the anticipation of damage to the large vascular structures, pancreas, or duodenum. Perinephric hematomas that are stable should not be explored. After the source of bleeding has been stopped, further stabilizing the patient with fluid resuscitation and appropriate warming is important. After such measures are complete, perform a thorough exploratory laparatomy with appropriate repair of all injured structures.

Indications for laparatomy include; Hemodynamic instability with evidence of intra-abdominal bleeding (grossly positive DPL or positive FAST), peritoneal signs and Chest radiograph showing evidence of diaphragmatic tear. Diagnostic tests showing: Active extravasation from a major abdominal vessel or a contained hematoma adjacent to a major vessel suggesting injury, solid organ injury with active extravasation, pancreatic injury, hollow viscous injury, intraperitoneal bladder rupture.

2.6.2 General principles of non-operative management of traumatic injuries

Physical examination remains the cornerstone of trauma triage. Peritonitis and/or hemodynamic instability constitute strong indications for emergency laparatomy. The findings of significant traumatic injury can be subtle and the diagnosis of intra-abdominal injury uncertain. Moreover, between 20% and 40% of patients with significant hemoperitoneum have benign abdominal examination upon initial assessment(M. A. Gad et al., 2012). The physical examination has significant limitations in certain situations. For example, the older trauma patient taking medications such as angiotensin converting enzyme inhibitors or beta blocking agents may not manifest the signs of early shock. Similarly, young patients, especially with

short prehospital transport times, may not exhibit signs or symptoms of shock despite the presence of significant internal bleeding. Patients with associated severe head or spinal injury may be difficult to assess. Altered sensorium due to alcohol or other substances may affect the accuracy of clinical assessment. Combative and intoxicated patients pose further diagnostic dilemma, not only due to the lack of reliable physical examination, but also due to the potential danger to health care personnel and lack of cooperation during imaging studies, which require the patient to remain still. Especially challenging is the evaluation of a hemodynamically unstable patient with multiple injuries and 'competing priorities' (i.e., concurrent head injury, aortic injury, pelvic fractures, and extremity trauma). Probability of injury can be estimated from knowledge of the mechanism and confirmation by CT scan may allow observation if the patient is hemodynamically stable. In patients for whom clinical examination is not reliable, special investigations can be crucial in early and accurate triage. Lack of reliable physical examination may constitute a relative contraindication to nonoperative management of traumatic injuries in patients who fall into this 'indeterminate' zone.

Nonoperative management of blunt traumatic injuries is well established, and strategies based on CT scan diagnosis and the hemodynamic stability of the patient are now being widely used in the treatment of solid organ injury, including the liver, the spleen, the kidneys, as well as pelvic injuries. In blunt abdominal trauma (BAT), including severe solid organ injuries, selective nonoperative management has become the standard of care. If the decision has been made to observe the patient and to pursue nonoperative management, close monitoring of vital signs and frequently repeated physical examinations are instituted. An increased temperature or respiratory rate can indicate a hollow viscous perforation or abscess formation. Pulse and blood

pressure can also change with sepsis or intra-abdominal bleeding. Adjunctive laboratory testing, such as serial determination of white blood cell count, hemoglobin and hematocrit levels, and lactic acid level and base deficit can also help determine if the nonoperative approach is failing. The development of peritonitis on physical examination and lack of response to nonoperative treatment, constitute an indication for surgery.

2.6.3 General principles of non-operative management (NOM);

The patient should be alert, responsive and awake, always keep the mechanism of injury in mind, the patient should be examined repeatedly, the patient should be hemodynamically stable and have no obvious indication for laparatomy, maintain high index of clinical suspicion, be very cautious of multiple injured patients, high level of care with round the clock availability of laboratory, radiology and operating theatre.

2.7 Complications of blunt abdominal injury

Early post-operative complications: Thromboembolism, Post-operative bleeding, abdominal abscess, biliary fistula, Post-operative wound suppuration, Post traumatic hepatitis, pulmonary embolism and Sepsis.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Location of the study

The study was carried out at the emergency department and surgical wards of Moi Teaching and Referral Hospital. MTRH is a referral facility catering for the population of entire western Kenya and parts of Eastern Uganda estimated to be 20 million. The Moi Teaching and Referral Hospital is located in an urban setting of Western region of Kenya in Eldoret town, Uasin Gishu County. It is about 320km North West of Nairobi. The hospital is located along the Nandi Road, East of Eldoret town. There are signposts in strategic positions along main roads in the town to guide visitors, clients and patients to the hospital. The hospital has a bed capacity of 800 and an accident and emergency unit that is strategically placed to receive and handle trauma cases.

3.2 Study population

The study population was patients who presented with BAT at the emergency department and those who were admitted to surgical ward for BAT. The target population was patients admitted to surgical wards of MTRH for BAT. The sample population was patients who met the inclusion criteria of this study.

3.3 Study design and sampled population

This was an observational cross sectional study that began on October 2013 and ended in September 2014. Patients with BAT, who met the inclusion criteria, were consecutively recruited into the study until the desired sample size was reached. This involved the use of a structured interviewer administered questionnaire to capture the relevant data of BAT patients presenting for care at the emergency department and surgical unit at MTRH. The patient progress notes and patients medical records were

reviewed, interpreted and summarized into a closed ended questionnaire. Patients and caretakers were also interviewed using a standard questionnaire.

3.4 Variables

3.4.1 Demographics

Demographic details were age in years, sex, residence and level of education. Case number was used to conceal the identity of the participants

3.4.2 Causes of injury

This was either: Road traffic accident, and fall from a height, violence or assault, sports injuries.

3.4.3 Management

The decision on whether to opt for laparatomy or conservative management depended on the hemodynamic stability of the patient, surgeon preference and the laboratory and radiological findings.

3.4.4 Location of injury and associated Injuries

The spleen, liver, kidney and other intraabdominal organs.

Associated injuries included head injury, pelvic fracture, fractured ribs and others

3.4.5 Complications

Wound sepsis, peritonitis, pancreatitis, pulmonary embolism, intestinal obstruction, biliary obstruction, pleurisy, post traumatic hepatitis.

3.4.6 Outcome

The eventual result: morbidity (complications, length of hospital stay) and mortality.

Measured as length of stay in days and mortality as a percentage. Length of stay was the duration from time of admission to time of discharge or death.

3.5 Sample size

This study adopted a census form of sampling after reviewing previous hospital records that indicated that between 40-50 patients are seen yearly for blunt abdominal injury. At the end of the study period a total of 34 patients had been recruited into the study.

3.6 Study procedure and data collection

- Patients with BAT were received at casualty, stabilized according to ATLS protocol
- Eligible patients were identified by the researcher within 24hrs of admission either at casualty or surgical wards
- Written informed Consent/Ascent was obtained
- Interviewer administered questionnaire administered
- Secondary survey /physical examination
- Patients followed up until discharge/death
- Coded questionnaire included patients' characteristics, mechanism of injury
- Secondary survey on associated injuries, management options and complications
- Review of Laboratory results and radiological results length of stay and complications

3.7 Eligibility Criteria.

3.7.1 Inclusion Criteria.

- Patients with BAT who required admission

3.7.2 Exclusion Criteria.

1. Patients who had been operated on in other facilities and were referred for further management

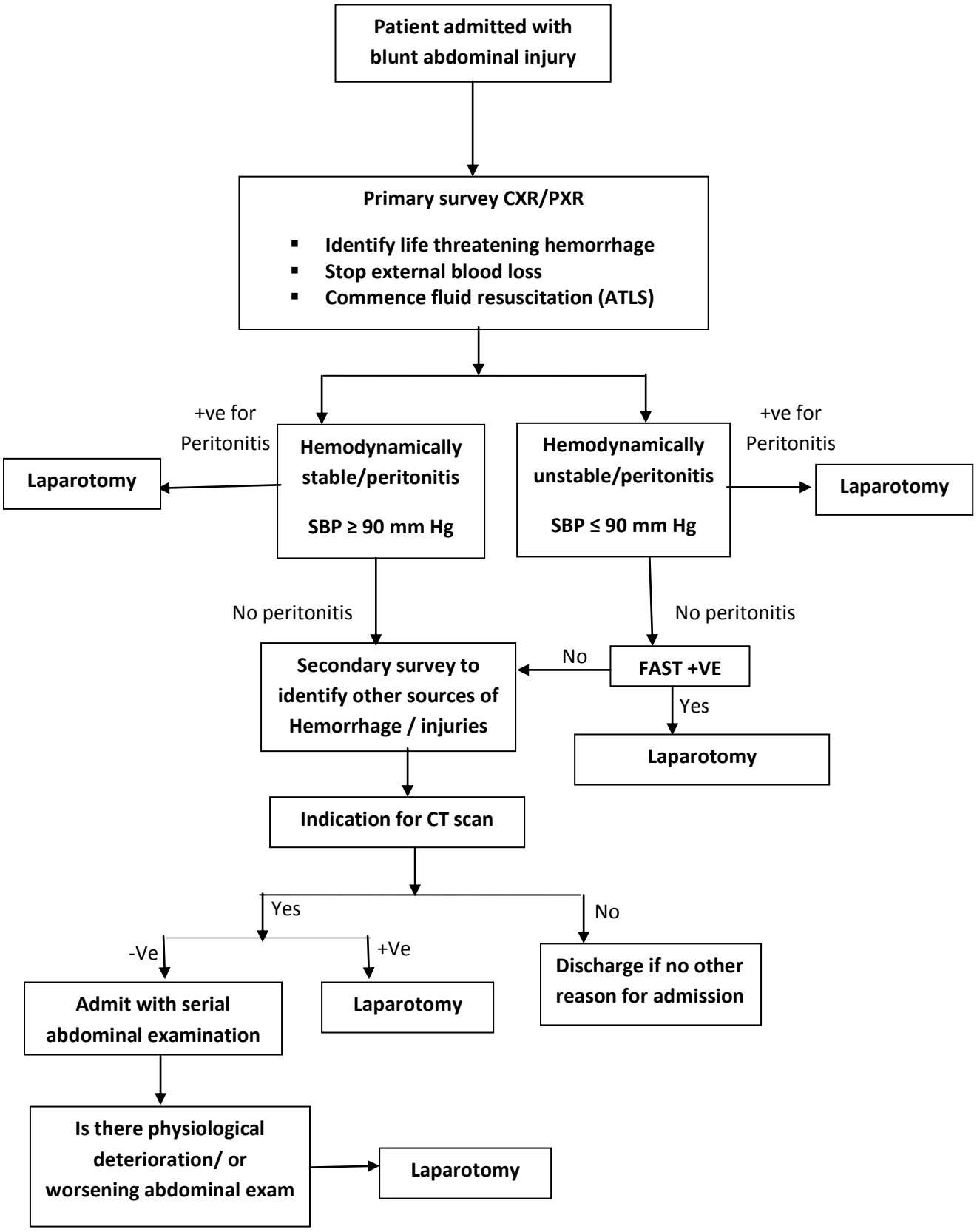

Figure 1: Management algorithm/flow chart

3.9 Quality Control

Development of questionnaire and review of data every day after data collection to check for missing data.

3.10 Data Management

Data was collected using validated and coded questionnaire. Data entry and verification was done by creation of variables for data coding and assigning numerical values for quantitative analysis. Data was checked on regular basis to ensure consistency and that coding and entry was accurate. SPSS version 20 statistical packages was used with defined measurable terms.

Presentation of data: Visual displays such as tables and figures were used to condense information, present it in a clear format, and highlight underlying relationships and trends.

3.11 Ethical considerations

The IREC approval was sought before starting this investigation (IREC approval number 1067). The patients were informed on the benefits of the study in a language that they fully understood and his/her written consent sought. For those below 18 years of age, consent was sought from the parent or legal guardian. Assent was however sought for those children who were below 18years but could comprehend the on goings of the study. This was voluntary participation and no patient was denied treatment whether s/he gave consent or not. The confidentiality of data was maintained during and after the research by use of serialization and use of a password only known to the investigator. Those who wished to withdraw from the study were free to do so without affecting their medical care at any point of the study. The identity of the participants was protected by use of case numbers instead of in patient numbers or names, and this was used from the beginning to the end of the study.

3.12 Limitation of Study

This was a hospital based study that took place within MTRH and lasted for a period not more than one year and thus the small sample size of 34 participants. Although acceptable statistically (minimum number is 25participants) the ability of the study to derive strong associations between variables and outcome is hampered by the small sample size. Future studies that can be done retrospectively or longer period prospective studies can be done to overcome this small sample size and derive stronger associations between variables and outcomes.

CHAPTER FOUR: RESULTS

Introduction

The results presented here are based on 34 patients who presented to MTRH with blunt abdominal trauma for a period of one year (between October 2013 and September 2014).

Demographics

The age of the patients ranged from 3 years to 65 years with mean of 28.4(SD 15.7) years and a median of 29(IQR 13, 36) years.

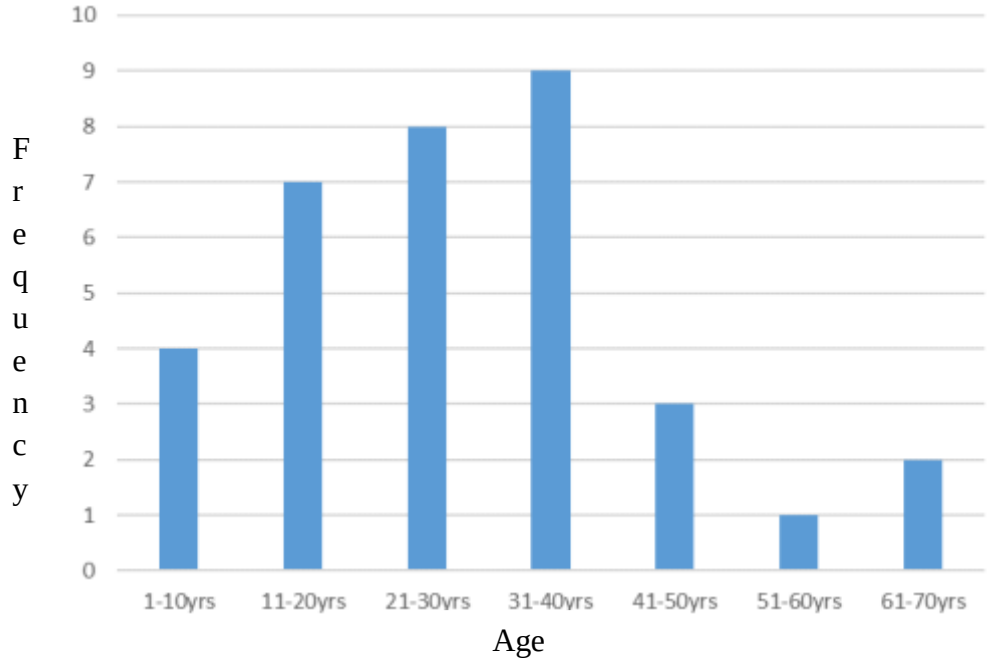

Figure 2: Age distribution

The most affected age is from 11yrs to 40yrs which constitutes the productive age group of the society.

Table 1: Comparison of age distribution

Age group	**Present Study (%) (n = 34)**	**Panchal et al (n = 50)**	**Musau P et al (n = 74)**
1 – 10	04 (11.8 %)	02 (04%)	-
11 – 12	07 (20.6 %)	09 (18%)	12 (16.3%)
21 – 30	08 (23.5 %)	18 (36%)	41 (53.8%)
31 -40	09 (26.5 %)	12 (24%)	15 (22.5%)
41 -50	03 (8.8 %)	05 (10%)	03 (3.7%)
51 – 60	01 (2.9 %)	03 (06%)	03 (3.7%)
› 60	02 (5.9%)	01 (02%)	-
Total	**34 (100 %)**	**50 (100%)**	**74 (100 %)**

The present study and previous studies indicate that blunt abdominal trauma affects the most productive age group of the society. There were 9 patients (26.5%) in the 31-40 age group in the current study whereas the other studies showed that majority of their patients were in the 21-30 age group.

Table 2: Mean and male to female ratio

Sex	**Present Study**	**Musau P et al**	**Mehta et al**
Male	29 (85.3%)	74 (92.5%)	56(79%)
Female	05 (14.7%)	06 (7.5%)	15 (21%)
Total	**34 (100%)**	**80(100%)**	**71 (100%)**
M:F Ratio	**5.8:1**	**12.3:1**	**3.7:1**
Mean	**28.4**	**28.2**	**25**

There is an obvious male preponderance in blunt abdominal trauma. Males in this study constituted 85.3% of the participants while Musau's study had 92.5% of the participants being males.

Table 3: Demographics characteristics

Variable	Category	Frequency	Percentage
Sex	Male	29	85.29
	Female	5	14.71
Residence	Uasin Gishu	13	38.24
	Nandi	5	14.71
	Baringo	4	11.76
	Elgeyo marakwet	3	8.82
	Kakamega	3	8.82
	Busia	3	8.82
	Others	3	8.82
Occupation	Employed	2	5.88
	Unemployed	32	94.12
Education level	None	1	2.94
	Primary	18	52.94
	Secondary	13	38.24
	Tertiary	2	5.88

Males constituted 85.3% (29) of the participants compared to females 14.7 %(5).Of the total participants 38.2%(13) came from Uasin Gishu followed by Nandi 14.7%(5) and the other neighboring counties of Baringo 11.8%(4),Elgeyo marakwet,Kakamega, Busia and others each at 8.8%(3,3,3,3).

Table 4: Causes of BAT

Injury mode	Frequency	Percent
RTA	**16**	**47.06**
Fall	**9**	**26.47**
Assault	**4**	**11.76**
Falling object	**3**	**8.82**
Hit by a cow	**1**	**2.94**
Sports	**1**	**2.94**
Total	**34**	**100**

Table 5: Comparison of causes of injury

Mode of Injury	Present Study (n = 34)	Smith J et al (n = 1224)	Mehta et al (n = 71)	Musau P et al (n = 27)
Road Traffic accident	16 (47.1%)	742 (60.6%)	38 (53%)	12(44.4%)
Fall	09 (26.5%)	85 (6.9%)	30(43%)	04 (14.8%)
Assault	04 (11.8%)	201(16.4%)	03 (04%)	10 (37.0%)
Others	05 (14.7%)	-	-	01 (3.8%)

RTA contributed for 47.1% of the injuries followed by fall 9(26.5%), others (sports 1, cow 1, and falling tree 3) contributed for 14.7% of the blunt abdominal injuries. Other studies have also demonstrated that road traffic accidents are the commonest cause of blunt abdominal trauma.

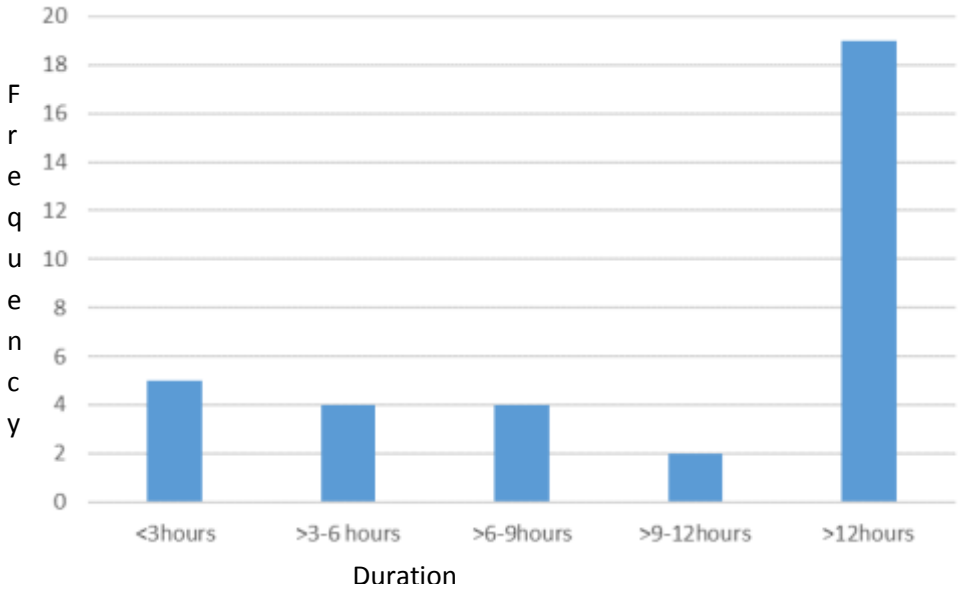

Figure 3: Duration before presentation

Those patients who were brought to hospital before 3hours included 5 (14.7%) of the participants, whereas the rest of the patients 29(85.3%) were hospitalized after 3hours.

Table 6: Clinical presentation at admission

Variable	Category	Frequency	Percentage
Symptoms	Pain	34	100.00
	Vomiting	11	32.35
	Distention	7	20.59
	Nausea	3	8.82
Signs	Tenderness	31	91.18
	Guarding	12	35.29
	Hematuria	3	8.82
	Seat belt sign	1	2.94

Pain was present for all patients, and 3(8.2%) patients experienced nausea at admission. Tenderness was present in 31(91.2%) participants. Hematuria and guarding was observed in 3(8.8%) and 12(35.9%) patients respectively. Seat belt sign was present in 1(2.9%) patient.

Table 7: Comparison of clinical presentation

Clinical Presentation	Present Study (n = 34)	Siddique et al (n = 50)	Panchal et al (n = 50)
Abdominal Pain	34 (100%)	46 (92%)	49 (98%)
Abdominal Distention	07 (20.6%)	14 (28%)	25 (50%)
Vomiting	11 (32.4%)	11 (22%)	06 (12%)
Hypotension (sys BP < 90mmHg)	04 (11.8%)	20 (40%)	20 (40%)
Tachycardia pulse>90bpm	11 (32.3%)	24 (48%)	40 (80%)
Hematuria	03 (8.8%)	02 (4%)	05 (10%)
Seat belt sign	01(2.9%)	-	-
Tenderness	31 (91.2%)	-	-
Guarding	12 (35.3%)	-	-

Table 8: Vitals at admission

Variable	Category	Frequency	Percentage
Blood pressure (systolic)	Low (<90 mmHg)	4	11.76
	Normal (90-120 mmHg)	30	88.23
Pulse rate	Normal (≤100 b/min)	23	67.65
	Tachycardia (>100 b/min)	11	32.35
Temperature	Low (<36.5^{o} C)	18	52.94
	Normal (36.5-37.5^{o} C)	16	47.06
Respiratory rate	Normal (12-20)	18	52.94
	High (>20)	16	47.06

Blood pressure was normal for (88.2%) 30 of the patients. Tachycardia was observed in 32.4% (11) of the participants. Hypothermia occurred in 18(52.9%) of the patients, while respiratory rate was high for 16(47.1%) patients.

Table 9: Vitals at admission and outcome of management

	Normal Vital signs		**Abnormal vital signs**	
	Discharged	Died	Discharged	Died
Blunt Abdominal Injury	30	0	3	1

None of the patients with normal vital signs died during the study period. A patient with abnormal vital signs at admission has a 30% chance of death

Table 10: Lab Investigations

Variable	**Category**	**Frequency**	**Percentage**
Hematocrit	Low (<36 %)	16	47.06
	Normal (36.0%-54.9%)	18	52.94
WBC	Normal (4.5-11.0x10^9/l)	15	44.12
	Elevated (>11.0x10^9/l)	19	55.88

Table 11: Radiological Investigations

Radiological Investigation	Frequency	Percentage	+ve for Injury	+ve percentage
U/S Abd	10	29.4%	8	80%
X- ray	14	41.2%	7	50%
CT Scan	4	11.8%	4	100%

Table 12: location of injury and type of surgery done

Organ involved	Number (n)	Type of Surgery
Mesentery	5	Repair / resection of involved segment of gut
Small intestine	4	Resection and anastomosis /ileostomy
Stomach	2	Repair in layers
Duodenum	1	Bypass surgery /primary repair
Ileum	1	Resection and primary anastomosis
Spleen	6	Splenectomy(6)
Liver	5	Packing (3)
		Conservative management (2)
Kidney	3	Nephrectomy (1)
		Expectant Management (2)
Total	27	

The spleen (24%) was the commonest injured solid organ in blunt abdominal injury with splenectomy being done for all splenic injuries. Majority of patients with splenic injuries presented to hospital early with hemodynamic instability that was not responsive to fluid resuscitation

NB; although the total number of patients who underwent laparotomy was 16 the total number of involved organs is more than this number because a single patient could have more than one injured organ.

The choice of procedure to be done intraoperatively depended on the severity of solid organ injury, organ injured, level of contamination of the abdominal cavity from gut content and the general condition of the patient.

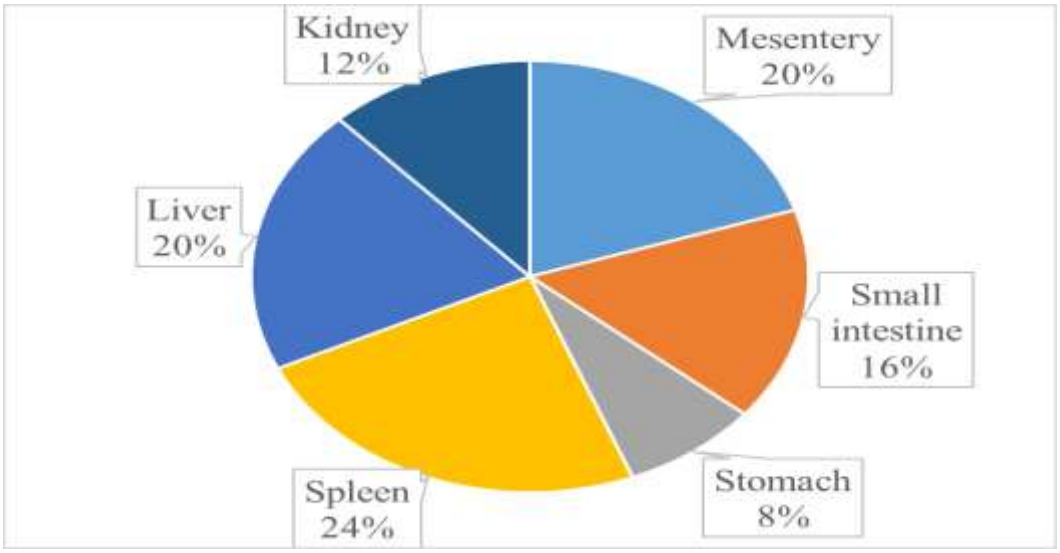

Figure 4: Location of injury

Table 13: Associated injuries

Associated injuries	**Present Study (n = 34)**	**Ayoade BA et al (n = 77)**	**Davis J et al (n = 437)**	**Masau P et al (n = 80)**
Thoracic	05 (14.5%)	06 (7.8%)	120 (27%)	17(21.3%)
Neurological(head injury)	-	02 (2.6%)	41(9.4%)	07 (8.8%)
Pelvic fracture	01 (2.9%)	14(18.2%)	15 (03%)	01 (1.3%)
Spine fracture	02 (5.9%)	-	03 (0.7%)	01(1.3%)
Limb fracture	-	-	-	02 (2.6%)
Bladder injury	01 (2.9%)	-	-	-
None	25 (73.5%)	-	-	52(65%)

There were 9 (26.5%) patients who had other associated injuries. This included ribs fractures 8.8%(3), spine fractures 5.9%(2) , chest injuries 5.9%(2) , pelvic fracture 2.9%(1) and bladder injury 2.9%(1).

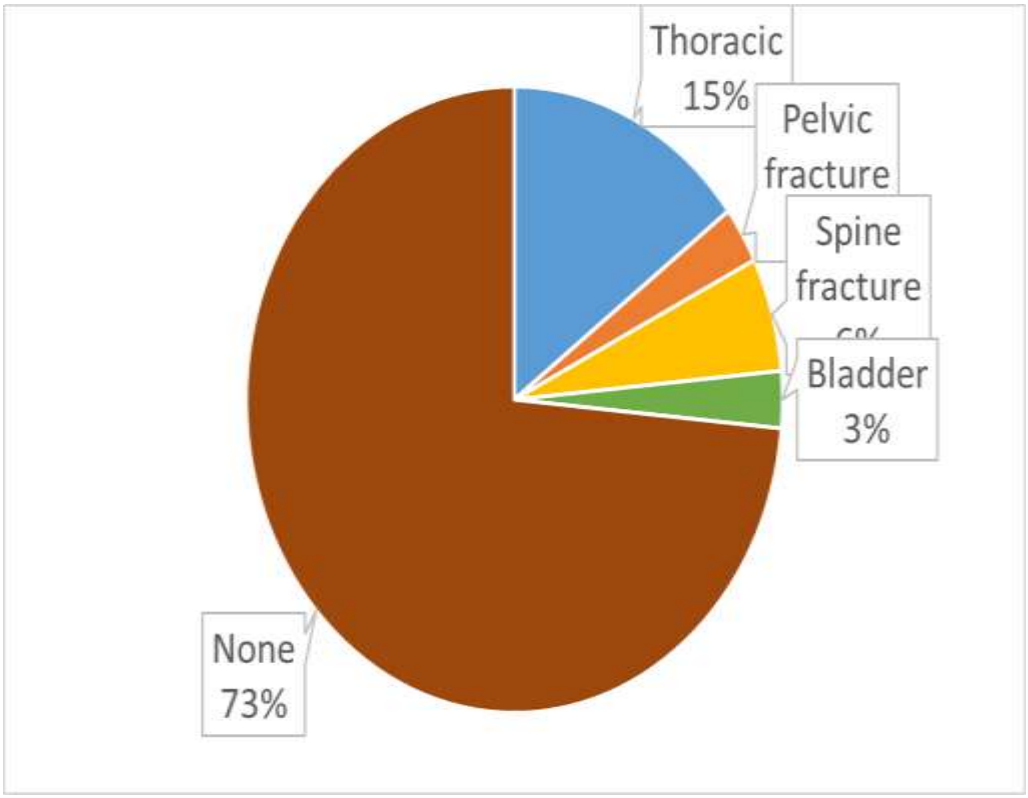

Figure 5: Associated injuries

Table 14: Operative mode of management

Variable	Category	Frequency	Percentage
Result	Positive	16	100
	Negative	0	0
Indication for laparatomy	Radiological findings	13	81.3
	Physical examination	16	100
	Hemodynamic instability	6	37.5
	Laboratory findings	5	31.3
	Multiple injuries	5	31.3
Decision maker	Resident	10	62.5
	Consultant	6	37.5
Surgery type	Primary	14	87.5
	Surgery after cons mgt	2	12.5
Duration before primary surgery	<3hrs	4	25.0
	4-6hrs	4	25.0
	7-9hrs	1	6.2
	9-12hrs	0	0
	13-15hrs	1	6.2
	>15hrs	6	37.5

All the laparotomies done were positive, meaning internal abdominal injuries were noted at the time of surgery therefore giving a negative laparotomy rate of 0%. A total of 16 patients were operated giving an operative management rate of 47%. Patients initially managed non-operative were 18 giving a NOM rate of 53%. Two patients failed in the NOM group giving NOM failure rate of 11.11%.

Table 15: Resuscitative or auxiliary management modality (n=18)

Variable	Category	Frequency	Percentage
Result	Intravenous fluids	18	100
	Blood transfusion	2	11.1
	Nasogastric suction	1	5.6

All patients who underwent conservative management received intravenous fluids, antibiotics, analgesics and nasogastric suctioning. Two patients received blood transfusion. One patient received a unit of blood while the other received two units. Indication for transfusion was hypotension secondary to blood loss not responsive to crystalloids. Out of the two patients who received blood transfusion one of them died giving a 50% chance of death if a patient requires blood transfusion after blunt abdominal trauma.

Table 16: Management outcome

Variable	**Category**	**Frequency (n=34)**	**Percentage**
Complications	**None**	**30**	**88.2**
	Wound sepsis	**2**	**5.9**
	Pneumonia	**2**	**5.9**
Discharge	**Alive**	**33**	**97.1**
	Died	**1**	**2.9**

On average patients took 6 days (IQR 4, 12) in the ward before discharge. Complications happened in 4(11.8%) patients. One patient was admitted to ICU and later succumbed to his injuries giving an overall mortality rate of 2.9%.

Table 17: Association between various variables and outcome

Variable	Category	Outcome		P-value
		Without Complications	With Complications	
Duration before presentation	Upto12 hours	13	2	>0.999 [f]
	>12 hours	17	2	
Age (yrs)	Median (IQR)	29(13, 36)	30(16, 41.5)	0.851[m]
Associated injuries	No	23	2	0.281[f]
	Yes	7	2	
Hemodynamically instability	No	25	3	0.559[f]
	Yes	5	1	
Duration before surgery	Within 3 hours	2	2	0.245[f]
	>3 hours	10	2	
Number of involved organs	0	12	1	0.275[f]
	1	14	1	
	2	4	2	
Injury mechanism	RTA	14	2	>0.99[f]
	Non-RTA	16	2	

[F] Fisher's Exact test; [m] Mann-Whitney test

NB: A variable outcome was created where all those who had either of the following: sepsis, thromboembolism, sepsis, death admission to ICU were regarded as having "bad outcome".

Association between outcome and other variables like duration before presentation, age, associated injuries, hemodynamically stability, duration before surgery, number of involved organs and injury mechanism was tested and none were statistically significant ($p>0.05$).

CHAPTER FIVE: DISCUSSION

5.1 Introduction

Trauma remains a leading cause of morbidity and mortality the world over. Management of BAT is challenging even to the best traumatologist. Abdominal findings may be absent in as many as 40% of patients with hemoperitoneum.

Occasionally clinical evaluation of blunt abdominal injuries may be masked by other more obvious external injuries. Negative laparotomies can be significantly reduced with proper and timely application of imaging methods in BAT patients along with physical examination.

Abdominal injury is often associated with extra abdominal injuries. It is therefore important to look out for associated injuries of the thorax, head and extremities.

5.2 Demographics

The results presented here are those of 34 patients who presented to MTRH with BAT for a period of one year between October 2013 and September 2014. This small sample size is comparable to a similar study by Musau et al(Musau et al., 2006) that was done in Kenyatta national hospital between Nov 2004 to February 2005 approximately 10years apart where the total number of patients were 27 patients with BAT.

The ages of patients ranged from 3years to 65 years with a mean of 28.4 (SD 15.7) and a median of 29years (IQR 13, 36). This compares well with other studies by Asaguo et al(Maurice et al., 2012) (2010) done at University of Calabar Teaching hospital, Nigeria where they found a mean age of 28.4 years. Young people have been found to be affected more as they are the mobile population who move from one place to the other in order to cater for their family needs.

In this study there were more males than females with a male to female ratio of 5.8:1.While the actual ratios may vary from study to study male dominance stands out and similar studies done locally have shown a male predominance in cases of blunt abdominal trauma. Musau et al (Musau et al., 2006)demonstrated a male to female ratio of 12.1:1, whereas Asaguo(Maurice et al., 2012) reported a male to female ratio of 5.3:1. In this era of women embracing jobs that were previously thought belong to men we are likely to see a change in the ratios in future studies.

Majority of the participants were from Uasin Gishu County and the surrounding counties .Most of the subjects were not in formal employment at 94.1 %. Nyongole et al in Tanzania demonstrated that 42.3% of patients were ordinary traders(OV Nyongole, 2013).

It was also noted that majority of the participants had attained primary education only (53%) and this is in keeping with findings by Zargar (Iran) who established that majority of trauma patients had lower level of education(Zargar, Modaghegh, & Rezaishiraz).

5.3 Presentation

Abdominal pain and vomiting were the main presenting symptom at 100% and 32.4% respectively. Tenderness and guarding was seen in 91.2% and 35.3% respectively. Gupta et al in India demonstrated abdominal pain and vomiting as the main presenting feature(Gupta et al., 1996).

The duration before hospitalization has been shown to influence the outcome of management of trauma patients. In our set up this did not seem to influence the outcome. Nineteen patients (55.9%) presented to the hospital more than 12hrs after the injury. This can be explained by the fact that majority of the severely injured patients don’t survive the poor infrastructure and long duration of travel and therefore

they do not arrive at the facility. In a study by Mnguni et al in Durban the mean prehospital delay was 8.2 hrs. (Mnguni, Muckart, & Madiba, 2012). This however did not influence the outcome and neither was it a predictor of outcome. However in a study by Musau et al they found out that delayed presentation to hospital contributed to mortality(Musau et al., 2006).

Majority of patients had normal vitals at admission meaning that majority of these patients were hemodynamically stable. Similar findings were demonstrated by Musau in his study where 80% of the patients had normal vital signs at admission(Musau et al., 2006).

5.4 Investigations

To aid in decision making both invasive and non-invasive investigations can be put into use. This includes laboratory investigations, laparoscopy diagnostic peritoneal lavage (DPL), ultrasound focused abdominal sonography for trauma (FAST), CT scan plain abdominal x-ray and contrast studies. DPL in previous studies was initially superior to radiology and like laparoscopy requires stable patients and is invasive .Githaiga and Adwok in KNH found DPL to be easy to perform, cheap and highly effective in diagnosing the injured abdomen in need of laparotomy. The use of DPL in diagnosis of blunt abdominal trauma has been rendered obsolete with the advent of the more superior CT scan and Magnetic Resonance Imaging (MRI).

CT scan is now the diagnostic modality of choice for hemodynamically stable patients to rule out extra peritoneal injuries and grading of solid organ injuries that can be managed conservatively.

In this study all the patients seen at the emergency department underwent resuscitation and primary survey according to ATLS protocol. Erect abdominal x-ray was done in 14 (41.2%) patients while CT scan done for 4 patients (11.8%).

Abdominal radiograph may provide indirect evidence of hollow viscous injury by showing air or gas in the peritoneum but lacks sensitivity and specificity. Despite MTRH being a level 6 referral facility patients underwent abdominal ultrasound at the radiology department instead of FAST at the emergency department. Other diagnostic modalities that haven't found much utility in management of blunt abdominal trauma includes laparoscopy.

This study illustrates the low usage 4(11.8%) of CT scan in hemodynamically stable patients and this can be explained by the high cost of the investigation.

Elevated white blood cell count is usually seen in cases of hollow viscous injury that results in peritoneal contamination and subsequent sepsis. In this study 19 patients (55.9%) had an elevated white blood cell count .A decrease in hematocrit is an indication of anemia secondary to bleeding and can be used as a guide to an ongoing bleeding . The standard indications for laparatomy from previous studies remains hemodynamic instability, peritonitis, free air under the diaphragm or fresh blood on rectal exam or in nasogastric tube.

5.5 Causes

Road traffic accident was the commonest mechanism of injury at 47.1% , similar findings were demonstrated by Ruhinda at Mbarara regional hospital in Uganda were 47% of trauma was as a result of RTA(G Ruhinda, 2008). In Nigeria Asaguo et al demonstrated that RTA was responsible for 90% of the injuries(Maurice et al., 2012). Locally Musau recorded 15% injuries secondary to RTA(Musau et al., 2006). Findings of this study point towards a rise in the number of trauma cases resulting from RTA. Therefore eradication of RTA will go a long way in the reduction of the morbidity and mortality associated with BAT.

5.6 Treatment

Presentation to hospital after injury depends on severity. Despite majority of patients coming from the environs of MTRH (Uasin Gishu 38.2%, Nandi 14.7%, and Elgeyo Marakwet 8.8%) only 5 patients (14.7%) presented to the hospital before 3hrs from the time of injury, with only one patient presenting 30mins after injury. The longest presentation was 15 days after injury. Despite the late presentation to hospital the mortality from blunt trauma remains low going contrary to the proponents of the golden hour rule of trauma. In the contrary this could mean that the severely injured patients die before reaching the referral facility and that those that arrive at the facility should not die if the appropriate measures towards their management are put in place

Management of blunt abdominal trauma continues to be challenging even to the most experienced surgeons. The decision as to whether a patient should undergo surgery or not is usually based on a number of factors the greatest being the hemodynamic stability of the patient. Hemodynamic instability despite adequate resuscitation is indicative of ongoing bleeding and thus the need for urgent laparatomy. In this study sixteen patients underwent laparatomy giving a laparotomy rate of 47% with a positive laparatomy rate of 100%. In Musaus study the overall operation rate was 70% with a negative laparatomy rate of 16.1%(Musau et al., 2006). The reduction in the number of negative laparotomies over a period of ten years can be attributed to improved diagnostic modalities and availability of more residents to care for BAT patients. Eighty seven point five percent (87.5%) underwent primary surgery and two patients (12.5%) failed in the conservative group and underwent surgery. Githaiga et al demonstrated an overall negative laparatomy rate of 6.9%. The spleen was the commonest injured solid intra-abdominal organ at 24% followed by the liver and mesentery at 20% each. G Ruhinda demonstrated splenic injury in 33.3% of his

patients while Asaguo et al in Nigeria had a 41.7% rate (G Ruhinda, 2008; Maurice et al., 2012). Howes et al in Kwazulu natal demonstrated the liver as the commonest injured solid intra-abdominal organ (Howes, Walker, Allorto, Oosthuizen, & Clarke, 2012). The liver and the kidneys were also injured at 14.7% and 8.8% respectively. Splenic injuries were managed by splenectomy whereas hollow viscous injuries were either repaired by resection and Anastomosis or placement of stoma based on the level of contamination and other surgical considerations. Abdominal injuries are commonly associated with other injuries and these may complicate management and affect the outcome. In this study 9 patients (27%) had other associated injuries and this included rib fractures (8.8%), spine fractures (5.9%), bladder injury and pelvic injury at 2.9% each. Musau in his study demonstrated that 35% of abdominal injuries were associated with other injuries(Musau et al., 2006). In a study by OV Nyongole et al 37% of patients had associated injuries(OV Nyongole, 2013).

The median duration prior to surgery was 7-9hrs and this is similar a study done at KNH by P Musau that showed most patients underwent surgery between 7-12hrs after presentation(Musau et al., 2006). However most notable is that 37.5% had to wait for surgery for more than 15hrs and this can be the lack of available theatre space and competition for available theatre space by other trauma emergencies. This observation should inform the need for a 24hr surgical emergency theatre to reduce the waiting time prior to surgery. On a positive note is that more than 50% of the surgeries were done within 6hours of admission.

Table 18: Changes in operative mode of management over 10 years

	Present Study		**P Musau 10yrs Before**	
Mode of Management	**Number(n)**	**Percentage (%)**	**Number(n)**	**Percentage (%)**
Operated	16	47.1	16	59.3
Conserved	18	52.9	11	40.7
	0% -ve laparotomy rate		16.1% -ve laparotomy rate	

Conservative management involved the use of intravenous fluids, antibiotics, blood transfusion and nasogastric suction .This study demonstrated a conservative management rate of 52.9% which is comparable to findings by P Musau whose conservative management rate was 54.2%(Musau et al., 2006). Currently there is a trend towards conservative management of blunt abdominal trauma with some authors demonstrating conservative management rates of as high as 88 %(Hommes et al., 2015). They have demonstrated that even grade 4 and 5 splenic injuries can be managed conservatively (Raza et al., 2013). This study therefore highlights that a lot has to be done in future if such high conservative management rates are to be achieved.

5.7 Outcome

5.7.1 Morbidity: Complications

Reviewed studies show that complications depend on the type of injury, organ injured and duration prior to surgery. Despite the long duration taken prior to surgery for approximately 36 % of patients there seems not to be an associated increase in the number of complications. Stewart et al in his study of 110 patients was able to demonstrate that a delay in intervention more than 4hrs was associated a statistically significant increase in number of complications. Frequent observations and examinations in those with subtle abdominal injuries would identify the patient unlikely to benefit from conservative management. This would ensure surgery in good time where indicated and thus reduce morbidity and mortality arising from delays in intervention.

Majority of patients (88.2%) recovered without any complication giving a complication rate of 11.8%, and this was caused by wound sepsis (5.9%), pulmonary embolism (2.9%), and ICU admission (2.9%). The findings of this study are comparable to Musau et al who demonstrated a complication rate of 12.5%. Other authors have demonstrated complication rates between 7-40%.

5.7.2 Morbidity: Length of stay

Average length of stay was 6 days in this study and this is comparable to most studies locally such as Githaiga et al whose figure was 6.5 days , P Musau showed an average of 6.4 days prior to discharge(Githaiga & Adwok, 2002; Musau et al., 2006) .

5.7.3 Mortality

Only one patient out of the 34 participants died from blunt abdominal trauma giving an overall mortality rate of 2.9%. Late presentation, ICU admission, need for blood transfusion and multiple injuries are associated with this unfavorable outcome.

Mortality has been found to correlate with admission to ICU, blood transfusion, delays in appropriate intervention, time taken from injury to admission and from admission to surgery and the causative agent. Patients who were severely injured presented early, were subjected to surgery in a hurried way, needed blood transfusion and ICU admission and tended to succumb to their injuries, particularly if presenting in shock. Delayed presentation to hospital and delayed surgery in excess of 24 hours was also noted to contribute to mortality. In his study Musau recorded a mortality rate of 8.1 as a result of blunt abdominal injury

While other studies (Musau et al., 2006 Mnguni et al., 2012, Ayoade et al., 2006, Aziz et al., 2014) have demonstrated the contribution of time prior to admission and surgery to mortality, this study contradicts the findings of other authors as demonstrated by the low mortality rate observed despite the prolonged time taken from the time of injury to admission and surgery.

CHAPTER SEVEN: CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

1. The commonest causes of blunt abdominal trauma in MTRH are RTA, fall from a height, assault and animal related injuries.
2. The important determinants of outcome is late presentation, admission to ICU and multiple injuries
3. Considerable amount of time is taken between diagnosis of blunt abdominal injury and definitive surgical intervention

6.2 Recommendations

1. Timely diagnosis and management of blunt abdominal trauma should be encouraged to reduce on morbidity and mortality
2. Reduction or eradication of road traffic accidents to reduce on number of BAT cases.
3. Development of a hospital protocol on management of blunt abdominal trauma patients.

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APPENDICES

Appendix 1: Questionnaire

Questionnaire

1. Demographic data

(a) Case number……

(b) Age…….

(c) Sex Male ☐ Female ☐

(d)Age at time of injury ……..Time of injury……. (24hr)

(e)Residence ……

(f)Occupation: employed ☐ unemployed ☐ others …….. (Specify)

(g)Level of education: primary ☐econdary ☐tertiary ☐none ☐

2. Mechanism of injury; Motor vehicle accident☐ Motor bike accident ☐ Pedestrian ☐ Vehicle accident ☐ Fall from Height ☐Assault ☐Others……..specify

3. Associated injuries; Head injury ☐ Fracture pelvis ☐ Fractured limbs ☐ Fractured rib ☐Others……..specify

4. Location of injury; Liver ☐ spleen ☐ kidney ☐ mesentery ☐ major vessel ☐ Others……..specify

5. Diagnostic modalities used; Physical examination ☐ Plain x-ray ☐Computed tomography ☐Diagnostic peritoneal lavage ☐Diagnostic laparatomy ☐

Blood studies ☐ (indicate) Hematocrit level …... Hemoglobin level ….. WBC count ……..Serum amylase levels …….Alt levels ……Ast levels ……..

- Urinalysis (hematuria) Yes ☐No ☐

6. Duration of stay before presenting to hospital ;< 3hrs ☐ >3-6hrs ☐ >6-9hrs ☐ >9-12hrs ☐ >12hrs ☐

7. Vitals: Bp……Pulse…….Temp…….Respiratory rate……..

8. Symptoms of abdominal injury: Vomiting Distension ☐Pain ☐Nausea ☐

9. Signs of abdominal injury: Guarding ☐Tenderness ☐Hematuria ☐ Seat belt sign ☐

10. Management modality

- laparotomy ☐Yes if Yes Positive ☐Negative ☐

  ☐No

- Conservative ☐

  Blood transfusion ☐(units…….)

  Intravenous fluids ☐

  Nasogastric suction ☐

11. Indications for laparatomy; Hemodynamic instability ☐Physical examination

Radiological findings ☐Laboratory findings ☐

Multiple injuries ☐

12. Decision maker in laparotomy; Senior consultant ☐ Consultant ☐ Resident ☐

13. Duration of stay before surgery

(a)Primary surgery; <3hrs ☐ >3-6hrs ☐ >6-9hrs ☐ >9-12hrs ☐ >12-15hrs ☐ >15hrs ☐

(b)Secondary surgery (surgery after initial conservative management);

<3hrs ☐ >3-6hrs ☐ >6-9hrs ☐ >9-12hrs ☐ 12-15hrs ☐ 5hrs ☐

14. Complications; Thromboembolism ☐ Pneumonia ☐ Hepatitis ☐ Wound sepsis ☐

Post-operative bleeding ☐ Abdominal abscess ☐

15. Duration of hospital stay ; Laparatomy; Days……

Conservative management; Days……

16. Outcome A. Laparatomy Discharged ☐ Died ☐

Autopsy: Yes ☐ No ☐

Cause of death……

B. Conservative management Discharged ☐ Died ☐

Autopsy: Yes ☐ No ☐

Cause of death……

C. Admitted to ICU Yes ☐ No ☐

Appendix 2: A: Consent Form (English version)

CONSENT FORM

CHARACTERISTICS, MANAGEMENT AND OUTCOME OF BLUNT ABDOMINAL INJURY PATIENTS AT MOI TEACHING AND REFERAL HOSPITAL, ELDORET.

INVESTIGATOR: DR. TANUI SHADRACK KIRWA PO BOX 404 KAPSABET, KENYA

I…….of

P.O Box…….

Tel……..hereby give informed consent to participate in this study in MTRH. The study has been explained to me clearly by Dr. Tanui Shadrack kirwa of P.O. Box 404 Kapsabet, Kenya.

I have understood that to participate in this study, I shall volunteer information regarding my past medical history and undergo medical examination. I am aware that I can withdraw from this study at any time without prejudice to my right of treatment at MTRH now or in the future. I have been assured that no injury shall be inflicted on me from my participation in this study. I have also been assured that all information shall be treated and managed in confidence. I have not been induced or coerced by the investigator (or his appointed assistant) to cause my signature to be appended in this form and by extension participate in this study.

Name (initials) of participant……

Signature……

Date……

Name of witness……

Signature……

Date……

Appendix 2 :B (Kiswahili Version)

KIBALI CHA KUHUSIKA KATIKA UCHUNGUZI JUU YA MATIBABU YA KUUMIA KWA TUMBO

Jina langu ni Daktari Tanui Shadrack Kirwa, mwanafunzi wa masomo ya udaktari ya ziada anayechunguza kuhusu matibabu tunayowapa wagonjwa wanaopata ajali ya tumbo Uchunguzi huu hauhitilafiani na matibabu unaopata kutoka kwa madaktari wanaokuhudumia kwa wodi na ni uchunguzi utakaosaidia hospitali kuhudumia wagonjwa kama wewe kwa njia muhafaka kwa siku za usoni.

Mimi.....Kutoka.....baad a ya kuelezewa juu ya uchunguzi unaondelea nakubali kuhusika katika huo uchunguzi. Naelewa kuwa matibabu yangu ni kuiingana na uamuzi wa madaktari wanaonitibu katika wodi.

Nimeelewa vilevile kuwa naweza kujiondoa kutoka kwa uchunguzi huu wakati wowote niamuapo hi la kuhatarisha matibabu yangu. Hakuna kishawishi nilochoahidiwa na sitarajihi kutunukiwa chochote kwa kuhusika kwangu kwa huu uchunguzi.

Sahihi..... Tarehe……..

(Mgonjwa)

Sahihi.....

Tarehe……

(Mchunguzi)

Appendix 3: Organ Injury Severity Score

LIVER INJURY SEVERITY SCORE

Grade I

- hematoma: subcapsular, <10% surface area
- laceration: capsular tear, <1 cm parenchymal depth

Grade II

- hematoma: subcapsular, 10-50% surface area
- hematoma: intraparenchymal <10 cm diameter
- laceration: capsular tear 1-3 cm parenchymal depth, <10 cm length

Grade III

- hematoma: subcapsular, >50% surface area of ruptured subcapsular or parenchymal hematoma
- hematoma: intraparenchymal >10 cm
- laceration: capsular tear >3 cm parenchymal depth
- vascular injury with active bleeding contained within liver parenchyma

Grade IV

- laceration: parenchymal disruption involving 25-75% hepatic lobe or involves 1-3 Couinaud segments
- vascular injury with active bleeding breaching the liver parenchyma into the peritoneum

Grade V

- laceration: parenchymal disruption involving >75% of hepatic lobe
- vascular: juxtahepatic venous injuries (retrohepatic vena cava / central major hepatic veins)

SPLENIC INJURY SEVERITY SCORE

Grade	Injury type	Description of injury
I	Hematoma	Subcapsular, <10% surface area
	Laceration	Capsular tear, <1cm
		Parenchymal depth
II	Hematoma	Subcapsular, 10%-50% surface area
		Intraparenchymal, <5 cm in diameter
	Laceration	Capsular tear, 1-3cm parenchymal depth that does not involve a trabecular vessel
III	Hematoma	Subcapsular, >50% surface area or expanding; ruptured subcapsular or parecymal hematoma; intraparenchymal hematoma $\underline{\geq}$ 5 cm or expanding
	Laceration	>3 cm parenchymal depth or involving trabecular vessels
IV	Laceration	Laceration involving segmental or hilar vessels producing major devascularization (>25% of spleen)
V	Laceration	Completely shattered spleen
	Vascular	Hilar vascular injury with devascularizes spleen

PANCREASE INJURY SEVERITY SCORE

Grade	Type of Injury	Description of Injury
I	Hematoma	Minor contusion without duct injury
	Laceration	Superficial laceration without duct injury
II	Hematoma	Major Contusion without duct injury or tissue loss
	Laceration	Major laceration without duct injury or tissue loss
III	Laceration	Distal transection or parenchymal injury with duct injury
IV	Laceration	Proximal transection or parenchymal injury involving ampulla
V	Laceration	Massive disruption of pancreatic head

Appendix 4: IREC Formal Approval

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET

Reference: IREC/2013/143
Approval Number: 0001067

23rd September, 2013

Dr. Tanui Shadrack Kirwa,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

APPROVED
23 SEP 2013
P.O. Box 4606 ELDORET

Dear Dr. Tanui,

RE: FORMAL APPROVAL

The Institutional Research and Ethics Committee have reviewed your research proposal titled:-

"Characteristics, Management and Outcome of Blunt Abdominal Injury Patients at Moi Teaching and Referral Hospital, Eldoret".

Your proposal has been granted a Formal Approval Number: ***FAN: IREC 1067*** on 23rd September, 2013. You are therefore permitted to begin your investigations.

Note that this approval is for 1 year; it will thus expire on 22nd September, 2014. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

You are required to submit progress report(s) regularly as dictated by your proposal. Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. The Committee expects to receive a final report at the end of the study.

Sincerely,

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc Director - MTRH Dean - SOM Dean - SON
Principal - CHS Dean - SPH Dean - SOD

Appendix 5: MTRH Approval

MOI TEACHING AND REFERRAL HOSPITAL

Telephone: 2033471/2/3/4
Fax: 61749
Email: director@mtrh.or.ke
P. O. Box 3
ELDORET

Ref: ELD/MTRH/R.6/VOL.II/2008

23rd September, 2013

Dr. Tanui Shadrack Kirwa,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

RE: APPROVAL TO CONDUCT RESEARCH AT MTRH

Upon obtaining approval from the Institutional Research and Ethics Committee (IREC) to conduct your research proposal titled:-

"Characteristics Management and Outcome of Blunt Abdominal Injury Patients at Moi Teaching and Referral Hospital, Eldoret".

You are hereby permitted to commence your investigation at Moi Teaching and Referral Hospital.

DR. J. KIBOSIA
DIRECTOR
MOI TEACHING AND REFERRAL HOSPITAL

CC - Deputy Director (CS)
- Chief Nurse
- HOD, HRISM